

Study 3.1

AQUATIC MACROINVERTEBRATES UPSTREAM OF ENGLEBRIGHT RESERVOIR

November 2010

1.0 Project Nexus

Yuba County Water Agency's (YCWA or Licensee) continued operation and maintenance (O&M) of the existing Yuba River Development Project (Project) has a potential to affect aquatic macroinvertebrates (BMI), which are considered a Forest Sensitive Species (FSS) by the United States Department of Agriculture Forest Service (Forest Service), upstream of the United States Army Corps of Engineer's (USACE) Englebright Dam.

2.0 Resource Management Goals of Agencies with Jurisdiction Over the Resource to be Studied

[Relicensing Participants - This section is a placeholder in the Pre-Application Document (PAD). Section 5.11(d)(2) of 18 CFR states that an applicant for a new license must in its proposed study "*Address any known resource management goals of the agencies or Indian tribes with jurisdiction over the resource to be studied.*" During 2010 study proposal development meetings, agencies advised Licensee that they would provide a brief written description of their jurisdiction over the resource to be addressed in this study. If provided before Licensee files its Proposed Study Plan and Licensee agrees with the description, Licensee will insert the brief description here stating the description was provided by that agency. If not, prior to issuing the Proposed Study Plan, Licensee will describe to the best of its knowledge and understanding the management goals of agencies that have jurisdiction over the resource addressed in this study. Licensee]

3.0 Existing Information and Need for Additional Information

Some sampling for BMI occurred in stream reaches potentially affected by the Project as recently as 2007. The South Yuba River Citizens League (SYRCL) collected three samples in the Middle Yuba River upstream of the Oregon Creek confluence (2004-2006) using the California Stream Bioassessment Protocol. They collected an average of 37 taxa with a tolerance value of 5.15 over this period (SYRCL 2007).

Additional data is needed to address potential Project effects on BMI..

4.0 Study Goals and Objectives

The goal of the study is to characterize BMI assemblages within Project-affected reaches upstream of Englebright Reservoir using the SWAMP protocol.

The objective of the study is to collect aquatic macroinvertebrate and physical data to meet the study goals.

5.0 Study Methods and Analysis

5.1 Study Area

For the purpose of this study, the study area includes 1) the Middle Yuba River from and including Our House Diversion Dam Impoundment to the confluence with the North Yuba River, 2) Oregon Creek from and including the Log Cabin Diversion Dam Impoundment to the confluence with the Middle Yuba River, 3) the North Yuba River from and including New Bullards Bar Dam Reservoir to the confluence with the Middle Yuba River, and 4) and the portion of the Yuba River from the confluence of the North and Middle Yuba rivers to Englebright Reservoir.

If YCWA proposes an addition to the Project, the study area will be expanded if necessary to include areas potentially affected by the addition. Sampling below Englebright Reservoir is not part of this study plan.

5.2 General Concepts and Procedures

The following general concepts and practices apply to the study:

- Personal safety is the most important consideration of each fieldwork team.
- Licensee will make a good faith effort to obtain permission to access private property where needed well in advance of entering the property.
- Field crews may make minor variances to the FERC-approved study in the field to accommodate actual field conditions and unforeseen problems. When minor variances are made, Licensee's field crew will follow the protocols in the FERC-approved study.
- When Licensee becomes aware of major variances to the FERC-approved study, Licensee will issue an e-mail to the Relicensing Contact List describing the variance and reason for the variance. Licensee will contact by phone the Forest Service (if the variance is on National Forest System land), USFWS, SWRCB and CDFG to provide an opportunity for input regarding how to address the variance. Licensee will issue an e-mail to the Relicensing Contact List advising them of the resolution of the variance. Licensee will summarize in the final study report all variances and resolutions.
- Licensee's performance of the study does not presume that Licensee is responsible in whole or in part for measures that may arise from the study.

