Section D: U.S. Department of the Interior
Fish and Wildlife Service 10(j) Recommendations
Klamath Hydroelectric Project - FERC No. 2082

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Recommended License Conditions Pursuant to 10(j) of the Federal Power Act

The Federal Power Act (16 U.S.C. 791 *et seq*.) requires in section 10(j) that each license issued for a hydropower project contain conditions to adequately and equitably protect, mitigate damages to, and enhance, fish and wildlife (including related spawning grounds and habitat) affected by the development, operation, and management of the Project. 16 USC 803(j). These conditions are based upon recommendations from the United States Fish and Wildlife Service (Service), the National Marine Fisheries Service (NMFS), and state fish and wildlife agencies.

Pursuant to Section 10(j) and to carry out the purposes of the Fish and Wildlife Coordination Act (16 U.S.C. 661 *et seq*) (FWCA), the Service recommends that the following terms and conditions to protect, mitigate damages to, and enhance fish and wildlife resources be included in the new license for the Klamath Hydroelectric Project, No. 2082 (Project).

These recommendations were developed by the Service to support the resource agency management goals and objectives. The Service's primary goal is to establish safe and effective fish passage, restoration, and habitat conservation for native fish at the Project's facilities consistent with the management goals detailed in the plans and policies described in Attachment C. The purpose of the Service's recommended conditions is to restore and maintain productivity of fish and wildlife populations and their habitats affected by Project development, as well as offset current and continuing impacts that result from Project operation and maintenance. The Service's goals (USDI Fish and Wildlife Service 2003c) regarding relicensing of the Klamath River Project are:

> 1) Restore native fish populations within the Klamath Basin to provide fishery resources necessary to meet Trust responsibilities for tribal, commercial, subsistence, and ceremonial purposes; and enhance ocean commercial harvest, recreational fishing, and the economic health of local communities.
>
> 2) Restore volitional passage for all life history phases of anadromous and resident fishes throughout their historical range. Provide necessary water quantity, flow regimes, water quality, and other habitat conditions for the recovery and long-term sustainability of native fishes.
>
> 3) Recover federally-listed threatened and endangered species in the Basin by avoiding jeopardy, avoiding and minimizing take, and completing recovery actions identified and

detailed in recovery plans. Protect and restore habitat for federally-listed and candidate species.

4) Protect, mitigate, and enhance habitat for waterfowl and other migratory birds, terrestrial wildlife, fish, plants, and invertebrates.

5) Enhance ecological function and watershed processes to meet the above goals.

Mitigation Policy

The Service's Mitigation Policy (USDI Fish and Wildlife Service 1981) is pertinent to our assessment of the proposed Project and the development of recommendations for fish and wildlife resources. That policy recommends avoiding impacts as the first priority; minimizing any impacts which can not be avoided; rectifying impacts by repairing, rehabilitating, or restoring affected environments; reducing or eliminating impacts over time; and finally compensating for impacts by replacing or providing substitute resources or environments. Thus, the Service's first priority is to eliminate Project impacts through modification of Project operations or facilities.

Most of the fish and wildlife resources affected by the Project are considered to be of high value and relatively scarce or becoming scarce on a national or ecoregion basis. Accordingly, the Service's mitigation goal is no net loss of in-kind habitat value.

Ecosystem Approach

The Service's Ecosystem Approach to Fish and Wildlife Conservation (USDI Fish and Wildlife Service 1994) also provides management goals and guidance for the conservation of fish and wildlife resources affected by Project development. That document states that the primary goal of a conservation approach is conserving natural biological diversity and ecosystem integrity, while supporting sustainable human use. The Ecosystem Approach also includes a planning and action framework. It recommends first identifying natural resource needs by examining ecosystem components from a historical perspective, and understanding why they have changed over time. Goals and objectives are then stated. Goals are to be broad, and defined by objectives that are more specific and quantifiable. The next step is to identify and implement action strategies to achieve objectives. The final step is to monitor and evaluate actions. The Ecosystem Approach and its goals should incorporate concepts such as:

- Perpetuation of natural communities of plants and animals;
- Maintenance of naturally-occurring structural and genetic diversity;
- Needs of rare and ecologically important species;
- Minimization of habitat fragmentation;
- Role of natural processes such as fire and floods; and,
- Maintenance of compatible, sustainable human activities.

The Service has prepared these preliminary recommended terms and conditions based on current information regarding the proposed relicensing of the Project. As more detailed plans are developed, new information becomes available, and Project operations begin under a new license, deficiencies may be observed and modifications to fish and wildlife protection, mitigation, and enhancement measures may be necessary. The Service will modify these section 10(j) recommendations as needed to be consistent with finalized design plans and with new information developed as a result of the Federal Energy Regulatory Commission's (Commission) environmental review process or to correct deficiencies or problems found during post-licensing monitoring or evaluations.

1. Downstream Fish Passage Habitat Protection, Mitigation, and Enhancement Plan

Recommendation: The Licensee shall, within one year of license issuance and after consulting with the Service, NMFS, affected Tribes, the Oregon Department of Fish and Wildlife (ODFW), California Department of Fish and Game (CDFG), and Bureau of Land Management (BLM), develop and submit for FERC approval, a Downstream Fish Passage Habitat Protection, Mitigation, and Enhancement Plan to mitigate for unavoidable and ongoing Project impacts to downstream migrating anadromous and resident fish. Reclamation should be consulted regarding fish passage at or associated with facilities owned or operated by Reclamation. The plan shall describe specific actions to be undertaken, and contain provisions to monitor the success of those actions. The schedule for completing the plan shall accommodate a 30-day review period for agencies to submit comments. The Licensee shall include in the Plan all comments received during consultation with the parties identified above, and an explanation of how all comments are accommodated in the Plan. All mitigation measures will be reviewed by the Fisheries Technical Subcommitee, established by Section 10(a) recommendation 4, prior to submission to FERC. The Plan shall be submitted to FERC for approval. The Licensee shall implement the Plan upon FERC approval. The plan shall at a minimum:

A. Assess the effectiveness of all downstream fishways for resident (including federally listed suckers) and anadromous species. Assessment will be done at each downstream fishway and will include the use of Full Duplex Passive Integrated Transponder (PIT) tagging with PIT tag detection facilities at each downstream fishway, including the downstream fishways at the East Side and the West Side developments. Full Duplex tagging and detection technology is necessary to track small fish ($\geq$60mm in fork length) of interest to agencies. Monitoring may need to be augmented with radio telemetry. This assessment will be conducted every other year for the first twelve years of the license and every three years thereafter through the license term.
    a. Juvenile trout outmigrants shall be collected from Klamath River tributaries in the Project reach (Scotch, Camp, Jenny, Fall, Shovel, and Spencer Creeks) and PIT tagged with Full Duplex marking.

    b. Juvenile anadromous fish shall be collected from the East Side and the West Side developments and from important Klamath River tributaries in the Project reach

(Scotch, Camp, Jenny, Fall, Shovel, Long Prairie, and Spencer Creeks) and/or locations upstream and PIT tagged with Full Duplex marking.

B. Evaluate the survival of downstream migrating juvenile fish as well as ongoing and unavoidable losses resulting from the Project fish passage program;
C. Identify fish habitat protection, mitigation, and enhancement measures which fully mitigate the ongoing and unavoidable losses;
D. Implement the measures above, and monitor them to ensure their effectiveness.

Justification: Other than 1) decommissioning the East Side and West Side Diversions, 2) a gulper proposed at J.C. Boyle Reservoir to replace the downstream fishways at J.C. Boyle Dam, and 3) modifications to the J.C. Boyle upstream fishway that are necessary for compliance with the current license, the Applicant has not proposed fishways at mainstem developments nor has the Applicant proposed to mitigate for unavoidable and ongoing Project impacts to downstream migrating anadromous and resident fish. Relative to a without Project scenario, Project facilities will continue to affect downstream fish movement, even with the prescribed downstream fish passage facilities. These impacts include the loss of fish from migrating through Project reservoirs; stress; disease; impacts from angling in Project reservoirs; delayed migration timing; avian and other predation; residualization; and other factors. Even when screens and downstream migrant facilities perform to criteria, some salmon, steelhead, federally listed suckers, lampreys, and resident fish smaller than 60 mm will be entrained in the system's surface and/or deep water intakes and be lost. These losses would reduce the number of outmigrating fish available for passage and diminish biological productivity and connectivity. While we are proposing other measures to address some of the Project's ongoing effects, the intent of this program is to minimize mortality to federally listed suckers and lampreys, reduce losses of resident fish species, and increase overall anadromous smolt survival above the dams to offset this continued, unavoidable loss of outmigrating fish. After initial installation, downstream fishways may require monitoring and appropriate operational modifications.

Impacts: When first installed, downstream fishways may require modification to operate in an effective manner to provide safe, timely and effective fish passage. Monitoring and appropriate operational modifications of fishways are likely to be necessary. In addition, downstream fishways may have qualitative as well as quantitative impacts on target fish populations. For example, the effects of stress have been studied at passage facilities at several projects, including the effects of passage stress in relationship to predation (Petersen et al. 1990). These authors noted that stress had sublethal effects to fish physiology, and that these effects probably increased the fish's exposure and vulnerability to predation. Another study (((Park et al. 1984) in (Wedemeyer et al. 1985)) examined the post-transport mortality of downstream migrating spring-run Chinook and steelhead and noted that spring-run Chinook are among the least resistant to stress-mediated fish diseases. This study also indicated that delayed mortality in spring-run Chinook was higher than that for steelhead, and was as high as 50 percent. Delayed mortality of salmonids in the estuary or ocean residence is also linked to earlier downstream passage through hydropower systems (Budy et al. 2002). Delayed mortality caused by sublethal

impacts to fish sensory systems associated with passage through hydropower facilities and the resulting increased vulnerability to predation has been found to comprise a significant portion of the total mortality (Ferguson et al. 2006). These studies indicate that downstream fishways on the Klamath River will need to be monitored and adjusted to minimize outmigrant mortality.

2. Upstream Fish Passage Habitat Protection, Mitigation, and Enhancement Plan

Recommendation: The Licensee shall, within one year of license issuance and after consulting with the U.S. Fish and Wildlife Service, National Marine Fisheries Service; affected Tribes; Oregon Department of Fish and Wildlife; California Department of Fish and Game; and Bureau of Land Management, develop and submit to FERC for approval an Upstream Fish Passage Habitat Protection, Mitigation, and Enhancement Plan to mitigate for unavoidable and ongoing Project impacts to upstream migrating anadromous and resident fish. The Licensee shall consult with the Bureau of Reclamation (Reclamation) regarding fish passage at or associated with facilities owned or operated by Reclamation. The plan shall describe specific actions to be undertaken, and contain provisions to monitor the success of those actions. All mitigation measures will be reviewed by the Fisheries Technical Subcommittee prior to approval (see section 10(a) recommendation for a description of the Fisheries Technical Subcommittee). The schedule for completing the plan shall accommodate a 30-day review period for agencies to submit comments. The Licensee shall include in the Plan all comments received during consultation with the parties identified above, and an explanation of how all comments are accommodated in the Plan. The Plan shall be submitted to FERC for approval. The Licensee shall implement the Plan upon FERC approval. The plan shall, at a minimum:

A. Assess the effectiveness of all upstream fishways for resident (including federally listed suckers at Keno Dam) and anadromous species. Assessment will be done at each upstream fishway and will include the use of Full Duplex PIT tagging with Full Duplex PIT tag detection facilities at each upstream fishway on Project dams, including Keno Dam. Monitoring may need to be augmented with radio telemetry. This assessment will be every other year for the first twelve years of the new license and every three years thereafter throughout the license term.

B. Evaluate the survival of upstream migrating adult fish as well as ongoing and unavoidable losses resulting from the Project fish passage program;

C. Identify fish habitat protection, mitigation, and enhancement measures which fully mitigate the ongoing and unavoidable losses;

D. Implement the measures above, and monitor them to ensure their effectiveness.

Justification: When first installed, upstream fishways may require modification to operate in an effective manner to provide safe, timely and effective fish passage. Monitoring and appropriate

operational modifications of fishways are likely to be necessary. Relative to a without Project scenario, upstream fish movement, even with the prescribed upstream fish passage facilities, will be negatively affected by continuing impacts associated with the Project. These impacts include the loss of fish migrating through Project reservoirs; stress; disease; losses from angling in Project reservoirs; delayed migration timing; avian and other predation; and other factors. Even when upstream migrant facilities perform to criteria, some salmon, steelhead, federally listed suckers, lampreys, and resident fish will be lost. These losses would reduce the number of fish available for spawning and diminish biological productivity and connectivity. The intent of this additional program is to minimize mortality to federally listed suckers and lampreys, reduce losses of resident fish species, and increase overall returns of anadromous fish above the dams.

Impacts: Upstream fishways may have qualitative impacts on target fish populations. For example, migration delays caused by tailrace effects may have a greater impact on fish populations than injury and mortality (Federal Energy Regulatory Commission 1994). Migration delays are well documented for anadromous salmonids in the Pacific Northwest (Haynes and Gray 1980; Rondorf et al. 1983; Schadt et al. 1985; Vogel et al. 1990). False attraction can occur when upstream migrants are attracted to turbine discharge or spillway flows rather than to fishway flows. False attraction also occurs when upstream migrants detect the scent of their natal stream downstream of its natural outlet (Fretwell 1989). This happens when water from a natal stream is diverted through a canal or pipe to a hydroelectric project. In either instance, without proper Project modifications there may be extensive migratory delays.

3. Fish Habitat Protection, Mitigation, and Enhancement Plan

Recommendation: Within one year of license issuance, the Licensee shall, for the conservation, and development of, and mitigation of damages to, fish and wildlife resources, develop and submit a Fish Habitat Protection, Mitigation, and Enhancement Plan (FHP) to FERC for approval. The Licensee shall develop the FHP in consultation with the Service, NMFS, CDFG, ODFW, and the affected Tribes. The goal of the FHP shall be the restoration of fish habitat above and below the Project to mitigate the continued effects of the Project on fish habitat. All mitigation measures will be reviewed by the Fisheries Technical Subcommittee prior to approval (see section 10(a) recommendation for a description of the Fisheries Technical Subcommittee). The schedule for completing the FHP shall accommodate a 30-day review period for agencies to submit comments. The Licensee shall include in the FHP all comments received during consultation with the parties identified above, and an explanation of how all comments are accommodated in the FHP. The FHP shall be submitted to FERC for approval prior to implementation.

The Licensee shall fund fish habitat restoration to mitigate affected habitat connectivity and habitat loss. Implementation of the FHP shall be completed by the fifth anniversary of the issuance of a new license.

The FHP shall include, but not be limited to, the following measures:

A. Provide compensatory mitigation for a total of five miles of bypassed river channel (four miles below J.C. Boyle Dam and one mile below Copco 2 Dam).

B. Provide compensatory mitigation for a total of 14.1 miles of riverine channel inundated by Project reservoirs (6 miles for Iron Gate reservoir, 4.4 miles for Copco reservoirs; and 3.7 miles for J.C. Boyle reservoir).

C. Develop and implement a plan for habitat mitigation and enhancement for U.S. Forest Service (USFS) and BLM lands on Jenny, Fall, Spencer, and Shovel Creeks. Some of these projects have already been identified by the USFS and BLM for Spencer Creek Pilot Watershed Analysis (USDI Bureau of Land Management et al. 1995). Habitat mitigation may include cooperative funding with the water users on these tributaries to improve adult and juvenile fish passage facilities at irrigation diversions or other constructed fish barriers in the upper basin. Habitat enhancement may also include purchase of instream water rights. The Licensee shall fund the planning and implementation of projects on Federal lands to meet associated agency requirements under the National Environmental Policy Act and the Endangered Species Act. The Licensee shall fund the maintenance of these projects and monitoring to determine their effectiveness.

D. Provide compensatory mitigation such as for any continuing effects on fish and wildlife that are not avoided in future operations. These effects may include, but are not limited to: 1) effects of hydroelectric peaking operations on: a) fish productivity in the bypassed reaches, b) fish productivity in the peaking reach, and c) fish productivity in the Link River and Keno reaches to the extent that hydroelectric operations affect flows in those reaches; 2) effects of water impoundment on: a) water quality, including temperature, within the Project area and downstream, b) the prevalence of toxic algal blooms and fish diseases within the Project area and downstream, c) gravel depletion, d) reduced flood flows, and e) ramping and stranding impacts.

Justification: The Applicant has not proposed any mitigation for the loss of fish habitat due to the continued operation of the Project. The bypassed channels have been impacted heavily and will continue to be impacted by Project operations. The habitats that were inundated by the reservoirs will continue to preclude these riverine areas from native fish habitat use. Impacts of hydroelectric peaking and impoundment of waters will continue to some extent, and to the extent that these impacts have not been avoided, it is prudent to provide compensatory mitigation, in accordance with the Mitigation Policy of the Fish and Wildlife Service (see description of the Policy in the Introduction). There are excellent opportunities to provide for fish habitat compensatory mitigation within the watersheds described in element C, above.

