Action Alternatives' Incremental Contribution to the Cumulative Condition

All categories of CVP Water Service Contractors would experience small reductions in delivery allocation as a result of the Action Alternatives under the future condition. Figures H-3.4-6 through H-3.4-9 show the year-by-year change in CVP delivery allocation simulated by PROSIM. CVP M&I and agricultural contractors north of the Delta would experience a five percent reduction in allocation in one out of the 70 years simulated (Figures H-3.4-6 and H-3.4-7).

CVP M&I contractors south of the Delta would experience a five percent reduction in allocation in one year and a five percent increase in allocation in another year, out of the 70 years simulated (Figure H-3.4-8). Therefore, there would be no long-term net change in the CVP M&I contractors south of the Delta delivery allocation. Out of the 70 years simulated, CVP agricultural contractors south of the Delta would experience allocation reductions of five percent in two years and an increase of five percent in one year (Figure H-3.4-9).

The PROSIM modeling suggests small and infrequent changes in allocations to CVP Water Service Contractors related to implementation of one of the Action Alternatives. The allocation, although small and infrequent, must be considered a significant impact. It is recognized that use of water by PCWA in accordance with its water rights in its place of use has a priority to the CVP's rights at Folsom to the extent that such CVP rights are used for export.

3.4.2.5 Environmental Protection and Mitigation Measures

The net reduction in CVP water delivery allocation to north of the Delta agricultural contractors has been identified as a significant unavoidable impact. This change in delivery allocation would result as an indirect effect of the Action Alternatives due to Reclamation's changes in operation of the CVP system in response to changes in PCWA's river diversions upstream of Folsom Reservoir.

The Proposed Project consists of diversion and use of American River water to benefit interests in Placer County. Because the American River flows through Placer County, state and federal law protect it from adverse water supply impacts associated with the operation of the CVP and SWP. Both the County of Origin Protection and the Watershed of Origin Protection guarantee Placer County a priority right to water that is senior to the water rights held by the CVP and SWP for water export. This protection guarantee applies even if it means a reduction of water supply that is available for service to existing CVP and SWP customers. The net result of the statutory and policy protections embodied in the County of Origin Protection and the Watershed of Origin Protection is to ensure that even if the project has a significant adverse impact on the CVP and SWP customers, the project may proceed.

Unavoidable Adverse Impacts

Areas north of the Delta are protected, in terms of overall CVP operations, by the area of origin statues. Because PCWA cannot assure that water supply impacts would be reduced to less-than-significant levels, to fulfill the disclosure requirements of CEQA, this EIS/EIR must indicate that water supply impacts are considered significant and unavoidable.

3.5 FISH RESOURCES AND AQUATIC HABITAT

3.5.1 AFFECTED ENVIRONMENT

3.5.1.1 Regional Setting

The regional setting for fish resources includes the American and Sacramento rivers and reservoirs, as well as Oroville Reservoir and the Feather River, that may be influenced by implementation of the Proposed Project or alternatives and other reasonably foreseeable future actions within the American River Basin that influence future CVP operations. The area is defined in Section 3.2.1 and shown on Figure 2-1. The fish resources, including lifestage histories, are described in the Cumulative Report (Appendix D of the Draft EIS/EIR). For the lower American River, Sacramento River and Delta, species of primary management concern include those that are recreationally or commercially important (fall-run chinook salmon (*Oncorhynchus tshawytscha*), American shad (*Alosa sapidissima*), striped bass (*Morone saxatilis*)), and federal- and/or state-listed species of the region (winter- and spring-run chinook salmon, steelhead (*Oncorhynchus mykiss*), delta smelt (*Hypomesus transpacificus*), Sacramento splittail (*Pogonichthys macrolepidotus*)), and candidate species under the federal ESA (fall-run chinook salmon).

Section 3.19, ESA Compliance, identifies ESA Section 7 requirements and provides an evaluation of impacts upon federally listed special-status species. The discussion identifies conclusions and determinations for each species and associated critical habitat, where designated.

3.5.1.2 Project Area Setting

The project area represents the direct effect study area for fish resources and aquatic habitat and encompasses the Middle Fork American River from Ralston Afterbay to the confluence with the North Fork and downstream to Oregon Bar (see Figure 2-2). Federal- and state-listed species are not known to occur in the upper American River. Species of management concern within the project area in the upper American River include rainbow trout (*Oncorhynchus mykiss*) and brown trout (*Salmo trutta*). Upstream migration of anadromous fish in the American River system is limited to the 23-mile reach of the lower American River below Nimbus Dam, which physically blocks further upstream migration.

Middle Fork American River

The Middle Fork American River supports both warm and coldwater fish species year-round. Operation of PCWA's MFP, constructed in 1962 (including Ralston Afterbay), results in cooler summer and fall water temperatures, thereby improving habitat suitability for rainbow trout and brown trout for a portion of the river below Ralston Afterbay (Corps 1991; Reclamation 1996a). Brown trout are resident stream fish, meaning they spend their entire lifecycle in fresh water. Spawning generally occurs during November and December (Moyle 1976). Brown trout fry typically hatch in seven to eight weeks, depending on water temperature, with emergence of young three to six weeks later.

Optimal riverine habitat for brown trout reportedly consists of cool to coldwater, silt-free rocky substrate, an approximate 1:1 pool-to-riffle ratio, and relatively stable water flow and temperature regimes (Raleigh et al. 1986). Moyle (1976) reported that while brown trout will survive for short periods in water temperatures in excess of 80.6°F, optimum water temperatures for growth range from 44.6°F to 66.2°F, with a preference for temperatures in the upper half of this range. Brown trout tend to utilize lower reaches of low to moderate gradient areas (less than one percent) in suitable, high gradient rivers (Raleigh et al. 1986).

As with brown trout, rainbow trout also are resident stream fish whose optimal riverine habitat reportedly consists of coldwater, silt-free rocky substrate, a 1:1 pool-to-riffle ratio, and relatively stable water flow and temperature regimes (Raleigh and Duff 1980 *in* Raleigh et al. 1984). Moyle (1976) reported that while rainbow trout will survive in water temperatures of up to 82.4°F, optimum water temperatures for growth and completion of most lifestages reportedly range from 55.4°F to 69.8°F. Rainbow trout spawning generally occurs from February to June (Moyle 1976). Rainbow trout fry emerge from spawning nests approximately 45 to 75 days after spawning, depending on water temperatures.

In addition to rainbow and brown trout, fish sampling surveys of the Middle Fork American River conducted by the USFWS in 1989 from Ralston Afterbay downstream to the confluence with the North Fork American River documented the presence of hitch (*Lavinia exilicauda*), Sacramento sucker (*Catostomus occidentalis*), pikeminnow (*Ptychocheilus grandis*), and riffle sculpin (*Cottus gulosus*) (Corps 1991). No federal- or state-listed species or species proposed for listing under the federal ESA or CESA are reported in the Middle Fork American River.

North Fork American River

Downstream of its confluence with the Middle Fork, the North Fork American River supports warmwater fish species year-round, including smallmouth bass (*Micropterus dolomieu*), pikeminnow, Sacramento sucker, riffle sculpin, brown bullhead (*Ictalurus nebulosus*), and green sunfish (*Lepomis cyanellus*). Although some rainbow and brown trout are present, summer and fall water temperatures are generally too warm for significant spawning and early-lifestage rearing of trout. The majority of trout that do occur in the North Fork American River below the confluence with the Middle Fork American River are believed to be transitory downstream adult and/or sub-adult migrants that have dispersed into the area from upstream habitats (i.e., Middle Fork American River).

Project Site to Oregon Bar

The primary fish species that exist within the American River through the project area and downstream to Oregon Bar include those listed previously for the North Fork and Middle Fork American River, as well as spotted bass (*Micropterus punctulatus*), largemouth bass (*Microptemus salmonides*), and other centrarchid species. Coldwater fish, such as the native rainbow trout and introduced brown trout, also occur within the project area. However, use of the project area by trout is primarily limited to transitory downstream adult or sub-adult migrants with little, if any, use of the project area for spawning or early-lifestage rearing (J. Hiscox, pers. comm. 1997; S. Lehr, pers. comm. 1997; J. Nelson, pers. comm. 1997). No anadromous salmonids or federal- or state-listed or species proposed for listing under the federal ESA or CESA are known to occur in the project area.

Auburn Ravine

Auburn Ravine flows include natural streamflow augmented by agricultural delivery and return flows, hydroelectric generation releases, wastewater treatment plant discharges from the City of Auburn, and stormwater runoff from the City of Auburn. The existing Auburn Ravine mean monthly flows are presented in **Table 3.5-1**.

Table 3.5-1
Estimated Streamflows in Auburn Ravine under Present Management Conditions
(Mean Monthly Flow, cfs)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
117	120	132	66	88	82	114	99	43	30	39	84

Source: Eco:Logic Engineering Water Balances; Nevada Irrigation District (NID) Gauge in Auburn Ravine below Highway 65 *in* City of Lincoln 1999

Auburn Ravine - Estimated Natural Flow Conditions

Natural flows estimated for Auburn Ravine exhibit significant monthly variations. Relatively high flows associated with storm runoff occur during winter months, particularly January, and flows decline to very low levels during spring months, with no natural flow during summer months. Estimated mean monthly natural streamflows in Auburn Ravine at the Highway 65 Bridge in the City of Lincoln range from approximately 70 cfs in January to 0 cfs in summer and early fall months (City of Auburn 1997 *in* City of Lincoln 1999) (**Table 3.5-2**).

Table 3.5-2
Estimated Natural Streamflows in Auburn Ravine Near Highway 65 Bridge in Lincoln
(Mean Monthly Flow, cfs)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
70.6	50.9	32.3	20.1	2.4	0.2	0.1	0.0	0.0	4.1	11.7	38.2

Source: City of Auburn 1997 *in* City of Lincoln 1999.

Auburn Ravine - Existing Flow Conditions and Supplemental Source Waters

Historically, Auburn Ravine has been used to convey water from multiple sources. Under existing conditions, the natural streamflow of Auburn Ravine is supplemented by four primary sources: (1) PG&E Drum-Spaulding Project source water; (2) PCWA deliveries from the North Fork American River through the Auburn Ravine Tunnel; (3) City of Auburn treated effluent discharges from its wastewater treatment plant; and (4) Auburn Ravine watershed stormwater runoff.

These supplemental sources result in streamflows that vary considerably from estimated natural flow conditions in Auburn Ravine. Without the influence of these supplemental water sources, Auburn Ravine would remain an intermittent stream carrying only flow originating at its headwaters and runoff from the watershed. Although Auburn Ravine flows can vary substantially on a daily and monthly basis, in general, these supplemental flows significantly augment the estimated natural late summer and early fall streamflows. Therefore, in comparison to the estimated natural flows, existing condition flows in Auburn Ravine are higher in summer months and lowest during fall months.

Pacific Gas and Electric Company Drum-Spaulding Project Source Water

PG&E's Drum-Spaulding system and Nevada Irrigation District's (NID) Upper Yuba River system are integrated to meet the water demands of western Placer and Nevada counties, while at the same time maximizing hydroelectric power production. This joint system is one of the oldest and most complex water systems in California, with storage reservoirs and canals that can capture runoff from the north, middle and south forks of the Yuba River, the Bear River, and the Upper North Fork of the American River, and route that water through a series of hydroelectric plants and to customers all the way to Folsom Reservoir.

Much of the water supplies provided by the Drum-Spaulding system are delivered either to NID or PCWA to meet the consumptive demands of their customers. Consumptive deliveries to NID and PCWA via Auburn Ravine occur during the "irrigation season" (April 15 to October 15). Most of the consumptive demand satisfied through deliveries to Auburn Ravine is for irrigated commercial agriculture in Zone 5 (primarily rice and pasture), most of which occurs on land between Highway 65 and the Sacramento River. Over the course of the current planning horizon (2030) it is not anticipated that the consumptive demand for irrigation water deliveries via the Auburn Ravine will change.

In addition to these consumptive use deliveries to PCWA and NID during the irrigation season, PG&E often spills substantial amounts of hydroelectric system water to Auburn Ravine. PG&E's Drum-Spaulding system originally terminated at its Wise Powerhouse in the Auburn Ravine, and all of the water that ran through the hydroelectric system that was not delivered for consumptive use at other locations was spilled into the Auburn Ravine. A lawsuit by downstream landowners on the Auburn Ravine to prevent flooding by these spills forced PG&E to construct the South Canal in 1931. Since then, the South Canal delivers most of the spill water into Folsom Reservoir. However, the capacity of the South Canal is less than the Wise Canal, which delivers water into Auburn Ravine upstream of the Wise Powerhouse. The result is that, in winter and spring, when demand for consumptive deliveries from the Wise Canal is low and the Wise Canal is running at full capacity for hydroelectric power production, a substantial amount of water is still spilled into the Auburn Ravine.

Today, the South Canal also is used for consumptive delivery at a capacity of about 450 cfs, of which PCWA has contractual entitlement to 244.8 cfs, with NID entitled to the remainder. The

South Canal is at about elevation 900 at its point of discharge to Auburn Ravine. At the peak of the summer delivery season, 100 percent of the capacity of the PG&E canal system below Rollins Reservoir is used to meet consumptive deliveries to NID and PCWA. During these periods the hydroelectric operation becomes secondary to the water delivery requirements, and there is no excess spill water in Auburn Ravine.

PG&E operates the Wise Powerhouse with flows from the Yuba and Bear rivers to generate power year-round, with the exception of the four to six weeks in the late fall when it shuts down the hydroelectric system for maintenance. As indicated above, PG&E powerhouse releases to the South Canal are conveyed to Auburn Ravine for use by NID and PCWA deliveries to irrigation customers within their respective service areas. These releases are made over the course of the entire irrigation season. Additionally, throughout much of the summer, PG&E continuously releases flows of approximately 31 cfs (20 mgd) from the Wise Powerhouse South Canal into Auburn Ravine, thereby providing supplemental streamflows when the ravine would naturally become dry. **Figure 3.5-1** shows the Auburn Ravine watershed and related water supply delivery infrastructure. **Figure 3.5-2** provides a regional view of the Auburn Ravine watershed and related water supply service areas for PCWA and NID.

PCWA North Fork American River Source Water

PCWA currently has the ability to pump approximately 50 cfs of American River water to Auburn Ravine during the irrigation season. The transferred water is pumped through the Auburn Ravine Tunnel using the seasonal (temporary) American River pump station.

When PCWA's consumptive water demands increase beyond the amount available from PG&E (244.8 cfs), PCWA operates the seasonal American River pump station and delivers water into Auburn Ravine via the Auburn Ravine Tunnel. This water is delivered to PCWA customers along Auburn Ravine west of Highway 65.

The seasonal American River pump station has been used at times to deliver the full capacity (50 cfs) of North Fork American River water to Auburn Ravine. For instance, during the 1977 drought event, the seasonal American River pumps were used to supply Auburn Ravine with 8,500 AF of North Fork American River water and an exchange of water took place with NID. North Fork American River water was delivered to NID via the Auburn Ravine Tunnel and PG&E water that normally would have been delivered to NID via Auburn Ravine was instead delivered to PCWA's water treatment plants and canals within the Auburn, Newcastle, Penryn, Loomis, Rocklin, and Lincoln areas.

In more recent years, the seasonal pump station has provided a maximum annual delivery of approximately 2,900 AF of North Fork American River water to Auburn Ravine. The American River supply is used to meet peak irrigation demands, primarily during summer months. Agricultural return flows also contribute to the streamflow conditions of Auburn Ravine from April through September/October.