- Global Positioning System (GPS) data will be collected using either a Map Grade Trimble GPS (sub-meter data collection accuracy under ideal conditions), a Recreation Grade Garmin GPS unit (3 meter data collection accuracy under ideal conditions), or similar units. GPS data will be post-processed and exported from the GPS unit into Geographic Information System (GIS) compatible file format in an appropriate coordinate system using desktop software. The resulting GIS file will then be reviewed by both field staff and Licensee's relicensing GIS analyst. Metadata will be developed for deliverable GIS data sets.
- Licensee's field crews will record incidental observations of aquatic and wildlife species observed during the performance of this study. All incidental observations will be reported in the appropriate Licensee report (e.g., incidental observations of special-status fish recorded during fieldwork for the Special-Status Turtles – Western Pond Turtle Study will be reported in Licensee's Stream Fish Populations Study report). The purpose of this effort is not to conduct a focus study (i.e., no effort in addition the specific field tasks identified for the specific study) or to make all field crews experts in identifying all species, but only to opportunistically gather data during the performance of the study.
- Field crews will be trained on and provided with materials (e.g., Quat) for decontaminating their boots, waders, and other equipment between study sites. Major concerns are amphibian chytrid fungus, and invasive invertebrates (e.g., zebra mussel, *Dreissena polymorpha*). This is of primary importance when moving: 1) between tributaries and mainstem reaches; 2) between basins (e.g., Middle Yuba River, Yuba River, and North Yuba River); and 3) between isolated wetlands or ponds and river or stream environments.

5.3 Study Methods

The study methods consist of the following four steps: 1) select sampling sites; 2) collect SWAMP data; 3) analyze SWAMP data; 4) QA/QC SWAMP data; and 5) prepare report. Each of these is discussed below

Licensees will obtain all necessary permits prior to performing fieldwork.

5.3.1 Step 1 – Select Sampling Sites

Licensee will collect BMI data at 7 sites, which are generally located upstream and downstream of major Project facilities. The general locations, from upstream to downstream on each reach, are:

- Middle Yuba River
 - Within 0.5 mile downstream of Our House Diversion Dam
 - Immediately upstream of Oregon Creek
 - Immediately upstream of confluence with North Yuba River
- Oregon Creek
 - Within 0.5 mile downstream of Log Cabin Diversion Dam
 - Immediately upstream of confluence with Middle Yuba River

- North Yuba River
 - Within 0.5 mile downstream of New Bullards Bar Dam
 - Immediately upstream of confluence with North Yuba River

To the extent possible, the sites will be co-located with other relicensing study sites, such as for fish sampling upstream of the USACE's Englebright Reservoir and, as a second priority, with locations where BMI samples have been historically collected.

Licensee will select the sites, and then invite interested and available Relicensing Participants into the field to comment on selected sites.

5.3.2 Step 2 – Collect SWAMP Data

5.3.2.1 Data Collection

Sampling methods will conform to the standard targeted riffle composite (TRC) methods for documenting and describing BMI assemblages and physical habitat described by the SWRCB's Surface Water Ambient Program (SWAMP) in February 2007. Each study site will be wadeable and about 250 meters (m) in length. Before sampling begins, the number of riffle habitat units contained in the site will be visually estimated. A total of eight samples will be taken from a targeted riffle habitat within the site to form a single composite riffle sample. More than one kick sample per riffle may be collected. However, if there are fewer than eight distinct riffles in the site, sampling points will be spread throughout the site as much as possible. If there are more than eight riffles in the site, one or more riffle units will be skipped at random. When possible, each riffle will have a "core area" defined, avoiding edges along channel margins and the upstream or downstream edges of the riffle. The core area of each riffle will be divided into nine equal quadrants in a three by three grid. One quadrant will be randomly selected for a kick sample. If more than one sample must be collected from a particular riffle, a second quadrant will be randomly chosen and sampled. Samples will be taken moving upstream from the most downstream riffle unit to minimize instream disturbance..

Samples will be collected by rubbing cobble and boulder substrates and disturbing finer substrate upstream of a D-frame kicknet fitted with a 0.02-inch (in.) diameter mesh net. Each of the eight subsamples collected to form the composite riffle sample will cover one square foot of the stream bottom. A one square foot grid will be used when taking samples to ensure consistency of sample area. The subsamples will be combined in a jar, preserved with 95 percent ethanol, and labeled to form a single composite sample for that study site.