Impacts: The Project continues to reduce fish habitat quality through the continued loss of 14.1 miles of riverine habitat within the Project's reservoirs. Of this, much of the river channel was low gradient stream habitat and at least 2.5 miles was important spawning habitat for resident and anadromous salmonids. These river segments historically provided spawning, incubation, and rearing areas for juvenile anadromous salmonids (Fortune et al. 1966; Hamilton et al. 2005; Lane and Lane Associates 1981). Production capacity for rainbow trout, Chinook, coho, Pacific lamprey, and steelhead are reduced due to the continued occupation of the river habitat by Project's reservoirs. Spring-run Chinook spawning and rearing habitat will continue to be unavailable for use by this segment of the Chinook population. Rainbow trout and other native species will have reduced habitat quantity and quality in the Project area. In addition, there will be continued loss of upstream and downstream migrating fish caused by fishway inefficiencies, reservoir mortality due to predation, migration delays, and water quality impacts.

Effects of hydroelectric peaking are summarized in Attachment A. Effects of water impoundment are described in Recommendations 6, 7, 8, 9, 10, 11, and 12.

4. Pacific Lamprey Management Plan and Evaluation

Recommendation: For the conservation and development of, and mitigation of damages to Pacific lamprey, the Licensee shall, within two years of license issuance, in consultation with the Service, NMFS, CDFG, ODFW, and the affected Tribes, develop and submit to FERC for approval, a Pacific Lamprey Management Plan (PLMP). The PLMP will include telemetry studies to evaluate upstream and downstream passage of Pacific Lamprey through Project fishways and reservoirs. The PLMP shall use the results of these studies as well as lamprey passage information from other Klamath Basin facilities to direct operational and structural improvements in Project fishways. The completed PLMP shall include the following measures to be developed and implemented by the Licensee:

a. Monitor and evaluate: 1) the timing of juvenile lamprey outmigration through the Project; 2) downstream passage routes and proportion of juvenile lamprey which use each route; 3) juvenile lamprey survival through the Project; and 4) the effects of reservoir fluctuations on juvenile lamprey rearing.

b. Develop and implement plans to modify or replace existing Project structures and operations to achieve upstream and downstream survival and passage levels that are commensurate with the best levels achieved elsewhere in the Klamath River Basin.

The PLMP shall describe specific actions to be undertaken, and contain provisions to monitor the success of those actions. The schedule for completing the PLMP shall accommodate a 30-day review period for agencies to submit comments. The Licensee shall include in the PLMP all comments received during consultation with the parties identified above, and an explanation of

how all comments are accommodated in the PLMP. The PLMP shall be submitted to FERC for approval. The Licensee shall implement the PLMP upon FERC approval.

Justification: The FLA does not contain a Pacific Lamprey Management Plan or measures that identify and mitigate for the Project's effects on Pacific lamprey during the term of the new license. This recommended Plan is consistent with agency, Tribal and Klamath River Basin Fisheries Task Force goals and objectives for anadromous fish restoration.

Impacts: The Project continues to block Pacific lamprey from historical habitat above the dams (Hamilton et al. 2005). The Klamath River Basin Fishery Resources Restoration Act (Public Law 99-552) directs the Secretary of the Interior to restore and maintain fish populations in the Klamath River Basin Conservation Area to optimum levels. The lack of Project fishways has impeded the Secretary's ability to successfully comply with this directive, as well as the ability of numerous agencies, Tribes, and the Klamath River Basin Fisheries Task Force to achieve published fish restoration goals.

5. Decommissioning Plan for the East Side and West Side Developments

Recommendation:

If FERC approves the Licensee proposal to decommission the East Side and West Side Developments, within one year of license issuance, the Licensee shall, for the conservation and development of, and mitigation of damages to, fish and wildlife resources, develop and submit to FERC for approval a Decommissioning Plan for the East Side and West Side Developments. The Decommissioning Plan shall be developed in consultation with the Service, NMFS, CDFG, ODFW and the affected Tribes. The schedule for completing the plan shall accommodate a 30-day review period for agencies to submit comments. The Licensee shall include in the Plan all comments received during consultation with the parties identified above, and an explanation of how all comments are accommodated in the Plan. The Plan shall be submitted to FERC for approval prior to implementation. The Decommissioning Plan shall include, but not be limited to, identification of optimal periods of the year to avoid impacts to fish and wildlife resources due to decommissioning, and a comprehensive plan for managing resources after decommissioning.

The Plan shall describe specific actions to be undertaken, and contain provisions to monitor the success of those actions. The schedule for completing the Plan shall accommodate a 30-day review period for agencies to submit comments. The Licensee shall include in the Plan all comments received during consultation with the parties identified above, and an explanation of how all comments are accommodated in the Plan. The Plan shall be submitted to FERC for approval. The Licensee shall implement decommissioning within three years of the Commission order requiring decommissioning and results shall be monitored to determine future needs in continued consultation with the Service, NMFS, CDFG, ODFW and the affected Tribes.

Justification:

The Applicant has proposed decommissioning of the East Side and West Side Developments, but provided very little detail of how decommissioning would be implemented, and failed to identify measures to minimize impacts to fish and wildlife. A Decommissioning Plan for East Side and West Side Developments, developed in consultation with the agencies and affected Tribes, will ensure that all aspects of decommissioning are considered and timed to avoid impacts to federally listed suckers, redband trout, anadromous salmonids, and other fish and wildlife resources. The Plan will also ensure compliance with all state and federal laws, as well as best management practices.

Impacts: Dismantling water related developments and dewatering power canals often result in the loss of habitat or in mortality to fish and wildlife. Without careful consideration and planning for the needs and habitat use of federally listed suckers, redband trout, anadromous salmonids, and other fish and wildlife resources, decommissioning may negatively impact these species and fail to minimize mortality.

6. Instream Flows

Recommendation:

1. East Side and West Side Powerhouses: The Department recommends that the Commission grant the Licensee's proposal to decommission East Side and West Side powerhouses. In the event that these facilities are not decommissioned as proposed by the Licensee, ramp rates at the powerhouses shall not exceed one inch per hour any time of the day or night or shall not exceed 300 cfs in any one 24 hour period. Ramp rates shall apply to all hydroelectric flow-regulated (controlled) operations including load following, re-regulating, and Project start-up and planned Project shutdowns.

2. Keno: The Keno facility shall be managed as a modified run of the river facility and the Licensee shall discharge inflow as available, below Keno Dam. On a 24 hour basis, the Licensee shall make every reasonable effort to hold river flows below Keno Dam to within ±10 percent of the measured Project inflow. Project inflow shall be measured as the sum of the three-day running average flow from Link River and the Reclamation projects including Straits Drain, Lost River, and North/ADY Canal. Flow records shall be made available to the Tribal, Federal and State resource agencies upon request.

3. J.C. Boyle: See Attachment A, the Bureau of Land Management 4(e) condition No. 4.

4. Copco 2: Licensee shall provide a minimum flow of 730 cfs in the Copco 2 Bypassed Reach. If inflow is less than 730 cfs, the Licensee shall direct all inflows into the

bypassed reach. If 40 percent of inflow is greater than 730 cfs, the Licensee shall direct 40 percent of the inflow into the bypassed reach. Inflow shall be computed as a running average of flows during the prior three days at J.C. Boyle Powerhouse gage (#11510700) added to a new gage to be installed by the licensee at Shovel Creek. Flow records shall be made available to the Tribal, Federal and State resource agencies upon request.

Ramp rates at the Copco 2 Dam shall not exceed one inch per hour any time of the day or night or shall not exceed 300 cfs in any one 24 hour period. Ramp rates shall apply to all hydroelectric flow-regulated (controlled) operations including load following, re-regulating, and Project start-up and planned project shutdowns.

5. Fall Creek: Licensee shall provide a minimum of 40 percent of the instantaneous flow, as measured above the Fall Creek power canal diversion, into the bypassed reach. To ensure compliance, the Licensee shall install gages in Fall Creek above the power canal diversion and within the bypassed stream channel. Flow records shall be made available to the Tribal, Federal and State resource agencies upon request.

   Ramp rates at Fall Creek power canal diversion shall not exceed one inch per hour any time of the day or night or shall not exceed 300 cfs in any one 24 hour period. Ramp rates shall apply to all hydroelectric flow-regulated (controlled) operations including load following, re-regulating, and Project start-up and planned Project shutdowns.

6. Spring Creek: Licensee shall provide the following minimum flows at Spring Creek:
   - Full un-diverted flows from June 1 through September 15.
   - 50 percent of the flow above the diversion to remain instream during the remainder of the year, regardless of flow volume.

   Flow records shall be made available to the Tribal, Federal and State resource agencies upon request.

   Ramp rates at Spring Creek diversion shall not exceed one inch per hour any time of the day or night or shall not exceed 300 cfs in any one 24 hour period. Ramp rates shall apply to all hydroelectric flow-regulated (controlled) operations including load following, re-regulating, and Project start-up and planned Project shutdowns.

7. Iron Gate Dam: With the exception of biologically based pulse releases, Licensee shall operate its facilities to ensure that the Project operates as a run-of-the-river facility. In so doing the Licensee shall make releases from its Iron Gate Dam facility that are equivalent to the combined instantaneous inflow to the Project including tributary inflow, spring accretion flow, irrigation return flows and releases made by Reclamation from its Klamath Reclamation Project.

Ramp rates at Iron Gate Dam shall not exceed 125 cfs per hour and 300 cfs per 24 hours when flows are greater than 1,750 cfs, and 50 cfs per 2 hours and 150 cfs per 24 hours when flows are 1,750 cfs or less.

Justification:

Instream Flows:
The ecological structure and functioning of aquatic, wetland, and riparian ecosystems depend largely on the hydrologic regime, or pattern and quantity of water flowing through the system (Gorman and Karr 1978; Junk et al. 1989; Mitsch and Gosselink 1993; National Research Council 1992; Poff et al. 1997; Poff and Ward 1990; Sparks 1992). Intra-annual variation in hydrologic conditions plays an essential role in the dynamics among species within such communities through influences on reproductive success, natural disturbance, and biotic interactions (Poff and Ward 1989). Modifications of hydrologic regimes can indirectly alter the composition, structure, and functioning of aquatic, riparian, and wetland ecosystems (Bain et al. 1988; Lillehammer and Saltveit 1984; Stanford and Ward 1979; Ward and Stanford 1983; Ward and Stanford 1989). The literature consistently illustrates the adverse effect of inadequate flow on aquatic organisms (Annear et al. 2004). Research also indicates that beyond prescribing a minimum flow, managers should determine an appropriate flow regime based on season and water year type ((Richter et al. 1997) and (Stanford et al. 1996)). The artificial manipulation of flow without reference to a baseline hydrograph can profoundly impact habitat and fish communities (Poff and Allan 1995).

Project alterations to the hydrologic regime include the impacts associated with impounding waters at five dam sites, use of storage to change the timing of flows through hydroelectric dams and river reaches, diverting the majority of flows from bypassed reaches of the Klamath River, and ramping river water surface elevation rapidly.

The Applicant's proposal includes operations essentially equivalent to the status quo. To correct this imbalance, the Service's flow recommendations include significant increases in flows in the bypassed and regulated reaches to support aquatic life and to improve water quality. Flow restoration will sustain well-connected and functional riparian and aquatic habitats to which the native aquatic and riparian communities are adapted.

Based upon the current configuration of Project facilities, it is unlikely that the Applicant is capable of providing any appreciable flows in excess of Project inflow on a continuous basis. Project inflow is derived from a combination of tributary inflow, spring accretion flow, irrigation return flows and releases made by the U.S. Bureau of Reclamation (BOR) from its Klamath Reclamation Project. The instream flow recommendations are actions that are deemed to be within the capacity of PacifiCorp to perform.

Ramping Rates:
Project ramping occurs when operations require an increase or decrease in flow through the turbines to adjust for shifts in power demand or to adjust flows for other reasons. Ramping also occurs during Project drawdown for flood control, as well as when outflow is reduced to facilitate reservoir refill. Ramping can also occur when maintenance activities require lowering Project reservoirs to access structures. Unplanned outages are an uncontrollable cause of Project ramping. Project start-up after planned and unplanned outages also involves ramping.

Sudden flow changes in stream reaches due to Project operations can adversely impact fish and aquatic resources. Significant rapid flow reduction in bypassed, peaking, and regulated reaches affects a fish population by dewatering redds and stranding fry or juvenile fish. Rapid flow increases in bypassed, peaking, and regulated reaches can wash out existing redds, displace fry, displace macroinvertebrates, or adversely impact amphibian populations in these reaches. Downramping of only 1 inch per hour can impact fish populations. One very significant ramping event at a very unusual time can cause a significant limiting condition for one or more age classes of fish, or a section of habitat to be impacted for a long period (Hunter 1992).

Large flow fluctuations can also result in increased erosion of important small substrates such as gravel and small cobble, which can reduce available habitat for spawning fish and macroinvertebrate species. Daily and hourly flow fluctuations may increase the rate of erosion of shallow shoreline habitats, and with the cumulative effect of sediment recruitment blocked by dams, magnifying the effect on aquatic, terrestrial, riparian, botanical and recreational resources.

One of the most thorough studies of the effects of hydropower fluctuation on fish habitat was conducted in 2003 and 2004 by Federal, State, Tribal, and private researchers in the Hanford reach of the Columbia River near Richland, Washington (Anglin et al. 2005). The researchers integrated hydrodynamic modeling and Geographic Information System analyses with empirical, physical and biological data. This study confirmed that flow fluctuations from hydropower operations caused significant mortality in juvenile fall Chinook. The following excerpt documents the relative impact of peaking operations:

> We found that although rearing habitat varies with streamflow, stability is likely more important to juvenile Chinook than absolute flow level. Stable flows and habitat conditions require less movement and less energy expenditure than constantly fluctuating flows and spatially variable habitat conditions. Stable flows would also help to reduce the potential for stranding or entrapment of juveniles. (page 3).

The Hanford study on stranding and entrapment also provides insight into the stranding component of PacifiCorp's peaking analysis (PacifiCorp 2005a). The Hanford researchers noted that previous efforts to quantify the magnitude of stranding and entrapment were confounded by low fish sampling probabilities. Anglin et al. (2005) stated the following comment:

> …most important, the sampling approach had problems with detecting stranded fish. Fish stranded on substrates within the Hanford Reach are inherently difficult to find (i.e. detectability is low, even when fish are present). On larger substrates fish tend to migrate downwards as water recedes, requiring excavation of the site to locate dead fish. On finer substrates, fish are exposed to predators and are often quickly removed. Because of the problems with detection of stranded fish, the estimates of stranding and entrapment impacts are likely biased low. (page 57).

The Hanford study focused on entrapped fish to counter the sampling bias inherent in surveys for stranded fry. These entrapped fish remained visible in isolated pools or channels longer, facilitating a more accurate count. However, while these fish may not die from outright desiccation, these fish are significantly impacted by predation and thermal mortality.

The current FERC license does not include conditions that require PacifiCorp to apply specific ramping rates to operations, with the exception of the J.C. Boyle Peaking Reach, which has ramp rates of 9 inches per hour, and below Iron Gate Dam at 250 cfs or 3 inches per hour, whichever is less. Stranding of anadromous salmonids and other fish in the Klamath River has been documented at these high ramp rates (USDI Fish and Wildlife Service 1998).

The Applicant's study of impacts of ramping and stranding in the Project reach was not adequate. Field surveys were unable to detect stranded trout fry and yielded small numbers of stranded sculpin, suckers and dace, and because the Applicants's visual detection methods had little success, PacifiCorp's stranding and entrapment study results are consistent with the findings from the Hanford study. However, the Applicant's examination of isolated pools and side channels did find trapped trout fry, larval suckers and dace. Contrary to resource agency interpretation and the Anglin et al. (2005) study, PacifiCorp discounted these observations, since fish were not technically stranded and generally still alive. A different interpretation, supported by the Hanford study, is that fish populations are severely impacted by flow fluctuations since chronic stranding, desiccation, depredation, and thermal mortality occur as a result.

Ramping rates recommended by the Service are consistent with license conditions at other hydroelectric projects and are based on recommendations from Hunter (1992) and other ramp rates applied at hydro projects from the Pacific Northwest. The recommended ramping rates are feasible to apply at the Project, effective for protecting aquatic and riparian resources, and have been accepted for implementation at other hydroelectric projects by FERC.

1. Flow Recommendations for the East Side and West Side Powerhouses:

The Department supports the Applicant's proposal to decommission the East Side and West Side Powerhouses.

