Appendix B-2

Biological Evaluation – Aquatic Vertebrates & Invertebrates

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May 2003

BIOLOGICAL EVALUATION
AQUATIC VERTEBRATES AND INVERTEBRATES

Pit 3, 4, and 5 Hydroelectric Project
(FERC No. 233-081)

U.S. Forest Service
Shasta-Trinity and Lassen National Forests
May 2003

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SUMMARY

Pacific Gas and Electric Company has submitted an application to the Federal Energy Regulatory Commission to relicense the Pit 3, 4, and 5 Hydroelectric Project (FERC No. 233-081, Project) situated along the Pit River in northeastern Shasta County, California.

The Forest Service has submitted preliminary 4(e) license conditions that move the aquatic habitat in the Pit River Project bypass reaches toward a more natural range of variability. Preliminary flow-related conditions (Conditional flows) are referred to in this document due to the lack of receipt of all the aquatic research work done in 2002 regarding the flows. The effects of the proposed relicensing to Forest Service Sensitive listed aquatic species are evaluated in this Biological Evaluation in the context of the preliminary license conditions.

Hardhead fish (*Mylopharodon conocephalus)* occur in Project bypass river reaches and are an important food source for local bald eagles. Increasing the Pit 3 Project bypass reach discharge from the current 150 cubic feet per second (cfs) to the Conditional 400 cfs will provide for increased hardhead population and biomass production. Aquatic studies referred to in this BE, performed in the Project area, span 18 years. They have consistently indicated that adult hardhead habitat will increase substantially. Hardhead fry and juvenile habitat should remain near or above existing levels. Introduction of spawning gravel will create additional hardhead spawning sites. A slight warming of the water temperature in the Pit 3 bypass reach will bring the ambient water temperature closer to cited optimal hardhead habitat conditions.

Adult hardhead habitat will increase significantly in the Pit 4 bypass river reach as well when the present Project flow release increases from 150 cfs to 450 cfs. Fry and juvenile hardhead habitat will likely provide for sufficient production to fully saturate the increased adult hardhead habitat, based on the results of the various studies.

The following aquatic mollusks are listed as Forest Service Sensitive, and either do occur or have the potential to occur in the Project bypass reaches and/or reservoirs: the California floater mussel (*Anodonta californiensis*), the Great Basin rams-horn snail (*Helisoma newberryi newberryi*), the topaz juga snail (*Juga (Calibasis) acutifilosa*), the scalloped juga snail (*Juga (Calibasis*) occata, and the montane peaclam (*Pisidium (Cyclocalyz) ultramantanium*). They are all, except for the California floater, either 'crenophiles' (preferring spring habitats) or 'crenocoles' (occurring only in springs). The habitat requirements for all of these mollusks are quite specialized and their tolerance to significant disturbance is very limited. Implementation of the increased Conditional flows will require physical adjustments by individual mollusks. Overall habitat conditions for these mollusks should improve with the Conditional release flows, however. Additional habitat may either be made accessible or created.

Research literature concludes that construction of Project facilities has seriously impacted these various aquatic mollusk species. Beneficial results will likely occur when Conditional release flows are increased toward the levels that these organisms evolved with and adapted to in the Pit River, along with the Conditional flow shaping that promotes a more natural range of variability.

Foothill yellow-legged frogs (FHYLF) (*Rana boylii*) are known to occur within the Pit 4 reach and have been seen at one location within the Pit 5 reach, approximately one mile below the Pit 5 dam. Foothill yellow-legged frogs are only known to breed within the Pit 4 reach. Three breeding sites have been located upstream of, or in the vicinity of Deep Creek: Bedrock Tadpole site (RK 42.7), Upper Deep Creek (RK 41.45) and Lower Deep Creek (RK 40.75). Egg masses were only identified at the latter two Deep Creek sites. This species inhabits shallow water at the margins of rivers and streams in California and Oregon and are generally found in association with low gradient stream riffles that have rocky substrates and partly shaded banks. This frog generally lays eggs on the downstream side of non-vegetated cobbles and boulders in areas of lower than ambient flow velocities. Sites are often near confluences of tributaries and located in wide, shallow reaches where changes in flow would result in less change in the breeding microsite. This species has experienced declines in recent years and is a California Species of Special Concern, a Forest Service Sensitive species and a candidate for Federal listing, as a result.

Research literature also links declines in this species with modification of riverine systems, introduction of bullfrogs, signal crayfish and other exotic aquatic predators. Dams and other water diversion projects have resulted in changes in sediment and flow regime, which, in turn, cause geomorphic changes to the aquatic system and declines in sensitive aquatic species such as the foothill yellow-legged frog.

EFFECTS DETERMINATION

It is my determination that the Project, as proposed and including the preliminary Forest Service 4(e) license conditions, may affect individuals, but is not likely to result in a trend toward Federal listing or loss of viability for the hardhead, California floater, Great Basin rams-horn, the topaz juga, the scalloped juga, the montane peaclam and the foothill yellow-legged frog. Beneficial effects are expected for the foothill yellow-legged frog over the long term.

I. INTRODUCTION

U.S. Forest Service (Forest Service) Sensitive Species are defined in the Forest Service Manual (FSM), amended June 23, 1995 as 'those plant and animal species identified by a Regional Forester for which population viability is a concern, as evidenced by significant current or predicted downward trends in population numbers or density, or habitat capability that would reduce a species existing distribution'.

The Pacific Gas and Electric Company has submitted an application to the Federal Energy Regulatory Commission for a new license for its Pit 3, 4, 5 Hydroelectric Project (FERC No. 233-081) located in the Pit River Basin in Shasta County, California. The application constitutes the proposed action.

The intent of this Biological Evaluation (BE) is to satisfy the following objectives of FSM 2670.22 regarding Sensitive Species in the context of the proposed action: 1. Develop and implement management practices to ensure that species do not become threatened or endangered because of Forest Service actions; 2. Maintain viable populations of all native and desired nonnative wildlife, fish and plant species in habitats distributed throughout their geographic range on National Forest System lands; and 3. Develop and implement management objectives for populations and/or habitat of sensitive species. Policy is established elsewhere in the FSM 2670.32 to 'Avoid or minimize impacts to species whose viability has been identified as a concern'. This BE is prepared in accordance with implementing regulations [19 U.S.C. 1536 (c), 50 CFR 402.12 (f) and 402.14 (c)].

This BE will address the following aquatic organisms listed on the Regional Forester's Sensitive Species list for Region 5, dated June 8, 1998, amended May 7, 2003 that either do or could occur in the project area: the California floater mussel (*Anodonta californiensis*), the Great Basin rams-horn snail (*Helisoma newberryi newberryi*), the topaz juga snail (*Juga (Calibasis) acutifilosa*), the scalloped juga snail (*Juga (Calibasis) occota*), the montane peaclam (*Pisidium (Cyclocalyz) ultramontanium*), the foothill yellow-legged frog (*Rana boylii*) and the hardhead fish (*Mylopharodon conocephalus*). The proposed action will be reviewed to determine potential effects on these Sensitive Species.

The proposed action is tempered by preliminary license conditions submitted by the Forest Service because the existing project occupies Forest Service land. The Forest Service has authority to impose these conditions under Section 4(e) of the Federal Power Act. Effects to the Sensitive Species covered in this BE will be discussed in response to the proposed action accompanied by the relevant preliminary 4(e) license conditions.

II. CURRENT MANAGEMENT DIRECTION

Current Forest Service management direction regarding Sensitive Species can be found in the following documents:

* Forest Service Manual and Handbooks (FSM/H 2670)
* National Forest Management Act (NFMA)
* National Environmental Policy Act (NEPA)
* Lassen National Forest Land and Resource Management Plan (1992), as amended in 1994.
* Shasta-Trinity National Forest Land and Resource Management Plan (1995).

The project occurs on federally owned lands also managed under the Northwest Forest Plan Record of Decision (NFP ROD). Central to the NFP ROD is the Aquatic Conservation Strategy (ACS) that a) seeks to prevent further degradation of aquatic ecosystem health and watersheds while restoring such integrity, and b) maintains natural disturbance regimes. It is incumbent upon the Forest Service to review the proposed action in light of the nine ACS objectives, bring the proposed action up to current environmental standards, and move the existing project towards consistency with the NFP ROD.

Where the desired and existing resource conditions are not the same, the objective is to move the resources towards their desired condition. The preliminarily prescribed 4(e) license conditions attempt to move the existing project and associated ACS objectives closer to their natural range of variability.

General Forest Service direction for Sensitive Species is summarized below:

- As part of the NEPA process, review programs and activities, through a biological evaluation, to determine effect on sensitive species.

- Avoid or minimize impacts to species whose viability has been identified as a concern.

- If impacts cannot be avoided, analyze the significance of potential adverse effects on the population or its habitat with the area of concern and on the species as a whole.

- Establish management objectives in cooperation with the States when a project on National Forest System lands may have a significant effect on sensitive species population numbers or distribution.

III. DESCRIPTION OF THE PROPOSED ACTION

The Pacific Gas and Electric Company (PG&E) has applied for a new license for its existing Pit 3, 4, 5 325-megawatt Hydroelectric Project (FERC No. 233-081, Project) located along a 30 mile reach of the Pit River Basin in Shasta County, California. The Federal Energy Regulatory Commission (Commission; FERC) is authorized to issue licenses for up to 50 years based partly '…. for the adequate protection, mitigation, and enhancement of fish and wildlife (including related spawning grounds and habitat)…' (FERC, DEIS 2003). The project occupies 746 acres of federally owned lands administered by the Lassen and Shasta-Trinity National Forests (Forests).

The Project is comprised of three facilities: the Pit 3, 4 and 5 powerhouses and their accompanying hydraulically connected developments, including four dams, four reservoirs, associated tunnels, surge chambers and penstocks. Timeframes for initial Project construction-to-completion extend from 1923 to 1956.

Much greater detail about the proposed action can be found in the Draft Environmental Impact Statement (FERC, DEIS 2003) and the License Application (2001).

Proposed Environmental Measures

Section 4(e) of the Federal Power Act allows the Commission to issue licenses for hydropower projects on Federal lands provided the project will not be inconsistent with the purposes for which the Federal reservation was created.

The proposed action will be reviewed in the context of the preliminary 4(e) conditions submitted to the Commission by the Forest Service in October 2002. License condition numbers will be omitted due to revisions that are still occurring. The specific 4(e) license conditions that affect aquatic resources will be summarized here.

Preliminary condition to establish a flow regime for affected National Forest System Lands (NFSL). Maintain minimum streamflows in the Pit River of 400 cubic feet per second (cfs) in the Pit 3 Project bypass reach and 450 cfs in the Pit 4 Project bypass reach with provisions for flow shaping.