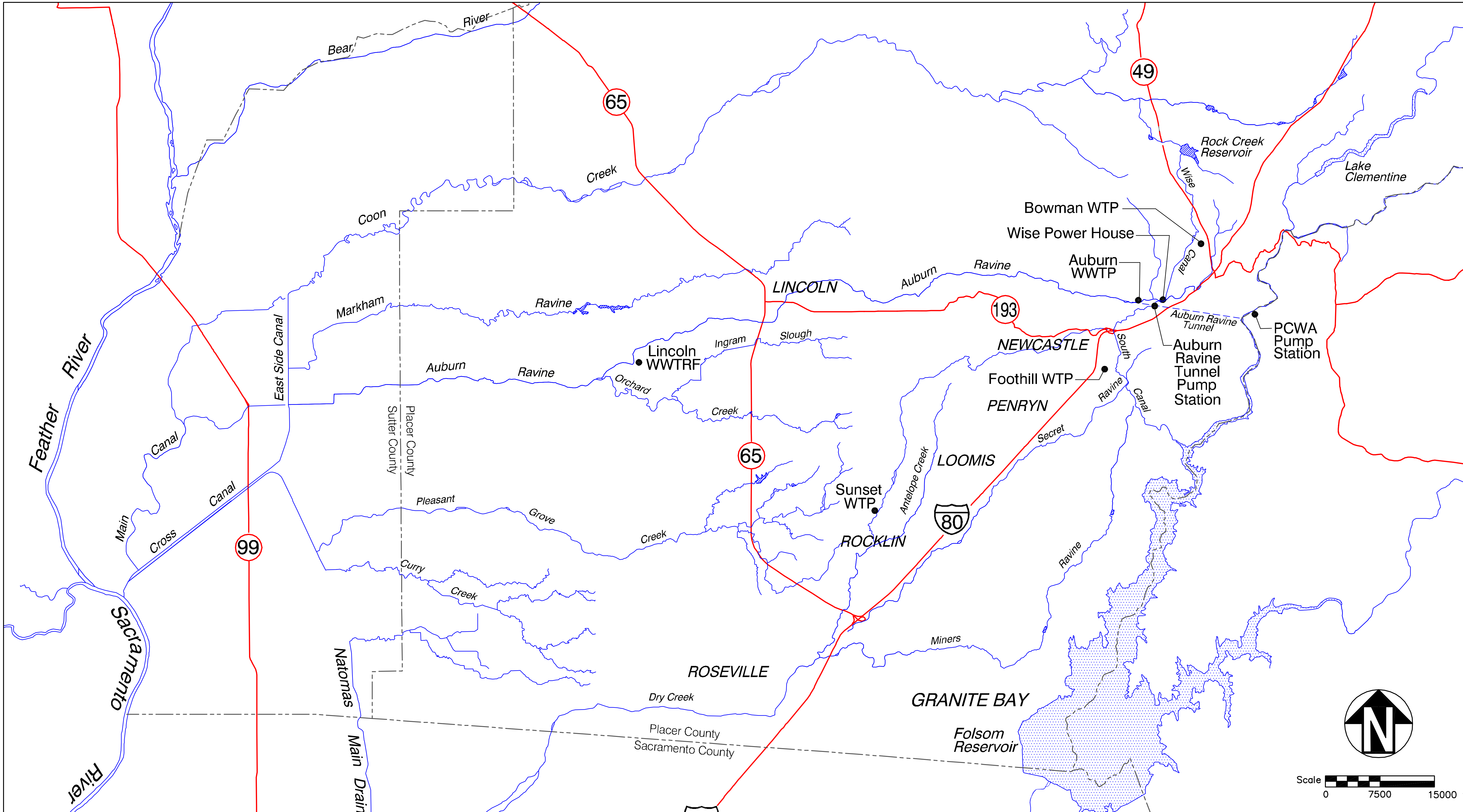

Figure 3.5-1 Auburn Ravine Watershed and Related Delivery System Infrastructure

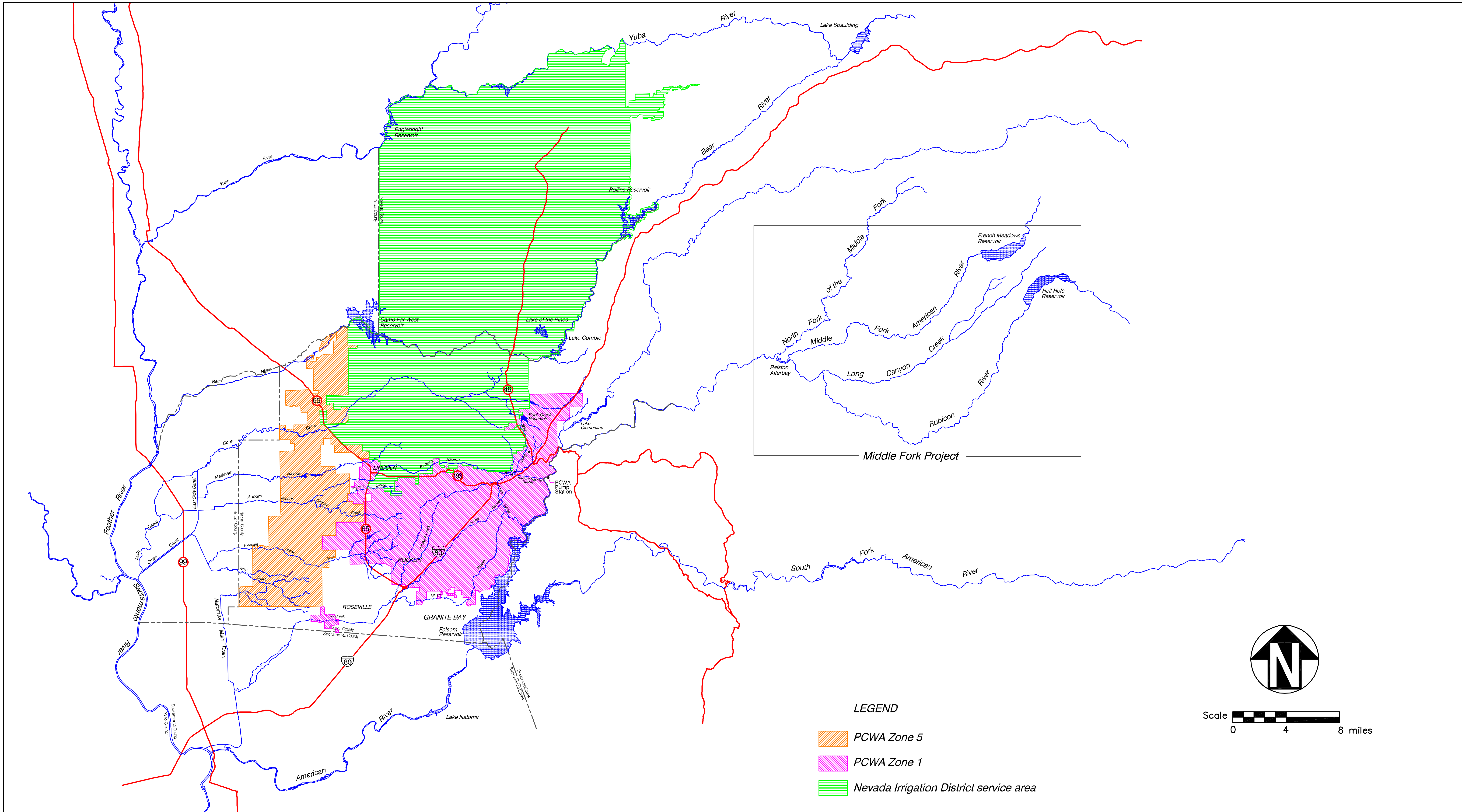

Figure 3.5-2 Regional View of Auburn Ravine Watershed

In addition to being able to supply water to Auburn Ravine from the American River, PCWA has the ability to pump approximately 50 cfs of water directly from the Auburn Ravine Tunnel to PG&E's South Canal via the Auburn Ravine Tunnel pump station (constructed in 1990). This pump station is located directly above the Auburn Ravine Tunnel and lifts water approximately 200 feet from the tunnel to PG&E's South Canal. Once within the South Canal, this water flows by gravity toward the Foothill WTP. The Auburn Ravine Tunnel pump station has been used infrequently in the past, due to the high cost of double-pumping the American River water.

Water pumped from the American River historically has been delivered into Auburn Ravine. When American River water has been needed, PCWA orders a cutback in its PG&E deliveries to Auburn Ravine and reassigns the water to delivery at other, higher elevation locations. By exchanging American River water for PG&E's Drum/Spaulding water in this fashion, PCWA has been able to save half the energy cost that would otherwise be incurred in double-pumping the American River water from the 500-foot elevation of the American River to the 700-foot elevation of the Auburn Ravine Tunnel, and then pumped again to the 900-foot elevation of the South Canal (**Figure 3.5-3**)

While the water exchange has been effective during the irrigation seasons of past years in reducing double-pumping costs, PCWA has still been required to double-pump water during the annual PG&E canal maintenance outage in late October and early November. During these outages, water is not available from PG&E, and PCWA must double-pump American River water to supply the Foothill WTP and treated water customers.

City of Auburn Wastewater Treatment Plant Discharges

The City of Auburn's Wastewater Treatment Plant (WWTP) lies along the Auburn Ravine approximately one-half mile below PG&E's Wise Powerhouse South Canal crossing and one-half mile above the outlet of PCWA's Auburn Ravine Tunnel. The City continuously releases approximately 3.9 cfs of treated effluent into Auburn Ravine year-round. The City of Auburn WWTP service area water supply source is imported from the Drum-Spaulding Project (Yuba/Bear River system) and delivered by PCWA. The treated wastewater effluent releases are a function of the WWTP inflow and are unrelated to other sources of water released into Auburn Ravine. Likewise, direct releases to Auburn Ravine from other source waters are independent of the City of Auburn's WWTP.

Auburn Ravine Watershed - Stormwater Runoff

The Auburn Ravine headwaters lie within the City of Auburn. Urban stormwater runoff occurs in response to rainfall and due to over-watering of landscaped areas.

Fish Resources and Aquatic Habitat Considerations

The current flow augmentation in Auburn Ravine is particularly beneficial for chinook salmon and steelhead. Higher spring and summer flows support greater habitat diversity, increased quantity and quality of habitats, and lower summer water temperatures than what would be found

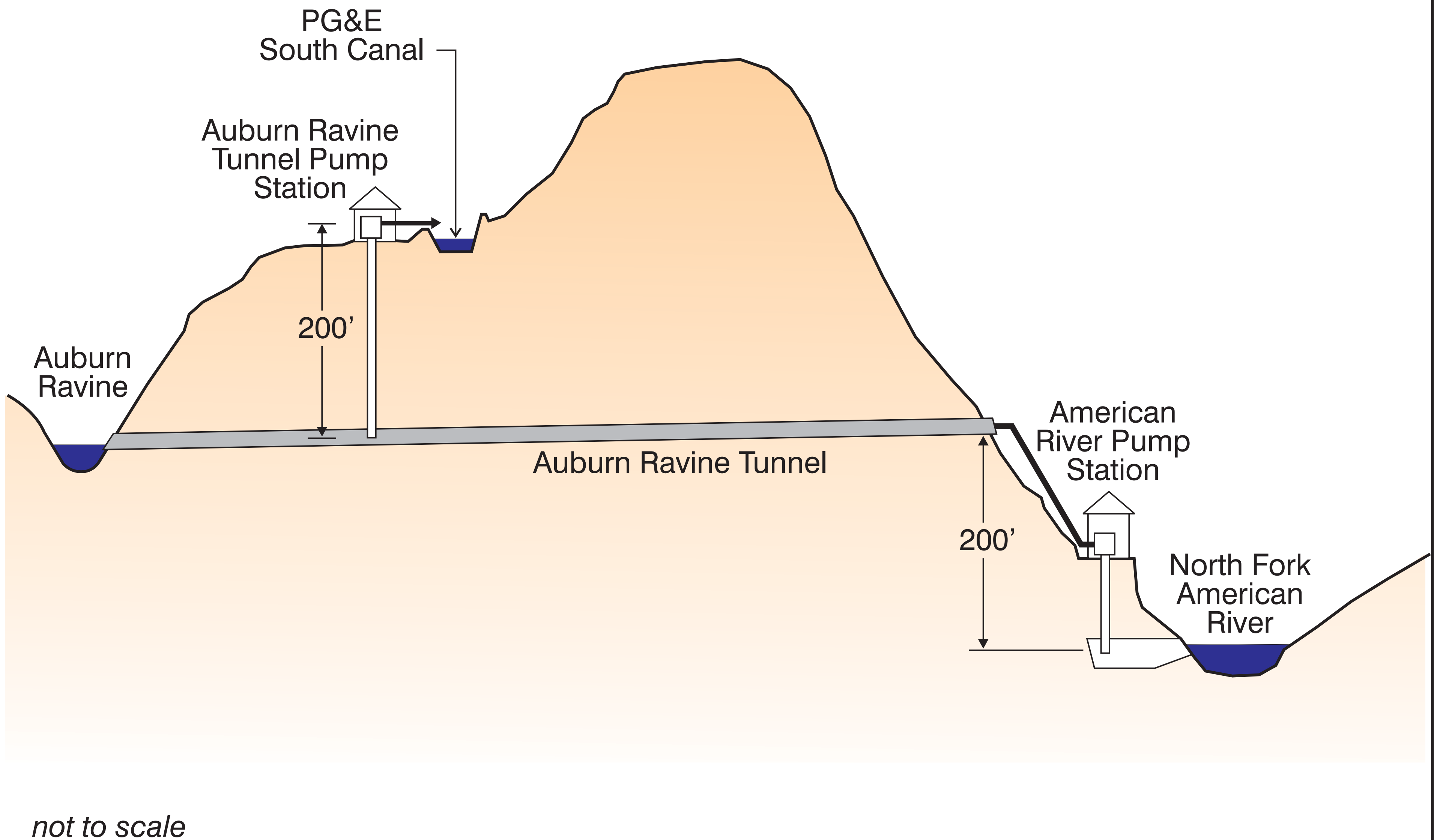

Figure 3.5-3 Hydraulic Profile of Water Deliveries from the American River Pump Station

under natural conditions (City of Lincoln 1999). Current water management practices, therefore, greatly enhance potential anadromous salmonid production in Auburn Ravine (City of Lincoln 1999).

Although flow augmentation provides obvious beneficial effects for anadromous salmonids in Auburn Ravine, concern has been raised about an increase in salmonid straying into Auburn Ravine due to the existing deliveries of North Fork American River water into Auburn Ravine, as well as the project's contribution to the Lincoln Wastewater Treatment and Reclamation Facility (WWTRF) discharges. The issue of straying is of particular concern because steelhead are listed as threatened under the federal ESA, fall-run chinook salmon are listed as a candidate species under the federal ESA, and spring-run chinook salmon are listed as threatened under both the federal ESA and CESA. Presumably, the possibility of increased straying of anadromous salmonids into Auburn Ravine is a concern because of potential impacts, including competition and genetic introgression, on fish native to Auburn Ravine.

Fish surveys of Auburn Ravine conducted in 1997, 1998, and 1999 indicate a fish population assemblage typical of a Sierra Nevada foothill stream (City of Lincoln 1999). In general, these surveys found steelhead/rainbow trout, Sacramento pikeminnow, Sacramento sucker and hitch in upstream areas characterized by more complex structure and gravel substrates (City of Lincoln 1999). The fish assemblage in areas downstream of the Highway 65 Bridge included a number of non-native sunfish family members, mosquitofish, and carp. Habitat in the downstream locations is characterized by lower stream gradient and slower velocity, less complex structure, and sand substrate (City of Lincoln 1999). The federally listed splittail are not believed to use Auburn Ravine. Auburn Ravine does not provide conditions consistent with big-river, floodplain, and estuarine habitat normally used by splittail (Sommer et al. 1997). Although it is possible that some splittail could exist in Auburn Ravine, given the absence of splittail in fish surveys, and given the absence of appropriate habitat, splittail are not expected to occur in Auburn Ravine (City of Lincoln 1999).

Fall-run Chinook Salmon

Fall-run chinook salmon from the Feather River and Nimbus hatcheries historically have been stocked by CDFG in Auburn Ravine, Doty Ravine, and Coon Creek (Cramer and Demko 1997 *in* City of Lincoln 1999). Typically, about 100,000 fall-run chinook salmon fingerlings from Nimbus Fish Hatchery are released annually into Auburn Ravine. In March 1998, CDFG released 140,000 fall-run chinook salmon fingerlings into Auburn Ravine. No chinook salmon were collected or observed during the fish surveys conducted in 1997, 1998, or 1999. However, anecdotal information from long-time residents indicates that fall-run chinook salmon historically migrated as far upstream as Auburn to spawn. Lincoln area residents report that as many as several hundred fall-run chinook salmon spawned just upstream of Lincoln in the fall of 1985 (City of Lincoln 1999).