After numerous observations of fish strandings in the Link River, ODFW entered into an interim agreement with PacifiCorp to have minimum flows of 90 cfs at Link River Dam and 450 cfs at

the Eastside powerhouse in the early 1990s (Amy Stuart pers comm.). In 2001, the Service's Biological Opinion for endangered suckers required a minimum flow at Link Dam of 250 cfs from June to October, when needed. Since there is no gage below the dam, the only gage data that can be evaluated to assess minimum flow needs is the Link River flow data below the Eastside powerhouse, approximately one mile downstream from Link River Dam. While the "minimum flow" below the Eastside powerhouse is 450 cfs, this reach of the river frequently fluctuates between less than 450 cfs and greater than 3,000 cfs. For example, from the period May 1 to August 30, 2005, the flow ranged from 437 to 3,790 cfs, largely due to hydroelectric peaking at the Eastside powerhouse. Meanwhile, flows below Link River Dam have been observed as low as 25 cfs although the minimum flow required is 90 cfs. While there is no formal FERC ramp rate, an existing agreement with ODFW calls for 20 cfs/5 minutes for 0-300 cfs, 50 cfs/30 minutes for 300-500 cfs, and 100 cfs/30minutes for 500-1500 cfs. Fish salvages are required per the 1996 Biological Opinion below 300 cfs.

Wetted Perimeter Analysis (Link River below Eastside Powerhouse): The Licensee conducted a wetted perimeter analysis in the Link River above and below the Eastside powerhouse. The Licensee's analysis of wetted perimeter in the Link River consists of a total of 11 transects in different habitat types that evaluated change in wetted perimeter under different flow regimes, with 4 transects below the Eastside powerhouse discharge and 7 above the Eastside powerhouse discharge. The wetted perimeter analysis presented in Figure 1 shows the 4 individual wetted perimeter transects (dotted or dashed lines) located below the Eastside powerhouse and a combined summary of the four transects (solid line).

The wetted perimeter analysis in the Link River below Eastside powerhouse indicates that the percent of wetted perimeter change from 50 to 3,000 cfs is 42% for all types of habitat and 62% in riffle habitats. Even with flow changes from 450 to 3,000 cfs, the wetted perimeter change is 18% for all habitats and 31% in riffle habitats. These are very substantial changes and represent severe dewatering of the channel bed.

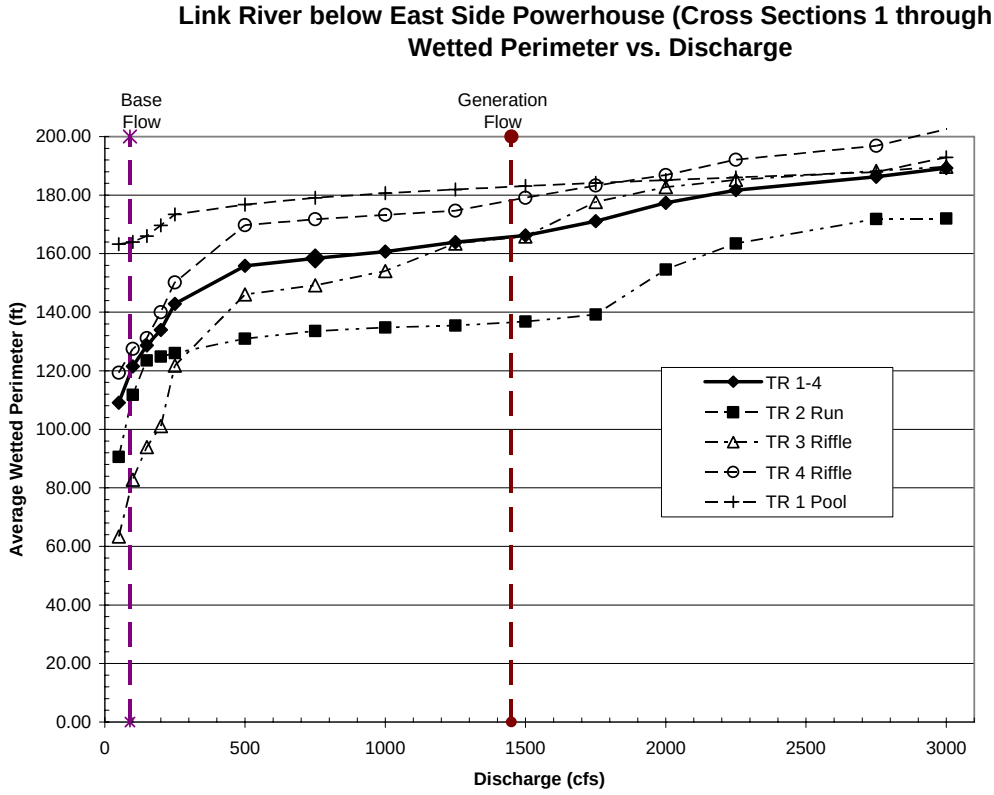

Figure 1. Wetted perimeter versus discharge for the combined and 4 individual habitat transects of Link River flows below Eastside powerhouse.

Project Impacts in Link River Reach: The minimum flow pursuant to agreement with ODFW for below Link River Dam is 90 cfs, yet during site visits in recent years, such as the PacifiCorp-led tour on September 26, 2000, barely an estimated 25-30 cfs was flowing downstream from the dam, primarily dam leakage and flow via the fish ladder. Even the current 90 cfs minimum flow is inadequate and only provides some flow for passage and little flow for rearing native fish.

Numerous fish kills have been documented in the Link River, particularly when flows drop below 300 to 500 cfs (Amy Stuart, ODFW pers comm.). One resident along the Link River documented in a letter to "Pacific Power and Light" (the Licensee) a large fish kill with numerous flow changes and the river height falling from 3-4 feet in a period of 3-4 minutes. The resident commented that only the residents that live along the river observed stranded and dead fish because "twenty minutes later the river rose in a rapid fashion, washing away the dead fish" (letter from (Wagstaff 1992) to Jerry Rope at Pacific Power and Light, April 12, 1992). The resident indicated that this was not an isolated incident and this situation had occurred repeatedly for the past 13 years. When he contacted the Licensee, the Licensee's responses ranged from "we are working on that problem" to "those aren't game fish."

2. Flow Recommendation for the Keno Reach:

The minimum flow requirement below Keno Dam, per FERC article 58 and ODFW agreement is 200 cfs. Flows generally range from as low as 200 cfs up to 1700 cfs during the summer although there is no generation at Keno Dam. PacifiCorp regulates flows at Keno Dam to maximize generating efficiency at J.C. Boyle and downstream peaking facilities and to keep the Keno pool within one foot of the high water mark to allow gravity irrigation facilities to operate. There is no FERC ramp rate requirement, but PacifiCorp indicated a self-imposed, non-regulatory ramp rate of 500 cfs or 9 inches per hour in the FLA. The number of hourly flow changes greater than 500 cfs per hour averages 28 for each year for water years 1995 to 2001.

Flows received at Keno Dam are a combination of flows from Link River and irrigation return water from canals downstream from Link River that return water to Lake Ewauna. Reclamation and PacifiCorp have an agreement that PacifiCorp operate Keno Dam to hold Keno Reservoir within a variance of only 0.5 foot (see Figure 3). The steady reservoir elevation allows Reclamation to manage its irrigation water through its diversion channels from Keno Reservoir, and enables PacifiCorp to more effectively plan downstream load following operations at the J.C. Boyle powerhouse (PacifiCorp 2004c). Approximately 5,900 acre feet of water storage is provided by the 0.5 foot variance in reservoir elevation, which equates to approximately 30 days of a flow of 100 cfs (Hicks, pers. comm.). Currently, this storage is being utilized to provide flow fluctuations in support of hydroelectric peaking operations at J.C. Boyle Dam, downstream, as shown in Figure 4. We recommend that this storage be used to dampen the unnatural flow fluctuations coming out of Keno Dam (see Figures 3 and 4) to support better fish habitat.

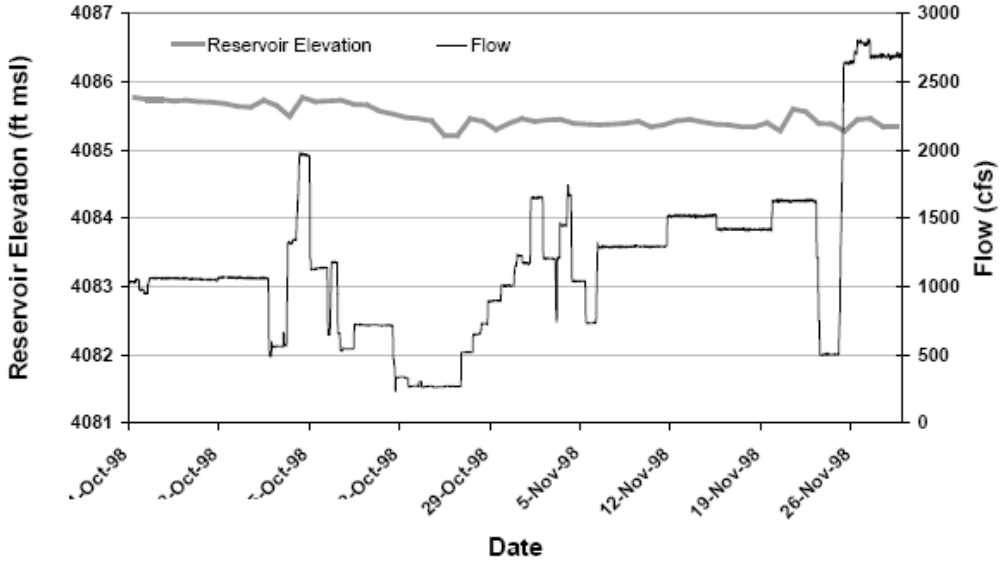

Figure 3. Keno Reservoir elevation and hourly discharge below Keno dam during October and November 1998 (PacifiCorp 2004c)

The flow recommendation for the Keno reach also allows a +/- 10% of inflow within the irrigation season to allow for adjustments due to changes in inflow and outflow from the Reclamation Project on a daily basis. The intent is to provide some "smoothing" of flows in the Keno reach to accommodate the one inch per hour ramp rate under the Licensee's control, and also accommodate flow fluctuations due to the Reclamation Project above Keno Dam.

Decreasing the amount of unnatural flow fluctuations in the Keno reach will substantially restore aquatic and riparian resources toward a more natural condition that supports redband trout and federally listed suckers. In addition, the reach will need to provide better habitat conditions than those present to promote the potential future migration of anadromous fish.

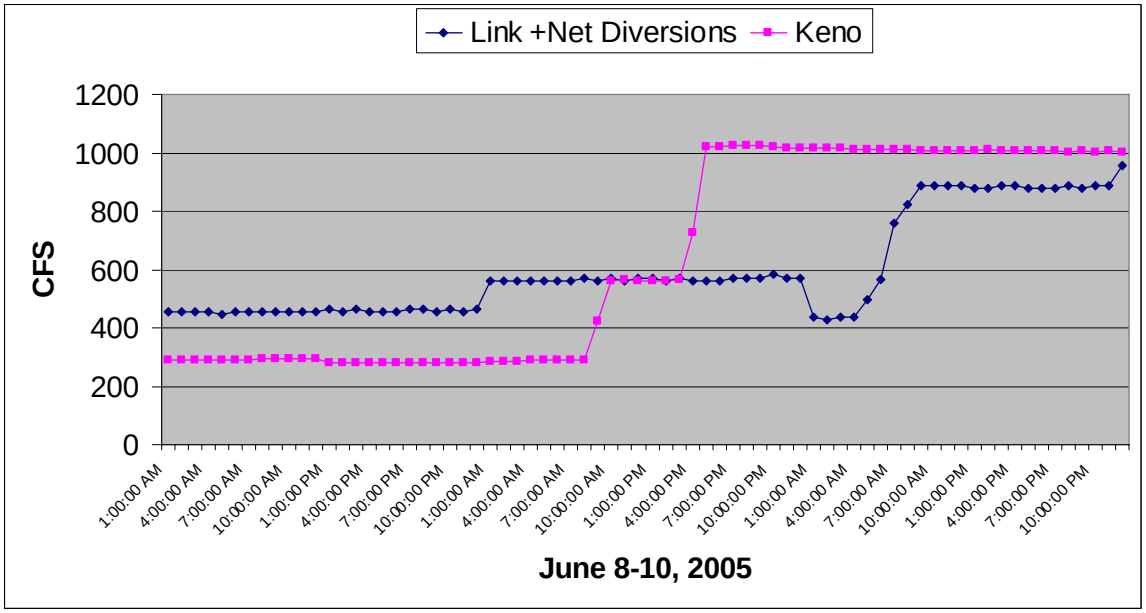

Figure 4. Comparison of flows in Link River, including net diversions from Reclamation Project facilities, and below Keno Dam, during June 8-10, 2005 (Reclamation data)

Project Impacts in Keno Reach: PacifiCorp did not conduct a flow study or a flow fluctuation study in this reach. PacifiCorp states that flows below Keno Dam, in the Keno Reach, are dependent entirely on what is delivered to Lake Ewauna / Keno Reservoir by Reclamation and other irrigation operations, and that PacifiCorp has no discretion or control over flows in the Keno Reach (PacifiCorp 2004c). This is contradicted by the fact that 80 percent of the inflow to Lake Ewauna is from Link River while approximately 20 percent is from agricultural returns with a very small amount from municipal and industrial inputs (PacifiCorp 2004c). PacifiCorp can and does alter flows in the Link River and Keno Reach for hydroelectric Project purposes,

including maintenance actions, and to maximize peaking at downstream Project peaking facilities.

While the Keno Reach is not as severely impacted as the bypassed or peaking reaches downstream, flows are ramped up and down to re-regulate flows to maximize peaking at downstream facilities and to regulate incoming flow from Reclamation irrigation (see Figures 3 and 4. For example, from the 4-month period from May 1 to August 30, 2005, the gaged flow below Keno Dam ranged from 279 to 5,490 cfs, with no apparent cause for high or low flows.

The practice of using reservoir storage to follow short-term peaks in power demand – known as load following – results in rapid and significant changes in river flow and reservoir elevation. The greater storage at Keno Dam (compared to J.C. Boyle Reservoir), with a 6 inch daily reservoir fluctuation, has given PacifiCorp more options to maximize peaking at the downstream J.C. Boyle and the Copco peaking facilities. The Applicant describes Keno Dam operation as: "The steady reservoir elevation allows Reclamation to manage its irrigation water through its diversion channels from Keno reservoir, and enables PacifiCorp to more effectively plan downstream load following operations at the J.C. Boyle powerhouse" (PacifiCorp 2004c).

Although the Keno Reach has some of the better existing conditions for native redband trout among the Project-affected reaches, the trout fishery is impacted by the low flows and frequent flow fluctuations from PacifiCorp and Reclamation flow regulation. Effects of these flow fluctuations are of the types described for the peaking reach, but of much less magnitude. Institution of a minimum flow and combination with a more restrictive ramp rate will reduce the incidence of fish kills, and increase habitat, survival and productivity of native fish.

Project impacts occur from a combination of periodic low flows in combination with a high ramp rate. Impacts are greatest during very high and cold water temperatures and often lead to fish die-offs. For example, in June 2003 flows in the Keno Reach were reduced by PacifiCorp in order to limit the amount of inflow to the J.C. Boyle Reservoir during a Project outage for maintenance at the J.C. Boyle Powerhouse. Due to both rapid declines in flow, the sustained low flow of 250 cfs and hot weather and water temperatures, a fish die-off occurred in the Keno Reach. The large fish and macroinvertebrate die off occurred due to the rapid de-watering in combination with the high water temperatures of the Klamath River which stranded fish and caused stressful conditions. An unknown amount of macroinvertebrate abundance was lost but was significant considering abundance ranges from 11,000 to 21,000 m^2 in the Keno reach of the Klamath River (Tinniswood 2006).

A second large fish-die off occurred later that summer in late July and early August and was caused by a combination of algae die-off, very warm water, and low flows (flows in the Keno Reach ranged from 413 cfs to 521 cfs during the die off), and resulting lack of DO for fish, that occurred the previous nights. The stressful conditions (low DO, warm water temperatures, and low flows) probably resulted in an epizootic of columnaris which appeared to be the immediate cause of death of most fish sampled.

As recently as December 10, 2005, ODFW district staff observed fish mortality and heavy macroinvertebrate loss when river flows below Keno Dam were reduced from 1,140 cfs on December 4, 2005 to 333 cfs on December 6, 2005 (Tinniswood 2006). This reduction of flow coincided shortly after the JC Boyle bypass canal failure on December 2, 2005. Low flows of 358 cfs continued until 14 December when mean flows were increased to 770 cfs when the increase in flow coincided with the completion of repairs on the JC Boyle bypass canal on December 15,2005. Flows were then increased again to a mean of 1170 cfs for the date. Although ODFW staff were unable to be on site in the Keno reach until December 10, four days following the drawdown for the canal repair, dead redband trout and tui chub were observed as well as thousands of blue chub and fat head minnow stranded in the shallows. The loss of macroinvertebrates was unquantifiable but significant and probably in the millions of organisms for the entire reach. In summary, the fish and macroinvertebrate stranding and die-off occurred due to a drastic decrease in river flows during very cold water temperatures of 2º-3º C.