Preliminary condition directing the licensee to develop an analysis and, after obtaining Forest Service approval and after filing with the Commission, describe how to operate the Project to minimize impacts to the recession limb of natural spills into the Pit 3 and Pit 4 Project bypass reaches. Regulate the up and down ramping rates of emergency or planned maintenance outages to minimize adverse ecological effects of unnaturally rapid flow and stage fluctuation.

Preliminary condition prescribing a spring season freshet flow of 1,500 cfs for two days in the Pit 3 and Pit 4 Project bypass reaches to benefit aquatic habitat in each year that such a flow does not naturally occur by March 1. This will occur after obtaining consent from the Forest Service and after filing such a plan with the Commission.

The final component of this preliminary condition is to develop and implement an Adaptive Management Plan, approved by the Forest Service, for peak flow management to reduce large flow fluctuations. The purpose is to extend the duration of spring peak flows in order to minimize effects on aquatic biota and allow biota access to the floodplains to complete life history processes.

A preliminary condition has been submitted to develop a gravel supply augmentation and large woody debris management plan.

A preliminary condition has been submitted to develop a water quality plan as it relates to Forest Service aquatic habitat.

A preliminary condition has been submitted to envelope the following studies, among many others, into a comprehensive Land and Habitat Management Plan for Mitigating Project Effects to NFSL: develop a fish population and condition trend-monitoring plan outlining sampling to be conducted in the Pit 3 and Pit 4 bypass reaches and reservoirs. Monitor benthic macroinvertebrate populations in the Pit 3 and Pit 4 bypass reaches. Develop an amphibian monitoring protocol to monitor changes in foothill yellow-legged frog use of the Pit 4 reach, as well as distribution or presence of Cascades Frogs and/or foothill yellow-legged frogs in the Pit 3 reach. Implement activities to remove or expedite removal of riparian vegetation that may eventually die off from inundation at base flows to improve breeding habitat conditions for FHYLF.

IV. DESCRIPTION OF AFFECTED SENSITIVE SPECIES

Fish

Hardhead (*Mylopharadon conocephalus*). The hardhead is a physically large representative of the cyprinid 'minnow' family, occasionally growing up to 60cm in length. It frequently associates with the Sacramento pikeminnow (*Ptychocheilus grandis,* with which it is closely related) and the Sacramento sucker (*Catostomus occidentalis).* Unlike the latter two species, the hardhead is more sensitive to the watershed developments that have occurred during the past 150 years in California. They also respond adversely to river and reservoir systems having ecosystems established with introduced fish, particularly Centrarchid (bass) species (Moyle 2002).

The Pacific Southwest Region of the Forest Service designated the hardhead as a Sensitive Species in 1998. The California State Department of Fish and Game has designated the hardhead as a 'Fish Species of Special Concern' in 1995. These designations reflect the sensitivity of the species to disturbances affecting the larger

middle-to-lower elevation river systems in which they are found. Relatively undisturbed reaches of such rivers are their preferred habitat, along with reservoirs.

Pit River hardhead delimit the northern edge of their geographic distribution. Besides preferring river reaches that are generally undisturbed, they are normally distributed in reaches where water temperatures in the warmer summer season reach or exceed 20 degrees C. Optimal temperatures may actually range from 24-28 degrees C (Moyle 2002). Their tendency to reside near the surface of reservoirs may relate to their apparent intolerance of lower oxygen levels normally associated with warmer water, however. This behavior has been observed in Britton and other Project reservoirs, which could partially explain the noted success of local bald eagle feeding on hardhead (PG&E 2001). Hardhead appear to be the second most important prey item for Project area bald eagles (PG&E 2001).

Riverine resident adult hardhead prefer deep pools and runs of relatively clear water with velocities of 40 cm/sec or less. Substrate preferences range from sand up to boulders (Moyle 2002). They are truly omnivorous, focusing on benthic aquatic invertebrates as juveniles. Adults expand their diet to include filamentous algae, crayfish and other larger invertebrates, as well as plankton and water surface insects (Moyle 2002, Moyle et. al 1995). Adults generally reside in the lower half of the stream water column wherever they choose to establish residency (Moyle 2002). This was confirmed during recent snorkel sampling (R2 2003). Sampling elsewhere has indicated that adults are on average 10 years old when 45 cm in length (Moyle 2002). Hardhead collected in the Pit River generally did not exceed approximately 40 cm (PG&E 2001, Stillwater Env. Services 2002).

Despite hardhead sensitivity to disturbance, river systems comprised of rather remote hydroelectric project reaches, such as the Project complex on the Pit River, often contain robust hardhead populations as a component of the hardhead/sucker/pikeminnow ‘guild’ (Moyle 2002).

This fact has been confirmed by recent sampling on Project waters. Hardhead were the second most abundant fish species sampled in the Pit 3 bypass reach in terms of biomass, second only to rainbow trout (FERC, DEIS 2003). They comprised the greatest biomass of any fish species captured in the Pit 3 bypass reach in June and July 2002 via electro-fishing and gill netting in pool habitat (Stillwater Env. Services 2002). Such significant hardhead biomass values in the Pit 3 bypass reach may appear surprising considering the average sampled temperatures in the reach do not exceed 19 degrees C in any summer month (PG&E 2001). In fact, Pit 3 bypass reach water temperatures ranged from 15.3-16.7 deg. C during the sampling in June and July 2002 (Stillwater Env. Services 2002).

It was originally anticipated that hardhead could be adversely affected in the Pit 3 bypass reach when initial flow releases began in 1987 from the relatively cold, lower elevation of Britton Reservoir (PG&E 2001). This response did not occur. Perhaps hardhead native to the naturally spring-fed Pit River, occurring in the northernmost area of the species geographic distribution, can thrive in river reaches having summer water

temperatures somewhat cooler than the 20 degrees C cited in literature as a minimum threshold for optimum habitat.

The hardhead biomass values were nearly identical in the Pit 4 bypass reach as those estimated in the Pit 3 Bypass reach, and were a close second to Sacramento sucker (FERC, DEIS 2003). Hardhead dominated Pit 4 snorkel results in terms of number of individuals seen (51%; Stillwater Env. Services 2002).

There is clear evidence of local hardhead shunning waters dominated by introduced fish species, particularly centrarchids, on Britton Reservoir. The hardhead observed in Britton Reservoir are generally located in the 'upriver' half of the water body where the water flows in a more riverine manner, and few bass are found (PG&E 2001). The more typically lacustrine lower half of the reservoir, dominated by bass, are generally free of hardhead (PG&E 2001). In general, it appears that hardhead can maintain their population levels only in systems where the native fish fauna comprise 90% or more of the total fish population, and bass are absent (Brown and Moyle 1993, as cited by Moyle et. al 1995).

Hardhead early life history stages are still poorly known. Eggs may require two years to develop inside the adult female prior to release (Moyle 2002). Adults congregate prior to spawning in riffles, runs or 'pool heads' and likely deposit eggs onto a gravel substrate similar to their 'guild-partnering' Sacramento pikeminnow. A single female may release up to 24,000 eggs (Moyle 2002). The most common months for spawning likely occur in April, May and June (Moyle 2002). It is plausible that Pit River hardhead spawn in the latter half of the typical time period considering the naturally cooler temperatures found in Pit River bypass reaches compared to optimum temperatures cited in literature.

Newly hatched larval/post larval hardhead fry require shallow edge water with slow water velocity. Dense vegetative cover may also be required (Moyle 2002). No individual larval or post-larval hardhead were seen or collected during sampling in the Pit 3 bypass reach in 2002, where Sacramento pikeminnow and Sacramento sucker larvae were collected (Stillwater Env. Services 2002). The adult hardhead biomass is relatively large in the Pit 3 bypass reach, however, so the larval hardhead were likely either actually present or would have been present at another time period.

When hardhead fry grow to juvenile size of around 2 cm, they tend to migrate into areas with substrates of cobbles and small boulders. Larger juveniles can then select habitats typical of adult hardhead with water velocities of 30 cm or less until achieving full adult size (Moyle 2002). There have been recent observations in Project bypass reaches of individual hardhead representing a series of life stages stacked vertically in one location, with the adults residing near the river bottom (R2 2003).

Description and Analysis of the Effects to Hardhead of the Proposed Action with Implementation of Preliminary 4(e) License Conditions

The mapping exercises conducted in select reaches of the Pit 3 and 4 bypass channels in August 2002 condensed five different water depth and velocity ecosystem guilds down to three once the mapping began. The modification was needed to allow for completion of the sample reach mapping during the relatively short timeframes that various elevated discharges occurred in (R2 2003).

A possible drawback to the otherwise logical decision to decrease the five guilds to three is that hardhead adult habitat may no longer cleanly fit into any one of the remaining three guilds. For example, the original habitat suitability guilds labeled 'medium/medium' and 'deep/medium' were abolished and replaced by a 'juvenile trout' guild that partially combines the previous two. Adult hardhead preferences include a portion of the now expanded 'deep/slow' and 'deep/fast' guilds. Deep/fast velocities begin at 0.8 feet per second; adult hardhead reside in flows up to 1.3 feet per second (R2 2003, Moyle 2002).

A critical conclusion is found in the Discussion section of the report by R2 (2003) affecting hardhead (and other fish species) in the Pit 3 and Pit 4 bypass reaches: "The microhabitat mapping results indicate that habitat is available for each guild at all flows, and that it responds to changes in flows by shifting location…. Shallow/slow and juvenile microhabitat areas generally do not vary as much with flow. There was greater variety and dispersion of the four microhabitats when flows were at 400 cfs and below than at 600 cfs and above."

Pit 3 Bypass Reach.

A preliminary 4(e) license condition has been submitted that initially increases the minimum base flow discharge into the Pit 3 Project bypass reach from the current 150 cubic feet per second (cfs) to 400 cfs year-round. Seasonal and water-year-type variations will be developed within one year of license issuance to shape releases between a range of 300 cfs and 1,000 cfs.

Instream Flow Incremental Methodology (IFIM) procedures, now referred to as '1D', were employed in 1984 to estimate the extent of fish habitat for various fish species at selected minimum flow releases on sampling sites of the Pit River Project bypass reaches (PG&E 2001, FERC, DEIS 2003). Hardhead adult and combined fry/juvenile habitat measurements were part of the study.

The Weighted Usable Area (WUA) estimates for hardhead adult, calculated as square feet per 1,000 linear feet of river, increased by about 70%, from approximately 4,250 square feet to 7,250 square feet when comparing 150 cfs to 400 cfs discharges (PG&E 2001; FERC, DEIS 2003). The estimation that the increase in hardhead adult habitat increase is beginning to 'flatten' at approximately 400 cfs provides a compelling argument for the preliminary conditional flow being very 'cost/species beneficial' in a generic sense.

This is a very significant discovery because the size of the hardhead population responsive to Pit 3 bypass reach minimum flow releases is likely determined by usable habitat area for adult hardhead fish. The adults can live up to 10 years or longer, and egg production per individual female can reach 24,000 eggs (Moyle 2002). This prolific reproductive strategy indicates that suitable habitat for the hardhead adult lifestage likely determines carrying capacity in a given reach of river, assuming other hardhead lifestage habitat and environmental parameters are conducive for survival.