Physical habitat and water quality will be characterized at each site. The habitat scoring criteria outlined by the SWAMP provides an effective measure of the physical integrity of a stream. Prior to implementation, field crews will calibrate their visual measurements on a test stream. The following list of quantitative measures of chemical and physical/habitat characteristics will be collected at each site:

- Reach-wide Parameters
 - GPS coordinates
 - Water temperature, specific conductance, pH, and dissolved oxygen using approved standardized procedures and instruments
 - Total length and gradient (percent slope) and average width and depth
- Transect-specific Parameters
 - The wetted width of each riffle will be taken at a minimum of three cross-sectional transects and averaged.
 - Water velocity (using a topset rod and flowmeter) will be measured at each of the eight sample points.
 - Substrate composition will be visually estimated at each sample point (area disturbed in front of the net) using the following categories: fines (<0.25 cm), gravel (0.25 to 0.8 cm), cobble (0.8 to 25 cm), boulder (>25 cm), and bedrock.
 - A pebble count will also be conducted along a single transect established from each sample point. This parameter will be measured by randomly choosing 10 points along the transect, reaching down to the point at the end of a wooden dowel or tip of the boot, and measuring the width of the particle along the intermediate axis. “Pebble count” in this context is in reference to the sample approach first described by Wolman (1954) and adapted for use (including reduced sample size) in the SWAMP protocol. It does not refer to a specific size class of sediment.
 - Substrate consolidation and percent embeddedness will also be characterized while conducting the pebble count. Estimates will be obtained while collecting the BMI sample by noting whether the substrate is lightly, moderately, or heavily surrounded by fine sediment.
 - Average canopy cover will be estimated at each riffle sampled using a densiometer four times from the center of habitat unit.
 - If field or analytical methods deviate from SWAMP protocols, reasons for the deviation and alternate methods will be explained and documented.

Each composite sample will be rinsed in a standard no. 35 sieve (0.5 mm) and transferred to a tray with twenty, 4 inch square grids for subsampling. Subsampling will be performed using a stereomicroscope with magnifications of 10 to 20 times magnification.

Subsamples will be transferred from randomly selected grids to Petri dishes where the aquatic macroinvertebrates will be removed indiscriminately with the aid of a stereomicroscope and placed in vials containing 70 percent ethanol and 2 percent glycerol. In cases where aquatic macroinvertebrates abundance exceeds 100 organisms pre grid, half grids will be delineated to assure that a minimum of three discreet areas within the tray of benthic material will be subsampled. At least 500 aquatic macroinvertebrates will be subsampled from a minimum of five grids, or five half grids.

The debris from the processed grids will be placed in a remnant jar and preserved in 70 percent ethanol for later quality control testing. Subsampled aquatic macroinvertebrates will be identified by a taxonomist approved by the California Department of fish and Game (CDFG) for U.S. Environmental Protection Agency (USEPA) evaluations using standard aquatic macroinvertebrate identification keys (e.g., Kathman and Brinkhurst 1998, Merritt and Cummins 1996, Stewart and Stark 1993, Thorp and Covich 2001, Wiggins 1996) and other appropriate references.

All organisms retained on a 0.5-mm screen will be removed from the subsample and a standard level one taxonomic effort will be used as specified in the Southwestern Association of Freshwater Invertebrate Taxonomists (SAFIT) in 2006. Historical datasets that may have been identified using a different method, such as CAMLnet (CDFG 2003) or to a different taxonomic level will be standardized to the SAFIT level one before calculating metrics or running statistical analyses.

Finally, the CDFG Aquatic Bioassessment Laboratory (ABL) will be contracted to perform an external QC review of the sample identification. Fifteen to twenty percent of the samples collected will be randomly selected for QC by the taxonomist and sent to the CDFG ABL.

5.3.3 Step 3 - Data Analysis

Analytical methods will conform to the standard methods describing BMI assemblages and physical habitat outlined by SWAMP. Standard biological metrics, plus additional relevant metrics, will be calculated for each site (Table 5.3.3-1) and presented in graphical or tabular form.