Many fish die-offs have occurred in the Keno Reach since ODFW staff began to keep records in their monthly reports. ODFW concludes that in most cases, when fish die-offs occur in the Keno Reach, PacifiCorp, not Reclamation, alters flows in the Keno Reach for Project purposes. This alteration results in adverse impacts to fish and aquatic resources. Die-offs are more severe during episodes of very warm or cold water temperatures, in combination with low flows or cumulative down ramps that reduce the river to low flows (Bill Tinniswood, ODFW. pers comm.). For this reason, reduced flow fluctuations need to be established as part of the new license to protect fish and aquatic life from Project operational impacts.

3. J.C. Boyle:
See Attachment A, the Bureau of Land Management 4(e) condition No. 4.

4. Flow Recommendation for the Copco 2 Bypassed Reach:
At Copco 1 Dam, 100 percent of the instream flow below 3,200 cfs goes through the penstocks and powerhouse. Diversion at Copco 2 Dam is 97 percent of the instream flow below 3,200 cfs. Flow is 5 to 10 cfs below Copco 2 in the Copco 2 Bypassed Reach.

The Service participated in an inter-agency group of fisheries professionals to develop methodology for instream flow recommendations. The participating agencies were the Service, NMFS, BLM, Reclamation, CDFG, and ODFW. Explanation of the instream flow methodology developed by this group is located in this section, below, and in the BLM's section 4(e) conditions (Attachment A). The Service recommends implementing an instream flow regime based on the best available information in order to meet the objective of restoring instream habitat for fish in the Project reaches. The Instream Flow Council (IFC) recommends developing instream flow prescriptions that address five riverine components: 1) hydrology; 2) habitat; 3) geomorphology; 4) water quality; and 5) connectivity (Annear et al. 2004). The Project operations and facilities, coupled with upstream land and water use, have profoundly impacted all five of these components. As a result, data must be carefully evaluated in the

context of multiple interacting parameters. No one tool should be considered definitive, but rather employed in conjunction with other sources of information to provide perspective and guidance in developing recommendations.

The IFC also notes that utilizing a percentage of unimpaired hydrology can serve as a robust and reasonable starting point in preparing a flow recommendation where site specific data is problematic (Annear et al. 2004). The caveat to using this standard setting approach is the need to augment it with site specific assessments of how biological and geomorphic processes respond to flow. The Service and its partners considered utilizing the PHABSIM results provided by the Licensee and found that problems with the results precluded their use (for explanation, see Attachment A, condition 4). Instead, the group decided to develop minimum base flow recommendations based on hydrology and a percentage of inflow approach, where needed, to provide for inter-and intra- annual variation.

Two aspects of using a percentage of inflow approach lend themselves to the Project in particular. First, this approach translates into a simple and direct flow prescription. Requiring PacifiCorp to bypass a percentage of inflow eliminates the confounding complexities of multiple other water users and regulators in the Upper Klamath Basin. Second, this approach provides flexibility to accommodate ongoing watershed restoration. Interior and many other stakeholders are actively working towards enhancing instream flows in the Klamath River through efforts such as wetland restoration and water conservation. By avoiding a static flow requirement, this approach will allow impacted resources to benefit from future restoration initiatives both within and upstream of the Project.

Base Flows: The Service recommends a minimum base flow in the Copco 2 Bypassed Reach, that equals 40 percent of the mean annual inflow for that reach. The recommended reservation of at least 40 percent of the mean annul flow is supported by the hydrologic methods proposed by Tennant (1976), Tessman (1980), Estes and Orsborn (Estes and Orsborn 1986), and the IFC (Annear et al. 2004). Reserving at least 40 percent of the mean annual flow for aquatic resources is also supported by site specific information from the PHABSIM results, wetted perimeter analysis, an unimpaired hydrology approach, side channel analysis, and water temperature modeling information. Different site specific supporting information is available for different reaches (see discussions below, above, and in Attachment A).

In his study of 11 streams in Montana, Nebraska, and Wyoming, Tennant (1976) found empirical support for the Montana Method, which recommends base flows that provide good survival conditions for most aquatic species. The Montana Method recommends base flows of 40 percent of the mean annual flow received under unimpaired conditions to provide "outstanding" habitat from October to March and "good" habitat from April to September (Tennant 1976). Tennant (1976) empirically studied only 30 percent and 60 percent flows, and found that base flows equaling 30 percent of mean annual flow provides good aquatic habitat and 60 percent provides outstanding aquatic habitat conditions. He also recommends using "undepleted" USGS hydrology data for flow recommendations. "Otherwise, recommendations from the Montana Method may relate to depleted stream conditions and result in less than ideal flows" (Tennant 1976). We based our base flow recommendations on the best available gage information (longest period of record) for each reach, and under "depleted" conditions (i.e., diversions upstream of the reaches have reduced flows from what would be expected under natural conditions, also termed "impaired"). Based on Tennant's analysis, we found that 30 percent of these "depleted" flows would likely be "less than ideal" for fish and other aquatic life, and chose 40 percent of the "depleted" flows as likely providing good aquatic habitat. Then we endeavored to collect independent information in any and all reaches to test that assumption. We found that the independent information provides good support for the 40 percent of "depleted" flows recommendation.

Seasonal Flow Variation: Seasonal flows above the 40 percent minimums will take place in all of the mainstem Project reaches except the bypassed reaches, where most higher flows are diverted to the powerhouses. In order to promote a more natural hydrologic pattern in the bypassed reaches, we adopted the modified Montana method of Tessman (1980). Tessman (1980) modified the Montana Method by using either 40 percent of the mean annual flow or 40 percent of the mean monthly flow, whichever was greater. This modification represents an important improvement over the traditional "flatline" Tennant flow requirement and provides intra-annual variability during the wetter part of the year. We adapted the Tessman approach to the two bypassed mainstem reaches by requiring either: 1) 40 percent of mean annual flow or 2) 40 percent of the three day running average, whichever is greater below the Copco 2 Dam. Our approach uses a smaller time step than Tessman (1980), 3 days instead of monthly, to provide for more frequent variations, facilitate Project operations, and accommodate the relatively small storage capacity of the Project reservoirs.

Upstream storage and diversions have impacted flow into PacifiCorp's Project since construction. As a result, we do not have access to an "unimpaired" hydrograph. We do have access to USGS gage data over an extended period of record (i.e. the past 44 years) that includes a range of water year types as well as a variety of regulatory constraints. This record of what has actually been delivered to the Project provides the foundation for the recommended minimum base flows in the bypassed reach. By using 40 percent of the mean annual flow received by PacifiCorp over 44 years, we have recommended minimum flows that will, on average, be available to the Applicant.

We acknowledge that during drier months and drier water year types, these flows will not always be available. This is not unique to the Klamath. As Tessman notes, "There will be circumstances when the actual flow is less than the minimum flow value. The minimum flow is not intended to suggest that stream flow should be augmented when naturally occurring flows are less. Minimum flows simply serve as a constraint on withdrawal." ((Tessmann 1980), p. 7-8). In instances when the minimum release of 40 percent of the mean annual flow is not available, Tessman recommends releasing a flow equal to the mean monthly flow into bypassed reaches. Under our recommendation, whenever the three day running average drops below the required minimum releases, diversion at that facility shall cease and all inflow be directed to the respective bypassed reach.

Comparison with PHABSIM Results:
Almost 100 years of extreme flow reduction in the Copco 2 Bypassed Reach has created an artificial channel that limits the applicability of PHABSIM weighted usable area (WUA) curves for developing appropriate instream flows. The riparian encroachment of large alder trees in the riverine channel is reflected in the WUA curves. In the Copco 2 Bypassed Reach, the minimum flow release of 5-10 cfs is less than 0.5 percent of the mean annual flow and has transformed a major river into a wadable stream and boulder field. The riparian encroachment of large alder trees in the riverine channel creates fish habitat at much lower flows than would have naturally occurred in the channel. Habitat amounts increase with discharge only up to 100 or 200 cfs to any significant degree (see Figure 29, (PacifiCorp 2005e)), above which increased flows have little effect on the amount of modeled habitat in the channel. Nevertheless, the recommended minimum flows of 730 cfs in the Copco 2 Bypassed Reach are supported by the Applicant's PHABSIM results in that they would provide approximately 95 percent, 98 percent, and 87 percent of maximum WUA for fry, juvenile, and adult redband/rainbow trout, respectively, in the Copco 2 Bypassed Reach.

If the instream flow recommendation is implemented, flows in the Copco 2 Bypassed Reach will be significantly increased and the channel will change significantly. Encroached riparian vegetation will recede up the channel slope and the low flow channel will reform. These alterations will significantly change results that would be obtained from a new PHABSIM analysis.

Comparison with Unimpaired Hydrology and Tennant Approach: Another line of evidence in support of the minimum recommended flows utilizes the recently developed Natural Flows of the Upper Klamath River (USDI Bureau of Reclamation 2005). At this time, we regard this estimate of natural flows in the Klamath River to be an approximation because the National Research Council will be reviewing it by next year, and other estimates of natural flow also exist and will be reviewed. The Tennant method recommends a minimum of 30 percent of unimpaired or "undepleted" flows be used as a base flow to provide good aquatic habitat conditions. Reclamation's Natural Flows provide a 51 year hypothetical record of the flows at Keno Dam under natural, unimpaired conditions. The mean annual flow using this hypothetical record is 1,810 cfs at Keno Dam. Accretions from the Keno gage to Copco 2 Dam were estimated from

the actual 44 year gage records (Parker, pers. comm.) and added to this hypothetical mean annual flow, yielding an estimated mean annual flow at Copco 2 Dam of 2,074 cfs. Our recommended minimum flow in the Copco 2 Bypassed Reach is 35.2 percent of the mean annual unimpaired flows estimated in this way, providing good validation of the recommended minimum flows.

Ramp Rates: See general discussion of ramp rate recommendations and their impacts, above.

Project Impacts in Copco 2 Bypassed Reach: Of all river reaches impacted by the Project, the Copco 2 Bypassed Reach is the most strongly affected. Copco 2 Bypassed Reach is approximately 1.4 miles long, and extends from Copco No. 2 Dam to Copco No. 2 Powerhouse. The powerhouse discharges directly into Iron Gate Reservoir. The channel is in a deep, narrow canyon with a steep gradient, and consists of bedrock, boulders, large rocks, and occasional pool habitat. The Project's ability to divert up to 3,200 cfs, combined with decades of minimum flows in the bypassed reach of 5-10 cfs, have resulted in the almost complete de-watering of this reach. Except during spill events, between 98 and 99.5 percent of the flow into this reach is diverted. As a result, riparian vegetation has encroached on the channel and adversely altered channel characteristics. PacifiCorp's instream flow habitat curves show this riparian encroachment and narrowing of the channel. As the water level is simulated to increase above a base flow, relatively large areas become flooded, resulting in a steep initial increase followed by a flattened curve in simulated WUA for trout and suckers (PacifiCorp 2005e).

Fisheries surveys conducted by the Applicant indicate that the fisheries in the Copco 2 Bypassed Reach are in poor condition in comparison to the other Project reaches (PacifiCorp 2004d). In the Copco 2 reach, only 3 native species were captured with backpack electrofishing, whereas 7 were captured in the Keno and J.C. Boyle Bypassed Reaches, and 5 in the Peaking reach. Catch per unit effort (CPUE), an index of fish density, of redband/rainbow trout with the backpack electrofishing effort was much less successful in the Copco 2 Bypassed Reach, an average of 7.5 in comparison to combined CPUE of 46.2, 18.6, and 19.1 for the Keno, J. C. Boyle, and Peaking reaches, respectively. Sampling of the fisheries in the Project reaches using angling was largely unsuccessful in the Copco 2 Bypassed Reach, whereas the other reaches had caught large numbers (96, 262, and 187 trout in the Keno, J. C. Boyle, and Peaking reaches, respectively) and a variety of sizes of fish.

The Copco 2 bypassed channel is expected to adjust significantly to the addition of flows to the levels recommended here. Riparian vegetation and associated sediment will be removed by the additional flows and deposited into Iron Gate Reservoir. Reservoir fisheries will likely improve due to the additional habitat surface area provided by large woody debris. Fisheries in the Copco 2 Bypassed Reach are expected to improve due to the significantly increased amount of habitat area and quality.

5. Flow Recommendation for Fall Creek:

PacifiCorp's diversion on Fall Creek has a 50 cfs capacity and only 0.5 cfs bypass requirement. PacifiCorp diverts 99 percent of the streamflow except during the infrequent and brief storm events when flows exceed 50 cfs. There is no formal or informal ramp rate.

To address flow requirements in Fall Creek, the Service recommends that PacifiCorp implement an instream flow regime based on the best available information for this tributary. At this time, information for flow requirements of native aquatic species within Fall Creek comes from a USGS gauge on Fall Creek just above Iron GateReservoir (No. 11512000) and PacifiCorp's instream flow study (PacifiCorp 2005e).

Given the best available information, the Service recommends applying the Tennant method of setting flow for Fall Creek in a similar manner to that for the Copco 2 Bypassed Reach. To provide good habitat based on hydrology, Tennant recommends a minimum of 40 percent of the average annual unimpaired flow. To adapt the Tennant method to this relatively small and unstudied watershed, we recommend reserving at least 40 percent of the instantaneous flow to mimic an acceptable level of intra-annual variability and provide good aquatic habitat. Applied to the historic USGS flow data, this would range from 22 to 14 cfs. The weighted usable area curves provided in the FLA indicate this range of flows will provide roughly 50 percent of the simulated adult rainbow trout habitat and 95 percent of the simulated juvenile rainbow trout habitat.

Ramp Rates: See general discussion of ramp rate recommendations and their impacts, above.

Project Impacts in Fall Creek:
Over 20 years of streamflow data from the USGS (1933 through 1959) indicates mean monthly flows in Fall Creek above Iron Gate Reservoir range from a high of 50 cfs (in February) to a low of 33 cfs (in August). Currently, PacifiCorp's diversion on Fall Creek has a 50 cfs capacity and only 0.5 cfs bypass requirement. PacifiCorp diverts 99 percent of the streamflow except during the infrequent and brief storm events when flows exceed 50 cfs. This causes a significant impact on the hydrology and aquatic resources of Fall Creek. The PacifiCorp instream flow study presented in the FLA provides some preliminary documentation of the habitat impact. The results depict increasing habitat for redband/rainbow trout with increasing flow throughout the range of the simulation (up to 30 cfs), with no appreciable flattening of the curves (PacifiCorp 2004c).

6. Flow Recommendation for Spring Creek:

The diversion at Spring Creek is 16.5 cfs to augment flows into Fall Creek hydroelectric plant. Approximately 0.22 cfs is returned to Spring Creek. There is no formal or informal ramp rate.

The best available information documenting Project impacts on Spring and Jenny Creek water quality is provided by studies performed by the BLM. The Project's Spring Creek diversion impacts stream temperature in both Jenny and Spring Creeks, based on water temperature data collected by the BLM in 2004 and summarized in its April 25, 2005, filing with the FERC (USDI Bureau of Land Management 2005). According to BLM (2005), when PacifiCorp diverts water, temperatures in Spring Creek below the diversion increase and the number of days that the temperature exceeds the State of Oregon water quality standard also increases. This impact continues downstream, evidenced by increases in water temperature in Jenny Creek below the confluence with Spring Creek. This impact is particularly adverse during the warmer months as the native aquatic species evolved under a flow regime influenced by cool spring inflows. Implementation of our recommended flow regime in Spring Creek should mitigate this water quality impact.

Beyond impacting water temperature, PacifiCorp's Spring Creek diversion also reduces aquatic habitat. However, PacifiCorp has yet to present data that quantify this impact. When such information becomes available, the Service may modify the flow recommendation for Spring Creek.

Ramp Rates: See general discussion of ramp rate recommendations and their impacts, above.

Project Impacts in Spring Creek:
The PacifiCorp diversion impacts fisheries resources in both Spring and Jenny creeks. In 2004, BLM identified redband trout (*Oncorhynchus mykiss ssp.*) in Spring Creek. Although few individual fish were found, these trout are present in the creek as well as in the PacifiCorp diversion canal. When PacifiCorp diverts water, it dries approximately the downstream third of Spring Creek. Although small, Spring Creek provides important cool-water summer fish habitat in the Jenny Creek Watershed. PacifiCorp's diversion compromises the connectivity and amount of that habitat.

BLM's temperature data shows a moderate temperature effect in Jenny Creek from the PacifiCorp diversion (Table 3). This temperature difference could be physiologically and biologically significant to both redband trout and Jenny Creek suckers (*Catostomus rimiculus*). When water temperatures are near a fish's critical thermal maxima, small increases can negatively impact fish health or reproductive fitness, or even cause death ((Bjornn and Reiser 1991) and US EPA 2003). Summer is a critical period for recovering from spring spawning and for replenishing body fat reserves in order to grow during the summer and develop gametes through the non-feeding winter. Although BLM does not have specific data relating the cooling effect of Spring Creek water to trout and sucker health and reproduction, the water temperature data shows that the cooling effect of Spring Creek flows can be as much as 5.4°F during the summer months. The cooling effect was measured definitively one mile downstream from the mouth of Spring Creek (at BLM-14) and is projected to impact an additional two miles downstream from this site. BLM snorkeling data shows that the Jenny Creek reaches downstream of Spring Creek are important summer habitat for adult suckers and trout (USDI

1999). The water withdrawals from PacifiCorp's diversion would undoubtedly affect these adult fish during the summer months.