Hardhead larval fry require river edge habitat with generally shallow depths and comparatively slow water velocities. The WUA estimated in 1984 for hardhead fry and juveniles also increased by about 40% when comparing 150 cfs to 400 cfs, from approximately 7,250 square feet to 10,250 square feet (PG&E 2001).

There is every indication based on the sampling conducted in 1984 that significantly larger hardhead populations would thrive in the environment of the conditional release flows. As stated by FERC in the DEIS (2003): "Increasing minimum flows in the Pit 3 reach to the range of flows recommended by…. the FS (400 cfs) would increase the amount of physical habitat (WUA) available to… all lifestages of hardhead".

A reanalysis of these sites was conducted recently because the 'Physical Habitat Simulation System' hydraulic modeling techniques have changed since completion of the 1984 studies. These results were made available after the DEIS (FERC 2003) was distributed so conclusions based on this recent work is not summarized in the DEIS.

One site labeled 'Lower Pool 52.6' (situated in a pool upstream from the Pit 3 Power House) revealed an increase in adult hardhead 'WUA' habitat of approximately 50% when the flow increased from 150 cfs to 400 cfs (from just under 40,000 square feet per 1000 linear feet, to about 62,500 square feet). Estimated hardhead fry/juvenile habitat measurably decreased at the same two flows from 14,750 square feet down to 8,850 square feet. Total 'WUA' increased, however, from 54,400 square feet to 71,250 square feet. This measurement could be the most meaningful of all, if the division between fry/juvenile and adult hardhead habitat in the study does not precisely represent what occurs ecologically in the river. Another significant result is the greater to much greater total area of both adult and fry/juvenile hardhead habitat estimated in the reanalysis vs. the 1984 sampling.

Another sampling site is labeled 'Lower Riffle/Run' and is located near Weir Creek. Adult hardhead WUA habitat was estimated to have increased slightly when comparing 150 cfs to 400 cfs: 2,450 square feet, up to 2,800 square feet. Fry/juvenile hardhead habitat, unlike the Lower Pool 52.6 sampling site, revealed a dramatic <u>increase</u> when moving from 150 cfs to 400 cfs: roughly 10,500 square feet up to 18,500 square feet. Total 'WUA' was estimated to have increased from 12,800 square feet to 21,300 square feet. The hardhead habitat area estimations for all flows in the reanalysis were literally 'orders of magnitude' greater than the area estimates derived in 1984 for the same locations.

Another site was labeled ‘Upper Pool 57’ and was located near Rock Creek. Adult hardhead WUA estimates increased by about 50%, from 26,500 square feet to 39,500 square feet, when the discharge increased from 150 cfs to 400 cfs. Fry/juvenile hardhead habitat also increased slightly at the two flows, from 28,000 square feet to 30,200 square feet. Total ‘WUA’ increased from 54,550 to 69,800 square feet. A comparison with the 1984 work indicates a ‘more-than-doubling’ of adult hardhead habitat upon the reanalysis. The 1984 fry/juvenile hardhead habitat estimates are similar to slightly greater than the values generated by the reanalysis, however.

The remaining Pit 3 bypass reach sample is at a location labeled ‘Pit 3 Upper Riffle/Run’ and was situated near Delucci Ridge. Here, the adult hardhead habitat more than doubled, from 2,600 to 5,700 square feet, while the fry/juvenile hardhead habitat increased from 9,300 to 12,500 square feet when the flow increased to 400 cfs. Total ‘WUA’ estimates increased from 11,900 square feet to 18,250 square feet. All habitat area estimates increased with the reanalysis compared to the work done in 1984.

Approximately 400 cfs were released into the Pit 3 reach on August 6-7, 2002 to allow for mapping exercises and snorkel observations. The resulting measured area for the guild habitat type of ‘shallow/slow’, best accommodating hardhead larval and post-larval fry, decreases at the two Pit 3 bypass reach sampling sites when the flow increases from 150 cfs to 400 cfs. The estimated reduction in area is from approximately 18,000 square feet at 150 cfs, to 10,000 square feet per 1,000 linear feet of river at the 400 cfs flow at the Delucci sampling site. The decrease is from approximately 4,500 square feet down to 2,500 square feet per 1000 linear feet of river at Weir Creek for the same two approximate discharges (R2 2003).

Snorkel observations were done to confirm assumptions of the mapping exercises. Results indicated that hardhead fry appeared to successfully utilize a broader microhabitat range than the criteria initially developed from literature (R2 2003). R2 (2003) also noted that ‘Most shallow/slow habitat tracks the water’s edge with increasing discharge in all sites’. This general habitat observation is likely conducive to hardhead fry survival and may explain the estimated increase in habitat for this lifestage when comparing the IFIM work done in 1984.

The ‘deep/slow’ habitat guild accommodates hardhead adults as well as some fry and juveniles. The ‘deep/slow’ and the slower portion of the ‘deep/fast’ habitat types mapped in 2002 typify preferred hardhead adult habitats. Deep/slow habitat decreases slightly from approximately 31,000 square feet per linear 1000 feet of river at 150 cfs, down to approximately 28,000 square feet at 450 cfs at Delucci (R2 2003).

The ‘deep/slow’ guild also decreases at Weir Creek from about 20,000 square feet per 1000 linear feet down to about 15,000 square feet when comparing the smaller to the greater flow discharges, respectively. Despite these two specific sample site decreases, the deep/slow habitat generally persisted at comparable levels throughout the range of release flows, frequently located around pool margins that are inhabited by hardhead (R2 2002).

The deep/fast guild decreases similarly as the 'deep/slow' guild at Delucci, but then increases rather dramatically above 400 cfs (R2 2003). The habitat guild increases from about 32,000 square feet to 40,000 square feet per 1000 linear feet at Weir Creek. The deep/fast guild is 'well represented spatially in the Pit River, reflecting the size and gradient of the channel' (R2 2003). In this context, the total area of deep/fast habitat per 1000 linear feet of river usually comprises a relatively large surface area of many of the sampled stream reaches (example, Weir Creek).

The estimated hardhead larval/post larval fry WUA habitat increased as per the 1984 IFIM work. The possibility that a minor decrease to hardhead larval/post-larval fry habitat may occur with discharge of 400 cfs, based on the sampling conducted in 2002 alone (R2 2002), cannot be dismissed. If this habitat were to decrease somewhat for the entire Pit 3 bypass reach after implementation of the preliminary flow condition (even after accepting the observation that hardhead fry use a somewhat broader habitat guild than originally thought), then the same conclusion should be drawn for hardhead that was drawn by FERC (2003) for trout: "Although WUA (weighted usable area) available to fry and juvenile trout (in the Pit 4 reach) would decrease by about 10 percent, the amount of habitat available to these earlier life stages should still be adequate to support recruitment to the adult lifestage". Based on the prolific egg production capabilities of adult female hardhead along with their lifespan, this species could conceivably experience a decrease in fry production of more than 10% and still fully seed the available adult habitat.

The measurable decrease in shallow/slow habitat at the two Pit 3 sampling sites is likely due to particular inherent characteristics of those sampling sites. Wider cross-sectional areas tend to provide the most shallow/slow habitat (R2 2003). This shallow/slow guild didn't shift in locations and expand to different areas of the Delucci sample reach until flow exceeded 400 cfs. The Weir Creek sampling site was even more confined than Delucci, so shallow/slow habitat decreased up to a discharge of 800 cfs.

It is also possible that the two chosen sampling reaches did not cleanly represent the 'average reach' of the Pit 3 bypass section regarding the shallow/slow habitat (see discussion under Pit 4 reach, below). On the other hand, the shallow/slow habitat guild comprised the smallest relative area of all the guilds when combining all the sampled reaches throughout the Project area (R2 2003).

An additional predicted environmental change when Pit 3 bypass reach flows increase to 400 cfs is also conducive for hardhead survival. As stated by FERC in the DEIS: "The results of temperature modeling reported in the license application indicate that increasing minimum flow releases would tend to increase summer water temperatures in the Pit 3 reach…". Field observation elsewhere in California has determined that hardhead appear to thrive in riverine waters that reach summer temperatures of at least 20 degrees C. Laboratory studies indicate that hardhead may actually consider water temperatures of 24-28 degrees C as optimal (Moyle 2002). The expected increase in water temperature with discharges of 400 cfs would move the average summer water

temperature closer to the 20 degrees C threshold that best accommodates hardhead elsewhere in California.

A seasonal and water-year-type flow-shaping model is to be developed and proposed within one year of license issuance as per the preliminary flow-related license condition. The outcome of this will not likely adversely affect any hardhead lifestage. The model must be developed cooperatively with the Forest Service and the other Federal and California State resource agencies. The Forest Service must approve the model proposal. The cooperating entities and the Forest Service will ensure that the final flow-shaping model will create no harm to listed or other important fish and aquatic organisms of the Pit River.

The preliminary flow-related condition requires that a freshet flow be released in March if after March 1 in any given year, a naturally occurring flow of at least 1,500 cfs has not yet occurred in either the Pit 3 or Pit 4 bypass reaches. The peak of 1,500 cfs would begin within two days of the ramping up toward the peak. The results from such a flow release should not adversely affect spawning behavior, eggs, larval or post-larval hardhead fry because there is no evidence that such behavior or occurrence of these life stages begins in March in the Pit River. This conclusion is partially due to the slightly cooler ambient water temperature in the Pit River Project bypass reaches compared to the hardhead preferences cited in literature. Pit River hardhead also occur at the northern extent of the species range, which may also imply that spawning and larval hardhead rearing begins no earlier than April in the Pit River, perhaps even later.

A preliminary 4(e) license condition has been submitted that mandates that a gravel augmentation program be initially studied for the Pit 3 bypass reach with an eye toward implementation. The Federal Power Act specifically identifies spawning gravel as one of the considerations for which FERC is required to issue new licenses (see Introduction). R2 (2003) states the following: "It was concluded that R2 field crews would simply note if distinct spawning gravel patches were observed during habitat mapping (***none were noted, so this is not discussed further in this document)"*** (emphasis added).

This preliminary license condition will likely improve overall hardhead fish production regarding the early life stages. For example, despite hardhead spawning behavior not being readily known, adults apparently utilize gravel substrate for depositing their eggs (Moyle 2002). The R2 field crews did not incidentally note distinct spawning gravel patches in 2002. Additional gravel may therefore promote more larval and post-larval hardhead fry, which could then more rapidly saturate the carrying capacity of newly created adult hardhead habitat. Benefits of gravel augmentation will likely include greater aquatic insect production as well.