Spring-run Chinook Salmon

Occurrence of either adult or juvenile lifestages of spring-run chinook salmon have not been documented in Auburn Ravine. Spring-run chinook salmon are not believed to be native to

Auburn Ravine but, over the last 15 years, spring-run chinook salmon from the Feather River and Nimbus hatcheries have been stocked in Auburn Ravine by CDFG (Cramer and Demko 1997 *in* City of Lincoln 1999). In March 1998, CDFG released 77,400 spring-run chinook salmon fingerlings into Auburn Ravine and the same number in Doty Ravine, which combines with Auburn Ravine and Coon Creek prior to the combined waters flowing into the Cross Canal (Cramer and Demko 1997 *in* City of Lincoln 1999). Spring-run chinook salmon from the Feather River Hatchery are interbred with fall-run chinook salmon and do not represent a genetically uncontaminated stock (CDFG 1994 *in* City of Lincoln 1999).

Central Valley Steelhead

Currently, there is little detailed information regarding steelhead specific to Auburn Ravine. Steelhead/rainbow trout were not collected during the fish survey conducted in 1997, although juveniles were collected in upstream areas in the 1998 and 1999 surveys. It can be difficult to definitively determine whether juveniles are the anadromous steelhead or resident rainbow trout. The fish survey conducted in 1998 reported that some of the captured juveniles exhibited the iridescent silvery sides typical of smolting salmonids (City of Lincoln 1999). The juvenile steelhead/rainbow trout collected during the 1999 survey reportedly did not exhibit any obvious visual characteristics of emigration associated with the anadromous form (i.e., steelhead) (City of Lincoln 1999).

Steelhead have not been reported to have been planted in Auburn Ravine. Rainbow trout historically were planted in Auburn Ravine until 1965. Rainbow trout continues to be planted in water bodies connected to Auburn Ravine (e.g., the Bear River and associated reservoirs) (City of Lincoln 1999).

Anecdotal information suggests that adult steelhead, exhibiting the silver-side characteristics of recent migration from the ocean, have been captured and released by anglers in the Ophir area. Long-time residents report that steelhead/rainbow trout routinely spawned near Auburn.

Juvenile steelhead would be expected to rear in Auburn Ravine for a year or more prior to emigration to the ocean. Therefore, summer rearing habitats are an important factor in the survival of these juveniles, and the current water management practices in Auburn Ravine provide this habitat.

3.5.2 ENVIRONMENTAL CONSEQUENCES/IMPACT ANALYSIS

3.5.2.1 Methodology

Facilities-Related Analysis Approach

Facilities-related effects include those associated with construction, operation, and maintenance of the pump station facilities, and restoration of the previously dewatered channel, and are limited to the immediate project area setting. To determine if potential impacts to fish resources may occur as a result of construction of project facilities, the duration of construction, the potential turbidity, sedimentation, and siltation resulting from construction, and the composition of the fish communities present in the immediate project area (North Fork American River) were considered and evaluated.

Operation and maintenance considerations include potential impacts associated with project facilities and fish screen functions on the aquatic resources of the upper American River. To determine potential impacts to fish passage resulting from alternative facility operations, fish swimming velocities, and the length of the bypass tunnel were considered and evaluated. Finally, as part of the operation considerations, fish communities present in the project area, as well as their respective lifestages, were assessed to determine if any potential impacts would be associated with backwater created by the new diversion facilities. Additionally, the analysis evaluated potential impacts to adult salmonid emigration patterns resulting from operational changes in Auburn Ravine flows. To determine if salmonid genetic stock in Auburn Ravine would be expected to be impacted from alternative operations, a literature review regarding chemical detection limits and olfactory response mechanisms of salmonids was conducted. Auburn Ravine water composition and hatchery influences also were evaluated.

Diversion-Related Analysis Approach

Extensive hydrologic, water temperature, and early lifestage salmon mortality modeling was performed to provide a quantitative basis from which to assess potential diversion-related impacts to fish resources and aquatic habitats within the study area.

Modeling output provided monthly values for each year of the 70-year period of record modeled for river flows, reservoir storage and elevation, and for each year of the 69-year hydrologic simulation period modeled for river water temperatures. Water temperature modeling encompassed a 69-year period because the model is based upon a calendar year, whereas the hydrologic modeling is based upon a water year. River water temperature output was then used in Reclamation's chinook salmon mortality models to characterize water temperature-induced losses of early lifestages of chinook salmon under each simulated condition. Output from the salmon mortality models provided estimates of annual (rather than monthly mean) losses of emergent fry from egg potential (all eggs brought to the river by spawning adults), which is presented in terms of survival.

The specific hydrologic, water temperature, and salmon mortality modeling output used to assess potential impacts to fish resources and aquatic habitats are identified in Section 3.5.2.3, Impact Indicators and Significance Criteria, for each water body potentially affected.

Application of Modeling Output

The models used in this analysis (DWR's UARM, Reclamation's PROSIM, reservoir temperature models, American and Sacramento water temperature models, and the lower American and Sacramento river chinook salmon early-lifestage mortality models) are tools that have been developed for comparative planning purposes, not for predicting actual river conditions at specific locations at specific times. The 70-year and 69-year periods of record for PROSIM and temperature modeling, respectively, provide an index of the kinds of changes that would be expected to occur with implementation of a specified set of operational conditions.

Reservoir storage, river flows, water temperature, and salmon survival output for the period modeled should not be interpreted or used as definitive absolutes depicting actual river conditions that will occur in the future. Rather, output for the with-project and the cumulative condition can be compared to that for the without-project condition to determine:

- Whether reservoir storage or river flows and temperatures would be expected to change with implementation of the project alternative;
- The months in which potential reservoir storage and river flow and temperatures changes could occur;
- A relative index of the magnitude of change that could occur during specific months of particular water year types, and whether the relative magnitude anticipated would be expected to result in impacts to fish resources within the regional area; and
- The relative degree to which alterations in operations of Folsom Dam and Reservoir, as directed by the principles of coldwater pool management, could eliminate or minimize temperature increases.

The models used, although mathematically precise, should be viewed as having "reasonable detection limits." Establishing reasonable detection limits is useful to those using the modeling output for impact assessment purposes, and prevents making inferences: (1) beyond the capabilities of the models; and (2) beyond an ability to actually measure changes. Although data from the models are output to the nearest 100 AF, tenth of a foot in elevation, tenth of a cfs, tenth of a degree Fahrenheit, and tenth of a percent in salmon mortality, these values were rounded when interpreting differences for a given parameter between two modeling simulations. For example, two simulations having river flows at a given location within one percent of each other were considered to be essentially equivalent. Because the models provide reservoir storage data on a monthly time-step, measurable differences in reservoir storage were evaluated similarly. Similar rounding of modeled output was performed for other output parameters in order to assure the reasonableness of the impact assessments.

Commonly used field-temperature monitoring equipment (in situ temperature loggers, thermometers, electronic meters) have a total error of measurement of 0.2°F or more. Therefore, modeled differences in temperature of 0.2°F or less could not be consistently detected in the river by actual monitoring of water temperatures. In addition, as mentioned above, output from Reclamation's water temperature models provides a "relative index" of water temperatures under the various operational conditions modeled. Output values indicate whether the temperatures would be expected to increase, remain unchanged, or decrease, and provide insight regarding the relative magnitude of potential changes under one operational condition compared to another. Therefore, for the purposes of this impact assessment, modeled temperature changes that were within 0.3°F between modeled simulations were considered to represent no measurable change. Temperature differences of more than 0.3°F were assessed for their biological significance. This approach is very conservative (rigorous). For example, USFWS and Reclamation, in the Trinity River Mainstem Fishery Restoration Draft EIS/EIR (USFWS et al. 1999), used a change in long-term average water temperature of 0.5°F as a threshold of significance, and the Central Valley RWQCB generally uses a change of 1.0°F or more as a threshold of significance.

<u>Assessment Methodologies</u>

The impact assessment methodologies defined below are discussed in terms of comparing the modeled output for one condition to output from a second condition depicting the additional surface water diversions associated with the Proposed Project or Upstream Diversion Alternative. Hence, throughout this methodology section, reference will be made to comparing modeled output from the Action Alternatives to that under another condition without implementation of a project (i.e., either the existing condition or No Action/No Project Alternative). The same basic methodologies described below were used to assess cumulative impacts (i.e., 2025 with the project versus existing condition) and for evaluating the project's incremental contribution to the cumulative condition.

Upper American River Basin

To assess diversion-related impacts to fish resources and aquatic habitat in the upper American River associated with the Action Alternatives or the cumulative condition, a flow comparison was performed to determine the difference between monthly mean flows for all of the months of the 70-year period of record relative to the basis of comparison. Monthly mean flows were further examined to determine the difference between monthly mean flows for the high-flow season (i.e., December through June) and the low-flow season (i.e., July through October) of the 70-year period of record.

Ralston Afterbay

No substantial storage-, elevation-, or temperature impacts to the fish resources of Ralston Afterbay would be expected to occur because, as a regulating afterbay of the MFP, its monthly storage, elevation, and temperature regimes would be expected to remain relatively similar under the Action Alternatives compared to the existing condition. Any small changes in storage, elevation, or temperature that could occur would constitute a less-than-significant impact to Ralston Afterbay fish resources.

Folsom Reservoir

<u>Warmwater Fisheries</u>

Because Folsom Reservoir's warmwater fish species (black bass, sunfish, crappie, and catfish) use the warm upper layer of the reservoir and nearshore littoral habitats throughout most of the year, seasonal changes in reservoir storage, as it affects reservoir water surface elevation (feet msl), and the rates at which water surface elevation changes during specific periods of the year, can directly affect the reservoir's warmwater fish resources. Reduced water surface elevations can reduce the availability of nearshore littoral habitats used by warmwater fish for spawning and rearing, Therefore reducing spawning and rearing success and subsequent year-class strength. In addition, decreases in reservoir water surface elevation during the primary spawning period for nest-building, warmwater fish (March through July) may result in reduced initial year-class strength through warmwater fish nest "dewatering."

To assess potential elevation-related impacts to the warmwater fish of Folsom Reservoir, the following two-phased approach was used. First, a relationship between reservoir water surface elevation and acres of nearshore littoral habitat containing submerged structure (submerged macrophytes and/or inundated terrestrial vegetation) was developed. Using this relationship, the mean number of acres of littoral habitat was estimated for each month of the primary spawning and rearing period (March through September) under the Proposed Project and the cumulative condition relative to that modeled for the basis of comparison.

Second, the magnitude of change (feet) in reservoir water surface elevation occurring each month of the primary spawning period for nest-building fish (March through July) under the Proposed Project and the cumulative condition was determined and compared to that modeled for the basis of comparison. A recent study by CDFG, which examined the relationship between reservoir elevation fluctuation rates and nesting success for black bass, suggests that a reduction rate of 0.15, 0.18, and 0.39 meter per day (m/day) or greater would result in 100 percent nest mortality (or zero percent nest survival) for largemouth bass, smallmouth bass, and spotted bass, respectively (Lee et al. 1998). However, CDFG reservoir biologists suggest that, on the average, a nest survival rate of at least 20 percent is necessary to maintain the long-term population levels of high-fecundity, warmwater fish (D. Lee, pers. comm. 1998). Using nest survival curves developed by CDFG (Lee et al. 1998), reservoir fluctuation criteria were developed that would provide a minimum nest survival rate of approximately 20 percent for largemouth bass, the bass species found by CDFG to be most sensitive to reservoir elevation fluctuations.

A reduction rate of nine feet per month would represent an approximate water level decrease of 0.3 feet per day (ft/day) (0.09 m/day) during a nesting event, which would correlate to an approximate nest survival rate of 20 percent for largemouth bass (Lee et al. 1998). Therefore, a decrease in mean Folsom Reservoir water surface elevation of nine feet or more per month was selected as the threshold beyond which spawning success of nest-building, warmwater fish (black bass, sunfish, crappie, and catfish) could potentially result in long-term population declines. To evaluate impacts to warmwater fish, the number of times that reservoir reductions of nine feet or more per month could occur under the Proposed Project and the cumulative condition were compared to the number of occurrences that were modeled to occur under the basis of comparison.

Criteria for reservoir elevation increases (nest flooding events) are not recommended by CDFG. Because of overall fishery benefits, greater reservoir elevations that would be associated with rising water levels would offset negative impacts due to nest flooding (Lee et al. 1998). Therefore, the likelihood of spawning-related impacts from nest flooding is not addressed for reservoir fisheries.

Coldwater Fisheries

During the period when Folsom Reservoir is thermally stratified (April through November), coldwater fish within the reservoir reside primarily within the reservoir's metalimnion and hypolimnion where water temperatures remain suitable. Reduced reservoir storage (TAF) during this period could reduce the reservoir's coldwater pool volume, thereby reducing the quantity of habitat available to coldwater fish species during these months. Reservoir coldwater pool size generally decreases as reservoir storage decreases, although not always in direct proportion because of the influence of reservoir basin morphometry. Therefore, to assess potential storage-related impacts to coldwater fish habitat availability in Folsom Reservoir, end-of-month storage modeled for each year of the 70-year period of record under the Proposed Project and the cumulative condition was compared to end-of-month storage under the basis of comparison for each month of the April through November period. Substantial reductions in reservoir storage were considered to result in substantial reductions in coldwater pool volume and, therefore, habitat availability for coldwater fish. Impacts to the coldwater fisheries were further assessed by determining whether seasonal changes in reservoir storage, and associated changes in water-surface elevation, would be expected to indirectly affect coldwater fish species by adversely affecting the productivity of their primary prey species (threadfin shad (*Dorosoma petenense*) and wakasagi (*Hypomesis hipponensis*)).

Lake Natoma

No storage- or elevation-related impacts to fishery resources of Lake Natoma are expected to occur because as a regulating afterbay of Folsom Reservoir, its monthly storage and elevation would be affected little, if at all, by the Proposed Project or cumulative condition, relative to the basis of comparison. Consequently, no quantitative assessment of potential storage- or elevation-related impacts to fishery resources in this water body is warranted.

Because the increased diversion under the Proposed Project and the cumulative condition could alter the temperature of water released from Folsom Dam, and because Lake Natoma's water temperature at any given time is largely dictated by the temperature of water released from Folsom Dam, these additional diversions could change seasonal water temperatures within Lake Natoma. The small changes in lake temperatures that could occur would not be expected to adversely affect the lake's warmwater fisheries. Conversely, increases in lake temperatures could adversely affect coldwater species such as rainbow trout stocked by CDFG. To assess the potential impacts of altered lake temperatures to fishery resources within the lake, monthly mean temperatures of water released from Nimbus Dam were determined for the Proposed Project and the cumulative condition, and compared to monthly mean temperatures modeled under the basis of comparison for each month of the year. Temperatures of water released from Nimbus Dam were used as an “index” to represent the relative changes in Lake Natoma water temperatures that could occur under the Proposed Project, relative to the basis of comparison.

Nimbus Hatchery

Because the additional diversions could alter Lake Natoma water temperatures during some months, and because Nimbus Hatchery diverts its water supply directly from Lake Natoma throughout the year, the Proposed Project or cumulative condition could change hatchery water temperatures during some months of the year. Nimbus Hatchery production remains relatively unaffected when hatchery temperatures remain below 60°F. However, increased disease and mortality of hatchery-reared fish often occurs when temperatures exceed 60°F. Losses from these factors become a particular problem when hatchery water temperatures exceed 65°F for extended periods. Water temperatures exceeding 68°F for even short periods (days) are particularly detrimental to hatchery fish held at high densities, and could require the hatchery to release and/or transfer most or even all of its fish to prevent unacceptably high mortality (B. Barngrover, pers. comm. 1997).

To assess potential temperature-related impacts to Nimbus Hatchery operations, monthly mean temperatures of water released from Nimbus Dam under the Proposed Project and the cumulative condition were modeled and compared to those modeled under the basis of comparison for each month of the year. The number of years of the 69 years modeled that monthly mean Nimbus Dam release temperatures would exceed the index values of 60°F, 65°F, and 68°F under the Proposed Project and the cumulative condition were determined and compared to the frequency of exceedance of these temperature index values under the basis of comparison. In addition, for each month of the year, the mean temperature of water released from Nimbus Dam for the years exceeding each of these temperature index values was determined.