7. Flow Recommendation for Downstream of Iron Gate Dam:

At Iron Gate Dam, 100 percent of flows below 1,735 cfs go through penstocks and the powerhouse. Flows in excess of 1,735 cfs are spilled. The FERC ramp rate is 250 cfs or 3 inches per hour whichever is less. More recently, the NOAA Fisheries Biological Opinion for coho revised the ramp rates to 125 cfs per hour and 300 cfs per 24 hours when flows are greater than 1,750 cfs and 50 cfs per 2 hours, and 150 cfs per 24 hours when flows are 1,750 cfs or less (National Marine Fisheries Service 2002).

Project inflow is derived from a combination of natural flow, tributary inflow, spring accretion flow, irrigation return flows and releases made by Reclamation from its Klamath Reclamation Project to total the Biological Opinion obligations for coho downstream from Iron Gate Dam. To date, PacifiCorp has been unclear and not entirely responsive in providing information on Project operations. However, it is clear from flow records that PacifiCorp uses storage to "shape" releases and has the ability to provide minimum flows, on a daily, weekly, or even monthly basis that differ from the real-time inflow from Link River Dam. Based upon modeling results, water releases from Reclamation's Link River Dam would take 2-3 days to reach the IGD if the Project did not act to reduce travel time. With the Project in place and operating, that same release would take a week or more to reach IGD. In addition, the Project impounds approximately 52,000 acre feet of potential active storage.

The recommended run-of–river operations constitute a flow regime that 1) protects aquatic resources whenever PacifiCorp has operational discretion and 2) acknowledges that "fish flows" will not always be available for release by PacifiCorp.

Outside of the FERC relicensing, developing appropriate target flow recommendations for the Klamath River below Iron Gate Dam as been a prime objective of multiple Federal, State, and Tribal agencies in their efforts to pursue restoration of anadromous salmonids of the Klamath River. The Department asked Dr. Thomas Hardy of the Utah Water Research Laboratory to work with professionals from these agencies and Tribes to develop flow recommendations for Iron Gate Dam. This effort produced a Phase I document that was based on information that was available (Hardy 1999) and a Phase II document that was based on a flow model developed with site specific hydrologic, hydraulic, habitat, and fisheries information (Hardy and Addley 2001). In this document, Hardy and Addley (2001) recommend instream monthly flows at IGD for 90, 70, 50, 30 and 10 percent exceedance ranges corresponding to the Reclamation Dry, Below Average, Average, Above Average and Wet water year types as designated by the Natural Resource Conservation Service. Methodology used in developing Hardy and Addley (2001) is being published in Hardy et al. (in press). In addition, Hardy and Addley's work will be reviewed by the NRC in 2006.

Project Impacts Downstream of Iron Gate Dam:
Though Iron Gate Reservoir allows high flows to pass, their magnitude is often decreased. The reduction of flood flows has resulted in changes in the distribution of riparian vegetation due to changes in the availability of sediments. Less active bed scour, erosion, deposition, and channel migration downstream results in less fresh sediment surfaces available for colonization by seedlings of riparian plants (Johnson 1992).

7. Geomorphic and Juvenile Outmigrant Flows at Copco No. 2

Recommendation:

At a minimum, once annually between February 1st and April 15th, diversion to the Copco No. 2 Powerhouse should be suspended when inflow to Copco Reservoir first exceeds 3,300 cfs during this time period.

- Suspension of diversion shall be maintained for a minimum of seven days.
- The streamflow shall be measured from the gage below J.C. Boyle Dam at RM 225 and a new gage to be installed at Shovel Creek, combined.
- The down ramp rate shall not exceed 300 cfs per 24 hours, measured at a new gage to be stalled below the Copco No. 2 powerhouse.

Justification:

Flood flows at bankfull levels or above are needed to provide natural scour to the channel to maintain natural levels of sediment transport, shallow aquatic habitats, and riparian vegetation. All of these features are important fish habitat components. High flows naturally occur from about December through June. However, due to the potential for salmonid eggs or alevins to be disturbed by high flows in December, January, and February, the flood flows should be implemented starting in March.

Impacts: The Project has altered the natural annual hydrograph of the Copco 2 Bypassed Reach by reducing the frequency and magnitude of flood flow events (see Figure 1-17 in PacifiCorp Exhibit E, Water Use and Quality, (PacifiCorp 2004b)). Extremely reduced flows in the Copco 2 Bypassed Reach have resulted in a significant degree of riparian encroachment into the active channel, a significantly reduced channel, and reduction in aquatic habitat availability (PacifiCorp 2004c).

Klamath Project reservoirs are relatively small, and are not operated for flood control. Though reservoirs allow high flows to pass, their magnitude is often decreased and the flood flows do not pass through the bypassed reaches. The reduction of flood flows has resulted in changes in the distribution of riparian vegetation due to changes in the availability of sediments. Less active bed scour, erosion, deposition, and channel migration can result in less fresh sediment surfaces available for colonization by seedlings of riparian plants (Johnson 1992).

For spawning, salmonids are dependent on the gravel sediments that are normally maintained by flood events, and riparian vegetation is important for providing stream edge habitats for juvenile rearing. Salmonid egg incubation and fry development occurs in the winter months in the Klamath River. These life stages can be adversely affected by high flow events that could wash the eggs or fry downstream prematurely (Jensen and Johnsen 1999). However, higher flows in spring appear to increase survival of spring out-migrants (Cada and Sale 1993; Kjelson and Brandes 1989; Kope and Botsford 1990), but see (Williams and Matthews 1995)).

8. Gravel Augmentation

Recommendation:

Within one year of license issuance, the Licensee shall, for the conservation and development of, and mitigation of damages to, fish and wildlife resources, develop and submit to FERC for approval a Gravel Augmentation Plan (GAP) for the Project reaches and Klamath River below Iron Gate Dam to improve habitat resources for resident trout and anadromous salmonids. The GAP shall be completed in consultation with the Service, NMFS, CDFG, ODFW and the affected Tribes. The schedule for completing the plan shall accommodate a 30-day review period for agencies to submit comments. The Licensee shall include in the Plan all comments received during consultation with the parties identified above, and an explanation of how all comments are accommodated in the Plan. The Plan shall be submitted to FERC for approval prior to implementation. The goal of the GAP shall be the development and implementation of a comprehensive management plan to provide spawning gravel in reaches of the Klamath River that have lost spawning gravel due to impoundments. The GAP shall include, but not be limited to, the following measures:

1. Identification of priority spawning and holding reaches
2. Assessment of flows needed to transport gravels and maintain holding habitats (pools)
3. Identification of areas for removal of deposits of large debris
4. Identification of priority areas for gravel augmentation, volumes of gravel, and flows to implement deposition of gravel in target areas.

The Licensee shall file the Plan with the Commission for approval, with copies to the agencies consulted. The Licensee shall implement gravel augmentation within three years of license issuance and results shall be monitored to develop future augmentation needs with continued consultation with the Service, NMFS, CDFG, ODFW, and the affected Tribes. Gravel augmentation needs shall be reviewed at least every five years for the duration of the license.

Justification: Gravel augmentation will restore spawning gravel to portions of the Klamath River channel that have been deprived of any sediment inputs for decades. As a result, these portions of the channel now have little if any gravel necessary for the spawning life history stage of salmonids and other native fishes.

The development of a Plan will maximize the likelihood of success in restoring spawning habitat quantity and quality and at the same time minimize the potential damage to critical areas, such as the deep pools in the J.C. Boyle Bypassed Reach immediately below the input of 220 cfs of spring water. These areas were likely to have been used historically and have potential as holding areas for spring-run Chinook adults. This type of coolwater refugial habitat is necessary for this run of fish (McCullough 1999). Juvenile spring-run Chinook would rear in the cool water habitat adjacent to the springs in the J.C. Boyle Bypassed Reach. Water temperatures in this spring influenced areas do not vary substantially from 50 to 55^{o}F throughout the year (USDI Bureau of Land Management 2003) and would also provide relatively warmer water during winter months, benefiting rearing spring-run Chinook by providing optimal temperatures for juvenile growth (McCullough 1999).

Impacts: Native species in the Klamath River evolved under the seasonal variability of an unregulated river, with a freely moving bedload. However, the Project's dams have been collecting and storing sediments for decades, while reaches below the dams have been deprived and scoured of gravel and finer sediments. PacifiCorp (PacifiCorp 2004c) reports that the Project impacts alluvial features (and therefore potential salmonid spawning material) from Iron Gate Dam to the confluence with Cottonwood Creek.

In most Project reaches, the river bed is coarsened as smaller gravels are transported downstream without being replaced, and larger gravels and cobbles that are unsuitable for use by spawning fish dominate (Kondolf and Matthews 1993; PacifiCorp 2004c). PacifiCorp's Water Resources Final Technical Report, dated February 2004, indicated that the Project causes a deficit of sediment for transport between dams and below the Project. Sediment supply is especially limited in the below J.C. Boyle Dam. Indeed, "pebble count results indicate potential bed coarsening immediately downstream of Project dams and in the J.C. Boyle peaking and bypassed reaches" (PacifiCorp 2004c). In addition, the Project may have significantly coarsened the channel bed from downstream of Iron Gate Dam to the confluence with Cottonwood Creek (PacifiCorp 2004c).

A natural river transports sediment inputs from upstream to downstream reaches through flood flow events. Reservoirs trap gravels that would otherwise be supplied from upstream. In most Project reaches, the river bed is coarsened as smaller gravels are transported downstream without being replaced, and larger gravels and cobbles that are unsuitable for use by spawning fish dominate (Kondolf and Matthews 1993; PacifiCorp 2004c). This effect is particularly critical in the J.C. Boyle Bypassed and Peaking reaches and below Iron Gate Dam.

Changes in the flow and sediment regimes due to Project operations and facilities impact the potential establishment of desirable riparian vegetation. J.C. Boyle Dam reduces the input of gravel, sand, and silt to this reach ((PacifiCorp 2004b), Exhibit E 5-148). In addition, flow diversions and changes in the flow regime reduce the potential for scouring and sediment deposition of the limited material that is transported downstream of the dam (PacifiCorp 2004c), pp. 6-135). Further, since the streamflows, sediment supply, and bed mobility are reduced, the

extent of substrate appropriate for establishment of willows and other native riparian plants is decreased.

According to PacifiCorp analysis, the Project contributes to the lack of willows in streamside areas (PacifiCorp 2004b), Exhibit E 5-102). Riparian hardwoods typically germinate and establish on freshly deposited alluvium in channel positions low enough to provide adequate moisture but high enough to escape scour (Scott et al. 1993). The Project, however, maintains static hydrologic and geomorphic conditions that do not provide alluvium over a large portion of the area where willows have the best potential to establish.

In the upper portion of the J.C. Boyle Bypassed Reach, the river is constrained by sidecast material present in the margins of the active stream channel. This material was generated during the construction of the J.C. Boyle canal and road and continues to impact 1.5 miles of the channel. The sidecast material has constricted the channel and altered the riparian vegetation along most of the reach (PacifiCorp 2004b), Exhibit E, 5-25). Alteration of instream flows and changes in sediment regimes result in decreased bank stability and loss of riparian vegetation (Hill et al. 1991). Desirable riparian vegetation (e.g., willow) does not establish and survive in the conditions created by the boulder-sized rocks comprising the sidecast. Further, in some areas this material has entered the active channel and is causing accelerated bank erosion on the opposite bank (PacifiCorp 2004c).

9. Temperature Control Device Feasibility Study

Recommendation:

The Licensee shall contract with an independent third party (to be approved by NMFS, Service, ODFW, and CDFG) to conduct a study to determine the potential effectiveness of a Temperature Control Device for Iron Gate and Copco No. 1 Dams. The study should include an uncertainty analysis to quantify model performance for all years simulated, establish a realistic target water temperature schedule, and assess impacts of temperature control options on Iron Gate Hatchery operations. The study methodology and results shall be subject to review and approval by the Service, NMFS, CDFG, and ODFW. If the study demonstrates that the established watere temperature target is attainable, the Licensee shall construct and/or operate Temperature Control Devices at Iron Gate and/or Copco No. 1 Dams.

Justification:

Water temperatures below the Project (PacifiCorp 2004c) during summer months often exceed recommended criteria to protect salmonids (USEPA 2003). The Project exacerbates the effects of high temperatures on downstream fisheries during late summer due to the thermal lag produced by the water impoundments (PacifiCorp 2005d). This effect inhibits cooling of the river during the early fall.

Deas (2003) provided a water quality model and analysis of the potential benefits of a temperature control device indicating that modest benefits could be obtained by construction of new intake structures and choosing combinations of intake outflows to provide lower temperature releases from Iron Gate Reservoir. Although it does not appear that the optimum combination of water releases was identified by the analysis, a reduction in water temperature of 1.1 to 1.8 EC for a period of 1-1/2 months in August – September was predicted. PacifiCorp's evaluation of temperature control alternatives (PacifiCorp 2005c) concluded that temperature control options were not feasible.

However, more recent assessments have led the Service to conclude that further analyses should be carried out. First, Reclamation reviewed the above results and concluded that further analysis would be appropriate (USDI Bureau of Reclamation 2005, memo dated Sept. 27,2005,from T Vermeyen, Technical Service Center; and USDI Bureau of Reclamation 2005, memo dated October 6, 2005 ,from T Vermeyen, Technical Service Center) (attached to Service letter to C. Scott, PacifiCorp dated November 17, 2005). Additionally, the USGS has begun analyses of potential temperature control alternatives for Iron Gate and Copco No. 1 dams using their Systems Impact Assessment Model (SIAM). Preliminary results indicate that mixing flows from the upper outlet with a new lower outlet at Iron Gate Dam could result in significant cooling (2 to 3EC) throughout September, while maintaining a reduced thermocline at the end of September, allowing further cooling in October (Campbell and Heasley, pers comm.).

There are indications that even this modest cooling of water temperatures during the critical fall spawning period would benefit anadromous fish production in the Klamath River below Iron Gate Dam. Salmon Production Model (SALMOD, see Bartholow et al. 2001) simulations run by USGS showed that earlier spawning by fall Chinook salmon, with at least 2^{o}C cooling, produced more juvenile fish in the following spring than spawning at the normal time in October (Campbell, pers. comm.). Predicted emergence times averaged four weeks earlier for the early spawning scenarios than for spawning in October. SALMOD predicted larger numbers of juvenile fish spread out over longer periods of time for the early spawning scenarios. Twenty nine percent of modeled fish produced from October spawning were exposed to springtime stream temperatures greater than 10C (temperature above which disease is more prevalent), but this dropped to twelve and eight percent for progeny of adults that spawned two and three weeks earlier. The predicted number of Chinook presmolts exiting the study area was 38 percent higher for the early spawning scenarios. In addition, the average weight of migrating juveniles was predicted to be 13 percent to 22 percent greater for those fish produced from early spawning (Campbell, pers. comm.). Larger juveniles may have potentially higher survival rates when they reach the ocean as smolts.

Thus, according to these modeling results, improvement of early fall river temperatures could markedly increase production of juvenile fall Chinook. Due to the significance of potential benefits to aquatic resources, additional analysis on the practicability of temperature control devices at both Iron Gate and Copco No. 1 Dams is warranted.

Impacts:

Changes in water temperature due to reservoir impoundments are well documented (Crisp 1977; Jaske and Goebel 1967; Sylvester 1963; Wunderlich and Shiao 1984). Reservoirs reduce annual and daily fluctuations in temperature and delay the warming and cooling periods by acting as thermal sinks. The changes caused by Project reservoirs were demonstrated by Bartholow et al. (2005), who modeled the effect of hypothetical removal of the Klamath hydroelectric dams on thermal characteristics of the Klamath River. They found that dam removal would restore the timing of the river's seasonal thermal signature by shifting it approximately 18 days earlier in the year. Without dams, river temperatures would more rapidly track ambient air temperatures, and would be cooler in the late summer and fall and winter (when air temperatures are cooling) and warmer in spring (when air temperatures are warming). Both of these changes would be beneficial to salmonids, as described below.

PacifiCorp (2005, AR-2, September 2005) also modeled the expected thermal lag condition caused by reservoirs to assess temperature differences between existing conditions and hypothetical without Project conditions. Model results showed that river reaches cool and heat relatively quickly without the reservoir volumes (assuming no reservoirs). Under existing conditions, water temperatures are generally cooler in the spring and warmer in the late summer and fall than in most of the without dam alternatives. The Project dams warm water temperatures by 1 to 5 EC during the months of August through November, and cool water temperatures by 1 to 3 EC during the months of February through June (PacifiCorp 2005, Figures 1-1 through 1-5, Appendix B, AR-2).