Table 5.3.3-1. Biological metrics calculated to assess BMI assemblages

BMI Metrics	Description	Predicted Response to Impairment
RICHNESS MEASURES		
Taxonomic Richness	Total number of individual taxa	Decrease
No. EPT Taxa	Number of taxa in the insect orders Ephemeroptera, Plecoptera, and Trichoptera	Decrease
Ephemeroptera Taxa	Number of mayfly taxa	Decrease
Plecoptera Taxa	Number of stonefly taxa	Decrease
Trichoptera Taxa	Number of caddisfly taxa	Decrease
Coleoptera Taxa	Number of beetle taxa	Decrease
COMPOSITION MEASURES		
% EPT	Percent of the composite of mayfly, stonefly, and caddisfly larvae	Decrease
% Ephemeroptera	Percent of mayfly nymphs	Decrease
Shannon Diversity Index	General measure of sample diversity that incorporates richness and evenness	Decrease
TOLERANCE/INTOLERANCE MEASURES		
California Tolerance Value (CTV)	CTVs between 0 and 10 weighed for abundance of individuals designated as pollution tolerant (higher values) and intolerant (lower values)	Increase
No. of Intolerant taxa	Taxa richness of those organisms considered to be sensitive to perturbation	Decrease
% Tolerant Organisms	Percent of macrobenthos considered to be tolerant of various types of perturbation	Increase
% Dominant Taxon	Measures the dominance of the single most abundant taxon. Can be calculated as dominant 2, 3, 4, or 5 taxa	Increase

Table 5.3.3-1. (continued)

BMI Metrics	Description	Predicted Response to Impairment
FEEDING MEASURES		
% CF+CG Individuals	Percentage of BMIs within the collector-filterer and collector gatherer functional feeding groups	Increase
% Scrapers	Percent of macroinvertebrates that graze upon periphyton	Variable
% Non-gastropoda Scrapers	Percentage of BMIs within the scraper functional feeding group excluding gastropod scrapers	Decrease
% Predators	Percent of macroinvertebrates that prey on living organisms	Decrease
% Shredders	Percent of macroinvertebrates that shred leaf litter	Decrease

5.3.4 Step 4 – Analyze SWAMP Data

Aquatic macroinvertebrates will be identified to Southwest Association of Freshwater Invertebrate Taxonomists (SAFIT) level 2 (Richards and Rogers 2006), and metrics outlined in Rehn *et al.* (2007) will be calculated. Metrics will be used to formulate the Hydropower IBI described by Rehn (2009).

5.3.5 Step 5 – Prepare Format and Quality Assurance/Quality Control SWAMP Data

Following data collection and identification of taxa, Licensee will subject all data to quality assurance/quality control (QA/QC) procedures including, but not limited to, spot-checks of data and review of electronic data for completeness. If any datum seems inconsistent, Licensee will investigate the problem. Data QA/QC will include the CDFG ABL review described above.

5.3.6 Step 6 – Prepare Report

Licensees will prepare a report that includes the following sections: 1) Study Goals and Objectives; 2) Methods and Analysis; 3) Discussion; and 4) Description of Variances from the FERC-approved study proposal, if any. In addition, the report will compare the data collected with any historic data that are available.

6.0 Study Proposal Consultation

This study proposal includes one study-specific agency consultation:

- Licensees will invite interested and available Relicensing Participants into the field to comment on selected sampling sites.

7.0 Schedule

Licensee anticipates the schedule to complete the study as follows assuming the PAD is filed on November 1, 2010, and FERC issues its Study Determination by October 4, 2011:

Select Sampling Sites (Step 1).....	May 2012
Collect Data (Step 2).....	July 2012
Analyze Data (Step 3).....	August 2012
QA/QC (Step 4)	September 2012
Prepare Report (Step 5).....	October 2012

8.0 Consistency of Methodology with Generally Accepted Scientific Practices

This study is consistent with the methods used in other FERC hydroelectric relicensing efforts in California where BMI are an issue.

9.0 Level of Effort and Cost

[Relicensing Participants – YCWA will include a cost range estimate for this study in its Proposed Study Plan. Licensee]

10.0 References Cited

California State Water Resources Control Board Surface Water Ambient Monitoring Program (SWAMP) Bioassessment SOP 001.

Kathman, R.D., and R.O. Brinkhurst. 1998. Guide to the freshwater oligochaetes of North America. Aquatic Resources Center, College Grove, TN. 264 pp.

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