Lower American River

The additional diversions by PCWA could affect lower American River flows and water temperatures during portions of the year. The lower American River is the water body within the study area with the greatest potential to experience impacts to fisheries associated with implementation of the Proposed Project and the cumulative condition due to anticipated changes in Reclamation's operation of Folsom Reservoir. In addition, a number of fish species of primary management concern utilize the lower American River during one or more of their lifestages. For these reasons, species-specific impact assessments were warranted for this water body and were conducted for the following five species of primary management concern:

- Fall-run Chinook Salmon
- Steelhead
- Splittail
- American Shad
- Striped Bass

These species are of primary management concern due either to the importance of their commercial and/or recreational fisheries (i.e., chinook salmon, steelhead, American shad, and striped bass) and/or because they are a species currently listed under the federal ESA and/or CESA (i.e., steelhead, chinook salmon, and splittail). Because the species selected for species-specific assessments include those sensitive to changes in both river flow and water temperature throughout the year, an evaluation of impacts to these species is believed to reasonably encompass the range of potential impacts to lower American River fish resources that could occur under the Proposed Project or the cumulative condition relative to the basis of comparison.

Potential impacts resulting from changes in river flows and water temperatures were evaluated for each of the five species of primary management concern. Because these species are known to use the lower American River during discrete time periods associated with specific lifestages, potential impacts were evaluated using species-specific assessment parameters, where appropriate. The impact assessment methodologies used to assess potential flow- and water temperature-related impacts to the five indicator species are described below.

Fall-run Chinook Salmon

Watt Avenue represents the river location above which approximately 98 percent of fall-run chinook salmon spawning occurs. To assess flow-related impacts to fall-run chinook salmon spawning, incubation and initial rearing, monthly mean flows at Watt Avenue and below Nimbus Dam under the alternatives were compared to monthly mean flows under the existing condition for each month of the October through February period. In addition, monthly mean flows at Watt Avenue and below Nimbus Dam under the cumulative condition (i.e., 2025 with the American River Pump Station Project) versus both the existing condition and future No Action/No Project Alternative conditions were evaluated to assess flow-related impacts to fall-run chinook salmon spawning incubation and initial rearing. If a cumulative impact (versus the existing condition) was found to be significant, then the Action Alternatives' incremental contribution to the cumulative condition was assessed.

Changes in flows during the period March through June also were assessed at Watt Avenue to further address potential impacts to fry and juvenile lifestages rearing during these months. Flows at the mouth were compared between modeling simulations to assess flow-related impacts to adult immigration and juvenile emigration. The frequency with which specified flow levels were met was determined under the alternatives, and was compared to that under the existing condition.

Water temperature-related impacts to lower American River fall-run chinook salmon were evaluated through three distinct assessments focusing on distinct lifestages and periods, including: (1) adult immigration (September through November); (2) spawning/incubation and initial rearing (October through February); and (3) juvenile rearing and emigration (March through June) using the multi-step analysis described below.

Adult Immigration (September Through November)

Temperature-related impacts to adult immigration were based on water temperature at the mouth of the lower American River and at Freeport on the Sacramento River. The 69-year average water temperatures for each month of the September through November period that would occur at the American River mouth and at Freeport under the Proposed Project and the cumulative condition were compared to those under the basis of comparison. In addition, monthly mean water temperatures at the American River mouth and at Freeport were compared for each month of the adult immigration period over the 69-year period of record. Therefore, a total of 483 months for each month were included in the analysis.

Spawning/Incubation and Initial Rearing (October Through February)

First, the long-term average water temperatures for each month of the October through February period that would occur below Nimbus Dam or at Watt Avenue under the Proposed Project or cumulative condition were compared to the long-term average water temperatures for each of these months, at these same locations, under the basis of comparison. Because water temperatures generally warm with increasing distance downstream during October, and because 98 percent of all spawning occurs upstream of Watt Avenue, the most conservative assessment of thermal impacts to chinook salmon spawning and incubation during October is based on Watt Avenue temperatures. Therefore, all temperature assessments for the month of October are based on temperatures at Watt Avenue. Conversely, because water temperatures generally cool with increasing distance downstream during the period November through January, and because water temperatures generally change little between Nimbus Dam and Watt Avenue during February, temperature impact assessments for spawning and incubation during the months November through February are based on water temperatures below Nimbus Dam, thereby providing the most conservative assessment.

Second, the number of years (of the 69 years modeled) that monthly mean water temperatures would exceed 56°F below Nimbus Dam or at Watt Avenue was determined for each month of the October through February period and compared to those modeled under the basis of comparison.

Third, for each month of the October through February period, the mean water temperature below Nimbus Dam or at Watt Avenue for the years (of the 69 years modeled) exceeding the 56°F index value was determined under the Proposed Project or the cumulative condition and compared to those under the basis of comparison.

Finally, Reclamation's Lower American River Fall-Run Chinook Salmon Mortality Model was used to assess potential temperature-related impacts to the early lifestage of chinook salmon. Annual early lifestage survival (the complement of mortality) estimated for the Proposed Project and the cumulative condition were compared to that estimated for the basis of comparison for each year of the 69-year period of record. Model output represents the percentage of potential emergent fry produced, based on all eggs brought to the river by spawning adults, that would survive under the temperature regime that would occur under each model simulation. The model calculates temperature-induced mortality (the percentage of potential emergent fry lost as a result of temperature-induced mortality of pre-spawned eggs, fertilized eggs incubating in the gravel, and pre-emergent fry). Losses for each of these three early lifestages are then tallied by the model and output as a percent loss (mortality) from egg potential (all eggs brought to the river by immigrating adults) for each year modeled. The complement (i.e., survival = 100 - mortality) of these calculated percent losses is discussed for impact assessment purposes.

Juvenile Rearing and Emigration (February Through June)

The same methodology was used to evaluate potential temperature-related impacts to fall-run chinook salmon juvenile rearing and emigration with the following modifications:

- The period of assessment was February through June;

- The number of years (of the 69 years modeled) that monthly mean water temperatures would exceed the index value of 65°F were determined at Watt Avenue and the lower American River mouth;

- Mean water temperatures for the years (of the 69 years modeled) that were shown to exceed the 60°F and 65°F index values were determined at Watt Avenue; and

- Reclamation's Salmon Mortality Model was not used, because it does not assess mortality beyond the emergent fry lifestage.

The temperature index values for immigration/emigration and spawning/incubation are different because adult and juvenile fall-run chinook salmon are believed to tolerate water temperatures up to 65°F without substantial adverse impacts, whereas incubating eggs and pre-emergent fry incur substantial reductions in survival when water temperatures exceed 60°F. Because the majority of fall-run chinook salmon and steelhead rearing is believed to occur above Watt Avenue (River Mile (RM) 9.5), and because water temperatures generally increase between Nimbus Dam and Watt Avenue during the February through June period, use of Watt Avenue water temperatures for assessing temperature-related impacts to juvenile chinook salmon during this period provides the most conservative assessment.

In addition to the assessments described above, temperature-related impacts to juvenile emigration through the lower portion of the river were assessed based on temperatures at the mouth using the temperature index value described above.

<u>Steelhead</u>

Because environmental conditions required by steelhead are not significantly different from those required by fall-run chinook salmon, flow- and temperature-related impact determinations for steelhead for the period October through June were based on the same modeling output used to assess impacts to fall-run chinook salmon during this period. However, because steelhead rear within the lower American River year-round, additional flow and temperature impact assessments were made for the months of the year not addressed by the fall-run chinook salmon assessments (i.e., July through September).

Flow-related impacts to steelhead during the July through September period were assessed via the same methods used to assess flow-related impacts to fall-run chinook salmon during the October through June period.

Temperature-related impacts to steelhead juvenile rearing during the July through September period were assessed via the same methods used to assess temperature-related impacts to fall-run chinook salmon juvenile rearing and emigration during the March through June period. In addition, the number of months exceeding 65°F for each model simulation, as well as the average temperature for the months exceeding this index value, also was determined. Because no steelhead mortality model has been developed for the lower American River, no steelhead mortality modeling could be performed as a part of the assessment for this species.

Splittail

Splittail may spawn in the lower American River in extremely low numbers, with the majority of splittail spawning that could occur taking place in the lower sections of the river (i.e., downstream of RM 12). Consequently, altered river flows from the alternatives could impact the availability of potential splittail spawning habitat within the lower American River by reducing the amount of riparian vegetation that would be inundated during the splittail spawning season (February through May).

The lower American River from RM 5 to the mouth is largely influenced by the water surface elevation of the Sacramento River. Sacramento River stage often controls the water surface elevation here, and the extent to which splittail spawning habitat, particularly inundated riparian vegetation, along this lower reach of the river channel would be available. Conversely, river stage in the portion of the river between RM 8 and RM 12, which is characterized by abundant backwater habitat, is controlled primarily by lower American River flows. The frequency and duration of riparian vegetation flooding in this area and, therefore, the quality and quantity of potential splittail spawning habitat has the potential to be impacted by reduced flows.

To assess flow-related impacts to potential splittail spawning habitat availability during each month of the February through May period, for each year of the 70-year period of record, the amount of riparian habitat inundated in acres (dependent variable) was regressed against flow in cfs (independent variable). Using river flows at Watt Avenue (RM 9.5), the number of acres of flooded riparian habitat between RM 8 and RM 9 was determined under the Proposed Project and the cumulative condition and for the basis of comparison, and these values were compared for assessment purposes. Field measurements conducted for the interim reoperation of Folsom Dam and Reservoir indicated that the total amount of riparian vegetation inundated within RM 8 to RM 9 ranged from 2.4 acres at a river flow of 4,540 cfs to 35.8 acres at a river flow of 22,570 cfs (SAFCA 1999).

The simple linear regression analysis performed identified a positive, statistically significant ($r^2=0.99$; $P<0.001$) relationship between flow and the total acreage of riparian vegetation inundated within RM 8 to RM 9. This relationship is defined by the equation:

$$\text{Habitat} = (0.001874 \times Q) - 6.4585$$

Where: Habitat = the total amount of riparian vegetation inundated within the study area (acres); and
Q = flow within the study area (cfs)

The x-intercept of the linear regression line occurs at 3,456 cfs, which indicates that zero acres of riparian habitat are inundated within the study area at river flows of approximately 3,456 cfs or less. For river flows between 3,456 cfs and 22,571 cfs, the total acreage of riparian vegetation inundated within the study area increased by approximately 1.9 acres for each 1,000 cfs increase in flow. As previously discussed, field observations determined that the first 2.4 acres of riparian vegetation inundated primarily occurred within a narrow strip along the riverbank. This inundation zone was noted as being very shallow (i.e., generally less than two feet deep) and, therefore, unlikely to provide suitable potential habitat for splittail. Based on this observation, more than 2.4 acres of inundated vegetation must be present within the study area before potentially suitable splittail spawning habitat would be available.

Splittail reportedly spawn at water temperatures from 48°F to 68°F (Wang 1986). To evaluate potential temperature-related impacts to splittail, the number of years (of the 69 years modeled) that monthly mean water temperatures at Watt Avenue and the mouth would be within this preferred range during the period February through May was determined under the Proposed Project and the cumulative condition, and compared to that under the basis of comparison. For the purposes of assessing temperature-related impacts to splittail in the American River, water temperatures at Watt Avenue and the mouth effectively represent the range of water temperatures that splittail would encounter when using the lower portion of the river for spawning and initial rearing.

American Shad

The flow-related impact assessments conducted for fall-run chinook salmon and steelhead described above provided for an evaluation of the relative change in monthly mean flows in the lower American River under the Proposed Project and the cumulative condition for all months of the year. Consequently, findings from these assessments also were used, in part, to assess potential flow-related impacts to American shad.

Because the majority of American shad spawning migrations into the lower American River are believed to occur during May and June, changes in river flows during these months warrant further assessment for this species. The relative number of adult American shad entering the lower American River during May and June is believed to be largely influenced by flows at the mouth. Snider and Gerstung (1986) recommended flow levels of 3,000 to 4,000 cfs during May and June as sufficient "attraction flows" to sustain the American shad fishery in the lower American River. Impacts to American shad attraction flows were assessed by determining the number of years (of the 70-year period of record) during which May and June flows at the mouth would be less than 3,000 cfs under the Proposed Project and the cumulative condition, compared to that determined for the basis of comparison.

To evaluate potential water temperature-related impacts to American shad spawning, monthly mean water temperatures under the Proposed Project and the cumulative condition were determined and compared to those under the existing condition for the months of May and June. A conservative approach for assessing potential water temperature impacts was to assume that American shad may spawn throughout the river and, therefore, to evaluate water temperature conditions below Nimbus Dam and the mouth. Specifically, the number of years (of the 69 years modeled) that mean May and June water temperatures below Nimbus Dam and the mouth would be within the reported preferred range for American shad spawning (60°F to 70°F) was determined under the Proposed Project and the cumulative condition and compared to that under the basis of comparison.

<u>Striped Bass</u>

Although no study to date has definitively determined whether striped bass spawn in the lower American River, it is believed that little, if any, striped bass spawning occurs there (DeHaven 1978, *in* Snider and Gerstung 1986). Nevertheless, the lower American River is used by juvenile striped bass for rearing and supports a striped bass sport fishery during May and June.

The flow-related impact assessments conducted for fall-run chinook salmon and steelhead address all months of the year. Hence, potential flow-related impacts to striped bass, as they pertain to juvenile rearing habitat availability, were assessed using the same data produced to assess flow-related impacts to fall-run chinook salmon and steelhead.

In addition to juvenile rearing considerations, the number of adult striped bass entering the lower American River during the summer is believed to vary with flow levels and food production. Snider and Gerstung (1986) suggested that flows of 1,500 cfs at the mouth during May and June would be sufficient to maintain the striped bass sport fishery in the lower American River. Hence, potential flow-related impacts to the striped bass sport fishery were assessed by determining the number of years (of the 70-year period of record) that flows at the mouth would be less than 1,500 cfs in May and June under the Proposed Project and the cumulative condition, compared to the number of years this would occur during these months under the basis of comparison.

Optimal water temperatures for juvenile striped bass rearing are reported to range from approximately 61°F to 73°F (USFWS 1988). Therefore, to evaluate potential water temperature-related impacts to striped bass juvenile rearing, the number of years (of the 69 years modeled) that monthly mean water temperatures below Nimbus Dam and at the mouth during May and June would be within the preferred range of 61°F to 73°F for juvenile rearing was determined and compared to those modeled under the basis of comparison.

Shasta and Trinity Reservoirs

Potential elevation- and storage-related impacts to the warmwater and coldwater fisheries of Shasta and Trinity reservoirs were assessed using the same methods described above for Folsom Reservoir.

Keswick Reservoir

No storage- or elevation-related impacts to the fishery resources of Keswick Reservoir are expected to occur because, as a regulating afterbay of Shasta Reservoir, its monthly storage and elevation will be affected little, if at all, by the Proposed Project, alternatives or the cumulative condition. Consequently, no quantitative assessment of potential storage- or elevation-related impacts to fishery resources in this water body is warranted. Similarly, the Proposed Project, alternatives or the cumulative condition would not be expected to substantially alter the water temperatures within Keswick Reservoir. Consequently, a quantitative assessment of potential water temperature-related impacts to fishery resources within this reservoir was not warranted.

Sacramento River

Additional American River diversions could potentially alter seasonal Sacramento River flows, which could change the relative habitat availability for Sacramento River fish. To assess such flow-related impacts to upper Sacramento River fish, monthly mean flows released from Keswick Dam under the Action Alternatives and the cumulative condition were compared to releases from Keswick Dam under the basis of comparison for each month of the year. Potential flow-related impacts to lower Sacramento River fish were assessed in the same manner, except that this assessment used modeled flows at Freeport (RM 46).

Additional diversions could potentially alter Sacramento River water temperatures seasonally during some years. Changes in Sacramento River water temperatures that could occur as a result of implementation of the Proposed Project, alternatives or the cumulative condition would not be expected to be sufficiently large to adversely affect fish species present in the upper Sacramento River, with the possible exceptions of chinook salmon and steelhead. Elevated water temperatures could reduce spawning and rearing success of these anadromous salmonids because of their low thermal tolerance. For this reason, an assessment of changes to upper Sacramento River water temperatures focused on these fish species. Moreover, because: (1) thermal requirements of chinook salmon and steelhead are generally similar; (2) the NMFS Biological Opinion for Winter-run Chinook Salmon (NMFS 1993 as revised in 1995) has established quantitative temperature criteria for the upper Sacramento River to protect winter-run chinook salmon; and (3) Reclamation has developed a Sacramento River Chinook Salmon Mortality Model applicable to all four runs of chinook salmon, this assessment focused quantitatively on chinook salmon. Impact findings for the four runs of chinook salmon provide a technical basis from which to infer whether steelhead would be impacted by seasonal changes in water temperatures.