Temperatures are critical for salmonids on the Klamath River at three times of the year. In the spring months of March through May, juvenile salmonids need temperatures above 10 to 13 EC for optimal growth (U. S. Environmental Protection Agency 2003). The Project significantly delays the onset of these temperatures in the spring (PacifiCorp 2005, Figures 1-1 through 1-5, Appendix B, AR-2), slowing salmonid juvenile growth rates. Outmigration of juvenile fall Chinook salmon normally occurs by the summer months of June and July, in part, to avoid warmer temperatures. Juvenile disease risk is elevated at 14 to 17 EC and is high at 18 to 20 EC (EPA 2003). By slowing juvenile growth rates, juvenile outmigration is likely delayed, subjecting juvenile Chinook to higher disease risk.

High water temperatures in the mainstem Klamath River during summer months are commonly cited as a cause of decline of anadromous fish runs in the Klamath River (Bartholow 1995; Campbell et al. 2001). Temperatures commonly reach levels that are lethal to salmonids, and temperatures in the mainstem Klamath River get higher with a greater frequency, and stay higher for a longer time, than waters in adjacent coastal anadromous streams (Bartholow 1995). Spring-run Chinook, steelhead, and coho over-summer in the Klamath River as juveniles, making them especially vulnerable to these higher temperatures. Salmonid juveniles have been shown to use cool water areas to survive during these warm time periods, but these areas are limited on the Klamath River (Belchik 1997; Berman and Quinn 1991; Sutton et al. 2004).

The Project dams exacerbate the effects of high water temperatures on salmonid juveniles because while they decrease maximum temperatures in June and July, they also elevate minimum temperatures at that time and slow the cooling of both daily maximum and minimum temperatures in August and September (2005, AR-2, Sept). The elevation of minimum daily temperatures in June and July is likely to impact fish by removing the effectiveness of important thermal refugial areas (National Research Council 2003). The elevation of water temperatures in August and September prolongs the exposure of juvenile salmonids to high temperatures with impaired thermal refugia, which very likely increases mortality rates. Indeed, mortality of over 240,000 juvenile Chinook salmon in the Trinity and Klamath rivers was associated with water temperatures in excess of 20 EC in June, July, and August (Williamson and Foott 1998). As stated earlier, juvenile disease risk is high at 18 to 20 EC and temperatures are lethal above 23 EC (EPA 2003).

Adult salmonids also are likely impacted by the temperature effects of Project dams. Fall-run Chinook salmon enter the river in August and September. Upstream migration appears to be delayed when temperatures equal or exceed 22 EC, at which point adult Chinook seek out and reside in thermal refuges where temperatures are much cooler (Strange 2005). Thermal tolerances for adults are similar to those for juveniles identified above (EPA 2003). Project dams contribute to elevated water temperatures in August and September. These conditions may postpone spawning migration, leading to delayed spawning and egg development. In addition, elevated water temperatures in August and September increase adult mortality by causing salmonids to hold in poor quality habitat, becoming stressed and crowded (Matthews and Berg 1997; Schreck and Li 1991). Such conditions are known to lead to outbreaks of diseases such as *Flexibacter colunmaris* (Holt et al. 1975; Wakabayashi 1991) and *Ichthyophthirius multifiliis* (Bodensteiner et al. 2000).

10. Dissolved Oxygen Enhancement Feasibility Study

Recommendation:

The Licensee's proposal to install a hypolimnetic oxygenation system at Iron Gate Reservoir shall be studied further to demonstrate downstream effectiveness and the potential for adverse effects on nutrient levels and thermal stratification. The Licensee shall also study effectiveness of a hypolimnetic oxygenation system at Copco No. 2, and J.C. Boyle Dams and the potential for adverse effects on nutrient levels and thermal stratification. These studies shall develop recommendations that will control dissolved oxygen (DO) content of reservoirs and released waters from reservoirs to meet salmonid fish requirements for the geographic extent of Project DO effect without exacerbating algal blooms or disrupting reservoir thermal stratification. As a part of these studies, the role of nutrient input and cycling shall also be studied and remedies to the problems of hypereutrophication proposed. The Licensee shall develop and submit to FERC for approval a Dissolved Oxygen Enhancement Plan (DOEP) that will plan implementation of recommendations from these studies.

These studies and DOEP shall be developed in consultation with affected Tribes, NMFS, the Service, ODFW, and CDFG. The schedule for completing the studies and DOEP shall accommodate a 30-day review period for agencies to submit comments. The Licensee shall include in the studies and DOEP all comments received during consultation with the parties identified above, and an explanation of how all comments are accommodated in the plan. The DOEP shall be submitted to FERC for approval prior to implementation. If the Licensee does not adopt agency recommendations, a rationale for why these were not included should be included in the studies and DOEP. Within three years of license issuance, the Licensee shall fully implement the DOEP.

Justification:

In the Final License Application, PacifiCorp indicated that DO levels in water releases from Iron Gate and Copco No. 2 Dams do not meet the objectives of the Water Quality Control Plan for the North Coast Region (Basin Plan) (NCRWQCB 1996) during certain periods. To mitigate for this impact, PacifiCorp is proposing to install a hypolimnetic oxygenation system that will improve dissolved oxygen levels below Iron Gate Dam (PacifiCorp 2005b; PacifiCorp 2005c). However, the effectiveness of the system and potential effects of the system were not adequately studied by PacifiCorp. The extent of the Klamath River to which benefits would occur was not analyzed. In addition, the potential for increased DO levels in the hypolimnion to alter chemistry of the lake and cause a release of nutrients require further study. Deas (2003) found that "forced reaeration slightly decreased ammonia, noticeably decreased ortho-phosphate, slightly increased algae, and significantly increased nitrate in the outflow between mid-July and Mid-October." These changes may affect other conditions including algal dynamics and impact water temperatures. The oxygenation system could also impact water temperatures in the reservoir by breaking up the stratification, which would also impact water temperatures downstream and the effectiveness of any temperature control alternatives that may be considered.

PacifiCorp decided to not install hypolimnetic oxygenation systems at Copco No. 2 and J.C. Boyle Dams. However, DO levels below these dams are impacting fish during some portions of the year. Oxygenation at Copco No. 2 should be studied and an implementation plan developed to reverse these impacts. Nutrient levels interact with other physical and chemical factors to influence DO in reservoirs, and thus should be studied and incorporated as a part of the DOEP.

Impacts:

Salmonids are adversely affected by low DO levels. Adult salmonids showed reduced swimming speeds when DO was reduced below saturation (Reiser and Bjornn 1979; Vinson and Levesque 1994), and they exhibited avoidance behavior of low DO water (Warren et al. 1973; Whitmore et al. 1960). Egg incubation and juvenile rearing is also adversely affected by DO levels that drop below 8 mg/l (Groot and Margolis 1991; Reiser and Bjornn 1979). Davis

(1975) showed that the degree of adverse effects to both adult and juvenile salmonids from reduced DO levels is a function of temperature.

The Basin Plan objective for the river below Iron Gate is a minimum of 8 mg/l DO and a 50% lower limit of 10 mg/l. During fish spawning and egg incubation periods the minimum allowable DO is 9 mg/l. Iron Gate and Copco Reservoirs are stratified in the summer with extremely low DO levels in the hypolimnion (PacifiCorp 2005, Water FTR). DO concentration of water releases from Iron Gate are well below objectives for salmon in the summer and early fall, but levels are well elevated through mixing by the time waters reach the Shasta River (PacifiCorp 2005, Water FTR). Simulated DO levels downstream of Iron Gate Dam were 2-4 mg/l less under existing conditions than under the without Project scenario (PacifiCorp 2005d). Directly downstream of Iron Gate Dam, simulated DO levels under the without Project scenario approximated the minimum level of 8 mg/l, while DO levels were significantly below 8 mg/l under the existing conditions (PacifiCorp 2005d). The next location studied downstream was the Shasta River, where impacts to DO of the Project appear to be absent. It is unknown how far DO effects of the Project extend downstream of Iron Gate Dam.

During fish spawning and egg incubation periods, the minimum allowable DO is 9 mg/l. DO levels are well below these objectives in the upper portion of the J.C. Boyle Bypassed Reach due to impairment by J.C. Boyle Reservoir (PacifiCorp 2004c) WTR). Median and minimum DO levels are particularly impacted by the Project during the summer months (see Appendix A2 of (U. S. Department of the Interior 2004), Figures 13, 14, 19, and 20). The Project reduces DO levels at the upstream end of the bypassed reach by as much as 4 to 5 mg/L during the June to August period, and occasionally causes DO levels to approach zero (PacifiCorp 2004c), 4-53). This results in an apparent violation of Oregon DO standard (described at Exhibit E 3-147).

DO is very low below Copco No. 1 and Iron Gate Dams (PacifiCorp 2005b AR-1a); therefore, fish in the Copco Bypassed Reach and within and downstream of Iron Gate Reservoir are adversely affected due to inadequate DO levels. In the FLA, PacifiCorp acknowledges that, as a consequence of normal temperature stratification of Iron Gate Reservoir, high nutrient loading, and biological processes, the hypolimnetic water is deficient in oxygen during the summer and fall. PacifiCorp is proposing to install a hypolimnetic oxygenation system that will improve DO levels below Iron Gate Dam (PacifiCorp 2005b AR-1a and (PacifiCorp 2005c AR-1b).

PacifiCorp has argued that the Project reservoirs decrease nutrient loads and algal growth in the Klamath River below Iron Gate Dam by allowing organic matter from Upper Klamath Lake to settle in the reservoirs (PacifiCorp 2005d). However, this statement is not supported by analysis. Previous studies have concluded that the reservoirs do not trap nutrients from water, and may increase water nutrient levels (Campbell 1999; U. S. Environmental Protection Agency 1978). A recent nutrient budget analysis of Copco and Iron Gate reservoirs demonstrates that both reservoirs act as a source of nitrogen and phosphorus periodically, especially during the critical period of July through September (Kann and Asarian 2005).

11. Management Plan for Keno Reservoir to Improve Water Quality

Recommendation:

Within one year of license issuance, the Licensee shall, for the conservation and development of, and mitigation of damages to, fish and wildlife resources, form and lead a regional team whose purpose shall be to study and develop a Lake Ewauna - Keno Reservoir Water Quality Plan. The Plan shall be completed in cooperation with Reclamation, the Klamath Tribes, the Service, BLM, USGS, ODFW, ODEQ, the City of Klamath Falls, and other parties who use water from this impoundment. Based on the results of this study and plan, PacifiCorp shall mitigate impacts of the Project to the extent such impacts can be determined and mitigations feasibly implemented. Possible actions to improve water quality include restoration of wetlands, treatment wetlands, mechanical aeration, and/or mechanical removal of algae.

The schedule for completing the plan shall accommodate a 30-day review period for agencies to submit comments. If the Licensee does not adopt agency recommendations a rationale for why these were not included should be included in the plan. Within two years of license issuance , the Licensee shall file the Plan with FERC for approval, with copies to the agencies consulted, and implement upon FERC approval.

Justification:

Construction and operation of PacifiCorp's Keno Dam altered the elevation, storage, and flow characteristics of Lake Euwana and the Klamath River at Keno Reef (USDI Bureau of Reclamation 2005; PacifiCorp 2004 Water FTR). The impoundment created by Keno Dam is subject to serious water quality problems, including persistent anoxia, during summer months. These conditions are hypothesized to result from large quantities of organic matter (primarily in the form of blue green algae) originating in UKL and exceeding the assimilative capacity of the Link River and Lake Ewauna / Keno Reservoir reaches, resulting in a considerable oxygen-demanding load on the system in the summer. High pH and un-ionized ammonia are also associated with the heavy transfer of blue green algae from UKL. In addition to the UKL water releases, there are municipal, industrial, and agricultural return flows to this reach. Thus, the Licensee's operations and responsibilities for impacts interact with impacts of other users, who share responsibility for water quality conditions.

Impacts:

Between October and June, water quality conditions in the Lake Ewauna/Keno Reservoir are typically within acceptable limits for native fishes, including suckers and salmonids. However, water quality in the impoundment is not within DO criteria for suckers or trout from July through September in most years (Rich Piaskowski, BOR, pers. comm). The Keno impoundment experiences widespread, persistent anoxia annually during warmer months. During most years,

the Lake Ewauna reach of the Klamath River (Link River Dam to Keno Dam) has dissolved oxygen concentrations less than 6 mg/L and temperatures greater than 20^{o}C from mid-June through mid-November (Cameron, pers. comm.). At these levels, water quality impacts migrating suckers in Lake Ewauna/Keno Reservoir from July through September (Rich Piaskowski, BOR, pers. comm). These conditions are also not within North Coast Regional Water Quality Control Board and Environmental Protection Agency criteria for migrating anadromous salmonids (NCRWQCB 1996, USEPA 2003). These impacts extend downstream during some years. As the owner and operator of Keno Dam, the Licensee is at least partially responsible for addressing the water quality impacts at Lake Ewauna/Keno Reservoir.

12. Monitoring and Evaluation

A. Fish Disease Risk Monitoring and Evaluation

Juvenile Disease Risk - The Licensee shall develop a Juvenile Fish Disease Risk Monitoring and Management Plan (JDRP) with affected Tribes, NMFS, the Service, ODFW, and CDFG. All mitigation measures will be reviewed by the Fisheries Technical Subcommitee, established by Section 10(a) recommendation 4, prior to submission to FERC. The Plan will establish methods to evaluate the contribution of the Project to the disease risk for juvenile anadromous salmonids in the Klamath River, and to remediate this impact of the Project. This may require studies to determine key factors controlling disease risk and pathogen abundance and to better understand pathogen ecology. This plan will also include mitigation steps to be taken to minimize disease risk to reintroduced anadromous species above Iron Gate Dam, to resident species, and to fish production from Iron Gate Hatchery. In addition, the plan will include studies to assess the potential role of seasonal flows and managed pulse flows in controlling habitat for the intermediate host, *Manayunkia speciosa,* of the anadromous fish parasite, *Ceratomyxa shasta*. In order to assess this issue, test freshets of varying extent could be created to determine sufficient mobilization of the bed that results in scour of the algae mats and then subsequent testing of both the polychaete and myxozoan abundance. If appropriate, the Plan will include assessment of the benefits through restoration using geomorphic processes, management of flows, and water quality to minimize disease risk

Adult Disease Risk - The Licensee shall develop an Adult Fish Disease Risk Monitoring and Management Plan (ADRP) with the affected Tribes, NMFS, the Service, ODFW, and CDFG. All mitigation measures will be reviewed by the Fisheries Technical Subcommitee, established by Section 10(a) recommendation 4, prior to submission to FERC. The Plan will establish methods to evaluate the contribution of the Project to the disease risk for adult anadromous salmonids in the Klamath River, and to remediate this impact of the Project. This will include recommendations for the management of flows and water quality to minimize disease risk.

Emergency Response Pulse Flow Plan - The Licensee shall participate with the affected Tribes, NMFS, the Service, Reclamation, ODFW, and CDFG in development of a Emergency Response Plan (ERP). All mitigation measures will be reviewed by the Fisheries Technical Subcommitee,

established by Section 10(a) recommendation 4, prior to submission to FERC. This plan would provide an analysis of the conditions under which enhanced flows from Iron Gate and Copco Reservoirs might be available and effective in prevention or remediation of a juvenile or adult fish die-off, utilizing the estimated active storage of 52,000 acre feet (AF). In the event of emergency, these flows would be provided subject to request by the fisheries agencies subject the conditions of the Plan. Adaptive Management reports would be provided by the Licensee summarizing the successes and failures of such attempts and recommendations for future enhanced flow management.

Toxic Algae Bloom Risk – The Licensee shall develop a monitoring program with affected Tribes, NMFS, the Service, ODFW, and CDFG to assess the risk of toxic cyanobacteria blooms in Iron Gate and Copco Reservoirs on fish health and the environmental factors that lead to such blooms and their adverse effects on fish. A plan shall be developed and implemented to reduce the risk of cyanobacteria blooms on fish in consultation with these Tribes and agencies.

An interagency team of fisheries experts (Klamath Fish Health Assessment Team, KFHAT) has formed to provide an emergency plan and process to respond to potential fish kill events in their early stages (Klamath Fish Health Assessment Team 2005). The KFHAT should be consulted regarding the development of the JDRP, ADRP, and ERP.

The schedule for completing the above plans shall accommodate a 30-day review period for agencies to submit comments. If the Licensee does not adopt agency recommendations, a rationale for why these were not included should be included in the plans. Within two years of the development of disease risk monitoring and plans and agency approval, the Licensee shall fully implement the Plans.

Justification: Fish disease and die-offs in the lower Klamath River downstream from the Project are a serious management concern. Fish disease among anadromous fish has increased in recent years in both adults and outmigrating juveniles in the lower Klamath River (Williamson and Foott 1998; Foott et al. 1999, 2002, 2003, Nichols and Foott 2005). Conditions created by the Project apparently favor the organisms responsible for these diseases, as described below. During the September 2002 fish die-off below River Mile 36, increased flows provided from the Project helped trigger upstream migration and alleviated additional mortality due to disease (USDI Fish and Wildlife Service 2003a; McCracken 2002).