Pit 4 Bypass Reach

The preliminary 4(e) flow-related license condition requires that the current base annual discharge increase from 150 cfs to 450 cfs in the Pit 4 bypass reach. Similarly to the circumstance of the Pit 3 bypass reach, a seasonal and water-year-type flow-shaping model will be jointly developed among the licensee, the Forest Service, and the other participating natural resource entities and agencies.

The effects of various flow releases to fish habitat in the Pit 4 bypass reach were investigated by the licensee in 1984. Similarly to the results obtained for the Pit 3 bypass reach, adult hardhead habitat increased steadily from the existing 150 cfs flow release to the Conditional flow release of 450 cfs. The increase was approximately 50%. Unlike the 1984 results for hardhead fry/juvenile habitat in the Pit 3 bypass reach, the estimated area for this lifestage decreased by slightly less than 10% when comparing the present to the Conditional discharge.

The Licensee distributed reanalyzed preliminary 'IFIM-1D' microhabitat suitability curves in March 2003 for the Pit 4 bypass reach for the same locations as the 1984 sampling (PG&E 2003). The IFIM-1D reanalysis indicates that at one of the 'Lower Riffle/Run' sites on the Pit 4 bypass reach, adult hardhead habitat increases from approximately 2,000 square feet per 1,000 linear feet at 150 cfs, to about 5,000 square feet at 450 cfs. At the other Lower Riffle/Run site, adult hardhead habitat increases from about 2,500 square feet to 6,000 square feet per 1,000 feet when the discharge was elevated from 150 cfs to 450 cfs (PG&E 2003).

These IFIM-1D preliminarily reanalyzed results indicate little net change of fry/juvenile hardhead habitat when comparing 150 cfs to 450 cfs at two riffle/run sampling sites in the Pit 4 bypass reach. One of the sampling sites on the 'Lower Riffle/Run' indicates a decrease from approximately 16,000 square feet of Weighted Usable Area (WUA) per 1,000 linear feet of river, down to about 15,000 square feet when discharge was elevated from 150 cfs to 450 cfs. The other site yields fry/juvenile hardhead habitat that varies both upward and downward between 150 cfs and 450 cfs. The habitat area ends at a slightly lower level at 450 cfs vs. 150 cfs: approximately 14,000 square feet at 450 cfs vs. 15,500 square feet of WUA at 150 cfs, per 1000 linear feet (PGE 2003).

The reanalysis indicates that significantly more fry/juvenile hardhead habitat occurs per 1000 linear feet at all comparative discharges than what was calculated to exist in 1984. For example, comparing the second site described above at 450 cfs, the fry/juvenile hardhead habitat is now estimated to be about 14,000 square feet per 1000 linear feet. The estimate was about 11,000 square feet in 1984. The 6,000 square foot adult hardhead habitat estimate at 450 cfs described above has a projected 2,500 square foot estimate per 1,000 linear feet of river at the same location in 1984.

At one of two IFIM-1D sites described as the Pit 4 Upper Riffle/Run, the fry/juvenile hardhead habitat increases from about 4,000 square feet per 1,000 linear feet at 150 cfs, to 9,000 square feet at 450 cfs. At the other Upper Riffle/Run site, fry/juvenile hardhead

habitat increased from approximately 4,000 square feet of WUA to 6,800 square feet of WUA when the flow increased from 150 cfs to 450 cfs (PGE preliminary information 2003).

This IFIM-1D reanalysis yielded adult hardhead habitat at one of the Upper Riffle/Run sampling sites that remained fairly constant at about 2,000 square feet per 1,000 linear feet of river from 150 cfs to 450 cfs. At the second Upper Riffle/Run sampling site, adult hardhead habitat increased from approximately 1,200 square feet of WUA to 1,400 square feet of WUA when the discharge increased from 150 cfs to 450 cfs (PGE preliminary information 2003).

Comparing the reanalysis results for hardhead habitat with the results of the 1984 sampling at the second location of the Upper Riffle/Run: the fry/juvenile hardhead habitat increased from about 4,000 square feet of WUA in 1984 to about 6,800 of WUA at the 450 cfs discharge. Adult hardhead habitat for the second site was estimated to be 1,000 square feet of WUA in 1984, which increased to 1,400 square feet in the reanalysis.

Regarding the habitat mapping work done in 2002 (R2 2003), the mapped 'shallow/slow' ecological microhabitat guild either increased or remained relatively constant when discharge was ramped up to 450 cfs at the two other sampling sites (R2 2003). At the Tunnel Adit sampling reach, 'shallow/slow' habitat remained approximately steady at 4,500 square feet per 1000 linear feet. The habitat appeared to increase slightly to around 10,000 square feet at the Deep Creek sampling site.

The 'deep/slow' microhabitat guild decreased from approximately 19,000 square feet to 12,000 square feet per 1,000 linear feet of river at Tunnel Adit when the discharge was elevated from 130 cfs to 450 cfs. It also decreased from about 21,000 square feet to 17,000 square feet per 1,000 feet of river at the Deep Creek sampling site for the same flow release range, but was in the process of increasing with greater discharge at 450 cfs (R2 2003).

The 'deep/fast' microhabitat guild first increased, but then ultimately decreased from about 31,000 square feet to 24,000 square feet per linear 1,000 feet while increasing the discharge from 150 cfs to 450 cfs at Tunnel Adit. The guild increased from about 30,000 square feet to 44,000 square feet per 1,000 linear feet over the increasing flow range at the Deep Creek sample site. Most of the increase appears to be comprised of 'pool tail areas' (R2 2003).

The possibility cannot be dismissed that a minor decrease to hardhead post-larval fry/juvenile habitat (deep/slow guild, Tunnel Adit) may occur, on average, in the Pit 4 bypass reach at the Conditional discharge. If this habitat were to decrease somewhat for the entire Pit 4 bypass reach after implementation of the submitted flow-related condition (incorporating the observation that fry use a somewhat broader habitat guild than originally thought), then the same conclusion should be drawn for hardhead that was drawn by FERC (2003) for trout: "Although WUA (weighted usable area) available to fry and juvenile trout (in the Pit 4 reach) would decrease by about 10 percent, the amount

of habitat available to these earlier life stages should still be adequate to support recruitment to the adult lifestage". Based on the prolific egg production capabilities of adult female hardhead along with their lifespan, this species could conceivably experience a decrease in fry production of more than 10% yet still fully seed the available increased adult habitat.

The preliminary submitted flow-related 4(e) condition requires that a freshet flow be released in March if after March 1 in any given year, a naturally occurring flow of at least 1,500 cfs has not yet occurred in either the Pit 3 or Pit 4 bypass reaches. The peak of 1,500 cfs would begin within two days of the ramping up toward the peak. The results from such a flow release should not adversely affect spawning behavior, eggs, larval or post-larval hardhead fry because there is no evidence that such behavior or occurrence of these life stages begins in March in the Pit River. Hardhead spawning and larval/fry rearing begins no earlier than April in the Pit River, perhaps even later. The delayed timetable is likely influenced by the slightly cooler ambient water temperature found in the Pit River compared to the hardhead preferences cited in literature, and possibly because the Pit River hardhead occur at the northern extent of the species range.

A preliminary 4(e) license condition has been submitted that mandates a gravel augmentation program be initially studied for the Pit 3 bypass reach with an eye toward implementation. The Federal Power Act specifically identifies spawning gravel as one of the considerations for which FERC is required to issue new licenses (see Introduction). Based on the results, recommendations could be made to initiate a gravel augmentation program for the Pit 4 bypass reach.

This preliminary license condition will likely improve overall hardhead fish production regarding the early life stages if ultimately implemented in the Pit 4 bypass reach. For example, despite hardhead spawning behavior not being readily known, adults apparently utilize gravel substrate for depositing their eggs (Moyle 2003). The R2 field crews did not incidentally note distinct spawning gravel patches in 2002. Additional gravel may therefore promote more larval and post-larval hardhead fry, which could then more rapidly saturate the carrying capacity of newly created adult hardhead habitat at 450 cfs. Benefits of gravel augmentation will likely include greater aquatic insect production as well.

Summary of Effects to Hardhead of the Proposed Action with Preliminary 4(e) License Conditions.

Direct effects. The proposed action, accompanied by the preliminary 4(e) license conditions, will create a short-term adverse effect to living adult hardhead. Harm will likely occur to individual hardhead due to the stresses created by initially increasing Project bypass release baseflows. Establishment of new hardhead adult territories will likely be required via spatial adjustment. There may be no direct mortalities to adult hardhead caused by the Proposed Action and accompanying preliminary license conditions, however.

Hardhead eggs, larval/post-larval fry, and juvenile hardhead will also experience harm if the initiation of the new Conditional release flows were to occur in the late spring or early summer months when these lifestages would be present in the Pit River. Some direct mortality would likely occur to these young hardhead lifestages during the reestablishment of new spatially oriented habitat, unless the greater baseflow discharge initiates at another time period.

Once implementation of the preliminary flow-related license condition begins, the direct effects would shortly thereafter be beneficial to adult hardhead. Significantly greater measurable adult hardhead habitat will be created because of the greater flow release, on average, in both the Pit 3 and Pit 4 bypass reaches. The quantity of larval/post-larval hardhead fry habitat may decrease slightly, on average, throughout the Project bypass reaches but this conclusion is hardly certain. If it occurs, the possible reduction in appropriate habitat could lead either to a minor reduction in hardhead fry produced, or a greater density of individuals occurring within the newly created rearing habitat than what occurs presently.

There appears to be no cause for concern about insufficient fry and juvenile hardhead being produced from the greater number of hardhead adults. There will likely be sufficient numbers of hardhead fry and juveniles produced to fully seed and maintain a greater adult hardhead population resulting from the significant increase in adult hardhead habitat created in both reaches.

Indirect and Cumulative Effects. The overall population of hardhead is certain to increase substantially during the first few years after initiation of the increased baseflow discharge. It's possible that hardhead populations in the Pit 3 and 4 bypass reaches will be favorably responding to the greater discharges, and other cited preliminary 4(e) conditions, throughout the term of the new license. This longer timeframe may be in effect because riparian and other hydraulic responses require more time to fully adjust to the preliminary 4(e) conditions.

Positive longer-term indirect and cumulative effects should be detected by implementing the preliminary conditional that leads to development of a fish population and condition trend-monitoring plan. The plan will outline a sampling protocol in both the Pit 3 and Pit 4 bypass reaches. Creation of new hardhead fish habitat will eventually lead to an increased hardhead fish population until a more stable, greater 'carrying capacity' population level is achieved. This positive Project response will partially compensate for the downward overall hardhead California population trends seen during the past century that, if left unchecked, could warrant eventual listing on the Federal or California State Endangered Species list(s).

Recommendations. Implement the preliminary Forest Service 4(e) license conditions specified in this BE. Manage the aquatic habitat of the Pit 3 and Pit 4 bypass reaches adaptively if results of hardhead fish and fish habitat monitoring promote additional minor changes to these conditions over the term of the new license. Develop flow-

shaping models that do not adversely affect hardhead and, when and however feasible, promote greater hardhead production.

