

## 17.0 Chili Bar Reservoir Sediment Deposition Study Plan

This study is designed to investigate the quantity and general composition of sediment that has been deposited in Chili Bar Reservoir since the Chili Bar Dam was constructed in 1964, and the potential impacts of this sediment deposition on the 20-mile-long section of the South Fork American River from Chili Bar Dam to Folsom Reservoir (Reach Downstream of Chili Bar). The study would be conducted in three phases. Phase One would include a reservoir bathymetric study to determine the amount of deposition within the reservoir. Phase Two would occur concurrently with Phase One and would include sampling in the upper end of Chili Bar Reservoir at low water levels to characterize sediment composition. In Phase Three, the Licensees would then evaluate the significance of reduced sediment supply to the Reach Downstream of Chili Bar in context of the ongoing relicensing environmental studies. The results of the study would be reported to the UARP Relicensing Aquatic TWG and included in both the Sacramento Municipal Utility District's Upper American River Project (UARP) license application and Pacific Gas and Electric Company's Chili Bar Project license application. For the purpose of this study plan, SMUD and Pacific Gas and Electric Company are referred to jointly as the Licensees.

### 17.1 Pertinent Issue Questions

The UARP Relicensing Aquatic Technical Working Group (TWG) has not developed specific issue questions for this study plan. At the March 11, 2004 Aquatic TWG Meeting, the Licensees agreed to develop this plan in response to a September 9, 2003, letter from Banky Curtis of the CDFG to Randal Livingston of Pacific Gas and Electric Company, which transmitted the CDFG's comments on Pacific Gas and Electric Company's Chili Bar Project First Stage Consultation Document (FSCD). Specifically, CDFG's comment was:

Bathymetry and Reservoir Sediment Composition: The Department is concerned that disruption of natural bedload movement needs to be studied. The Department would like to discuss appropriate bathymetric sampling protocols to determine the quantity and composition of material being trapped behind the Chili Bar Dam and other upstream impoundments.

Also, in Pacific Gas and Electric Company's Chili Bar Relicensing Joint Meeting B, questions were raised by Bill Center of Camp Lotus:

What are the effects of sediment in Chili Bar Reservoir? How is PG&E going to address the sediment that is in the reservoir?

### 17.2 Background

Interested parties in SMUD's UARP Relicensing and Pacific Gas and Electric Company's Chili Bar Relicensing have postulated that deposition in Chili Bar Reservoir impacts ecological resources in the Reach Downstream of Chili Bar. This Chili Bar Reservoir Sediment Deposition Study Plan assumes that sediment would deposit in Chili Bar Reservoir in a fashion typical to long sinuous reservoirs. Deposition is a function of sediment size and water velocity. Sediment that is mobilized in streams at high water velocities is deposited in reservoirs as water velocities decrease. Typically, the larger-sized sediment deposits in the upper portion of the reservoir where water velocities decrease rapidly, usually resulting in a depositional fan and sediment bars near the inlet, which are conspicuous when the reservoir is low. Finer-sized sediment, such as silt, remain mobilized at lower velocities and move further into the reservoir before depositing, or pass through the reservoir entirely. This often results in a layer of fine silt and sand on the bottom of the reservoir with the greatest depth of deposition near the toe of the dam where velocities are lowest. This general pattern of deposition was observed at SMUD's Slab Creek Reservoir during a 1992 bathymetric and sediment survey. At Slab Creek Reservoir, most of the sediment was found in the upper portions of the reservoir. Sediment deposition in the lower portion of the reservoir was generally less 10 inches deep and composed chiefly of silt or mud.

Note that Pacific Gas and Electric Company has not dredged or otherwise made special efforts to reduce sediment deposition in Chili Bar Reservoir since the dam was constructed, nor has Pacific Gas and Electric Company needed to alter Project operations due to sediment behind the dam.

### 17.3 Study Objective

The study objectives would be to: 1) estimate the amount of sediment deposition in Chili Bar Reservoir; 2) generally characterize the composition of the deposited sediment; and 3) place Chili Bar Reservoir sediment deposition in context with environmental conditions observed in the Reach Downstream of Chili Bar.

### 17.4 Study Area

The study area would include Chili Bar Reservoir and the Reach Downstream of Chili Bar. This study plan does not propose any additional fieldwork in the Reach Downstream of Chili Bar.

### 17.5 Information Needed From Other Studies

Information needed from other studies includes the Licensees' various environmental studies being performed in the Reach Downstream of Chili Bar. Information from SMUD's Slab Creek Reservoir Sediment/Turbidity Study may also be useful. In addition, the results from this study would be used in other relicensing studies. For instance, the change in Chili Bar Reservoir usable storage would be used in the Chili Bar Reservoir Incremental Storage Study, and the updated Chili Bar Reservoir area-capacity may be incorporated in the UARP/Chili Bar CHEOPS™ Water Balance Model, if appropriate.

### 17.6 Study Methods, Analyses, and Schedule

As described above, the study would be performed in three phases, each of which is described below.

