4.15 Amphibian Habitat Test Flow Study Plan

This study is designed to provide information relating to special status amphibian and aquatic reptile species in stream reaches associated with Sacramento Municipal Utility District's (SMUD's) Upper American River Project (UARP) and Pacific Gas and Electric Company's (PG&E's) Chili Bar Project. Changes in habitat quality and structure used by target special status amphibian species will be qualitatively evaluated during various flow release scenarios to assess potential effects that may be associated with SMUD and PG&E project operations. The overall approach is to assess habitat conditions under various flow regimes at sites where target special status amphibian species are documented during the 2003 Visual Encounter Surveys (VES).

4.15.1 Pertinent Issue Questions

This Test Flow Study Plan addresses the following Aquatic/Water Issue Questions:

1. Does the Project affect special-status species? If so, where and how?

This test flow study plan only addresses effects of flows on amphibians and amphibian habitat. The survey methods for determining the presence, distribution, and abundance of amphibians and aquatic reptiles are outlined in the Amphibian and Aquatic Reptile Study Plan, approved May 1, 2002. Other aquatic species and resources are addressed in the Fish Survey Study Plan and the Aquatic Bioassessment Study Plan (benthic macroinvertebrates).

4.15.2 Background

SMUD's Initial Information Package lists 18 amphibians and aquatic reptiles that have a potential to occur in the vicinity of the UARP and/or Chili Bar projects based on SMUD's review of existing information (SMUD 2001, pp. E3-6 through E3-11). As described in the Amphibian and Aquatic Reptile Study Plan, nine of these are special status species, four of which have a very low likelihood of being affected by either project: California tiger salamander (*Ambystoma californiense*), western spadefoot toad (*Scaphiopus hamondii*), northern leopard frog (*Rana pipiens*), and Mt. Lyell salamander (*Hydromantes platycephalus*). Also, the project area is beyond the documented range of Yosemite toad (*Bufo canorus*), so specific VES are not proposed for this species. Likewise, because habitat requirements for western pond turtle (*Clemmys marmorata*) are encompassed by the remaining special status species that could occur within the project area, species-specific VES for western pond turtle will not be conducted during 2003 surveys. Thus, the following species will be targeted for test flow studies, if they are documented to occur at VES sites based on the results of the 2003 surveys: California red-legged frog (*R. aurora*) (CRLF), foothill yellow-legged frog (*R. boylii*) (FYLF), and mountain yellow-legged frog (*R. muscosa*) (MYLF). All three species are targeted for the UARP. Only FYLF will be targeted for the reach downstream of Chili Bar, as all sites targeting CRLF in this reach occur upslope of the main channel. Habitat characteristics generally associated with the target amphibian species in lotic areas are summarized in Table 1.

4.15.3 Study Objectives

The objective of this study effort will focus on identifying suitable habitat that exists under variable flow releases at known locations of frogs. The focus and goal of this study is to further our understanding of the correlation between flow and habitat for various species and life stages of amphibians.

4.15.4 Study Area

The general study area will include the mainstem of all Project stream reaches as identified by the Aquatics TWG, including the reach downstream of Chili Bar Dam. The study area will not include Project reservoirs nor tributary streams flowing into Project-affected reaches since the Project cannot affect flow in these reaches. Test flow studies will be conducted at all sites where Visual Encounter Surveys (VES) determine target amphibian species and stages (egg/tadpole) presence (FYLF, CRLF, and MYLF).