Determination. If the preliminary 4(e) license conditions are implemented in conjunction with the relicensing of the Pit 3, 4, and 5 Hydroelectric Project, FERC No. 233-081, then it is my determination that the proposed action may affect individual hardhead fish but is not likely to result in a trend toward Federal listing or loss of viability for the hardhead.

Foothill Yellow-Legged Frog

The foothill yellow-legged frog (FHYLF) is a relatively small- to medium-sized frog (up to 75 mm SVL). Many minute tubercles on its surface give the frog a "rough", toad-like appearance. There is complete hind-toe webbing and webbing extends to the tip of the longest toe. The tympanum is about half the size of the eye and is similar in color and rough like the skin around it, thereby making it difficult to see. The body color may range from gray to brown to olive and individuals differ in their intensity of mottling and spotting. The concealed surfaces of the hind legs and the posterior portion of the abdomen are usually yellow. The remainder of the abdomen is white. Individuals may have a pale buff triangle on the snout. Tadpoles are deep olive in color with dark spots on the tail and musculature. Ventral surface is silver. The tadpoles have many labial tooth rows, six or seven anterior and five or six posterior to the mouth.

This species inhabits shallow water at the margins of rivers and streams in California and Oregon (G. Fellers, National Biological Survey, personal communication) and are generally found in association with low gradient stream riffles that have rocky substrates and partly shaded banks. This frog ranges from northern Baja California, Mexico to central Oregon, west of the Sierra Nevada and Cascade Crests (*in* Lind et al. 1996). This species deposits 100-1200 eggs on the downstream side of cobbles and boulders over which a relatively thin, gentle flow of water occurs (Zweifel 1955). The timing of egg-laying typically follows the period of high flow discharge resulting from winter rainfall and snowmelt, usually occurring between late March and early June. Timing of egg laying is believed to be dependent on temperature and day-length, which directly affect hormonal cycles (*in* Lind et al 1996).

Kupferberg (App. A.2) believes that frogs are philopatric with respect to the breeding site, which is at the scale of geomorphic unit, i.e., a certain cobble bar or pool tail-out, not necessarily with respect to an oviposition site. Oviposition sites vary within a given breeding site both within a given breeding season and among years. Individuals select specific depths and velocities and are not necessarily wedded to specific rocks. In a multiple year study of FHYLF oviposition site selection on the Eel River, depth and velocity at egg mass did not vary significantly interannually, but distance from shore (and hence which rock was used) **did** vary significantly (Kupferberg 1996).

The Foothill Yellow-legged Frog (FHYLF), *Rana boylii* , is a California State Species of Special Concern (Jennings and Hayes 1994) , a USDA Forest Service Sensitive Species, and is also a candidate for Federal Listing (*in* Lind et al 1996). Fellers (1994) relates that

recent evidence indicates that amphibians are declining on a global basis. In the western United States extensive declines in frog, toad and salamander populations are occurring to such a degree that some species appear to be extirpated from their former ranges. Healthy, seemingly well-protected populations in Western National Parks have disappeared for no obvious reason from the very areas one would expect them to be best protected. This is the case for FHYLF in western parks. The most notable declines are in southern California and the west slope drainages of the Sierra Nevada and southern Cascade Mountains (Jennings and Hayes 1994, Fellers 1994). After one year of fieldwork, their data supported the general belief that FHYLF are absent from the southern portion of its range. They found only one (sub adult) frog south of Calaveras County in spite of surveying 310 sites in the southern Sierra foothills within the known range of the species. Reasons for declines in the southern portion of the range are largely unknown, but several human and natural factors are suspected, including air pollution, acid precipitation, increases in ultraviolet light, the introduction of native and non-native predatory fish into previously fishless streams and lakes, long-term fire suppression, extended drought, severe freezes and disease (*in* Fellers 1994*)*. Researcher also believe that decline has occurred with the modification of river habitats, introduction of bullfrogs, and signal crayfish and other exotic aquatic species, such as smallmouth and largemouth bass, which are predators and/or competitors of FHLYF. This is the hypothesis in the Pit River system and other river systems in northern California (Lind et al 1996, Kupferberg 1996).

Damming of rivers, with the resultant loss of aquatic diversity, has resulted in species declines for many aquatic species. Species declines are often associated with water diversion, impoundment, flow regulation, channelization and other habitat modifications (Kupferberg 1996). Such occurrences alter sediment and water flow regime, which, subsequently cause geomorphic changes to the aquatic system. Most of the historic focus has been placed on region-wide declines of anadromous fish in the Pacific Northwest, namely impacts upon salmonid spawning and rearing habitat, rather than taking an ecosystem approach, which would look at other sensitive aquatic species, such as the foothill yellow-legged frog (Kupferberg 1996). Lind et al (1996) also discuss impacts that link dams and water diversion projects to possible causes of declines of many native frogs. Few studies, to date have quantitatively evaluated the effects of these projects.

Lind et al (1996) discussed downstream effects of dams and believe that several changes appear consistent across most dammed systems; peak flows are decreased, year-round flows are generally lower, sediment concentrations and suspended sediments decrease substantially for many miles downstream, bed material typically becomes more coarse, the areal extent of riparian vegetation increases and direct habitat loss to riverine species as a result of reservoir filling.

Kupferberg (1996) relates that frogs selected sites over a range of spatial scales and timed their egg laying to avoid fluctuations in river stage and current velocity associated with changes in stage-discharge. The main sources of mortality were desiccation and subsequent predation of eggs in dry years and scour from substrate in wet years, both caused by changes in stage and velocity. At the finest scale, Kupferberg (1996) found

that frogs attached eggs to cobbles and boulders at lower than ambient flow velocities. At larger scales, breeding sites were near confluences of tributary drainages and were located in wide, shallow reaches.

Foothill yellow-legged frogs (FHYLF) are known to occur within portions of this analysis area. Surveys for FHYLF and other amphibians were conducted between 1999 and 2000 at Project reservoirs, along the three river reaches and in the lowermost portions of the tributaries (Spring Rivers 2001). FHYLFs were observed in the Pit 4 Reach downstream of Canyon Creek and in the Pit 5 Reach at one location less than one-mile downstream of the Pit 5 Reservoir. Adults and sub adult FHYLFs were observed in the Pit 4 Reach, but no tadpoles were found during the intensive 1999-2000 surveys (Spring Rivers 2003). Tadpoles *were* observed in the Pit 4 Reach, however, during Spring Rivers' July, 2001 follow-up surveys, during Spring, 2002 flow release studies (K Turner personal communication 2002) and during the August, 2002 base-flow and flow release studies (Spring Rivers 2003). During the August, 2002 surveys, 8 sites containing suitable FHYLF habitat were mapped and surveyed. Of the total, adults were observed in 4 of 8 sites: Bedrock Bar (RK 42.75), Bedrock tadpole site (RK 42.7), Upper Deep Creek (RK 41.45) and Lower Deep Creek (RK 40.75). Tadpoles were observed at the 3 latter sites and **egg masses were observed only at the Upper and Lower Deep Creek sites** (Spring Rivers 2003).

There are three known FHLYF breeding and tadpole rearing sites within the analysis area. They are all found along the Pit 4 reach upstream of, or in the vicinity of Deep Creek: 1. *Bedrock Tadpole* site (near Bedrock Bar – RK 42.7), 2. *Upper Deep Creek*, which occurs at a pool tail-out in the vicinity of the peninsula at the confluence of Deep Creek and the Pit River (RK 41.45 and breeding site #1 as per K. Turner's notes of 6/2/2002), and 3. *Lower Deep Creek* (RK 40.75 and breeding site #2 as per K. Turner's notes of 6/2/2002).

Dr. Sarah Kupferberg (pers comm) describes suitable FHYLF breeding sites on the Pit River as having the following characteristics:

- High width to depth ratio of the river, so lower velocities and slower rise of the river would occur at egg mass locations during high flow events,
- Close to tributaries, possibly providing adult refugia,
- Presence of bare, unvegetated rocks (cobble or small boulder) protruding only slightly from the river serving as adult perches,
- Water flowing through the site at a very slow rate, though not stagnant, and
- Eggs usually found attached to cobble and small boulders although some have been located on large boulders.

It appears that occupied sites have unique geomorphic properties that create stage to discharge and velocity to discharge relationships conducive for long-term occupation of a site over a range of historic variability in discharge (Kupferberg, App. A.2).

<u>Description and Analysis of the Effects to Foothill Yellow-legged Frogs of the Proposed Action with Implementation of Preliminary 4(e) License Conditions</u>

Pit 3 Bypass Reach

A preliminary 4(e) license condition has been submitted that initially increases the minimum base flow discharge into the Pit 3 Project bypass reach from the current 150 cubic feet per second (cfs) to 400 cfs year-round. Seasonal and water-year-type variations will be developed within one year of license issuance to shape releases between a range of 300 cfs and 1,000 cfs.

It is not known if the Pit 3 reach was historical FHYLF habitat. After construction of the Pit 3 Dam and the dewatering of the Pit 3 reach for a number of years because of diversion of **all** water from the reach for power generation, **any frogs which may have inhabited the reach historically were likely extirpated from that reach**. With the addition of 150 cfs in the Pit 3 reach in recent years (1987), barriers created by the Pit 4 dam may have prevented and continue to prevent recolonization of this reach by FHYLFs.

Currently, the Pit 3 reach is not considered suitable FHYLF habitat and was not surveyed as a result. Under the current flow regime of 150 cfs, suitable habitat for breeding and tadpole rearing does not exist. With an increase of flow to 400 cfs discharge, suitable breeding and tadpole rearing habitat may be created and a decrease in variability between high and low flows may enhance the potential for survival of eggs and tadpoles, affording survival and expansion of the population. During test release flows, habitat typing and snorkel observations were done to confirm assumptions of the mapping exercises for changes in fish habitat by flow discharge (R2 2003). R2 (2003) also noted that 'Most shallow/slow habitat tracks the water's edge with increasing discharge in all (study) sites'. This general habitat observation is likely conducive to FHYLF egg mass and tadpole survival.

An additional predicted environmental change when Pit 3 bypass reach flows increase to 400 cfs may also conducive for FHYLF egg and tadpole survival. As stated by FERC in the DEIS: "The results of temperature modeling reported in the license application indicate that increasing minimum flow releases would tend to increase summer water temperatures in the Pit 3 reach…". The expected increase in water temperature with discharges of 400 cfs may slightly improve temperatures conducive to survival and recruitment of FHYLFs in this reach.

However, since barriers for dispersal still exist and will continue to exist with Conditional flows, and frogs are not know to travel more than 0.5 km (Kupferberg personal communication), recolonization of this reach is unlikely without artificial reintroduction of frogs into this reach. Even with artificial reintroduction, survival and expansion of FHYLF in this reach would still be uncertain, as water temperatures may be too cold and gradients too steep.