#### **Phase One – Estimate Quantity of Deposition in Chili Bar Reservoir**

In Phase One, the Licensees would estimate the amount of sediment deposition currently in Chili Bar Reservoir by 1) comparing a current reservoir area-capacity curve to the project as-built area-capacity curve, and 2) examining existing aerial photographs, if available.

To develop a current Chili Bar Reservoir area-capacity curve, the Licensees would first prepare a bathymetric map of Chili Bar Reservoir. A Trimble Pro XRS differential Global Positioning System (GPS) and a digital depth sounder would be mounted on a motorboat to collect depth soundings at regular intervals according to a predetermined survey plan. Mapping would occur when Chili Bar Reservoir is at full pool. The GPS data logger would record sub-meter horizontal accuracy. Water surface elevations (and depth) would be monitored using a Solinst levellogger pressure transducer (accuracy of about 4 cm) that would be installed to reference a local benchmark and surveyed to a known United States Geological Survey (USGS) elevation. If a local USGS benchmark does not exist, one would be installed. Depths and positions would be collected in a predetermined grid pattern (about 150 feet between transects). Areas of greater sediment deposition concern, such as at the upstream end of the reservoir and near the toe of the dam, might require smaller grids to better map the changes in sediment levels. This determination would be made in the field as sampling is performed. The Licensees would generate a bottom profile map, and from this a current Chili Bar Reservoir area-capacity curve. To determine the net amount of deposition that has occurred since the Chili Bar Dam was constructed, the current area-capacity curve would be compared to the reservoir's as-built drawings. Due to typical inaccuracies in as-built drawings of this type, the Licensees would assume an error of at least plus or minus 10 percent in the as-built drawings.

The Licensees would compute the difference in gross storage (total volume of the reservoir) and the difference in usable storage (from the minimum operating level of 984 feet to the spill crest elevation of 997.5 feet) in Chili Bar Reservoir. The latter information would be incorporated into the Chili Bar Reservoir Incremental Storage Study to determine the extent to which sediment deposition has reduced usable storage (and the feasibility of reclaiming this storage capacity).

During Phase One, the Licensees would also take digital aerial photos of Chili Bar Reservoir at surface water elevation level of 984 feet, minimum operating pool. Photos at full pool are currently available. The Licensees would compare these photos to historic photos, if available, to determine any changes to the depositional pattern that has occurred over time.

### **Phase Two – Characterize Deposited Sediment**

Concurrently with Phase One, the Licensees would generally characterize the composition of the material deposited in Chili Bar Reservoir. As discussed above, in reservoirs such as Chili Bar, most sediment deposits in fans or in sediment bars near the stream inlet. Therefore, the Licensees will focus study efforts in this area. The investigations would include:

- Generally estimating the depth of deposited sediment in the fan and sediment bars at the upstream end of Chili Bar Reservoir Dam. When the reservoir is drawn down, the Licensees would establish about five transects across each major fan and sediment bar, and estimate the depth of sediment along each transect at 50 foot intervals by pounding a graduated metal bar into the ground. The sediment depth would be considered to be the depth at which the bar meets firm resistance.
- Estimating sediment composition by performing at each location where depth is estimated as described above. At each of these locations, the Licensees would estimate streambed particle size by conducting Wolman (1954) pebble counts. In addition, the Licensees will make a good faith effort to use a standard, hollow-core, hand auger along the transects to determine the sediment composition in the fan and sediment bars at depths. All sediment size information will be presented using the Wentworth scale (Wentworth 1922).

### **Phase Three – Evaluate Effect of Chili Bar Dam Sediment Deposition on Ecological Effects in the Reach Downstream of Chili Bar**

In Phase Three and using the information gathered in Phases One and Two and in the Licensees' relicensing studies in the Reach Downstream of Chili Bar, the Licensee will evaluate the significance of reduced sediment supply to the Reach Downstream of Chili Bar.

#### 17.7 Study Output

The study plan output would be a technical report prepared in the same format as the UARP Relicensing technical reports have been prepared to date, unless requested to be revised by the TWGs. It is anticipated that the report would be summarized in SMUD's UARP license application and Pacific Gas and Electric Company's Chili Bar Project license application, and appended to each application.

#### 17.8 Aquatic TWG And Plenary Group Endorsement

The Aquatics TWG approved this plan on March 25, 2004. The participants at the meetings who said they could "live with" this study plan were CDFG, USFS, BLM, SWRCB, Camp Lotus, PG&E and SMUD. None of the participants at the meeting said they could not "live with" this study plan. This study plan will be presented to the April 7, 2004 Plenary Group meeting for consideration for approval.

The study plan was approved by the Plenary Group on April 7, 2004 without modification. There was no one present at the meeting who objected to the study plan going forward for implementation.

#### 17.9 Literature Cited

Wentworth, C. K., 1922. A scale of grade and class terms for clastic sediments. *Journal of Geology* 30:377-392.

Wolman, M. G., 1954. A method of sampling coarse river-bed material. *EOS Transactions. American Geophysical Union* 35: 951-956.