A three-phased water temperature assessment was performed to evaluate potential temperature-induced impacts to the anadromous salmonid resources of the Sacramento River. First, monthly mean water temperatures at Keswick Dam (RM 301), the upstream extent of anadromous fish immigration, under the Action Alternatives and the cumulative condition were compared to monthly mean temperatures at this river location under the basis of comparison for each month of the year.

Second, the number of years of the 69-year period modeled that water temperatures at Keswick Dam and Bend Bridge would exceed the temperature criteria identified by NMFS in its Biological Opinion for Winter-run Chinook Salmon (NMFS 1993 as revised in 1995) was determined for the Action Alternatives and cumulative condition and compared to the number of years that these criteria would be exceeded under the basis of comparison. NMFS criteria used for this component of the assessment are as follows:

- Daily average water temperature not in excess of 56°F at Bend Bridge from April 15 through September 30; and

- Daily average water temperature not in excess of 60°F at Bend Bridge from October 1 through October 31.

Although the NMFS (1993) temperature criteria are stated as daily averages, the available hydrologic and water temperature models allow only for monthly mean temperature analyses and output. Consequently, this assessment was based on monthly mean water temperature data output from Reclamation's existing models.

Finally, Reclamation's Sacramento River Chinook Salmon Mortality Model was used to estimate annual, early lifestage losses (from egg potential) for fall-run, late-fall-run, winter-run, and spring-run chinook salmon populations. Temperature input to the Sacramento River Chinook Salmon Mortality Model consists of monthly mean temperatures at nine locations between Shasta Dam and Vina Bridge. Mortality estimates for each of the four runs were modeled under the Proposed Project and the cumulative condition, which were then compared to modeled mortality estimated for each run under the basis of comparison. Potential impacts to the four chinook salmon runs in the Sacramento River were evaluated using the same criteria established for the Lower American River Chinook Salmon Mortality Model (see discussion under Lower American River, Fall-Run Chinook Salmon).

To assess potential water temperature-related impacts to fish in the lower Sacramento River, the first phase of this assessment was conducted for the Freeport location.

Sacramento-San Joaquin River Delta

Increased surface water diversion could alter the quantity of freshwater flowing into and through the Delta. The abundance and distribution of several fish species of management concern that rely heavily upon the Delta for one or more of their lifestages, including delta smelt (federally threatened), splittail (federally threatened), longfin smelt (state species of special concern), and striped bass (recreationally important), can be affected by total Delta outflow, the location of X2 (two parts per thousand (ppt) isohaline in the Delta), and the export/inflow ratio.

To evaluate potential impacts to Delta fish resources, changes in monthly mean Delta outflow for the 70-year period of record under the Action Alternatives and the cumulative condition were determined for each month of the year and were compared to monthly mean Delta outflow under the basis of comparison. The frequency and magnitude of differences in Delta outflow were evaluated relative to life history requirements for Delta fish. In addition, changes in monthly mean X2 position were determined for all months of each year, with an emphasis on the February through June period.

Impacts to delta smelt, splittail, striped bass, and other Delta fishery resources were considered adverse if hydrology under the Action Alternatives or the cumulative condition showed a substantial decrease in monthly mean Delta outflow, relative to hydrology under the basis of comparison, during one or more months of the February through June period; if a substantial shift in the long-term monthly mean X2 position occurred (i.e., more than one kilometer (km)); or if Delta export/inflow ratios were increased to where allowable export limits would be exceeded. USFWS and Reclamation have in past documents (i.e., Draft Trinity River Mainstem Fishery Restoration EIS/EIR) applied a 10 percent modeled exceedance in changes in X2 position during the February through June period to determine potentially significant impacts to fish populations in the Delta. Therefore, the significance criteria utilized in this document (i.e., 1 km or more shift in X2 position) to determine potentially significant impacts to Delta fish populations is very conservative (rigorous) relative to the significance criteria utilized by the resource agencies in previous documents.

Oroville Reservoir and Feather River

Additional American River diversions could potentially alter seasonal lower Feather River flow due to changes in releases from the Oroville Reservoir to the lower Feather River to meet its share of Delta requirements under the Coordinated Operating Agreement (COA). The COA is an agreement between the SWP and the CVP on how they will share the responsibility to meet operational requirements in the Delta. Since the COA takes local reservoir operations into account, any change in either project's operations may have an impact on the other. To assess such flow related impacts to lower Feather River fish, monthly mean flows released from Oroville Reservoir under the cumulative condition were compared to releases under the basis of comparison for each month of the year.

Any changes in Oroville Reservoir operations could alter water temperatures seasonally in the Feather River downstream of the reservoir. To assess such water temperature impacts mean monthly water temperature data from Reclamation's existing Oroville and lower Feather River temperature models were used. The assessment was performed by comparing the modeled monthly mean water temperatures in the Lower Feather River at Oroville Dam, under the cumulative condition to monthly mean water temperatures at this location under the basis of comparison for each month of the year.

3.5.2.2 Applicable Laws, Ordinances, Regulations, and Standards

Management of non-anadromous fish and other aquatic species is the responsibility of the USFWS, whereas management of anadromous fish is the responsibility of NMFS. CDFG is a state “trustee agency” for aquatic species under CEQA. Sensitive aquatic resources are regulated by the federal ESA and CESA. The following discussion addresses fisheries management plans and other regulatory initiatives relative to aquatic resources in the study area.

Central Valley Project Improvement Act

The CVPIA (Title 34 of Public Law (P.L.) 102-575) amends the authorization of the CVP to include fish and wildlife protection, restoration, and mitigation as project purposes of the CVP having equal priority with irrigation and domestic uses of CVP water. It also elevates fish and wildlife enhancement to a level having equal purpose with power generation.

The CVPIA identifies several measures to meet these new purposes. Significant among these is the broad goal of restoring natural populations of anadromous fish (chinook salmon, steelhead, green and white sturgeon, American shad, and striped bass) in Central Valley rivers and streams to double their recent average levels. The Anadromous Fish Restoration Program (AFRP) directs the Secretary of the Interior to:

> *"... develop within three years of enactment and implement a program which makes all reasonable efforts to ensure that, by the year 2002, natural production of anadromous fish in Central Valley rivers and streams will be sustainable, on a long-term basis, at levels not less than twice the average levels attained during the period of 1967-1991 ..."*

The USFWS has assumed the lead role in the AFRP. Under USFWS direction, technical teams have assisted in the establishment of components of the AFRP. A key element of the program is instream flow recommendations, including objectives for the lower American River, upper Sacramento River, and the Delta.

The Secretary of the Interior also is directed under Section 3406(b)(2) of the CVPIA to dedicate and manage 800,000 AFA of CVP yield for the primary purpose of implementing the fish, wildlife, and habitat restoration and measures authorized by that title. Management of the 800,000 AFA for fishery and habitat restoration is still under consideration; however, Reclamation has voluntarily implemented AFRP flow-related actions both for the Delta and upstream reservoirs. Moreover, both Reclamation and the USFWS have required the implementation of the AFRP actions in any modeling studies associated with federal actions or otherwise affecting the CVP. While it is recognized that recent litigation regarding the accounting of 3406(b)(2) water has resulted in uncertainty in how to characterize 3406(b)(2) actions, Interior has yet to suggest any specific approach (for planning and impact assessment purposes) other than AFRP actions. Inclusion of AFRP flow-related actions both for the Delta and upstream reservoirs best represents implementation of management of 3406(b)(2) water.

Ecosystem Restoration Program Plan of the CALFED Bay-Delta Program

The mission of the CALFED Bay-Delta Program is to develop a long-term comprehensive plan that will restore ecosystem health and improve water management for beneficial uses of the Bay-Delta system. The program addresses problems in four resource areas: ecosystem quality, water quality, system integrity, and water supply reliability. Programs to address problems in the four resource areas will be designed and integrated to fulfill the CALFED mission.

The goal for ecosystem quality is to improve and increase aquatic and terrestrial habitats and improve ecological functions in the Bay-Delta to support sustainable populations of diverse and valuable plant and animal species. The CALFED Ecosystem Restoration Program Plan (ERPP) addresses this goal. The foundation of the ERPP is restoration of ecological processes that are associated with streamflow, stream channels, watersheds, and floodplains. These processes create and maintain habitats essential to the life history of species dependent on the Delta. In addition, the ERPP aims to reduce the effects of stressors that inhibit ecological processes, habitats, and species.

Key restoration actions for Sacramento River fisheries being proposed by this program include the following:

- Enhancing river flows;
- Restoring the natural river meander process;

- Enhancing riparian and riverine habitats;
- Maintaining suitable water temperatures for salmonids;
- Reducing fish losses at points of water diversion;
- Improving anadromous fish passage at existing barriers;
- Maintaining and improving water quality;
- Improving hatchery and stocking programs; and
- Improving management of inland harvest of salmonids.

Such restoration actions, when implemented over the next few decades, are expected to improve Sacramento River fisheries, including salmonid fisheries, over the existing condition. The ERPP establishes similar restoration goals for other major water courses throughout the Central Valley.

Restoring Central Valley Streams: A Plan for Action

In 1993, CDFG published *Restoring Central Valley Streams: A Plan for Action*, which was developed to address the protection of anadromous fish habitat in Central Valley streams (CDFG 1993). This plan identified the following five priorities for the lower American River, and establishes them as recommendations:

- Maintain specified instream flow releases below Nimbus Dam throughout the year;

- Establish minimum fall carryover storage at Folsom Reservoir to maintain suitable year-round stream temperatures;

- Control rapid-flow fluctuations to protect eggs and fry of anadromous fish;

- Develop a coordinated multi-agency management plan; and

- Develop and implement a continuing program for the purpose of restoring and replenishing, as needed, spawning gravel lost from the construction and operation of the CVP dams, bank protection projects, and other actions that have reduced the availability of spawning gravel and rearing habitat in the lower American River.

Steelhead Restoration Plan for the American River

In 1991, CDFG published the *Steelhead Restoration Plan for the American River*. The plan has two main objectives (CDFG 1991):

- Restoring and maintaining naturally produced steelhead as an integral component of the American River ecosystem; and

- Restoring the population to a level that will sustain a quality steelhead fishery and provide for other non-consumptive uses.

The plan focuses on restoring habitat conditions within the American River, and on supplementing the existing fisheries population with artificially reared fish. The plan also recommends that the overall CVP operations be adjusted to allow for the elimination of drastic flow fluctuations in the American River; states water temperature objectives during spawning, incubation, emergence, juvenile rearing lifestages; and suggests maintenance of a minimum coldwater pool in Folsom Reservoir throughout the summer.

National Marine Fisheries Service Biological Opinion for Winter-run Chinook Salmon

In 1993, NMFS assessed the potential impacts of Reclamation's operation of the CVP on the federally listed winter-run chinook salmon. Based on this assessment, NMFS issued a biological opinion concluding that operation of the CVP would likely jeopardize the continued existence of winter-run chinook salmon. Reasonable and prudent alternatives to CVP operations were developed to avoid jeopardy, including specific flow, temperature, reservoir storage, and diversion requirements in the Sacramento River and in the Delta. NMFS reinitiated consultation on CVP operations when the "Principles for Agreement" that formed the basis for the Bay-Delta Plan was originally signed, and they subsequently issued a revised biological opinion in 1995. Reclamation currently operates the CVP in accordance with the Biological Opinion for Winter-run Chinook Salmon (NMFS 1993, as revised in 1995).

U.S. Fish and Wildlife Service Biological Opinion for Delta Smelt

In 1995, Reclamation consulted with the USFWS on impacts to the federally listed delta smelt potentially resulting from CVP operations. The USFWS concluded that operation of the CVP would not jeopardize the continued existence of delta smelt. This conclusion was based on the benefits to delta smelt expected from operating the CVP in accordance with the Biological Opinion for Winter-run Chinook Salmon (NMFS, 1993 as revised in 1995) and the Bay-Delta Plan.

U.S. Fish and Wildlife Service Biological Opinion for Splittail

In 1995, Reclamation consulted with the USFWS on impacts to then-proposed threatened Sacramento splittail potentially resulting from CVP operations. The USFWS concluded in a conference opinion that operation of the CVP would not jeopardize the continued existence of Sacramento splittail. This conclusion was based on the benefits to Sacramento splittail expected from operating the CVP in accordance with the Biological Opinion for Winter-run Chinook Salmon and the Bay-Delta Plan. It is important to note that the USFWS officially listed the Sacramento splittail as a threatened species on March 10, 1999. Nevertheless, as stated by the USFWS biological opinion (page 1), "[*s*]*hould the Sacramento splittail listing action be finalized as proposed, the [USFWS] intends to adopt the conference opinion as the biological opinion for combined project effects*" (USFWS 1995).

Federal Energy Regulatory Commission License for the Middle Fork Project

Article 37 of the FERC license issued to PCWA for the MFP, as modified in 1981, specifies that flows in the North Fork and Middle Fork American rivers below Ralston Afterbay must be a minimum of 75 cfs year-round to support fisheries of the American River. This 75 cfs minimum flow requirement extends downstream of the confluence of the Middle Fork American River and the North Fork of the Middle Fork American River, and continues downstream for the North Fork American River to Folsom Reservoir. CDFG agreed with the modified fish flow releases and the flows are a part of PCWA's SWRCB permits.

Federal Energy Regulatory Commission License for Oroville Reservoir

An application for renewal for the power facilities at Oroville Reservoir is being prepared for submission to the FERC in 2006. During this process, the temperature and fishery resources of Oroville Reservoir and the lower Feather River will undergo detailed analysis to determine the appropriate flow and temperature requirements that will be part of the new license to maintain or enhance the fisheries of Oroville Reservoir and the lower Feather River.

3.5.2.3 Impact Indicators and Significance Criteria

Tables 3.5-3 and **3.5-4** list the impact indicators and significance criteria developed for use in assessing the significance of potential impacts upon fish resources and aquatic habitat that may result from facilities- and diversion-related activities.

Table 3.5-3
Fish Resources and Aquatic Habitat Facilities-Related Impact Indicators and Significance Criteria

Impact Indicators	Significance Criteria
❑ Streamflows through the project area.	❑ Decrease in habitat quantity, relative to the basis of comparison, of sufficient magnitude and frequency to adversely affect long-term population levels of species of management concern.
❑ Amount of turbidity, sedimentation, siltation, or contaminants/pollutants.	❑ Decrease in habitat quality, relative to the basis of comparison, of sufficient magnitude and frequency to adversely affect population levels of species of management concern.
❑ Area of backwater effect created by the water intake/diversion structure.	❑ Decrease in habitat quality and quantity, relative to the basis of comparison, of sufficient magnitude to adversely affect long-term population levels of fish species of management concern.
❑ Velocity of the water passing through the project area.	❑ Impediment to fish passage through the project site, relative to the basis of comparison, of sufficient magnitude to adversely affect migration of adult and sub-adult species of management concern.
❑ Source and amount of water, and fish community present in Auburn Ravine.	❑ Significant increase in straying of anadromous salmonids known to be genetically distinct from Auburn Ravine stocks.