The Applicant has not proposed any measures to increase the understanding of the possible contributions of the Project to disease and die offs in the Klamath River, or to manage to minimize disease outbreaks. The development of the JDRP, ADRP, and ERP for adult and juvenile salmonids will help ensure that agencies, Tribes, and the Applicant will explore all options for minimizing future fish die-offs and meet their management goals and objectives.

Impacts:

Outmigrating juvenile Chinook (*Oncorhynchus tshawytscha)* and steelhead (*O. mykiss*) within the Lower Klamath River Basin experience significant mortality from infectious disease, with recent estimates of disease-related mortality in downstream migrants as high as 90 percent (Foott, personal communication). The primary pathogens implicated in this mortality are the myxozoan parasites *Ceratomyxa shasta* and *Parvicapsulum minibicornis* (Williamson and Foott 1998; Foott et al. 1999; Foott et al. 2002; Foott et al. 2003). Algal buildup on substrate in the Klamath River below Iron Gate is believed to contribute to increasing habitat suitable for the polychaete worm that is the alternate host for *Ceratomyxa shasta* (Stocking and Bartholomew 2004). Increase in habitat probably provides for increased production of the polychaete, and subsequently the number of infective myxozoan spores in the water column.

The Project contributes to elevated water temperatures, which increase disease risk. Temperature was the only indicator and determinant of parasite load proposed for consideration by PacifiCorp (2005 – AR-2). However, the Project also may be increasing the amount of suitable habitat for the polychaetes, because high nutrient levels emanating from the Project, and Project-related reductions in the magnitude and extent of natural peak flows, have likely contributed to increased algal buildup downstream of the Project (McKinney et al. 1999).

The September 2002 fish die-off killed at least 33,000 adult fish, mostly Chinook salmon from infection by two pathogens (*Ichthyophthirius multifiliis* and *Flavobacterium columnare*) (USDI Fish and Wildlife Service 2003b). Impacts from the Project were not implicated in this event, but the event does illustrate the potential for catastrophic disease outbreaks among adult salmonids migrating to spawning grounds in the Klamath River. Project reservoirs result in higher water temperatures in the river in the fall (Bartholow et al. 2005) that elevate the risk of disease to adult fish downstream at least to Seiad Valley.

Our estimate of active storage for these reservoirs is different from the amount reported in the Applicant's documents, which report only the active storage that is available during normal operations. The USGS has estimated actual active storage in Copco and Iron Gate Reservoirs at approximately 52,000 ac/ft. (Campbell and Heasley, pers. comm.). They used a procedure outlined in the September 27, 2005, memo attachment to the U.S. Fish and Wildlife Service November 17, 2005, letter commenting on PacifiCorp's response to information request AR-1a, dated September 2005. A volume of 52,000 AF would provide approximately 875.4 cfs per day for a 30 day month (Campbell, pers. comm.).

Blooms of *Microcystis aeruginosa,* a blue green alga (cyanobacteria), have recently been reported in Iron Gate and Copco Reservoirs (Kann 2005). *M. aeruginosa* is a microscopic organism that is found naturally at low concentrations in lakes and streams. Occasionally, it forms a harmful bloom, a dense aggregation of cells that float on the water surface. This species forms a toxin (microcystin) that is a strong hepatotoxin, causing liver disease in fish (Carmichael 1988; Andersen et al. 1993; Sahin et al. 1995; Watanabe et al. 1996).

M. aeruginosa is commonly found in water bodies that are eutrophic and hypereutrophic (Watanabe et al. 1996). Excessive nutrients, poor water flow (stagnant conditions), and alterations of lake conditions such as land clearing, agricultural development, and water management have been associated with cyanobacteria blooms (Hallegraeff 1993; Florida Fish and Wildlife Research Institute 2005). Research on the lower Neuse River of North Carolina indicated that blooms of *M. aeruginosa* were triggered by high levels of nutrients and periods of low flows and decreased turbulence (Paerl 1987). The reservoirs of the Klamath Hydroelectric Project have created large areas with ideal conditions for the development of toxic blue green algae blooms. *M. aeruginosa* may naturally exist in small concentrations along the margins of the Klamath River, but it would likely be far less abundant if the reservoirs were restored to free-flowing river reaches. PacifiCorp states that "the risk of blue-green algae blooms in the Project area is less under the without-dams scenarios" (PacifiCorp 2005d).

B. Resident and Anadromous Fish Monitoring and Evaluation

Recommendation:

1. Resident Fish – The Licensee shall develop and implement a Resident Fish Monitoring Plan (RFMP) that meets the approval of the Service and the appropriate state wildlife agency . The RFMP shall be developed in consultation with the Service, NMFS, affected Tribes, ODFW, and CDFG. All measures will be reviewed by the Fisheries Technical Subcommitee, established by Section 10(a) recommendation 4, prior to submission to FERC. The RFMP will describe the protocol for:

A. Monitoring the distribution, population structure, and abundance of resident fish populations, including federally listed suckers, in all Project reservoirs and river reaches below Keno Dam. Monitoring will be at three-year intervals for the duration of the license. The Licensee shall use the sampling protocol in (Markle et al. (2000) and (Simon et al. (1995) for monitoring larvae, juvenile, and adult sucker populations.

B. Monitoring the number, size, and sex of spawning rainbow/redband trout in important Klamath River tributaries to the Project reach (Scotch, Camp, Jenny, Fall, Shovel, Long Prairie, and Spencer Creeks). Monitoring will be at three-year intervals for the duration of the license.

2. Anadromous Fish - The Licensee shall develop and implement an Anadromous Fish Monitoring Plan (AFMP) that meets the approval of the Service and NMFS and the appropriate state wildlife agency. All measures will be reviewed by the Fisheries Technical Subcommitee, established by Section 10(a) recommendation 4, prior to submission to FERC. The AFMP shall

be developed in consultation with the Service, NMFS, affected Tribes, ODFW, and CDFG. The AFMP will describe the protocol for:

A. Annually estimating the number, size, and sex; and determining, using a combination of PIT tag technology and analysis of returning fish marked in other ways, the timing, survival, and origin of all species of anadromous fish returning to Iron Gate Hatchery, passing upstream and downstream over Iron Gate Dam, and passing upstream and downstream at the upper end of the Project.

B. Annually estimating the spawning populations of each species of anadromous fish in mainstem reaches of the Klamath River in the Project area, as well as important Klamath River tributaries in the Project area (Scotch, Camp, Jenny, Fall, Shovel, Long Prairie, and Spencer Creeks). If deemed appropriate by the agencies, numbers coho spawners may be evaluated on other temporal schedules.

C. Estimating the numbers of juvenile outmigrant salmon originating from important Klamath River tributaries in the Project reach (Scotch, Camp, Jenny, Fall, Shovel, Long Prairie, and Spencer Creeks). This estimate will be at three-year intervals for the duration of the license.

C. Implementing any measures deemed necessary by the Service, NMFS, ODFW, CDFG, and Tribes to meet project passage goals.
D.

Justification:

The Project has blocked access to historical mainstream and tributary habitat at several locations for 45 to 85 years. Even with ladders, screens, and bypasses, Project facilities, will impact survival of resident and anadromous fish migrating within and beyond the Project. The goals and objectives of the Klamath River Fisheries Task Force (USDI Klamath River Basin Fisheries Task Force 2001), agencies, and Tribes in relicensing of the Project include the successful restoration of anadromous salmonids to their historical habitats. Fish produced at Iron Gate Hatchery will need to be distinguished from reintroduced, wild spawning fish for the purposes of managing successful reintroduction. Evaluation of passage facilities provided at Project dams will require that fish be marked so they can be identified as to their natal area. Project impacts on the survival of migrating fish must be identified and corrected.

Distribution and abundance studies of resident fish populations are necessary to assess any population trends in tributaries or in reservoirs to be able to evaluate habitat or population limitations. This information will provide the basis for ongoing protection, mitigation, and enhancement of resident fish populations.

The determination of timing and the estimation of survival of outmigrating fish (in particular, juvenile Chinook) from above Iron Gate Dam (including the upper basin) in outmigrating through the Project will require juvenile collection, PIT tagging, and downstream tracking; and the assessment of their returns as adults to the Klamath River will be used to evaluate progress towards Service management goals and objectives. Full Duplex tagging and detection technology is necessary to track small fish (≥60mm in fork length) of interest to agencies. This is particularly important for the estimation of survival of outmigrant Chinook salmon.

Assessment and monitoring of anadromous and resident fish spawning is necessary to understand the contribution of important Klamath River tributaries in the Project reach (Scotch, Camp, Jenny, Fall, Shovel, Long Prairie, and Spencer Creeks). The identification of juveniles allows returning adults (in particular adult Chinook salmon) produced above Iron Gate Dam (including areas above Upper Klamath Lake) to be identified at Iron Gate Dam during passage. This capability is necessary to assess progress towards recovery goals and implement measures to achieve these goals and objectives. It gives agencies the ability to manage the return of adults to their natal areas and evaluate the rate of adaptation to the reintroduction environment.

Recording of the timing of movements anadromous fish moving upstream and downstream is necessary to understand migration and manage Project operations and flow to minimize Project related mortality to migrating fish. Survival estimates are necessary to identify reaches where passage problems may exist and diagnose potential bottlenecks to the production of anadromous fish.

Impacts:

Coho salmon - Coho salmon, a federally listed species, have a three year peak in abundance. Assessment of recovery of the entire population is often based on how well the largest cohort performs. The Project area is believed to contain a substantial amount of spawning and rearing habitat, and utilization of this habitat should be monitored and assessed.

Federally Listed Suckers –Lost River and shortnose suckers are known to reside in the Project reservoirs (Desjardins and Markle 2000). Spawning shortnosed suckers have been observed upstream from Copco Reservoir; however, no recruitment has been attributed to these fish. J.C. Boyle Reservoir contains a sucker population with a diverse age class structure. These populations are apparently not self-sustaining, and are supported by drift of suckers from UKL over Keno Dam. However, these populations have value for eventual relocation (NRC 2003), and more information is needed as to their numbers and population structure.

Redband Trout - The Klamath mainstem in the Project reach and Jenny, Fall, Shovel, and Spencer Creeks are known to provide important habitat for rainbow/redband trout (Beyer 1984; Buchanan et al. 1990; California Department of Fish and Game 2005; Coots 1957; USDI Bureau of Land Management 2005; USDI Bureau of Land Management et al. 1995).

In 1974, a six mile reach of the Klamath River from Copco Reservoir upstream to the Oregon border was designated as Wild Trout Water by the California Department of Fish and Game (CDFG). This reach is currently managed under the California Wild Trout Program. Shovel Creek is the primary spawning tributary for the population of resident rainbow/redband trout in this reach. The lower 2.7 miles of this stream are accessible to rainbow/redband trout and it supports a healthy trout population. Angling regulations are in place to protect spawners and juvenile trout.

Spencer Creek is of particular importance to redband trout. Klamath River redband trout are of a unique stock indigenous to the river and its tributaries. Historically, redband trout rearing in the Klamath River in the Project area spawned mainly in Spencer Creek (Oregon Department of Fish and Wildlife 1997). Prior to the current passage problems at J.C. Boyle Dam (USDI Fish and Wildlife Service 2004), juveniles dispersed from this stream to rear in other reaches of the Klamath River before they returned (Fortune et al. 1966; Buchanan et al. 1990).

Anadromous Fish - Chinook salmon and/or steelhead migrated to Scotch, Camp, Jenny, Fall, Shovel, and Spencer Creeks before dams blocked access (Hamilton et al. 2005). From 1950 to 1960 (prior to the construction of Iron Gate Dam) CDFG records indicate that between 344 and 2,496 Chinook salmon returned to spawn in Fall Creek. During this same period, an estimated 25 to 400 Chinook spawned in Jenny Creek (Coots 1957; Coots 1962; Coots and Wales 1952; Wales and Coots 1954). Steelhead also spawned in Shovel Creek (Coots 1965).

Coho salmon were present in Fall Creek prior to dam construction (Coots 1957; Coots 1962). Hamilton et al. (2005) concluded this species migrated to at least Spencer Creek. Pacific lampreys were present in Fall and Spencer Creeks as well (Coots 1957; USDI Bureau of Land Management et al. 1995). There is evidence that steelhead used Long Prairie Creek (Coots 1965).

These tributaries and mainstem reaches in the Project area continue to provide suitable habitat (Beyer 1984; California Department of Fish and Game 2005; Oregon Department of Fish and Wildlife 1997; USDI Bureau of Land Management 2005; USDI Bureau of Land Management et al. 1995; Weyerhaeuser Company 1994). Comprehensive plans have been approved or proposed to manage reaches of Scotch, Camp, Fall, and Jenny Creeks (Oregon Department of Fish and Wildlife 1997; USDI Bureau of Land Management 2005), Shovel Creek (California Department of Fish and Game 2005), Spencer Creek (USDI Bureau of Land Management et al. 1995; Oregon Department of Fish and Wildlife 1997), and mainstem Klamath River in Oregon (Oregon Department of Fish and Wildlife 1997) for their continued provision of fish and aquatic habitat.

13. Aquatic Habitat Monitoring Plan

Recommendation:

Within one year of license issuance, the Licensee shall, for the conservation, and development of, and mitigation of damages to, fish and wildlife resources, complete an Aquatic Habitat Monitoring Plan (AHMP). The Licensee shall develop the AHMP in consultation with the Service, NMFS, CDFG, ODFW, BLM, and the affected Tribes. The goal of the AHMP shall be to adaptively manage the license conditions designed to restore aquatic habitat within the Project area to mitigate the continued effects of the Project on fish habitat (i.e., 10(j) conditions 6, 7, 8, 9, 10, 11, and condition 4 of Attachment A). All mitigation measures will be reviewed by the Fisheries Technical Subcommittee (FTS) prior to approval (see section 10(a) recommendation for a description of the Fisheries Technical Subcommittee). The schedule for completing the plan shall accommodate a 30-day review period for agencies to submit comments. The Licensee shall include in the Plan all comments received during consultation with the parties identified above, and an explanation of how all comments are accommodated in the Plan. The Plan shall be submitted to FERC for approval and will be implemented upon approval.

Aquatic Habitat Monitoring Plan (AHMP) – The Licensee shall, within one year after License issuance, file with the Commission for approval, an AHMP.

(a) The AHMP shall be designed to monitor how implementation of the license conditions that improve aquatic habitats within the Project reaches are effective in improving fish habitat quantity and quality for resident, migratory, and anadromous fish and to apply adaptive management, as needed.

(b) The Licensee shall report the monitoring results, and an evaluation of these results, annually to the FTS (see Attachment E). The Licensee shall coordinate with the Service, NMFS, ODFW, CDFG, and BLM, and the monitoring shall be consistent with other monitoring efforts (e.g., the RGMP).

  (1) The evaluation reports shall include at a minimum all relevant data collected and the Licensee's conclusions regarding the state of aquatic habitat (spawning, holding, feeding, juvenile rearing, riparian, and migratory.)

  (2) The report shall review the adequacy of flows for providing migration, rearing, and spawning habitat for native aquatic species; flow necessary to move spawning gravel; flow necessary to achieve riparian habitat management objectives; flow to support power generation; and flows necessary to provide opportunities for recreation.

(c) The Licensee shall develop and implement the following monitoring components of the AHMP as specified:

  (1) Habitat condition: Implement fish habitat surveys using FTS-approved protocols for monitoring effectiveness in meeting physical habitat objectives as described in the license conditions designed to restore aquatic conditions, including the RHMP and RGMP. Surveys shall include the identification of potential new spawning areas, substrate composition and particle size distribution, degree of

embeddedness, changes in aerial extent of riparian vegetation, riparian vegetation species cover. Surveys shall be conducted at five year intervals.

(2) Habitat productivity: Implement a monitoring program using protocols and methods outlined in the PacifiCorp bioenergetics report for the peaking and bypassed reaches (Addley et al. 2005). Begin two years after license issuance and repeat at five year intervals.

(3) Spawning habitat: Monitor the number, size, and sex of spawning rainbow/redband trout and anadromous salmonids (*Oncorhynchus mykiss*) in all of the Project Reaches. Monitoring of redband trout will occur at three-year intervals for the duration of the License. Monitoring of anadromous salmonids will occur annually for the duration of the License.

(4) Habitat Connectivity: Monitor native fish populations for effects of flow alteration on habitat use and connectivity between the Project reaches. This monitoring will occur at three-year intervals for the duration of the License.

(d) The following elements shall be described for all the monitoring components of the AHMP as described above [Section (b)]. The Licensee shall:

(1) Provide a description of the basis for measuring the effectiveness of resource protection, mitigation and restoration measures, and procedures to modify activities to achieve resource management objectives.

(2) Describe implementation strategies, methods, and protocols for monitoring. Describe the geographic scope, species, monitoring frequencies, and duration.

(3) Develop monitoring methods that facilitate a comparative analysis of results from previously completed studies to determine if mitigations and enhancements are effective in achieving license condition objectives.

(4) Identify a mechanism for revising monitoring strategies and methods to reflect improvement in sampling procedures and/or changes in regulations or environmental conditions.

(5) Describe how results of monitoring will be evaluated to determine what operational or structural changes are necessary to meet goals and objectives of the license conditions.