As a result, further discussion of the Pit 3 Reach will be limited and the rest of the analysis will focus on the Pit 4 reach.

Pit 4 Bypass Reach

The preliminary 4(e) flow-related license condition requires that the current base annual discharge increase from 150 cfs to 450 cfs in the Pit 4 bypass reach. Similarly to the circumstance of the Pit 3 bypassed reach, a seasonal and water-year-type flow-shaping model will be jointly developed among the licensee, the Forest Service, and the other participating natural resource entities and agencies.

There are two main questions to address with regard to how changes in the flow regime will affect FHYLF in the Pit River: 1. Will FHYLF be limited by space available for breeding under this Conditional flow proposal and 2. How does a change in flow regime influence survival? This analysis will focus on how well the Conditional flow meets these criteria. Since we believe that selecting a flow regime that will have optimal impacts on survival and recruitment is more important than a regime that maximizes breeding habitat area (Kupferberg App. A.2), the effects analysis will give more weight to survival.

The results from the Deep Creek breeding site during the 2002 test flows support Kupferberg's (App. A.2) hypothesis that FHYLF are more limited by the effects of unnatural flow fluctuation, and non-native predators, whose invasion is facilitated by the impaired flow regime, than they are limited by space.

Currently there are 3 **occupied** breeding and tadpole rearing sites within this reach. Five additional **unoccupied** sites "deemed as suitable habitat but unoccupied" also occur within this reach. Spring Rivers (2003) states in its conclusions that "Given the likelihood that the Pit 4 reach has more breeding sites than the two known sites in the Deep Creek area, total habitat from all sites combined should be used to assess what flows would maximize other shallow low-velocity areas of potential FHYLF breeding habitat in the Pit 4 reach." Kupferberg (App A.2) agrees that there must be other suitable breeding sites, but concludes that all scientists who were looking for egg masses and tadpole sites during surveys ***did not find them***. Although they attempted to predict "suitable FHYLF breeding habitat" in 2002 for the purposes of assessing suitability of habitat during different test flows, she believes that **the unoccupied sites were not appropriate surrogates for the occupied sites that they did not find**. As a result, our analysis of effect will focus on **occupied** breeding and tadpole rearing sites only, not the unoccupied sites in the vicinity of Malinda Gulch.

We also believe that all canopy types, disconnected and connected, should be included in the effects analysis. Kupferberg in Appendix A-2 and Addley in Appendix A-3 both feel that with increased flows, Canopy 2 habitat would become suitable breeding and tadpole rearing habitat over time. Kupferberg states that both categories represent suitable depth, velocity and substrate patches, but vary in terms of the time scale of their availability (immediate vs. post-riparian vegetation change). Because the terms of the license is 30

years, it is appropriate to assume that vegetation will respond in time to the new flow regime. Although it is unclear how long it will take for small willows will die off with inundation, it is more of a question of **when** they will die off rather than **if**. If the rate of die-off is not sufficient, then active vegetation removal at sites of concern may be recommended as outline in the Amphibian Monitoring and Vegetation Monitoring Plans. This habitat restoration technique was also discussed in Lind et al (1996) where they used chainsaws to remove vegetation to create suitable FHYLF breeding habitat. In essence, they changed Category 2 habitat patches to Category 2 habitat patches. The habitat mapping performed by R2 also corroborates that, given the channel morphology of the Deep Creek delta / debris fan, the discharge that maximizes FHYLF breeding habitat is around 600 cfs. We also believe that Canopy 3 shaded habitat is also suitable and should be included. Kupferberg studied FHYLF breeding habitat on the Eel River in NW California and found that frogs used shaded sites as well. Some breeding sites were in shaded river margins and shaded river margins also provide adult refugia in the summer. When all three canopy types are included the Conditional flow regime is expected to benefit the FHYLF in time. See Kupferberg (App. A.2) for further discussion.

Increased minimum base flows will also benefit FHYLF by reducing the magnitude of fluctuation between high flows and low flows. A breeding season base flow of between 400 – 600 cfs would benefit breeding frogs by providing a buffering to eggs and new tadpoles from changes in the magnitude of velocity change as well as changes in the direction of the water current when spills occur during the egg-laying season. Addley (App. A.3) also supports the Conditional flow regime with shaping of the 450 cfs flow in the Pit 4 reach. That is, providing higher spring flows (greater than 450 cfs) to benefit breeding conditions for FHYLF and possibly for other amphibians, spawning fishes and early YOY fishes, and then reducing flows during other time periods when the flow is biologically less important.

Implementation of the Conditional flow regime may also benefit survival of egg masses and tadpoles by negatively impacting non–native predators such as signal crayfish (*Pacifastacus leniusculatus*) and bullfrogs (*Rana catebiana*) in this reach.

In the Pit River, signal crayfish invasion has progressed during the years of flow alteration as a result of Project operations (Light et al 1995). In smaller unregulated Sierran streams, signal crayfish invasion is constrained by high intensity flow events (Light 2002). Crayfish are known predators of amphibian eggs and larvae and may pose a significant threat to FHYLF in the Pit River (Kupferberg App. A.2). The rapid disappearance of tadpoles at the Deep Creek site in May 2002, was suspected to have been caused by signal crayfish predation (Spring Rivers 2003), although the test flows could have also been a factor.

Signal crayfish are capable of long-distance movements (Holdich 1991) and can rapidly recolonize from the reservoirs and between the Pit River reaches, it is important that a more natural annual regime of high magnitude flow events occur to keep crayfish in check (Kupferberg App. A.2).

In addition, non-native bullfrogs also pose a dramatic threat to FHYLF populations. Bullfrogs are currently in the Pit 5 reach and could colonize the Pit 4 reach in the future. Bullfrogs are best eliminated or prevented from entering reaches by natural high flow events as has been observed in the Eel River (Kupferberg 1996).

In summary, a change in the flow regime from 150 cfs to 450 cfs with flow shaping is expected to benefit the FHYLF in the Pit 4 reach.

Summary of Effects to Foothill Yellow-legged Frog of the Proposed Action with Preliminary 4(e) License Conditions.

Direct effects. The proposed action, accompanied by the preliminary 4(e) license conditions, may create a short-term adverse impact to adult and larval FHYLF, especially if higher flows are initiated after oviposition. Harm may occur to individuals due to the stresses created by initially increasing Project bypass release base flows. Adults may need to establish new breeding rocks within their territories with increased flows, but this adjustment is not expected to significantly affect the FHYLF, as they have evolved in fluctuating riverine systems and appear to have adapted successfully. The population is expected to benefit and grow over time with increase habitat area created with new flows and increased survival and recruitment over time.

FHYLF eggs and tadpoles may also be adversely affected if initiation of the new Conditional release flows were to occur in the late spring or early summer months when these lifestages would be present in the Pit River. Some direct mortality would likely occur to eggs and tadpoles if flows are sufficient to shear egg masses from anchor rocks and smash tadpoles or temporarily deprive them of known or familiar food sources.

Beneficial results will likely occur when Conditional release flows are increased toward the levels that this species evolved with and adapted to in the Pit River, along with the Conditional flow shaping that promotes a more natural range of variability. The proposed flow regime would decrease the flow variability by approximately one-half an order of magnitude and the existing flow spikes that occur in the system would be buffered in magnitude and duration to provide a more natural ecologically based flow regime. This flow regime would have a natural timing, shape and duration of high flow events that Pit River native species are adapted to exploit based on their evolved life history strategies (Addley App. A-3).

A higher base flow will likely result in creating more suitable occupied breeding habitat patches and will also result in a decrease in the variability of high and low flows, which is likely to have optimal impacts on survival and recruitment of eggs, embryos and larvae survive to become recruits to the FHYLF population in the Pit River system.

Once implementation of the preliminary flow-related license condition begins, the direct effects would shortly thereafter be beneficial to adult and larval FHYLF. More breeding and tadpole-rearing habitat is expected to be created with increased flows and increase survival and recruitment is expected over time, in the Pit 4 reach and possibly in the Pit 3

reach. Dispersal barriers would need to be addressed in order to expect that recolonization of the Pit 3 reach might occur over time. See the above discussions for more detail.

Indirect and Cumulative Effects. The FHYLF population is expected to benefit with increased flows and shaping of flows to mimic natural hydrograph. This change in flows will reduce habitat suitability for signal crayfish and lessen the possibility of colonization of the Pit 3 and 4 reaches by bullfrogs.

Additional provisions in our 4e conditions to continue to monitor bass encroachment into the Pit 3 and 4 reaches will also help to reduce the potential for predation upon adult and larval FHYLFs.

Positive longer-term indirect and cumulative effects should be detected by implementing the preliminary Conditional flow that will lead to development of an Amphibian monitoring protocol and condition trend-monitoring plan. The plan will outline a sampling protocol in both the Pit 3 and Pit 4 bypass reaches. Creation of new FHYLF habitat will eventually lead to an increased FHLYF population here in the Pit system until a more stable, greater 'carrying capacity' population level is achieved elsewhere where FHYLF numbers are declining. This positive Project response may partially compensate for some of the negative California population trends seen during the past several decades, which, if left unchecked, could facilitate eventual listing on the Federal or California State Endangered Species list(s).

Recommendations. Implement the preliminary Forest Service 4(e) license conditions specified in this BE. Manage the aquatic habitat of the Pit 3 and Pit 4 bypassed reaches adaptively if results of FHYLF population and habitat monitoring promote additional data that positive responses are not occurring as predicted over the term of the new license. Develop flow-shaping models that do not adversely affect FHYLF adults and larvae and, when and however feasible, promote beneficial effects for the long-term survival and recruitment of young into the population. Focus should be placed first on learning more about the breeding habitat ecology of FHYLF in the Pit 4 reach and then on the Pit 5 reach. The concept of recolonization (planting frogs) of FHYLF into the Pit 3 reach should only be addressed after we have learned more about the lower two reaches.

Determination. If the preliminary 4(e) license conditions are implemented in conjunction with the relicensing of the Pit 3, 4, and 5 Hydroelectric Project, FERC No. 233-081, then it is my determination that the proposed action may affect individual FHYLF but is not likely to result in a trend toward Federal listing or loss of viability for the species. Beneficial effects are expected for FHYLF over the long term.

Aquatic Mollusks

All of the freshwater aquatic mollusks described below are sensitive to pollution, except to a minor degree the California floater (Frest and Johannes 1995). They are all generally cold-water forms, preferring clear and cold spring or spring-fed waters with dissolved oxygen at or near saturation. They are sensitive to large seasonal or diurnal water temperature fluctuations (Frest and Johannes 1995).

Aquatic mollusks perform important ecological functions as much as they are sensitive indicators of aquatic ecosystem health (Frest and Johannes 1995; Brim Box 2002). Freshwater mussels are considered the most endangered faunal group in North America, yet freshwater gastropods may be experiencing extinction rates higher than that of the bivalves (Brim Box 2002). Most are primary herbivores that help control growth of epiphytes. Others consume organic detritus and macrophytes (Frest and Johannes 1995).