Table 3.5-4 Fish Resources and Aquatic Habitat Diversion-Related Impact Indicators and Significance Criteria	
Impact Indicators	**Significance Criteria**
Upper American River Basin	
❑ Monthly mean flows from Ralston Afterbay downstream to Folsom Reservoir.	❑ Decrease in river flows, relative to the basis of comparison, of sufficient magnitude and frequency to adversely affect long-term population levels of species of management concern.
Folsom Reservoir	
Warmwater Fisheries	
❑ Mean number of acres of littoral habitat for each month of the primary spawning and rearing period (i.e., March through September).	❑ Decrease in the long-term average quantity (acres) of littoral habitat, relative to the basis comparison, of sufficient magnitude and frequency to adversely affect long-term population levels of warmwater fish, for any month of this period over the 70-year period of record.
❑ End-of-month reservoir water surface elevation (feet/msl) occurring each month of the primary spawning and rearing period for nest-building warmwater fish (i.e., March through September).	❑ Decrease in reservoir water surface elevation of more than nine feet per month, relative to the basis of comparison, of sufficient frequency to adversely affect long-term population of warmwater fish, for any month of this period over the 70-year period of record.
Coldwater Fisheries	
❑ End-of-month storage (TAF) for each month of the April through November period.	❑ Decrease in reservoir storage, relative to the basis of comparison, which also would reduce the coldwater pool, of sufficient magnitude to adversely affect long-term population levels of coldwater fish, for any month of this period over the 70-year period of record.
Nimbus Hatchery	
❑ Monthly mean water temperatures (°F) of water released from Nimbus Dam for each month of the year.	❑ Increase in water temperature, relative to the basis of comparison, of sufficient magnitude and frequency which would result in reduced hatchery production (using index temperatures of 60°F, 65°F, and 68°F) during any month of this period over the 69-year period of record.
Lower American River	
Fall-Run Chinook Salmon	
❑ Monthly mean flow (cfs) at the mouth for each month of the adult immigration period (i.e., September through December).	❑ Decrease in flow, relative to the basis of comparison, of sufficient magnitude and frequency to adversely affect upstream passage or olfactory response, for any month of this period over the 70-year period of record.
❑ Monthly mean water temperature (°F) at the mouth of the American River and at Freeport on the Sacramento River for each month of the adult immigration period (i.e., September through December).	❑ Increase in water temperature, relative to the basis of comparison, of sufficient magnitude and frequency to adversely affect adult immigration, for any month of this period over the 69-year period of record.

Table 3.5-4 (Continued)
Fish Resources and Aquatic Habitat Diversion-Related Impact Indicators and Significance Criteria

Impact Indicators	Significance Criteria
Lower American River (Continued)	
Fall-Run Chinook Salmon (Continued)	
❑ Monthly mean flows (cfs) below Nimbus Dam and at Watt Avenue for each month of the spawning and incubation and initial rearing period (i.e., October through February).	❑ Decrease in flow, relative to the basis of comparison, of sufficient magnitude and frequency to adversely affect long-term initial year-class strength, for any month of this period over the 70-year period of record.
❑ Monthly mean water temperatures (°F) below Nimbus Dam and at Watt Avenue for each month of the spawning and incubation and initial rearing period (i.e., October through February).	❑ Increase in water temperature, relative to the basis of comparison, of sufficient magnitude and frequency to result in substantial egg and alevin loss (e.g., resulting temperatures >56°F), for any month of this period over the 69-year period of record.
❑ Monthly mean flow (cfs) at Watt Avenue and the mouth for each month of the juvenile rearing and emigration period (i.e., February through June).	❑ Decrease in flow, relative to the basis of comparison, of sufficient magnitude and frequency to adversely affect juvenile rearing and emigration, for any month of this period over the 70-year period of record.
❑ Monthly mean water temperature (°F) at Watt Avenue, the lower American River mouth, and at Freeport for each month of the juvenile rearing and emigration period (i.e., February through June).	❑ Increase in water temperature, relative to the basis of comparison, of sufficient magnitude and frequency to adversely affect juvenile rearing and emigration (e.g., resulting temperatures >65°F) for any month of this period over the 69-year period of record.
❑ Average annual early lifestage survival.	❑ Decrease in annual early lifestage survival, relative to the basis of comparison, of sufficient magnitude and frequency to adversely affect long-term initial year-class strength over the 70-year period of record.
Steelhead	
❑ Monthly mean flow (cfs) at the mouth for each month of the adult immigration period (i.e., December through March).	❑ Decrease in flow, relative to the basis of comparison, of sufficient magnitude and frequency to adversely affect upstream passage or olfactory responses for any month of this period over the 70-year period of record.
❑ Monthly mean water temperature (°F) at the mouth of the American River and at Freeport on the Sacramento River for each month of the adult immigration period (i.e., December through March).	❑ Increase in water temperature, relative to the basis of comparison, of sufficient magnitude and frequency to adversely affect adult immigration for any month of this period over the 69-year period of record.
❑ Monthly mean water temperature (°F) below Nimbus Dam and at Watt Avenue for each month of the spawning and incubation period (i.e., December through March), as well as juvenile rearing (i.e., year-round).	❑ Increase in water temperature, relative to the basis of comparison, of sufficient magnitude and frequency to result in substantial egg and alevin loss (e.g., resulting temperatures >56°F) or substantial adverse affects to juvenile rearing (e.g., resulting temperatures >65°F) for any month of this period over the 69-year period of record.
❑ Monthly mean flow (cfs) at Watt Avenue for the spawning and incubation period (i.e., December through March), as well as juvenile rearing (i.e., July through September).	❑ Decrease in flow, relative to the basis of comparison, of sufficient magnitude and frequency to adversely affect initial year-class strength and juvenile rearing for any month of this period over the 70-year period of record.

Table 3.5-4 (Continued) Fish Resources and Aquatic Habitat Diversion-Related Impact Indicators and Significance Criteria	
Impact Indicators	**Significance Criteria**
Lower American River (Continued)	
Steelhead (Continued)	
❑ Monthly mean flow (cfs) at Watt Avenue and the mouth for each month of the juvenile emigration period (i.e., February through June). ❑ Monthly water mean temperature (°F) at Watt Avenue and the mouth for each month of the juvenile emigration period (February through June).	❑ Decrease in flow, relative to the basis of comparison, of sufficient magnitude and frequency, to adversely affect juvenile emigration for any month of this period over the 70-year period of record. ❑ Increase in water temperature, relative to the basis of comparison, of sufficient magnitude and frequency to adversely affect juvenile emigration (e.g., resulting temperatures >65°F) for any month of this period over the 69-year period of record.
Splittail	
❑ Monthly mean acreage of flooded riparian habitat at Watt Avenue during each month of the February through May spawning period. ❑ Monthly mean water temperatures (°F) at Watt Avenue and the mouth during each month of the February through May spawning period.	❑ Decrease in long-term average quantity of inundated riparian habitat, relative to the basis of comparison, of sufficient magnitude and frequency to adversely affect potential splittail habitat availability for each month of this period over the 70-year period of record. ❑ Substantial increase in the frequency, relative to the basis of comparison, in which water temperatures exceed the reported upper temperature range for splittail spawning (i.e., 68°F) for any month of this period over the 70-year period of record.
American Shad	
❑ Monthly mean flows (cfs) at the mouth during each month of the May through June spawning period. ❑ Monthly mean water temperatures (°F) below Nimbus Dam and the mouth of the lower American River during the May through June spawning period.	❑ Substantial decrease in the frequency, relative to the basis of comparison, in which flows at the mouth are above the CDFG recommended “attraction flow” of 3,000 cfs for American shad spawning migrations during each month of the identified period, over the 69-year period of record. ❑ Substantial increase in frequency, relative to the basis of comparison, in which water temperatures exceed the reported upper temperature range for American shad spawning (i.e., 70°F) for any month of the identified period over the 70-year period of record.
Striped Bass	
❑ Monthly mean flows (cfs) at the mouth during the May through June striped bass rearing period. ❑ Monthly mean flows (cfs) at the mouth during the May through June striped bass sport fishery. ❑ Monthly mean water temperatures (°F) below Nimbus Dam and at the mouth during the May through June rearing period.	❑ Decrease of flow, relative to the basis of comparison, of sufficient magnitude and frequency to adversely affect striped bass juvenile rearing for May and June over the 70-year period of record. ❑ Substantial decrease in the frequency, relative to the basis of comparison, in which flows at the mouth are above the CDFG recommended “attraction flow” of 1,500 cfs for the striped bass sport fishery for each month of the identified period over the 70-year period of record. ❑ Substantial increase in frequency, relative to the basis of comparison, in which water temperatures exceed the reported upper temperature range for striped bass rearing (i.e., 73°F) for any month of the identified period over the 69-year period of record.

Table 3.5-4 (Continued)
Fish Resources and Aquatic Habitat Diversion-Related Impact Indicators and Significance Criteria

Impact Indicators	Significance Criteria
Shasta and Trinity Reservoirs	
Warmwater Fisheries	
❑ Mean number of acres of littoral habitat for each month of the primary spawning and rearing period (i.e., March through September).	❑ Decrease in the long-term average quantity (acres) of littoral habitat, relative to the basis of comparison, of sufficient magnitude and frequency to adversely affect long-term population levels of warmwater fish for any month of this period over the 70-year period of record.`
❑ End-of-month reservoir water surface elevation (feet/msl) occurring each month of the primary spawning and rearing period for nest-building warmwater fish (i.e., March through September).	❑ Decrease in reservoir water surface elevation more than nine feet per month, relative to the basis of comparison, of sufficient frequency to adversely affect long-term population levels of warmwater fish for any month of this period over the 70-year period of record.
Coldwater Fisheries	
❑ End-of-month storage (TAF) for each month of the April through November period.	❑ Decrease in reservoir storage, relative to the basis of comparison, which also would reduce the coldwater pool, of sufficient magnitude to adversely affect long-term population levels of coldwater fish for any month of this period over the 70-year of record.
Sacramento River	
❑ Monthly mean flows (cfs) released from Keswick Dam for each month of the year.	❑ Decrease in flow, relative to the basis of comparison, of sufficient magnitude and frequency to decrease the relative habitat availability for upper Sacramento River fish for any month of this period over the 70-year period of record.
❑ Monthly mean flows (cfs) at Freeport for each month of the year.	❑ Decrease in flow, relative to the basis of comparison, of sufficient magnitude and frequency to decrease the relative habitat availability for lower Sacramento River fish for any month of this period over the 70-year period of record.
❑ Monthly mean water temperatures (°F) at Keswick Dam and Bend Bridge for each month of the year.	❑ Increase in water temperature, relative to the basis of comparison, of substantial magnitude and frequency to adversely affect spawning and rearing of anadromous salmonids for any month of the year for the 69-year period of record.
❑ Number of years that water temperatures at Keswick Dam and Bend Bridge would exceed the temperature criteria identified by NMFS in its Biological Opinion for Winter-run Chinook Salmon (NMFS 1993).	❑ Increase in the number of years that water temperatures exceed those stipulated in the NMFS Biological Opinion (i.e., 56°F and 60°F), relative to the basis of comparison, which would adversely affect winter-run chinook salmon over the 69-year period of record.
❑ Average annual early lifestage survival for fall-, late-fall-, winter-, and spring-run chinook salmon.	❑ Decrease in annual early lifestage survival for any run chinook salmon (i.e., fall-, late fall-, winter-, and spring-run chinook salmon), relative to the basis of comparison, of sufficient magnitude and frequency to adversely affect the long-term initial year-class strength over the 70-year period of record.

Table 3.5-4 (Continued) Fish Resources and Aquatic Habitat Diversion-Related Impact Indicators and Significance Criteria	
Impact Indicators	**Significance Criteria**
Sacramento River (Continued)	
❑ Monthly mean water temperatures (°F) at Freeport for each month of the year.	❑ Increase in temperature, relative to the basis of comparison, of sufficient magnitude and frequency to adversely affect spawning and rearing of anadromous salmonids for any month of the year for the 69-year period of record.
Delta	
❑ Monthly mean Delta outflow (cfs) for all months of the year.	❑ Decrease in Delta outflow, relative to the basis of comparison, of sufficient magnitude and frequency to adversely affect Delta fish resources over the 70-year period of record.
❑ Monthly mean location of X2 and Delta export/inflow ratios for all months of the year, with an emphasis on the February through June period.	❑ Change in position of X2 and Delta export/inflow ratio, relative to the basis of comparison, of sufficient magnitude and frequency to adversely affect spawning and rearing habitat and downstream transport flows over the 70-year period of record.
Oroville Reservoir	
Warmwater Fisheries	
❑ End-of-month reservoir water surface elevation (feet/msl) occurring each month of the primary spawning and rearing period for nest-building warmwater fish (i.e., March through September).	❑ Decrease in reservoir water surface elevation more than nine feet per month, relative to the basis of comparison, of sufficient frequency to adversely affect long-term population levels of warmwater fish for any month of this period over the 70-year period of record.
Coldwater Fisheries	
❑ End-of-month storage (TAF) for each month of the April through November period.	❑ Decrease in reservoir storage, relative to the basis of comparison, which also would reduce the coldwater pool, of sufficient magnitude to adversely affect long-term population levels of coldwater fish for any month of this period over the 70-year of record.
Feather River	
❑ Monthly mean flows (cfs) released from Oroville for each month of the year.	❑ Decrease in flows, relative to the basis of comparison, of sufficient magnitude and frequency to decrease the relative habitat availability for Feather River fish for any month of the year over the 70-year period of record.
❑ Monthly mean water temperatures (°F) below Oroville for each month of the year.	❑ Increase in water temperature, relative to the basis of comparison, of substantial magnitude and frequency to adversely affect spawning and rearing of anadromous salmonids for any month of the year for the 69-year period of record.

3.5.2.4 Impact Analysis

This section presents the analysis of potential facilities- and diversion-related fish resources and aquatic habitat impacts. A summary of the impact issues, level of significance, and environmental protection and mitigation measures is provided in the Executive Summary to the Final EIS/EIR, Table S-5.

Facilities-Related Impacts

No Action/No Project Alternative

Impact 3.5-1: Construction effects on aquatic resources of the North Fork American River.

No substantial changes from existing in-river construction activities would occur under the No Action/No Project Alternative. Although the duration of seasonal pumping would increase, no additional dredging activities would be expected to occur at the pump intake. Reclamation would continue to perform these activities in compliance with regulatory permit terms and conditions to protect water quality (Section 3.7, Water Quality). Therefore, disturbance of floor sediments and increases in turbidity are not expected to occur beyond existing levels. Based on these findings, no water quality-related impacts to aquatic life in the project area would result from construction under the No Action/No Project Alternative.

Impact 3.5-2: Fish impingement and entrainment at the point of diversion.

The No Action/No Project Alternative would include use of fish screening techniques approved by CDFG and would be included in the Streambed Alteration Agreement terms and conditions for the seasonal pump station. These provisions would be re-evaluated every five years. Implementation of these measures would protect juvenile and adult rainbow trout from entrainment and impingement at the intake. Compliance with the CDFG permit terms and conditions would reduce impacts to less than significant.

Impact 3.5-3: Alteration of habitat through creation of backwater on the North Fork American River upstream of the intake structure.

No substantial changes from the existing in-river construction activities would occur under the No Action/No Project Alternative. Because gradient control structures would not be constructed, water levels within the North Fork American River would not rise, and therefore upstream aquatic habitat would remain unchanged. Therefore, no impacts due to habitat alteration would result from the No Action/No Project Alternative.

Impact 3.5-4: Fish passage through the project area.

Under the No Action/No Project Alternative, fish migration into the project area from downstream of the project site is not likely to occur due to high-flow velocities through the one-half mile long bypass tunnel. Flows in the upstream portion of the tunnel range from about five feet per second (fps) at 100 cfs to 10 fps at 1,000 cfs (R. McLaughlin, pers. comm. 1998). Therefore, use of the project site by rainbow and brown trout, identified as the fish species of management concern in the project area, would continue to be limited to the downstream migration of adult and sub-adult fish through the project area (via the bypass tunnel) to Folsom Reservoir, and/or downstream passive transport of fish during high-flow events. Because no new or additional facilities or impediments would be constructed, as part of continued use of the seasonal pumps, fish passage impacts under the No Action/No Project Alternative would be less than significant.

Impact 3.5-5: Effects on salmonid stocks in Auburn Ravine.

Numerous issues have been raised regarding the potential for increased straying of American River steelhead and fall-run chinook salmon into Auburn Ravine if the selected alternative were to result in a change in water composition or flow volume. Such modifications of Auburn Ravine conditions raises the issue that the No Action/No Project Alternative could reassign the environmental cues which migrating American River salmonids home toward, thereby drawing American River fish into Auburn Ravine. It also has been suggested that Auburn Ravine salmonids may confuse the American River for their natal spawning grounds, due to the existence of American River water in their natal stream. In addition, the possibility of falsely attracting salmonids from the American River into Auburn Ravine due to the increased discharge of the Lincoln WWTRF during sensitive migratory months, has been identified as a concern. Attraction of American River fish into Auburn Ravine is of concern because the American River run consists primarily of hatchery stocks.