Table 1. Habitat characteristics generally associated with the target amphibian species in lotic areas.			
Habitat characteristics in lotic areas for the different life stages of the target species*			
Habitat parameter	**CRLF**	**FYLF**	**MYLF**
basic habitat type (all life stages)	Wetlands, wet meadows, ponds, lakes, pools, & low-gradient, slow-moving stream reaches below 5,000 feet	Streams below 5,000 feet	Streams, lakes, pools, & low-gradient, slow-moving stream reaches above 4,500 feet
depth and velocity	▪ adults associated with deep (>0.7 m [USFWS Recovery Plan citation]), still, or slow-moving water ▪ Tadpoles found in greater numbers at depths of 0.26–0.5 m (Reis 1999, as cited in USFWS 2002)	▪ eggs typically laid in <40 cm water depth, <10 cm/sec water velocity (Seltenrich and Pool 2002) ▪ adult females prefer plunge pools in a small stream (Van Wagner 1996) ▪ on the South Yuba River deep, channelized stream habitats were used by adults (Yarnell 2000, as cited in Seltenrich and Pool 2002) ▪ The depth at which eggs were laid in the South Fork Eel study varied from 4 to 43 cm, with an average depth 19.7 cm (Kupferberg 1996a). Average velocities at oviposition sites were 0.1 ft/s (3.2 cm/s). ▪ Metamorph and post-metamorph R. boylii were associated with water that had a low flow velocity of 0.04 m/s (0.14f/s) ± 0.09 m/s (0.28 f/s) that was adjacent to water of intermediate to fast flow velocities (Borisenko and Hayes 1999)	▪ gently sloping margins along open streams, typically 5-8 cm water depth for refuge from predators (tadpoles) and for suitable water temperatures for development (egg-laying)
water temperature		▪ majority of egg laying follows high flow discharge in spring (March – early June) at water temperatures of approx. 12-15°C ▪ On the South Fork Eel River, oviposition commenced when water temperatures reached approximately 54o F (12 °C) (Kupferberg 1996a)	▪ can overwinter in lakes that are not completely frozen (Fed Reg. Vol. 68 p. 2285) ▪ breeding typically begins as snow begins to melt
gradient	▪ < or equal to 2% gradient for adult habitat	▪ eggs and tadpoles typically found along gently-sloping banks (Kupferberg 1996a, Borisenko and Hayes 1999)	▪
substrate composition	▪ eggs often laid on submerged large woody debris such as root wads of fallen trees or submerged parts of living willows/other vegetation	▪ cobble and boulder substrates most common for egg laying, but also uses bedrock and pebbles eggs usually laid on bare/clean rock surfaces; females will scrape rocks clean if necessary	▪ silt or mud substrates ▪ eggs are attached to rocks, gravel, vegetation, or undercut banks ▪ adults can be found on fine sand, rubble, and boulder substrates
distance from shore	▪ variable	▪ eggs are laid relatively close to shore – typically < 5 m from the water's edge (Kupferberg 1996a)	▪ adults are found relatively close to shore

Table 1 (continued)

Habitat characteristics in lotic areas for the different life stages of the target species*

Habitat parameter	CRLF	FYLF	MYLF
emergent vegetation cover	▪ egg masses are typically attached to emergent vegetation; juvenile frogs prefer this habitat, along with organic debris for food and cover.	▪ tadpoles require aquatic cover to escape predation	▪ emergent vegetation required for egg mass attachment
adjacent riparian vegetation	▪ Arroyo willow, cattails, and bulrushes provide the most structurally suitable shrubby vegetation (Jennings 1988)	▪ low to moderate shade for adult and juvenile habitats ▪ breeding habitats located away from overhead cover (Seltenrich and Pool 2002) along open, sunny stream margins	▪ aquatic/riparian vegetation for cover
presence/abundance of algae, macroinvertebrates, and predators	▪ bullfrogs, garter snakes, and introduced fishes are known predators ▪ tadpoles rely on algae for food; adults rely on invertebrates	▪ algae and/or diatoms required for tadpoles, juveniles; adult diet includes aquatic and terrestrial invertebrates (Kupferberg 1996a, b) ▪ introduced bullfrogs, crayfish and fishes are significant egg and tadpole predators (Kupferberg 1997)	▪ non-native fishes thought to exclude MYLF from certain habitats (V. Vrendenberg, pers. comm., 2003)

* Primary source: Jennings and Hayes 1994.

4.15.5 Information Needed From Other Studies

Information from other studies will assist in identifying the distribution, quality, and quantity of available habitat for amphibians. The needed information will include: 1) results from the Amphibian and Aquatic Reptiles Study on amphibian presence and habitat characteristics at sites where targeted amphibians are documented to occur during 2003 VES; and 2) results from the Hydrology Study on stream flow, ramping rates and reservoir elevations.

As information becomes available, additional data from the following studies may also be used to interpret test flow study results, including: 1) results from the Channel Morphology Study on coarse sediment supply dynamics as it relates to suitable substrates/habitats for amphibian breeding locations; 2) results from the Water Temperature Study on how hydroelectric project facilities and operations affect temperatures in project-affected reaches; 3) results from the Fish Survey Study on the distribution of potential predators on amphibians; 4) results from the Aquatic Bioassessment Study on the distribution of suitable prey taxa, particularly for FYLF adults (of the three target species, FYLF rely most heavily on macroinvertebrates for prey [S. Kupferberg, pers. comm., 2003]), and the potential effects of project operations on prey abundance; and 5) results from the Riparian Vegetation Study on the extent of riparian vegetation in providing cover for adult habitats, and on vegetation encroachment onto cobble bars and other surfaces suitable for egg laying.

4.15.6 Study Methods And Schedule

Phase 1 – Identify study sites and train field crew
As mentioned above, test flow study sites will be selected based on presence of the target amphibian species as documented during VES. These sites will be selected to cover a range of habitat types, if possible, and particular importance will be given to known breeding localities. The extent of each study site will depend on the extent of contiguous suitable habitat and may include areas farther upstream and/or downstream of the original VES site, if suitable habitat is present. Test flow releases will be conducted after the breeding stage has been completed for the above-mentioned species, so as to limit any potential negative effects on amphibian populations in the study area. Since the test flow studies will be conducted after the breeding season, habitat conditions (particularly vegetation and water temperature) are likely to be different than during the breeding period. Field crews will bring photographs of test flow study sites taken during the breeding season VES and compare the conditions with those observed in the field during test flow surveys, so as to account for changes when conducting the habitat suitability assessment.