The present flow of the Pit River in the Project bypass reaches is augmented by discharge from more than 100 springs and spring/seep systems (Spring Rivers 2001). These springs are at least partly caused by porous lava flows associated with the Modoc plateau and Cascade Range geomorphic provinces and likely began in the late Cenozoic period when much of the deposits were formed (Montgomery 1988 as cited by Spring Rivers 2001).

The following Forest Service Sensitive listed aquatic molluscs have been observed in Project waters during the past three years (Spring Rivers 2001): Scalloped juga snail *(Juga (Calibasis) occata)*, Topaz juga snail *(Juga acutifilosa)*, and Great Basin rams-horn snail *(Helisoma newberryi newberryi)*, California floater [freshwater mussel] *(Anodonta californiensis)*, and Montane peaclam *(Pisidium ultramontanum)*, located upriver from Britton Reservoir but below the Highway 299 bridge.

The following Northwest Forest Plan Record of Decision Survey and Manage (Survey and Manage) listed aquatic molluscs have also been observed in Project waters during the past three years (Spring Rivers 2001): Nugget pebblesnail *(Fluminicola seminalis)*, and Globular pebblesnail *(Fluminicola n. sp. 18)*.

The following Survey and Manage aquatic molluscs have suitable habitat present in Project waters and therefore have the potential for occurrence. They will also be addressed in this BE: *Fluminicola* species n. sp. 14-17 and n. sp. 19-20, *Juga (Oreobasis)* n. sp. 3, and *Lyogyrus* n. sp. 3.

SPECIES DESCRIPTION

California floater [freshwater mussel] ***(Anodonta californiensis)*** – A Forest Service Sensitive listed species.

Isolated shells were found in the Pit 3 bypass reach during snorkeling surveys but no living individuals were located. Living individuals were discovered upriver from Britton Reservoir in the Pit River (Spring Rivers 2001). Several small mussel beds were located in the Pit 4 bypass reach besides the one discussed below. An occurrence of the California floater in any of these mussel beds was not described (Spring Rivers 2001).

The California floater was the third most abundant freshwater mussel among four species surveyed at the 'Malinda Gulch' freshwater mussel bed at river kilometer 46.3 in the Pit 4 bypass reach (Spring Rivers 2003). The total number of individuals was still relatively few, however. The mussel was relatively common and widespread throughout the Pit 1 hydroelectric project area during surveys in 1995 (Ellis 1996).

The mussel prefers slow moving to near zero-velocity water, with substrates ranging from silt and mud, to sand and gravel. They may do as well in lakes as in streams and rivers (Johannes and Frest 1995). Previous surveys in the Pit River upstream of the project noted a preference for finer substrates (Spring Rivers 2001). The mussel bed(s) currently found in the Pit 4 bypass reach comprise the known total Project occurrences. Malinda Gulch is the largest bed within the Project area. A formerly significant bed of mussels once occurred downriver from the Project under what is now the Pit 6 Reservoir (Spring Rivers 2003).

The historical species distribution once included the lower but lengthy reaches of the Columbia River. It also once inhabited areas in California southward to the San Joaquin Valley, and locales in Utah and Nevada (Taylor 1981).

The California floater is likely extirpated from Central Valley and Southern California habitats. Watershed developments typical of the past 150 years in California are the likely reasons, along with elimination of natural fish hosts (Taylor 1981).

Males and females occur as separate individuals, and become mature enough to reproduce in about five years. Males release sperm into ambient water. This may become drawn into female gills where eggs are stored, in mid-to-late summer (Pennak 1989 as cited by Spring Rivers 2003). The females may release up to three million larvae the following spring or summer. The larvae must encyst in a host fish within a maximum of 36 hours. Successful encysting provides a means for being transported and therefore extending the species range upriver (Spring Rivers 2003).

The most common hosts are likely native 'cyprinid' minnows, including the hardhead. Water temperature determines the length of time for encystment, perhaps averaging about a month at 20 degrees C (D'Eliscu 1972 as cited by Spring Rivers 2003).

Clean flowing, well-oxygenated water is preferred; however Frest and Johannes (1995) state that it '… is somewhat tolerant of polluted conditions'. Sedimentation, agricultural runoff eutrophication, water diversions, and possibly a reduction in host fishes are cited as threats to the mussel and are largely responsible for its historic decline (Brim Box 2002).

Juvenile mussels detach from the host fish over gravel or rock substrates, to which they must in turn attach. The preferred juvenile mussel habitat is differentiated from the adult substrate locations by being composed of faster flowing riffle areas. It appears that unnatural flow fluctuations in mid-to-late summer may be the most critical environmental factor capable of disruption to successful reproduction in the Pit 4 bypass reach (Spring Rivers 2003). The researchers monitored the Malinda Gulch mussel bed during the experimental freshet flows of up to 1,800 cfs in August 2002.

DESCRIPTION OF EFFECTS OF THE PROPOSED ACTION

Only 14 individuals (+/- 3) were located during six transect surveys in August 2002. The entire population of mussels in the Malinda Gulch bed was not identified to species, intentionally. This newly established population, however, is significant compared to zero individuals having been observed within the same six transects sampled in the year 2000 (Spring Rivers 2003). The California floater was located in the three transects closest to the riverbank, a statistically significant observation. The experimental flow releases of up to 1,800 cfs did not adversely affect the composition, structure or apparent survival of the mussels in the Malinda Gulch mussel bed. The researchers' conclusion: the California floater prefers water velocities below a relatively slow threshold of perhaps only 0.2 feet per second. No individuals sampled were located in water with faster velocities. In their opinion, the shell is not heavy and has a shape lending itself to scour susceptibility if placed in higher water velocities (Spring Rivers 2003).

Research conducted in 1995 in the Pit 1 Pit River area located California floaters that survived, if not thrived in bed locations that routinely had high flow project-related releases every afternoon (Ellis 1996). Perhaps slow velocity water is preferred but not required, or required for only a portion of any given day. As stated: "The fluctuations in water velocity resulting from operation of the Pit 1 Powerhouse did not appear to affect the distribution of *A. californiensis*" (Ellis 1996). It did appear that the mussels established themselves near the channel bank in locations that would experience the smallest increase in peaking flow discharge, however (PG&E 1996).

Relatively stable adult populations typify the California floater once established in mussel beds of 'continuously unpolluted' river segments (Frest and Johannes 1995). Ideally, the Malinda Gulch mussel bed will be subject to a minimal number of unseasonable flow releases; otherwise, a juvenile mussel recruitment year class could be lost.

Montane peaclam (*pisidium ultramontanum)* - a Forest Service Sensitive listed species.

The Montane peaclam has not recently been located in Project waters from Britton Reservoir downriver through the Pit 4 bypass reach. It is a relict species only found living in larger, perennial water bodies in northeastern California and south-Central Oregon.

Individuals have been found during Pit 1 and Hat Creek hydroelectric project surveys. In fact, they were relatively common, widespread, and found in most of the sites surveyed (Ellis 1996). It was located in both fine substrates with slow velocity water in Fall River, and in faster-velocity water of the mainstem Pit River downriver from the Highway 299 Bridge (Spring Rivers 2001).

Great Basin Rams-horn Snail (*Helisoma newberryi newberryi)*. A Forest Service Sensitive listed species.

This mollusk has at one time extended at least as far upstream as Fall River and Hat Creek, and downstream to Squaw Creek along the Pit River; it may now be extirpated from its lower distribution range. It was observed recently in Project waters (Spring Rivers 2001) in pool and reservoir habitats (Brim Box 2002). They require spring-fed pools and soft mud in which they may actually burrow into, becoming invisible to the eye. It occurs with the species addressed just below, along with *Fluminicola seminalis.* Management recommendations would therefore be similar or identical for each species (Furnish and Monthey 1998).

Topaz Juga Snail (Juga *(Calibasis) acutifilosa*). A Forest Service Sensitive listed species.

This snail occurs in the Pit River upstream of the Project near Fall River Mills (Brim Box 2002); in the Fall River and Hat Creek subdrainages; and in Project waters at Blue Spring in the peninsula between the confluence of Hat Creek and the Pit River at the upstream end of Lake Britton (Spring Rivers 2001). It was sampled at 11 Pit River sites in just three tributaries or general locations (Frest and Johannes 1995). Frest & Johannes recommend that it be listed as Endangered. Threats are pollution and the ponding of springs with elimination of flowing water habitat. They may be narrowly restricted to large springs and their outflow areas (Brim Box 2002).

It occurs with other *Fluminicola* species. They prefer well-oxygenated cold flowing large spring water with stable gravel to boulder substrates. The pristine, large spring habitats they exist in are threatened primarily by sedimentation, damming, direct diversions and reduced flows due to ground water extraction (Fresh and Johannes 1999). Researchers speculate that a lack of this particular kind of habitat naturally occurring in Project waters is the probable reason that none were observed in the bypass reaches (Spring Rivers 2001).

Scalloped Juga (*Juga (Calibasis*) occata). A Forest Service Sensitive listed species.

The scalloped Juga commonly occur in the Pit 3 bypass reach and to a lesser extent in the Pit 4 bypass reach (Spring Rivers 2001). General threats result from water pollution, impoundments, and mining. It exists in swift unpolluted areas with gravel/boulder substrate. It is usually found with *Fluminicola seminalis* and *Lyogyrus* n. sp. 3, both of which are described below in the Survey and Manage section.

Effects of the Proposed Action

1. **Direct and Indirect Effects common to all Forest Service Sensitive listed aquatic molluscs**. "Construction of the Pit 3, 4, and 5 Project reservoirs and downstream reservoirs (Pit 6, Pit 7, and Shasta) has reduced the amount of riverine habitat in the Pit River between Hat Creek and McCloud River from about 70 miles to about 23 miles, divided among the Pit 3, 4 and 5 bypass reaches" (FERC, DEIS 2003). Additionally, it has been concluded that "Existing dams on…. the Pit River by Pacific Gas and Electric have already caused extensive destruction of suitable habitat" (Furnish and Monthey 1998).

Pit River basin-specific aquatic mollusk adaptation and evolution, following their introduction to the Pit River, has occurred over a very long period of time. Virtually all the aquatic mollusk species have exploited the unique niche of the spring and spring/seep systems. As recently as the early 1900's, these organisms had approximately 37 more miles of riverine habitats to occur in with flows in Project reaches that averaged 3,000 cfs annually, and 2,000 cfs in the lower discharge summer season (FERC, DEIS 2003). These were likely the 'average long-term' conditions in which aquatic mollusk adaptations took place for all of the surveyed species.