PCWA's proposed operations would not change the quantity or seasonal distribution of North Fork American River water delivered to Auburn Ravine compared to existing conditions. Any future changes in these water deliveries would first require completion of additional environmental studies. Water diverted from the North Fork American River would be conveyed to the PCWA water supply distribution system using a process called double-pumping. After being pumped from the North Fork American River, water would flow within the Auburn Ravine Tunnel, and from the Auburn Ravine Tunnel would be pumped again into PG&E's South Canal by the Auburn Ravine Tunnel Pump Station (Figure 3.5-3**)**. The water would then flow within the South Canal where it would be delivered to the Foothill WTP (Figures 3.5-1 and 3.5-2). The American River water currently delivered to Auburn Ravine would remain within the limits of recent historical monthly maximum delivery rates.

The double-pumping commitment by PCWA is a more costly method of water conveyance but ensures that the potential impacts resulting from an increase in volume or a change in the seasonal distribution of flow in Auburn Ravine would be avoided. Still, American River water would be delivered to Auburn Ravine as historically conveyed, as well as via the Lincoln WWTRF. A thorough review of the mechanisms that salmonids utilize when homing to natal streams indicates that it is unlikely that the No Action/No Project Alternative would produce a genetic disruption of Auburn Ravine salmonid stocks primarily due to the acute olfactory homing mechanisms in the salmonid family; the environmental homing cues and the fate of these cues within the study area; the sequential imprinting process; the probable lack of persistent, native Auburn Ravine stocks within the Central Valley Evolutionarily Significant Unit (ESU); and the mitigation programs of other water projects affecting Auburn Ravine. These topics are discussed below.

Salmonids have an acute homing mechanism which leads to an uncanny fidelity in returning to natal streams. The homing of migrating salmon likely derives from the processing of olfactory cues found in stream waters. The olfactory homing hypothesis is based on three assumptions (Hasler and Wisby 1951). First, streams differ in chemical characteristics that are stable over time. Second, salmonids can distinguish the chemical differences between streams. Third, salmonids learn the chemical characteristics of their natal stream (called imprinting) prior to or during their seaward journey, remember these cues without reinforcement while in the ocean, and respond to them upon returning to freshwater to spawn.

Numerous years of research seem to validate the olfactory hypothesis assumptions. For instance, research indicates that salmonids have the ability to actively differentiate between different stream waters, even when the streams are proximate, using only their olfactory sense (Hasler and Wisby 1951; Shoji et al. 2000). Studies illustrate that the olfactory cue in which salmonids home toward is likely organic in nature. In fact, investigations cite distinct combinations of amino acids as the odor cue utilized in discriminating between stream waters (Shoji et al. 2000). The distinct cues of each stream may be a result of differences in watershed vegetation and soil. Other research indicates that salmonid adults can sense the unique chemical compounds released by conspecifics (juvenile salmonids rearing in the natal stream during the adult migration period) and respond to the signature of each specific population (Stabell 1992; Courtenay et al. 2001). Regardless of the exact compound utilized in the homing response, an overwhelming majority of the available research finds that the cue is organic.

The organic nature of the homing cue has an enormous implication for the analysis of potential impacts of the project alternatives, including the No Action/No Project Alternative. The American River water delivered for irrigation and municipal use is likely to encounter extreme and odor-altering environments before entering Auburn Ravine. The water utilized for irrigation may encounter new sources of organic material such as the vegetation and soil of the agricultural fields and conveyance canals, and the ambient organic signature in the American River water would be subject to decomposition by soil microbes. Similarly, the American River water delivered for municipal use and discharged into Auburn Ravine as storm runoff may be subject to lawn vegetation and soil. American River water municipally delivered within the service area of the Lincoln WWTRF and discharged as treated effluent into Auburn Ravine would be treated and likely heavily altered by the secondary wastewater treatment process utilized by the plant, which is designed to remove organic material (City of Lincoln 1999). Similarly, the municipally delivered water which is distributed to the service areas of Placer County Department of Public Works SMD No. 3 and the two City of Roseville WWTPs would undergo treatment as well, a process which is likely to drastically alter the homing cues before the treated effluent is discharged into Dry Creek and Pleasant Grove Creek. Therefore, the homing cues found in the American River water utilized within the PCWA watersheds are likely to be dramatically altered before entering Auburn Ravine, Dry Creek, and Pleasant Grove Creek suggesting that the water reaching these streams would retain low potential for attracting American River fish.

The timing of olfactory imprinting also is a key component to understanding the mechanisms that drive salmonid homing behavior. The majority of the research in this field suggests imprinting of stream odors is most sensitive during a developmental process called the parr-smolt transformation (PST) (Dittman et al, 1996), in which a juvenile salmonid prepares for life in the ocean. However some imprinting must occur before this time, as wild salmon home to their hatching area, not to the area of their PST. Many of the changes that occur in the PST process are related to elevations in thyroid hormones, and it is postulated that these hormones drive the imprinting process (Dittman and Quinn 1996). Research reveals that elevations in various thyroid hormones may occur at numerous lifestages including hatching and emergence (Tilson et al 1994). Thyroid hormone levels also are particularly sensitive to environmental cues such as exposure to novel water chemistry (Dickhoff et al. 1992), and changes in lunar phase (Grau et al. 1991), water temperature (Lin et al. 1985), photoperiod (Hoar 1976), water flow rates (Youngson and Simpson 1984), and juvenile swimming rates (Nishioka et al. 1985). Migration may actually stimulate an increase in thyroid gland production as well (McCormick and Bjoernsson 1994). Hence, it appears that the imprinting process associated with developmental-, environmental-, and migratory-induced surges in hormone levels may serve to provide a sequence of cached odors which adult salmonids use to find their natal streams (Dickhoff et al. 1992).

The sequential imprinting process found in salmonids has implications in the analysis of the No Action/No Project Alternative. The sequential process indicates that as wild-spawned salmon and steelhead in Auburn Ravine emerge, rear, and migrate, they may become imprinted with numerous odors during their downstream journey. To illustrate, a juvenile steelhead migrating from Auburn Ravine toward the ocean may become imprinted at various points along its journey determined by developmental processes and changes in environmental conditions. These imprinting points may include Auburn Ravine itself, the tributary confluence with the Sacramento River and its confluence with the American River, as flow, water temperature, and water composition likely change at these points. Upon returning from the ocean, the adult steelhead may reverse the olfactory memory constructed during the ocean-bound migration. The wild-spawned salmonid will not necessarily seek its natal waters automatically, but instead locate a series of points sequentially until the natal stream, presumably the last point in the sequence, is found. It is unlikely that an immigrating Auburn Ravine adult would stray into the American River because the immigrating adult will continue to be drawn upstream in the much larger Sacramento River by olfactory cues associated with the next sequential points north of the point at which the American River empties into the Sacramento River. Thereafter, the immigrating adult will continue to follow the Sacramento River northward until the adult reaches a point at which olfactory cues indicate that the adult should follow waters flowing into the Sacramento River from the canals into which Auburn Ravine drains, each of which has its own unique olfactory cues. Thus, the sequential migration of Auburn Ravine salmonids will guide the return to their natal spawning grounds.

Similarly, it is unlikely that an American River fish will stray into Auburn Ravine as a result of the No Action/No Project Alternative. While the American River salmonids reared in a hatchery may have fewer opportunities to imprint due to the relatively constant environmental conditions within the hatchery environment (Dittman et al. 1996), American River fish should become imprinted with the smell of the American River as their natal spawning ground during developmental changes. As these fish reach the American River during upstream migration as adults, they will be bombarded with the smell of their natal stream. In some cases, this smell is the only imprinted smell available to them during their juvenile lives. Hence, it is unlikely that salmonids from the American River will disregard the inherent drive to enter this natal stream, simply because a minute amount of diluted American River water may exist in the Sacramento River at their confluence. In addition, the water transferred from the North Fork American River to Auburn Ravine, having been subjected to myriad organic influences associated with the Auburn Ravine watershed, is likely to smell drastically different than the substantial lower American River flows that enter into the Sacramento River at the confluence. Therefore, the No

Action/No Project Alternative would not be expected to increase the straying rates of American River or Auburn Ravine salmonids.

Although a majority of the transferred American River water would end up in Auburn Ravine only after contact with new odor causing agents or extensive treatment, some raw American River water still would be delivered into Auburn Ravine via the Auburn Ravine Tunnel in the historical amount. The majority of the American River raw water diversions associated with implementation of the No Action/No Project Alternative occur in June, July and August, with a maximum diversion in July. This pattern and volume of water diversion releases to Auburn Ravine is consistent with the existing condition, and would not result in a change in the total volume or seasonal distribution of North Fork American River water to Auburn Ravine.

Although it is not the only stage associated with imprinting, the PST likely represents the most sensitive imprinting period (Dittman et al. 1996). The initiation of the PST is related to the emigration process of salmonids from natal drainages. Fall-run chinook salmon in the Central Valley emigrate from January through June, peaking in April, while steelhead emigrate from December through possibly June (SWRI 2001). Hence, the periods of peak emigration of juvenile salmonids do not correlate with periods associated with peak raw water deliveries. Therefore, continuation of historical levels of raw water deliveries is not expected to significantly affect the imprinting of juvenile salmonids in Auburn Ravine.

Similarly, immigrating adult salmonids in Auburn Ravine are not expected to be exposed to the olfactory cues or increased flows associated with the seasonal delivery of raw North Fork American River water. Adult migrations of chinook salmon begin in September and may extend through January, while adult steelhead typically immigrate November through April, peaking in January (SWRI 2001). Because relatively small discharges of American River water from the Auburn Ravine Tunnel occur during these times, the continuation of historical levels of raw water deliveries would not be expected to affect immigrating adult salmonids. The timing of critical periods of salmonid life history and the timing of water deliveries to Auburn Ravine are temporally inconsistent.

It is not likely that Auburn Ravine historically harbored a persistent native population of salmonids. Low elevation streams like Auburn Ravine may have been essentially dry in summer and fall, at least in the foothill regions. Because of their intermittent nature, these streams were not conducive to significant or consistent fall-run chinook salmon or steelhead populations (McEwan 2001). The population of salmonids currently residing in Auburn Ravine likely represents a conglomeration of strays from Central Valley drainages, and the genetic characteristics of the Auburn Ravine salmonids are likely not distinct. Furthermore, hatchery stocking records indicate that Auburn Ravine already has been influenced by chinook salmon of American River origin (SWRI 2001). Additionally, NMFS considers Auburn Ravine steelhead to be within the Central Valley ESU, and does not recognize them as genetically distinct from other populations within the ESU.

Considering the overwhelming weight of evidence concerning homing and straying in the salmonid family, it is unlikely that the No Action/No Project Alternative would cause potentially significant impacts to the salmonids of Auburn Ravine.

While the mitigated diversion plan for the American River pump station project alternatives no longer requires a change in the volume or seasonal distribution of American River water diversions into Auburn Ravine, the Lincoln WWTRF discharges would increase the amount of flow in Auburn Ravine, which some believe could potentially induce a "false attraction" of salmonids.

The relationship between the American River Pump Station alternatives and the City of Lincoln WWTRF is described under the Proposed Project impact analysis (Impact 3.5-11). The Proposed Project impact analysis also considers the relationship between the American River Pump Station and the Placer County Public Works SMD No. 3 and two City of Roseville WWTPs, which discharge into Dry Creek and Pleasant Grove Creek. The impact analysis (Impact 3.5-11) concludes that these relationships represent a less than significant potential impact of the Proposed Project. The No Action/No project Alternative would supply less water to these facilities than the Proposed Project. Therefore, the No Action/No Project Alternative deliveries of North Fork American River water to the Lincoln WWTRF, Placer County Pubic Works SMD No. 3, and the City of Roseville WWTPs represent a less than significant impact.

Proposed Project

Impact 3.5-6: Construction effects on aquatic resources of the North Fork American River.

Under the Proposed Project, construction activities associated with the new pump station and proposed intake pipeline would disturb river floor sediment and potentially increase riverbank erosion. In addition, under the Proposed Project, a series of gradient control structures and a permanent fish screen structure would be constructed. The Proposed Project also would close the Auburn Dam construction bypass tunnel and restore flows to the dewatered channel. It has been determined that a cofferdam would not be required as part of this construction. Therefore, cofferdam construction mitigation measures recommended in the Draft EIS/EIR (September 2001) are no longer proposed.

The magnitude of potential impacts to aquatic organisms would be dependent on the timing and extent of sediment loading, and river flows during and immediately following construction. However, minimal effects are expected to occur because: (1) much of the construction for this alternative would be performed in the dewatered river channel prior to river restoration; (2) sediment control measures, including regulatory agency permit terms and conditions, would be incorporated into a construction management plan (Section 3.7, Water Quality); and (3) any potential effects would be temporary in nature. Therefore, construction-related riverbed and bank disturbance would result in a less-than-significant impact upon fish and aquatic habitat.

Development of the vehicle turnaround and three-space handicapped accessible parking area across from the bypass tunnel outlet would occur as part of the channel restoration activities, and would occur prior to rewatering the riverbed. Due to the distance from the river, there would be no direct contribution of soil or rock materials to the river. All materials to be removed from the channel would be deposited in designated excavation material disposal locations and stabilized prior to restoring the river channel. The parking area proposed for the former Auburn Dam batch plant also is a sufficient distance from the river so that no direct contribution of construction materials to the water would be anticipated.

Implementation of construction BMPs for erosion control and grading activities would minimize the potential for direct release of materials to the river during road widening and trail improvement activities that would take place between the upper flat parking area and Oregon Bar at the river (Figure 2-7). Few improvements would be made from the point of the proposed vehicle turnaround area near Oregon Bar and the river itself. These improvements generally would include development of improved drainage courses for surface water runoff and would be performed manually to minimize the extent of vegetation and ground disturbance. Therefore, development of the public river access sites would result in a less-than-significant impact to fish communities present in the study area. Overall, construction effects on aquatic resources of the North Fork American River would be considered less than significant.

Impact 3.5-7: Use of river access parking area.

Use of the river access parking area potentially would involve up to 53 cars at one time, on a peak summer day. These vehicles could contribute oil or other contaminants to local surface water runoff. The parking areas would be designed to reduce the potential for direct contribution of vehicle-related materials to the river. Additionally, the river access improvements would include installation of sanitary facilities including portable restrooms and trash containers to minimize potential water quality impacts from increased human activity in the project area. Based on the limited use of the area and inclusion of drainage and sanitary improvements, increased use of the area is anticipated to have a less-than-significant effect on fish communities in the study area.

Moreover, the Proposed Project includes restoring the previously dewatered channel, resulting in increased habitat availability for fish resources in the project vicinity. The restored channel would be designed to self-regulate the transport of sediment moving into and out of the system, maintain the stability of bed and banks within the natural variability of erosion expected for the site, and promote development of diverse substrate and bar morphology similar to a natural river system. These design features would emphasize physical non-uniformity that provides diverse water depths and velocities and substrate complexity, promoting a diverse physical and aquatic environment that would eventually naturally support diverse riverine and riparian ecosystems. Therefore, overall, river restoration activities would result in improved fisheries communities and aquatic habitat in the project area.

Impact 3.5-8: Fish impingement and entrainment at the point of diversion.

The seasonal facility fish screen method is not in compliance with current CDFG screening criteria, and fish species present at the point of diversion are susceptible to entrainment. Although the Proposed Project would increase PCWA's rate and volume of diversion (from the existing diversion of 8,500 AFA over four months to 35,500 AFA over 12 months), loss of fish through impingement and entrainment would be expected to be reduced, due to the installation of a fish screen to be designed in consultation with CDFG fish screen experts. Therefore, the

Proposed Project would be expected to have a beneficial effect on larval and juvenile fish through reduction of entrainment at the point of diversion.

Reclamation and CDFG would evaluate the performance of the newly-constructed fish screen. PCWA would ensure the fish screen and pumping plant are operated and maintained properly for acceptable fish screen performance. This will include documentation of fish screen performance in an operations and maintenance log book, provision of quarterly reports to CDFG for the first two years of operation, and upon request thereafter, and coordination with CDFG staff for inspection and performance measurement purposes.

Impact 3.5-9: Alteration of fish habitat through creation of backwater upstream of the diversion and by restoration of the dewatered channel.

Under the Proposed Project, a series of gradient control structures would be constructed at the point of diversion to direct river flow to create flow velocities and river depth conducive to the proposed diversion. With the gradient structures at the point of diversion, water within the North Fork American River would be locally impounded, causing water levels to rise. The river stage at the point of diversion would increase up to approximately two feet, with changes in water depths decreasing with distance upstream. Preliminary design information indicates that the backwater effect would extend upstream approximately to Tamaroo Bar.