(6) Identify practices for data storage, distribution, and reporting.

(7) Provide a description of the specific monitoring activities proposed for future monitoring periods, including a schedule for completing such activities.

(8) Based on the results of monitoring and newly acquired data, apply adaptive management principles to achieve license condition objectives for riparian and aquatic habitat conditions.

Justification:

The AHMP will assist the evaluation of the effectiveness of license conditions for maintenance and restoration of aquatic and riparian resources. The AHMP includes provisions and processes for applying adaptive management principles. Quantifiable data for the habitat condition, productivity, spawning habitat, and habitat connectivity are necessary to determine effectiveness

of the proposed mitigations and to demonstrate if compliance with protection of the BLM reservation occurs.

The AHMP includes provisions and processes for applying adaptive management principles. A monitoring plan that includes an adaptive management strategy incorporates implementation, monitoring, and evaluation of results to allow the Licensee and consulting fisheries resource agencies to determine effectiveness of the Project mitigations and Conditions. Effective monitoring plans developed in coordination with the resource agencies will provide the best opportunity for achieving aquatic resource objectives in the Project area over the term of the License (Castleberry 1996).

The Required Minimum Streamflow in the J.C. Boyle and Copco 2 Bypassed Reaches, and Streamflow in the J.C. Boyle Peaking Reach are expected to produce changes in channel morphology that will mitigate for the continuing impacts under the new License. As additional minimum, peak, and variable flows are returned to the reaches, there will be alterations in the amount of available fish habitat due to changing channel configurations. Consequently, continuous monitoring, including fish abundance is required to assess changes in channel morphology and to allow for the appropriate instream flows to protect the BLM reservation. This information will be used as the basis for providing scientifically based alterations in instream flows to mitigate the impacts of Project operations.

Habitat condition, habitat production, spawning habitat, and habitat connectivity monitoring data will provide the basis for determining whether Required Minimum Streamflows are providing for the needs of fish habitat and fish populations as described in each license condition. Fish-habitat relationships generated for both bypassed and the peaking reaches reveal that Project operations have impacted substrate suitability and near shore vegetation cover. After implementation of the Required Minimum Streamflows, it is predicted that habitat will change. Fish passage provisions required under Section 18 prescriptions may result in additional species interactions, changes in fish community structure, and potential pathogen introductions. Fish habitat monitoring is needed to determine effects of Project operations and implementation of the Conditions on the resident, migratory, and anadromous fish species.

Project Impacts:

See impacts described under license conditions to improve aquatic habitats (6, 7, 8, 9, 10, 11, and condition 4 of Attachment A).

14. Riparian Habitat Management Plan (RHMP)

Within one year of license issuance, the Licensee shall, for the conservation, and development of, and mitigation of damages to, fish and wildlife resources, complete a Riparian Habitat Monitoring Plan (RHMP). The Licensee shall develop the RHMP in consultation with the Service, NMFS, CDFG, ODFW, BLM, and the affected Tribes. The goal of the RHMP shall be

to adaptively manage the license conditions designed to restore riparian habitats (6, 7, 8, 11, and condition 4 of Attachment A) within the Project area to mitigate the continued effects of the Project on fish habitat. All mitigation measures will be reviewed by the Fisheries Technical Subcommittee prior to approval (see section 10(a) recommendation for a description of the Fisheries Technical Subcommittee). The schedule for completing the plan shall accommodate a 30-day review period for agencies to submit comments. The Licensee shall include in the Plan all comments received during consultation with the parties identified above, and an explanation of how all comments are accommodated in the Plan. The Plan shall be submitted to FERC for approval and will be implemented upon approval.

Riparian Habitat Management Plan (RHMP) - The Licensee shall, within one year after license issuance, file with the Commission for approval, a RHMP.

(a) At a minimum, the RHMP shall:
    (1) Identify actions to minimize the effects of Project operations on riparian habitats, and
    (2) Identify site-specific restoration measures for riparian habitat impacted by the Project.

(b) The RHMP shall include the following objectives for BLM-administered lands as specified:
    (1) Mitigate impacts from Project facilities and/or operations by restoring degraded riparian habitats within all Project Reaches.
    (2) Conduct inventory of riparian areas as needed to develop restoration goals based on riparian ecological type and potential condition.
    (3) Identify activities necessary to restore hydrologic connectivity in the varial zone and diversity of riparian species. Mitigation should specifically:
        a. Increase riparian habitat on the low terraces in the Oregon portion of the J.C. Boyle Peaking Reach.
        b. Improve riparian condition in the J.C. Boyle Peaking Reach varial zone.
        c. Improve habitat conditions for TES plant and animal species associated with riparian, wetland or open water habitats.
        d. Reduce conditions that are conducive to the establishment of reed canary grass, yellow starthistle and other noxious weeds or invasive plant species.
    (4) Coordinate riparian habitat restoration activities with other plans for aquatic habitat, streamflow, geomorphologic processes and features, wildlife habitat, and vegetation management, including treatment of noxious weeds.
    (5) Monitor implementation of the Plan to determine whether planned actions are meeting license condition objectives; conform to accepted monitoring protocols including methods, locations, and monitoring intervals; and meet reporting requirements.
    (6) Monitor effectiveness of riparian mitigation and restoration and apply adaptive management principles to ensure RHMP objectives are accomplished.

Justification:

Mitigation and restoration of the riparian areas in the Project reaches is needed to maintain and restore aquatic and riparian resources. Since reed canary grass has invaded much of the riparian areas in these reaches (see Attachment A), management of this species through mitigation and restoration is necessary for re-establishment of desirable riparian vegetation.

According to analysis by the Nature Conservancy for the Control and Management of Reed Canary Grass in the Pacific Northwest: "…even highly infested areas can be restored to more desirable vegetation." (Tu 2004). Further, this analysis states that objectives can be accomplished in two to three years and continued monitoring and follow-up treatments for the next five to 10 years will be needed to prevent re-invasion.

The RHMP is intended to identify and implement site- specific activities to minimize Project-related impacts on riparian areas. Mitigation activities applied to the Project Reaches would reduce the impacts caused by the loss of desirable riparian vegetation and habitat due to the Project.

Implementation of the RHMP will provide for the hydrologic, geomorphic, and ecological processes needed for the establishment and survival of desirable riparian vegetation. Subsequently, fish and wildlife riparian habitat would be adequately protected.

Project Impacts:

For a discussion of Project impacts to riparian vegetation, see Attachment A.

15. Iron Gate Hatchery Operations

<u>Recommendation</u>:

a. The Licensee shall continue hatchery operations at Iron Gate Hatchery to meet hatchery target goals for fall-run Chinook, spring-run Chinook, coho and steelhead. The hatchery target goals for each species will be adjustable and developed by the Service, CDFG, ODFW, NMFS, and the Tribes, and will be approved by the Service, NMFS, and CDFG. The hatchery will provide mitigation as well as facilitate implementation of fish passage measures to restore/reconnect wild runs of anadromous and resident fish above and below the Project. The hatchery target goals will be adjusted by CDFG, NMFS, and the Service in response to ongoing impacts of the Project and implementation of the passage conditions. The above measures will be reviewed by the Fisheries Technical Subcommittee prior to approval (see section 10(a) recommendation for a description of the Fisheries Technical Subcommittee).

b. Marking of all Iron Gate hatchery (IGH) Chinook salmon releases shall be 25 percent, and marking of coho salmon releases shall be 100 percent, to develop a time series of accurate estimates of hatchery contribution and distinguish returning adult salmon that are the progeny of reintroduced fish above Iron Gate Dam.

c. Development of a Hatchery and Genetics Management Plan (HGMP) for IGH operations including, but not limited to: 1) an accurate adult census of natural salmonids; 2) the rate and contribution of hatchery strays to natural spawning stocks; 3) determining the rate of competition between hatchery and natural salmonids; 4) determining genetic characteristics of natural and hatchery coho salmon and steelhead stocks; 5) determining out-migration timing of hatchery and natural stocks; 6) maintaining Tribal trust and Resource Trustee obligations to mitigate for lost habitat; 7) developing conservation hatchery techniques; and 8) minimizing any negative effects from fish husbandry or juvenile release on native, naturally occurring populations of listed salmonids. This plan will be subject to review by the appropriate resource agencies (the Service, CDFG, NMFS, ODFW, and the Tribes). The above measures will be reviewed by the Fisheries Technical Subcommittee prior to approval (see section 10(a) recommendation for a description of the Fisheries Technical Subcommittee).

d. Fund 100 percent of hatchery operations and maintenance which are necessary to provide protection, mitigation and/or enhancement to the fishery resources impacted by the Project. This would include:

- 100 percent of any improvements to existing facilities
- 100 percent of any new construction
- 100 percent of the annual operating costs
- 100 percent of the fish marking, monitoring and recovery costs
- 100 percent of any permits and/or plans required by the State and/or Federal governments to operate existing or new facilities.

Justification:

The future role of Iron Gate Hatchery will be to compensate for ongoing and continuous impacts of irretrievable productivity lost due to the inundated Klamath River and impeded passage into historical habitats. The Iron Gate Hatchery provides a harvestable fishery. Until wild populations in the upper basin can provide sufficient, harvestable, self-sustaining runs, a hatchery program will be needed to supplement natural production in the upper basin.

The Licensee needs to fully fund mitigation for Project impacts and mark fish resulting from mitigation to ensure that agencies and Tribes can assess reintroduction efforts above the dam.

The progress towards reintroduction goals cannot be adequately assessed without being able to distinguish IGH fish from fish originating above Iron Gate Dam.

Requirements for future operation of IGH and any other hatchery facilities mitigating Project impacts should include a goal of designing future hatchery activities to complement the recovery of natural stocks in the Klamath River. To achieve this goal will require comprehensive monitoring and assessment of hatchery impacts. HGMP must also be in place that ensures that the fish used to reestablish fall-run Chinook, spring-run Chinook, steelhead, and Pacific lamprey be genetically appropriate and genetically robust. If they are not, it could impact the likelihood of success of reintroduction.

An effective and responsive mitigation hatchery program will require a substantial financial commitment. The Service considers the current license condition whereby the Licensee pays for 80 percent of IGH operations and the State of California pays for the remaining 20 percent inappropriate for a mitigation hatchery. The Licensee should bear the full cost of any measures necessary to mitigate Project impacts on fish and wildlife resources. The Service recommends that the FERC address this issue by requiring that the Licensee fund 100 percent of IGH operations and maintenance which are necessary to provide protection, mitigation and/or enhancement to the fishery resources impacted by the Project.

The lack of fish passage has prevented management agencies, the Tribes, and the Klamath River Basin Fisheries Task Force from meeting their goals and objectives. To ensure that mitigation for Project impacts is consistent with the goals and objectives of management agencies, the Tribes, and the Klamath River Basin Fisheries Task Force, the above anadromous fish hatchery mitigation of Project impacts is critical. Because of its location in the watershed and production capacity, the hatchery is also key to facilitate implementation of measures to restore wild runs of anadromous fish above the Project.

16. Adaptive Management Plan for Federally Listed Suckers

Recommendation: The Licensee shall develop a plan in consultation with ODFW and the Service to evaluate the need for a ladder built to sucker criteria at Keno Dam. During the months of February through May, or as otherwise recommended by the Service, the anadromous fish trap at that location shall be operated to gather data on the possible need for such a ladder for suckers. Data collected shall include information on species, size, sex, and estimated numbers. Regular visual examinations shall also be conducted to evaluate use of the ladder. The plan will be reviewed by the Fisheries Technical Subcommittee prior to approval (see section 10(a) recommendation for a description of the Fisheries Technical Subcommittee). The schedule for completing the plan shall accommodate a 30-day review period for agencies to submit comments. The Licensee shall include in the Plan all comments received during consultation with the parties identified above, and an explanation of how all comments are accommodated in the Plan. The plan shall be submitted to FERC for approval within one year of license issuance, and will be implemented upon approval.

Justification: The National Research Council (2003) stated that the primary value of the sucker populations in Project reservoirs was for potential reintroduction elsewhere. If the species remains listed under the ESA, a new recovery plan will probably further evaluate these populations. In section 18 prescriptions for passage at Keno, the Service reserved the right to prescribe a sucker ladder in the future at this location. This study will provide further information on management decisions regarding these populations.

Impacts: PacifiCorp (1997) found that some suckers attempted to use the current ladder at Keno Dam, but the ladder is regarded as ineffective for suckers. Current knowledge does not suggest that such passage is a priority; however, this understanding could change in the future.

17. Avian Collision and Electrocution Hazards

Recommendation: The Licensee shall, within one year of license issuance and in consultation with the Service, ODFW, BLM, and the U.S. Forest Service, complete an Avian Collision and Electrocution Hazard Avoidance Plan to ensure that adverse interactions between Project transmission and distribution lines and birds are minimized. The schedule for completing the plan shall accommodate a 30-day review period for agencies to submit comments. The Licensee shall include in the Plan all comments received during consultation with the parties identified above, and an explanation of how all comments are accommodated in the Plan. The plan shall be submitted to FERC for approval, and implemented upon approval. The plan shall include monitoring strategies sufficiently repetitive to detect sites causing mortalities. Any pole or tower involved in a bird fatality and all new or rebuilt power poles shall conform to guidelines established by (Avian Power Line Interaction Committee and USDI Fish and Wildlife Service 2005). Development and implementation of this plan shall be based upon the measures of the existing Avian Protection Plan for the Klamath Basin (PacifiCorp, Revision 4, 2005) and upon any existing Memorandum of Understanding (MOU) between the Licensee, the Service, and other agencies. Development and implementation of this plan will also include a review of existing measures to ensure that they are consistent with current management direction or guidelines. If deemed necessary by the U.S. Forest Service or BLM, a MOU specific to this Project shall be developed by the Licensee in consultation with those agencies, to be filed for Commission approval within two years from license issuance.

Justification: The bald eagle, golden eagle, osprey, prairie falcon and peregrine falcon have all been documented ((Isaacs et al. 2001; PacifiCorp 2004c), pp 5-55 through 5-60) within the Project and all are susceptible to collision or electrocution from existing transmission facilities. The Final License Application acknowledged that several poles along the transmission line south of the Copco II bypass are not raptor safe ((PacifiCorp 2004a), Executive Summary 5-5) and it is likely that other poles also impact raptor populations.

The Applicant has proposed to develop a Wildlife Resource Management Plan, including the monitoring of powerlines and retrofitting poles to decrease electrocution risk. The development

of the Avian Collision and Electrocution Hazard Avoidance Plan will more specifically augment the Applicant's Wildlife Resource Management Plan and provide more specific measures to protect and minimize mortality to all raptor species, and particularly federally listed bald eagles. These goals are consistent with those of wildlife management agencies.

Impacts: Poorly designed and constructed transmission lines and distribution lines pose a risk of collision or electrocution to many raptor species. Past surveys have probably not been sufficient to describe actual impacts. Several species that are prone to collision or electrocution hazards, including bald and golden eagles and peregrine falcons, are known to inhabit the project area (Brian Woodbridge, USFWS, pers comm.)

18. Bald Eagle Protection Measures and Management Plan

Recommendation:

Within two years of license issuance, in cooperation with the Service and the appropriate state agencies and federal land management agencies, the Applicant shall develop and implement a Bald Eagle Management Plan for the Project Area. The Plan will provide for monitoring, and for protection of bald eagle nest sites, roost sites, and regular foraging areas from human disturbance. Measures of the plan will be based on the Service's Draft Bald Eagle Management Guidelines (USDI Fish and Wildlife Service 2006) or on the successor to those Draft Guidelines, and shall incorporate local knowledge as available. The Plan shall include measures for evaluation of changes in prey base relationships. The Plan shall incorporate protections from powerline collision and electrocution as described in #17 above. The Plan shall require appropriate consultations with state and federal regulatory agencies regarding actions that might affect bald eagles.

Justification: In 2002 and 2003, ten bald eagle nest territories were identified as being adjacent to Project facilities or reservoirs (PacifiCorp 2004a). Some of these nest territories are on Project lands and would be protected by the provisions and restrictions above. Provisions also need to be made to maintain and protect bald eagle perch trees and roost trees and potential nest trees. New nest trees need to be identified and given the same protection as well known nest trees.

The Applicant has proposed to develop a Wildlife Resource Management Plan, including support of aerial bald eagle surveys and the protection of bald eagle habitat. The development of the Bald Eagle Management Plan will augment the Applicant's Wildlife Resource Management Plan and provide more specific measures to protect and minimize mortality to federally listed bald eagles. These goals are consistent with those of wildlife management agencies.

If bald eagles are removed from the federal list of threatened and endangered species (71 Federal Register 8238), protections of the Bald and Golden Eagle Protection Act will still apply to the species. These protections include prohibition of disturbance of nesting locations.

Impacts: As described in detail in USDI Fish and Wildlife Service 2006, some human activities may result in varying degrees of disturbance to bald eagles at various times of year. In some cases, such disturbance may result in nest abandonment and loss of eggs or juveniles, or abandonment of traditional foraging areas.

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