Breeding site locations will be marked with semi-permanent monuments to allow for photographic comparisons between seasons and/or flow conditions.

Because there is a degree of subjective data collection for this study, all field crew members will be trained together, so that the collected data can be analyzed and compared collaboratively among sites. Measurements and estimations will be made for the habitat parameters listed below, using consistent methods. Datasheets will be reviewed and used during the field training session.

Phase 2 – Collect data
Because the methodology and data collection efforts will necessarily be different for the three target species, protocols for data collection efforts are described by species below. Since much of the previous work on test flow releases and the effects of flow on habitat have been conducted for FYLF, the most detail has been provided for this species. Should evidence of breeding and/or adult habitat be found for the other two target species (CRLF and MYLF) within the Project-affected reaches, a subgroup of the Aquatics TWG will convene to develop an approach, with the help of expert amphibian biologists, for assessing effects of flows on habitat for these species.

In general, data collection will focus on providing information for the following specific study questions:
(1) Where and how much suitable habitat occurs at the lowest test flow release, and how do the characteristics of that habitat change at each subsequent (increased) flow release?
(2) Where and how much suitable habitat occurs at each of the test flows under consideration?

Foothill yellow-legged frog
For FYLF, the focus of data collection will be on the effects of flows on breeding habitat (egg-laying and tadpole-rearing), as adults typically summer and overwinter in tributaries. One two-person team will collect the data at a given site for each of the test flows to ensure continuity in data collection efforts. Data collection will focus on measurable habitat variables known to be important to FYLF. If available, data collected during the VES will be used for comparison purposes, and data collected during the test flow study will use the same methods employed during the VES. Data collection will focus on egg deposition and tadpole rearing locations, but will also consider adult habitat. To answer questions regarding location and extent of suitable habitat, we will map polygons (whenever possible) at all test flows onto digital, ortho-rectified aerial photographs and characterize habitat parameters. It is understood that these are site-specific studies, and that the results should be interpreted accordingly.

For this analysis of the effect of flows on the location and extent of suitable habitat, suitable habitats for breeding will be initially identified at the lowest flow (Flow A), based on criteria presented in the table above. Suitable habitat areas will be sketched as polygons onto aerial photographs of the site. Polygons will be sequentially numbered from downstream to upstream directly onto the aerial photograph. The following parameters will be measured/estimated for each polygon and recorded onto a standardized datasheet ("Polygon Parameters"):
1. Shape (oval, square, triangle, etc.)
2. Length and width (to later calculate area)
3. Average depth and velocity
4. Water temperature
5. Site gradient
6. Substrate composition (percent sand, gravel, cobble, boulder, and bedrock)
7. Distance from shore (perpendicular distance from center of polygon)
8. Emergent vegetation cover (percentage)
9. Adjacent riparian vegetation (species composition, percent overhead cover, and distance between suitable aquatic habitat and shaded cover), particularly areas that could provide cover for ambush predators
10. Presence/abundance of algae, macroinvertebrates, and predators (on a site-scale)

The shape, length, and width measurements of the polygon coupled with the aerial photographs will be used to estimate the area of the polygon. Depth will be measured at several locations throughout the polygon. Velocity measurements will be taken in the water column, at 60% of the total depth (or 20% and 80% of total depth at depths equal or greater than 2.5 feet), and at the surface, at several locations (e.g., across transects or along velocity isopleths) throughout the polygon. Because of the possibility of differing temperatures in edgewater and main

channel habitats, water temperature will also be measured in each polygon. The gradient of the site will be measured using an auto level and stadia rod. Substrate composition within the polygon will be estimated according to the modified Wentworth (1922) scale. Distance from shore will be measured from the center of the polygon to the nearest water's edge. Percent cover of emergent vegetation will be estimated within each polygon. Emergent vegetation will be grouped, and will not necessarily be identified to genus/species. The species composition of nearby or adjacent riparian vegetation will be noted, and percent overhead cover will be estimated for each polygon. Because adults may depend on terrestrial shade cover, distance between the polygon and adjacent riparian cover will also be measured.

Observations related to algal cover, macroinvertebrate presence (qualitative observations), and predator presence will be made at the site-scale only, under the lowest flow (Flow A). If significant changes occur under higher test flows (e.g., algae becomes dislodged under highest test flow), additional observations will also be recorded.