Creation of the gradient control structures would change the upstream aquatic habitat from a lotic (e.g., stream-like) environment to a slightly more lentic (e.g., lake-like) environment. However, the backwater effect would generally not eliminate riffle habitat, because the river in this vicinity generally consists of pools and runs. Reduced flow rates also could lead to sedimentation of the deeper pools and runs. These overall habitat conditions would tend to favor fish species such as centrarchids (e.g., green sunfish, and largemouth and smallmouth bass) more so than rainbow and brown trout, the fish species of primary management concern in the project area. In addition, the process of sedimentation potentially could alter macroinvertebrate species composition. These changes in aquatic habitat could represent a slight adverse impact to rainbow and brown trout populations.

However, a healthy aquatic community would continue to persist following creation of the backwater. Because rainbow and brown trout populations within the area are established through downstream migration from upstream spawning grounds rather than from spawning within the immediate area, recruitment of adult and sub-adult fish into the population would continue. The backwater would not be expected to significantly reduce the long-term population trends of rainbow and brown trout at the project site, compared to existing population levels. In addition, although macroinvertebrate community composition could be altered, macroinvertebrate populations would still be present. Furthermore, the backwater created by the Proposed Project would not be expected to adversely impact native fish species such as pikeminnow, Sacramento sucker, and hitch.

In addition to altered aquatic habitat, the created backwater also could potentially increase the availability of predator holding areas through reduced current velocities. However, because minimal, if any, salmonid spawning or early-lifestage rearing occurs within the project area, because fry and/or juvenile salmonids do not emigrate in mass through the project area, and because predation on adult and sub-adult salmonids is limited by their larger size, increased availability of predator holding areas due to reduced current velocities would not significantly impact long-term salmonid population trends within the project area.

Finally, although current velocities would be reduced, the backwater would not be expected to significantly increase average water temperatures on the North Fork American River. Water temperatures at the project site are generally at or near their equilibrium temperature. In addition, because of the relatively rapid turnover rate of water within the backwater, average temperatures would generally not be expected to change measurably from the existing condition. As a result, the overall change in aquatic habitat would not significantly reduce the long-term population trends of rainbow and brown trout, a healthy aquatic environment would remain within the backwater, the backwater would not increase rates of predation, and the backwater would not substantially increase temperatures.

Finally, the Proposed Project includes restoring a previously dewatered channel, resulting in increased habitat availability for fish resources in the project vicinity. Therefore, habitat alteration in the project vicinity due to implementation of the Proposed Project represents a beneficial effect on fish resources and aquatic habitat.

Impact 3.5-10: Impact of structures on fish passage through the project area.

Under the Proposed Project, fish passage from upstream to downstream and habitat availability would be greatly improved through river restoration. Minimum instream requirements would continue to be met past the point of diversion, and additional flow would be released from upstream reservoirs to meet future demands resulting in flows through the project area that would be equal to or higher than existing flows. Fish also would be able to pass the gradient control structures to reach downstream sites. Overall, the Proposed Project would result in a beneficial impact for fish passage through the project area.

Impact 3.5-11: Effects on salmonid stocks in Auburn Ravine.

Implementation of the Proposed Project would result in greater pumping capacities and greater delivery of water into the Auburn Ravine Tunnel from the American River Pump Station than under the No Action/No Project Alternative. However, deliveries in excess of the historical delivery rate into Auburn Ravine would be double-pumped into the South Canal for delivery to the Foothill WTP, thereby avoiding potential flow-related changes and related impacts in Auburn Ravine. In addition, the Proposed Project would not result in a change in the source water composition in Auburn Ravine. Therefore, the Proposed Project and No Action/No Project Alternative are very similar in their potential impacts to the aquatic resources of Auburn Ravine. Please refer to the No Action/No Project Alternative impact analysis (Impact 3.5-5) for further detail regarding these issues.

While the potential impacts described in the No Action/No Project Alternative are very similar to the potential impacts of the Proposed Project, the Proposed Project does differ in its relationship to the City of Lincoln WWTRF, Placer County Public Works SMD No. 3, and two City of

Roseville WWTPs. Because the Proposed Project has a greater diversion capacity than the No Action/No Project Alternative, a greater amount of water potentially would be supplied to these facilities under the Proposed Project.

While the mitigated diversion plan for the American River Pump Station Project no longer requires a change in the volume or seasonal distribution of American River water diversions into Auburn Ravine, the Lincoln WWTRF treated effluent discharges would increase the amount of flow in Auburn Ravine, which some believe could potentially induce a "false attraction" of salmonids. The potential for the "false attraction" of salmonids was considered by the City of Lincoln in its Draft EIR for the WWTRF (City of Lincoln 1999). The City of Lincoln (1999) concluded that the existing flows in Auburn Ravine during the steelhead spawning season would likely be adequate for migration both upstream and downstream of the WWTRF outfalls. However, the City of Lincoln (1999) determined that the supplementation to existing flows in Auburn Ravine by WWTRF effluent during the fall-run chinook salmon spawning months (October and November) could potentially create a "false attraction" of fall-run chinook salmon. The Lincoln Draft EIR deemed the potential for fall-run chinook salmon "false attraction" potentially significant. As a result of the potentially significant impact created by the City of Lincoln WWTRF, the City of Lincoln committed to monitoring adult fall-run chinook salmon migrations in Auburn Ravine.

The City of Lincoln (1999) Draft EIR indicated that the WWTRF will have a maximum discharge into Auburn Ravine of 12 mgd, or 18.6 cfs. The Proposed Project would supply only a fraction of the WWTRF inflows. At maximum buildout, the Proposed Project would contribute an average of 2.0 cfs during the months of October and November, the months of concern regarding "false attraction." Therefore, the Proposed Project would approximate only 11 percent of the total WWTRF discharge. Without any contribution from the Proposed Project, the Lincoln WWTRF discharge would still exceed 16 cfs during October and November, which may constitute a potentially significant impact. The additional contribution of North Fork American River source water provided by the Proposed Project during October and November would not significantly exacerbate any "false attraction" that may be created by the Lincoln WWTRF discharge into Auburn Ravine. Therefore, the potential for "false attraction" of adult salmonids into Auburn Ravine, more particularly to the Lincoln WWTRF outfall, represents a less-than-significant impact of the Proposed Project.

In addition, the Proposed Project would supply municipally delivered treated water to the service areas of three other WWTPs including Placer County Public Works SMD No. 3, and two City of Roseville WWTPs. During October and November, the Proposed Project-related collective discharge from these three plants would average approximately 2.8 cfs, while the collective planned capacities of the three WWTPs total 65 cfs. Hence, the Proposed Project-related discharge represents less than five percent of the collective planned capacities of these three WWTPs. It also should be noted that American River water deliveries to this area would increase independent of the Proposed Project as a result of increased deliveries by Roseville and San Juan Water District (SJWD), both of which supply only American River water. Overall, the distribution of water from the Proposed Project to the service areas of the Placer County Department of Public Works SMD No. 3 and the two City of Roseville facilities represents a less-than-significant impact.

Overall, a less-than-significant impact is expected to occur as a result of the Proposed Project.

Upstream Diversion Alternative

With the exception of the restoration of the river channel, the Upstream Diversion Alternative facilities-related effects would generally be the same as described for the Proposed Project (see Impacts 3.5-6 to 3.5-11).

Impact 3.5-12: Construction and maintenance effects on aquatic resources of the North Fork American River.

Under the Upstream Diversion Alternative, construction and operation activities would disturb floor sediments and potentially increase erosion. The magnitude of potential impacts to aquatic organisms would be dependent on the timing and extent of sediment loading, and river flows during and immediately following construction.

During annual maintenance activities involving sediment removal from behind the diversion structure, impacts from the Upstream Diversion Alternative on aquatic resources would be similar to the Proposed Project. For a further discussion of this impact, refer to Impact 3.5-6. As described for the Proposed Project, environmental protection measures would be implemented to protect fish from water quality effects. Overall, construction impacts on fish resources would be less than significant.

Impact 3.5-13: Fish impingement and entrainment at the point of diversion.

As described for the Proposed Project, the year-round pump station under the Upstream Diversion Alternative would include a fish screen to be designed in consultation with CDFG fish screen experts, thereby minimizing the potential for impingement and entrainment of fish at the point of diversion. Therefore, the Upstream Diversion Alternative would be expected to have a beneficial effect on larval and juvenile fish through reduction of entrainment at the point of diversion. For a further discussion of this impact, refer to Impact 3.5-8.

Impact 3.5-14: Alteration of fish habitat through the creation of a backwater upstream of the diversion.

Under the Upstream Diversion Alternative, backwater would be formed upstream of the diversion structure. The river stage at the point of diversion would increase up to approximately two feet, with changes in stream depths decreasing with distance upstream (J. Kaufman, pers. comm. 1998). The backwater would extend upstream to Tamaroo Bar. The change in aquatic habitat from a lotic environment to a slightly more lentic environment could represent a slight adverse impact to rainbow and brown trout populations. However, the backwater would not be expected to significantly reduce long-term population trends of rainbow and brown trout in the project area. In addition, the backwater effect would not be expected to significantly contribute to increased predation on salmonids, or increases in water temperature. Therefore, because the overall change in aquatic habitat would not significantly reduce the long-term population trends of rainbow and brown trout, because the backwater would not increase rates of predation, and because the backwater would not significantly increase water temperatures, the backwater effect would have a less-than-significant impact on fish resources and aquatic habitats. See additional discussion under Impact 3.5-9.

This alternative would not provide the added benefit of increasing open-water habitat in the project area because the bypass tunnel would continue to divert river flows through the project area.

Impact 3.5-15: Impacts of structures on fish passage through the project area.

Under the Upstream Diversion Alternative, fish movement through the project site would not be substantially changed from the existing or No Action/No Project Alternative conditions. Fish would be able to pass over the diversion structure. Fish screens at the point of diversion would be designed in consultation with CDFG fish screen experts and meet applicable criteria to maintain adequate approach and sweeping velocities and minimize impacts. Blockage of upstream fish migration due to velocity conditions in the bypass tunnel would not change under the Upstream Diversion Alternative. The Upstream Diversion Alternative effects on fish passage through the project area would represent a less-than-significant impact relative to the existing condition and compared to the No Action/No Project Alternative.

Impact 3.5-16: Effects on salmonid stocks in Auburn Ravine.

Operation of the Upstream Diversion Alternative would be the same as the Proposed Project relative to Auburn Ravine. Please refer to impact discussions 3.5-5 and 3.5-11.

Overall, a less-than-significant impact would be expected to occur as a result of the Upstream Diversion Alternatives.

Facilities-Related Cumulative Impacts

All future planned activities within the river channel would be responsible for implementing water quality protection measures according to regulatory and planning agency requirements. No significant cumulative impact upon water quality affecting fish resources would be anticipated.

Diversion-Related Impacts

The diversion-related analysis refers to certain tables and graphs prepared to provide additional representation of the modeling results and comparison of simulated conditions. These tables and figures are included in Appendix H to the Draft EIS/EIR and are labeled by the appendix letter, resource section number, and ordered as it is referenced in the impact analysis (H-3.5-1, H-3.5-2, etc.).

The timing and quantity of the increased diversion would be the same under the Proposed Project and Upstream Diversion Alternative. Therefore, the diversion-related impacts are expected to be identical and so, are discussed below as Action Alternative impacts.

No Action/No Project Alternative

The increased pump station diversion under the No Action/No Project Alternative would be less than evaluated for the Action Alternatives (see below). Based on the evaluation of modeling performed for the Action Alternatives, it is expected that the No Action/No Project Alternative would not result in significant effects on fish habitat or aquatic resources, nor would it result in a significant or considerable contribution to the cumulative condition.

Proposed Project and Upstream Diversion Alternative (Action Alternatives) Compared to the Existing Condition

<u>Upper American River Fisheries Impacts</u>

Impact 3.5-17: Flow impacts to fish resources on the North and Middle Forks of the American River upstream of the project site.

Simulated average long-term flows in the North and Middle Forks of the American River upstream of the project area under the existing condition and Action Alternatives are presented in Table H-3.5-1 (Appendix H to the Draft EIS/EIR). Simulation results show that the monthly mean flows upstream of the project site under the Action Alternatives would result in essentially equivalent monthly mean flows as in the existing condition for 801 months of the 840 months included in the analysis.

During the high-flow months (December to June), the change in streamflow due to the Action Alternatives would be negligible. During the low-flow period (July to November), project operations would result in both increases and decreases in monthly mean flow upstream of the project site. Reductions in flow during the low-flow period are of more concern than reductions in flow during the high-flow period, because fish resources during low flow may already be under stressed conditions. Reduction in monthly mean flows would occur between April and August and would range from no change in June to a decrease of 0.8 percent in July. All other months of the year would either experience no change or have an increase in flows of up to 0.7 percent. Over the long-term, implementation of the Action Alternatives relative to the existing condition would result in an increase in the upper American River flows upstream of the project site.

Figures H-3.5-1 through H-3.5-3 (Appendix H to the Draft EIS/EIR) show the exceedance curves for the flows on the North Fork American River upstream of the project site under the Action Alternatives relative to the existing condition. October through March flows would be essentially equivalent under the Action Alternatives relative to the existing condition. In April and May, the Action Alternatives would result in small reductions in flow when the flows would be within the 3,500 to 4,500 cfs range. The June and July exceedance curves are essentially equivalent between the Action Alternatives and existing conditions, with negligible reductions resulting from the Action Alternatives in July, for flows within the 500 to 1,100 cfs range. During June and July, the Action Alternatives would result in slightly higher flows than under the existing condition, for flows below 500 cfs. In the month of August, Action Alternative conditions would reduce upper American River flows within the 400 to 900 cfs range. For flows below 400 cfs, flows would increase under the Action Alternatives relative to the existing condition. Anticipated reductions in flow on the North Fork American River would not be expected to adversely impact fisheries because relatively small or no reduction in monthly mean flows would occur, and the majority of trout that occur in the North Fork American River below the confluence with the Middle Fork American River are believed to be transitory. Changes in the upper American River would represent a less-than-significant impact to fish resources upstream of the project site.

Impact 3.5-18: Water temperature impacts to fish resources of the North and Middle Forks of the American River upstream of the project site.

Under the Action Alternatives, decreases in flow during the low-flow condition would not be expected to result in increases in water temperature of the upper American River. Temperature changes that would result from the Action Alternatives relative to the existing condition upstream of the project area would generally not be measurable. Therefore, potential water temperature changes resulting from the Action Alternatives under low- and high-flow conditions represent a less-than-significant impact on the long-term population of rainbow or brown trout upstream of the project site.

Impact 3.5-19: Flow impacts to fish resources of the North and Middle Forks of the American River downstream of the project site.

Table H-3.5-2 presents simulated monthly mean flows in the upper American River downstream of the project site under the Action Alternatives relative to the existing condition. The Action Alternatives would exhibit lower monthly mean flows in all months of the year (except January), with decreases ranging from less than one percent in the high-flow winter months to 6.4 percent in July. Differences in monthly mean flows in the high-flow period (i.e., December to June) (Figure H-3.5-4) would range from 0.5 percent to 4.5 percent. The low-flow months (i.e., July to November) (Figures H-3.5-4 and H-3.5-6) would be subjected to changes ranging from 1.3 to 6.4 percent, with lower reductions in the fall months and greater reductions in the summer months, when greater volumes of water would be diverted at the pump station.

October through March flows would be essentially equivalent under the Action Alternatives relative to the existing condition. In April and May, the Action Alternatives would result in small reductions in flow when flows would be within the 3,500 to 4,500 cfs flow range. Because of the greater diversion rates in the summer months, the exceedance curves representing the Action Alternatives and the existing condition, start separating in June and display a greater spread in July, August and September (Figure H-3.5-6). However, in low-flow conditions, implementation of the Action Alternatives would result in an increase in flows relative to the existing condition.

Anticipated reductions in streamflow would not be expected to adversely impact fisheries in the North and Middle forks of the American River below the project site because relatively small or no reduction in monthly mean flows would occur, and the majority of trout that occur in the North Fork American River below the confluence with the Middle Fork American River are believed to be transitory. Moreover, the Proposed Project includes restoring a previously