Projected response to the preliminary 4(e) flow-related license condition: An increase in baseflow for the Pit 3 bypass reach from 150 cfs to 400 cfs and in the Pit 4 bypass reach from 150 cfs to 450 cfs. No sampled population of the California floater at Malinda Gulch in the Pit 4 bypass reach was found with local water velocities greater than 0.2 feet per second. Water velocities at the local population foci increased in all three transects with discharge release flows at 250 cfs; they became faster than 0.2 feet per second in two of the three transects. Likely all three transects would have flows greater than 0.2 feet per second at the Conditional discharge of 450 cfs.

The local increase in water velocity to a level greater than 0.2 feet per second could adversely affect individual mussels that would experience such an increase. On the other hand, the work done upriver from this Project, in Pit 1 Project river reaches, did locate mussels in water that experienced local water velocities greater than 0.2 feet per second for a significant portion of every day and those organisms appeared to be thriving (Ellis 1996). Perhaps their consistent tendency to occur near a riverbank may be the most limiting local environmental factor. This 'riverbank proximity requirement' could allow for local adaptation over a period of time where population migration would likely take place when base flows increase and then perhaps hold steady during much of the year.

The remaining Sensitive mollusk species would also likely need to adjust their specific existing site locations after base flows increased. Overall, however, more total habitat suitable for these aquatic mollusks is likely to be created as the Pit River bypass reach flows increase towards 20-25% of the levels that these organisms evolved in. The minor increase in overall ambient water temperature in the Pit 3 bypass reach may be favorably offset by the reduction in daily water temperature variations, a factor known to be detrimental for these mollusks (Frest and Johannes 1995). Average summer water temperatures in the Pit 4 reach would be reduced (FERC DEIS 2003) so there may be very little short-term harm introduced to existing individuals.

Decreasing existing extreme ramping rates for emergency or planned maintenance spills, particularly those during unseasonable timeframes, is included in the preliminary flow-related license condition. Implementation of this Condition will be beneficial to adult and juvenile California floaters, as well as the other Sensitive aquatic mollusks. Daily and seasonal flow variations have been identified as an impinging factor to health and vigor of these organisms, so implementation of the Condition would affect existing and future mollusks in a favorable manner.

Initiating a seasonable dry year freshet flow of up to 1,500 cfs in March, with an elongated decrease in flow, is part of the submitted preliminary flow-related license condition. Adoption of this Condition should not create adverse impacts to any life stage of the California floater, as it would occur during a time of year in which these organisms have evolved with and adapted to in the Pit River. It would also occur at a flow level less than historic base flow levels.

Cumulative Effects. Increasing the discharge in the Pit 4-bypass reach from 150 cfs to 450 cfs will likely adversely affect existing individual adults of California floater directly in at least the Malinda Gulch mussel bed during an initial short-term timeframe. A water velocity tolerance threshold of 0.2 feet per second for adult California floaters may not be absolute. However, a water velocity very near to this value, along with a near-shore geographic proximity requirement, appears to be. At least two of the adult populations sampled in the three transects at Malinda Gulch could possibly be extirpated during the first few years after increased baseflow release. It is probable, however, that newly created suitable habitat for all the aquatic mollusks adjacent to the existing populations (or elsewhere in the bypass reaches), may accommodate a successful geographic shift.

The projected short-term adverse effects to the Sensitive listed aquatic mollusks would not likely lead to an overall population decline during the timeframe of the license. It is probable that newly created suitable habitat could meet or exceed the existing quantity because of the much greater river flow volumes along with the diversity of habitat types seen by R2 observers up to 600 cfs. Potential fish host species numbers should also increase for the California floater, allowing for eventual seeding of newly created suitable locations both upstream and downstream. Because reduced instream flows are cited for cause of the aquatic mollusk overall decline, the Conditional flow increase will likely create greater habitat exploitation opportunities than what now exists in Project waters.

The California floater has an elongated lifespan with slow recolonization capabilities. Establishment of new populations is likely inevitable, however. Such an occurrence was noted between the year 2000 sampling and that done in 2002, where no California floaters were observed in the year 2000 (Spring Rivers 2003). It is probable that a population and total biomass of California floaters, perhaps starting from five to ten years beyond initiation of Conditional 14 flows, could meet or exceed that which occurs now at the 150 cfs base flow.

Recommendations. Implement the preliminary 4(e) license conditions specified in this BE. Manage the aquatic habitat of the Pit 3 and Pit 4 bypass reaches adaptively if results of aquatic mollusk habitat monitoring promote minor changes to these conditions over the term of the new license.

Determination. If the preliminary 4(e) license conditions are implemented in conjunction with the relicensing of the Pit 3, 4, and 5 Hydroelectric Project, FERC No. 233-081, then it is my determination that the proposed action may affect individual California floater mussels, Montane peaclam, Great Basin rams-horn snail, topaz juga snail, and scalloped juga snail, but is not likely to result in a trend toward Federal listing or loss of viability for these Forest Service Sensitive Species listed aquatic mollusks.

Survey and Manage Aquatic Mollusk Species

The following survey and manage aquatic mollusks have the potential to, or do occur in the Project area because suitable habitat has been determined to be present. They are all representatives of the *Fluminicola* genus. They possess the seven identification numbers of 14-20, and have the following common names respectively, all followed by pebblesnail: potem, flat-top, Shasta spring, disjunct, globular, umbilicate, and Lost Creek. An additional species also may occur: the nugget pebblesnail (*Fluminicola seminalis).*

All of these *Fluminicola* species are associated with cold-water springs in the Sacramento and Pit River systems. Three species have been located in the Pit River system: species 14 (the Potem pebblesnail; Frest and Johannes 1995) species 18 (the Globular pebblesnail), and the nugget pebblesnail (Spring Rivers 2001). The species group is associated with cold, perennial springs and a full spectrum of substrates ranging from mud to boulders. They feed on periphyton growth atop aquatic macrophytes, and probably detritus (Furnish and Monthey 1998).

Reduced dissolved oxygen levels or elevated water temperatures can threaten survival, along with fine sediment accumulation due to reduced flows.

The **Potem pebblesnail** (***Fluminicola*** n. sp. 14) occurs on muddy-silty substrate associated with small-sized coldwater springs and flowing runs. Sand and larger substrates may also be present. Sites are often shaded. Grazing on decomposing

deciduous leaves is a feeding strategy; it could be a detritovore. One or more locations known to the Pit River may be situated on Forest Service land; likely there are others yet to be discovered (Frest and Johannes 1999).

The **Flat-top pebblesnail (*Fluminicola n. sp. 15)***. Confined to cold springs and spring sources. Substrate preference is gravel, down to sand. Appears to be a 'perilithon' feeder/grazer (Frest and Johannes 1999). May (now) be an Upper Sacramento River endemic.

Shasta Springs pebblesnail (*Fluminicola n. sp. 16).* Occurs in the lower portions of larger springs, on pebbles and cobbles. Spring obligate.

Disjunct pebblesnail (*Fluminicola n. sp. 17)*. This species is endemic to the Upper Sacramento River system, at the Shasta Springs complex.

G**lobular pebblesnail (*Fluminicola* n. sp. 18).** The species may be photophobic, located in small springs and spring headwaters. It is found along the sides and undersides of stones in shaded areas. It was located at one site, a small spring-fed tributary (Little Falls Creek) to the Pit 4 bypass reach (Spring Rivers 2001) but is known elsewhere in Pit River tributaries (Frest and Johannes 1995).

Umbilic**ate pebblesnail (*Fluminicola* n. sp. 19).** Found at a single large spring tributary to Hat Creek near its headwater.

Lost Creek pebblesnail (*Fluminicola n. sp. 20)*. Found at two sites in Lost Creek, a presumed (lava tube modified) tributary to Hat Creek. Lives in swiftly flowing water on sand-cobble substrate. It is an apparent perilithon/phyton grazer requiring swiftly flowing water.

Nugget Pebblesnail (Fluminicola seminalis). This species prefers gravelly-cobble substrate with clear, cold flowing water (Furnish and Monthey1998). It was commonly located throughout most of the Pit 3 bypass reach, and to a lesser frequency along the Pit 4 bypass reach to a point one kilometer downriver from the confluence of Deep Creek (Spring Rivers 2001). It was also discovered in tributaries to Project reservoirs.

"Existing dams on…the Pit River have already caused extensive destruction of suitable habitat" (Furnish and Monthey 1998). Densities of 2000-3000 individuals per square meter were found on the Pit River (Furnish and Monthey 1998).

Cinnamon juga (*Juga oreobasis*) n. sp. 3. The species has the potential to occur along the Pit River; it is known from the Upper Sacramento River system. Suitable habitat is present in Project waters. It prefers cold springs and spring-flow runs, with sand to cobble substrate or exposed basalt bedrock. Appears in association with endemic Flumicola species.

Canary duskysnail (***Lyogyrus***) n. **sp. 3**. This snail is relatively small in size, barely more than a millimeter in length. This species is known to occur in one very large, cold spring complex tributary to the Pit River, and in a spring-fed portion of the mainstem of the Pit River. Individuals are only found in shaded areas on the undersides of cobbles and boulders, and they appear to be photophobic (Frest and Johannes 1995). They are probably grazers on 'perilithon' (living organisms growing on submerged rocks, including red algae at the Pit River site).

Knobby ramshorn (*Vorticifex*, 'species 1'). This species is a Pit River endemic, restricted to two known sites on private land adjacent to Forest Service lands. They are found in a large, pristine, cold spring complex, with at least some overlap with the spring complex that the Canary dusky snail is located. It is a perilithon feeder.

Habitat for and/or populations of any of the aforementioned species were surveyed in 2000 (Spring Rivers 2001). Affects to all of the species listed above and/or potential habitats should be affected favorably by implementation of the proposed action and accompanying preliminary 4(e) license conditions. In general, because the habitat requirements for the survey and manage species so closely resembles those of the Forest Service Sensitive listed aquatic mollusks, the effects described for those will apply here.

Increased discharge will affect the local environment of perhaps each and every one of the 100 or more cold water springs indicated from previous surveys. But beyond a possible requirement for adjusting the distribution of individuals, the proposed action should create beneficial effects. The organisms evolved in the Pit River with the natural discharge of 2,000 cfs in summer, and 3,000 cfs annually. It has already been determined that hydroelectric project development has severely impacted these species through water impoundments and diversions. Implementation of the proposed project will bring new bypass reach flows up to barely more than 20% of natural summer base flow levels. These flow changes can only be perceived as positive for the aforementioned aquatic mollusks once adjustments are made by existing individuals and newly created habitat is fully seeded.

Recommendation: Manage the Survey and Manage aquatic mollusks and suitable habitat, potentially affected by the Project and proposed action, in the same manner that the Forest Service Sensitive listed aquatic mollusks will be prescribed for. In addition, follow the management recommendations formally prescribed, to the greatest extent practicable, for each species found in the following document: "Management Recommendations for Survey and Manage Aquatic Mollusks", version 2.0; Furnish and Monthey 1998.

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