Photographs of each site will be taken under each flow from the upstream and downstream ends as well as from the middle of the site. Photographs of each polygon under various test flows will also be taken.

Mapping and data collection at polygons will be conducted at each of the test flows. Each subsequent mapping effort after the lowest baseflow (Flow A) will involve both (1) taking measurements at the habitat polygons mapped at the previous (and lower) test flow, and (2) identifying habitat polygons that become available under the new test flow.

Table 2. Data to be collected under each test flow release.

Test Flow	Location of data collection	Factors to be assessed[1]
Flow A (lowest flow)	suitable habitat (polygons) under Flow A	Polygon Parameters
Flow B	polygons considered suitable habitat during Flow A	subset of Polygon Parameters[2]
	suitable habitat (polygons) under Flow B	Polygon Parameters
Flow C (highest flow)	polygons considered suitable habitat during Flow A, and B	subset of Polygon Parameters[2]
	suitable habitat under Flow C	Polygon Parameters

[1]See explanation for each of these factors in text descriptions above (in this section)

[2]The subset of parameters to be measured will include average depth and velocity and distance from shore. The subset will NOT include shape, length and width, water temperature, substrate composition, emergent vegetation cover, and adjacent riparian vegetation measurements because these will not change for the polygon with increased flows.

As outlined in Table 2, three or four test flows are proposed for release to quantify the availability of amphibian habitat at sites where amphibians are observed during the VES. Actual flow releases are specified in Table 3, and will be based on the natural hydrograph, project facility (valve) and operational limitations. Target flows and locations are specified in Table 3.

Table 3. Sites and target flows for amphibian habitat test flow studies.

Site	Target Study Flows
Camino Reach	Three flows similar to PHABSIM: 10, 30, and 100 cfs
Slab Creek	Three flows similar to PHABSIM: 40, 75, and 150 cfs, plus the lowest boating study flow (~500+ cfs)

California red-legged frog

For CRLF, the focus of the data collection will be to determine effects of flow on breeding habitat, including backwater and slow-water habitats with suitable substrates for oviposition, such as emergent vegetation and other plant material. Because CRLF is state and federally listed, efforts to document effects of flows on habitat for metamorphs and adults will also be included in the survey effort. A detailed methodology will be developed in coordination with Aquatics TWG members and CDFG and USFWS biologists if CRLF egg masses, tadpoles, and/or subadults/adults are found in Project-affected reaches.

Mountain yellow-legged frog
MYLF use of the Project area is not well known. Both stream-breeding populations and lake- or pond-breeding populations exist within the vicinity of the project area. As such, the study approach for MYLF will depend on what life stages are found within Project-affected reaches during the VES. If breeding is documented in stream reaches within the Project area, data collection efforts will focus on the effects of flows on breeding habitat within these streams. If only adults are documented in the stream reaches, data collection efforts will focus on the effects of flows on adult overwintering habitat (i.e., deep pools). A detailed methodology will be developed in coordination with Aquatics TWG members and CDFG and USFWS biologists if MYLF egg masses, tadpoles, and/or subadults/adults are found in Project-affected reaches.

Phase 3 – Analyze Data
- See Analysis Section below.

Test Flow surveys will be conducted in fall 2003.

4.15.7 Analysis

Data analysis will include evaluating the location and extent of suitable habitat areas at each site under various test flows, and as compared among test flows. Data analysis will be largely qualitative, with some quantitative data to compare extent of suitable habitat at each site. Analysis of photographs (both aerial and on-the-ground), and comparisons with site photographs taken during VES, will provide more insight into the distribution of suitable habitats during the breeding season, and professional judgment will be used to analyze the potential benefits of increased flows to amphibian populations.

4.15.8 Study Output

A written report including the issues addressed, objectives, description of study area and sampling locations (e.g., maps and photos), methods, results, discussion and conclusions will be prepared after field visits and analyses are complete. The report will be prepared in a format that can easily be incorporated into SMUD's and PG&E's draft environmental assessment that will be submitted to FERC with SMUD's/PG&E's application for a new license.

4.15.9 Preliminary Estimated Study Cost

A preliminary cost estimate will be prepared after the Plenary Group approves this study plan.

4.15.10 TWG Endorsement

This study plan was approved on August 26, 2003 by the following participants of the Aquatic TWG: USFS, USBLM, Camp Lotus, PG&E, SWRCB, SMUD and CDFG. No participant said they could not "live with" the study plan. The Plenary Group approved the plan on September 9, 2003. The participants a the meeting who said they could "live with" this study plan were USFS, SWRCB, NPS, CDFG, El Dorado County, Taxpayers Association of El Dorado County, Teichert Materials, ARRA/Camp Lotus, El Dorado Irrigation District, SMUD, PCWA, City of Sacramento, FOR, and PG&E. None of the participants at the meeting said they could not "live with" this study plan.

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