Lassen Lodge Hydroelectric Project
FERC No. 12496

Sediment Transport Assessment Study Plan

Introduction:

On April 21, 2014 Rugraw, LLC (Rugraw), the license Applicant, submitted a Final License Application (FLA) to the Federal Energy Regulatory Commission (FERC) for the Lassen Lodge Project (Project) No. 12496 located on South Fork Battle Creek (SF Battle Creek) in Tehama County, California. Following a review period, several state and federal agencies provided comments on the FLA including California Department of Fish and Wildlife (CDFW) on June 20, 2014, the National Marine Fisheries Service (NMFS) on June 12, 2014, and the California State Water Resources Control Board (SWRCB) on June 19, 2014. Following receipt and review of comments from the resource agencies and review of the Applicant's supplemental information submittal, the FERC sent Rugraw an Additional Study Request on October 3, 2014. The request was for two additional studies related to water temperature and sediment transport modeling. In addition to the study requests, FERC noted that the Applicant should develop study plans and consult with the applicable resource agencies in development of those plans. The following information defines the sediment transport modeling study plan developed in consultation with the agencies, and Attachment 1 contains the agency consultation record.

Purpose:

Conduct screening level sediment transport assessment of the Upper Battle Creek channel area for the Lassen Lodge Hydroelectric Project upstream, at and downstream from the proposed diversion site and upstream, at and downstream from the power house site to address FERC requests for additional studies. Information from these studies will support the FERC License Application and Water Quality Certification Application being prepared by the project Applicant - Rugraw, LLC, for the Project.

Approach:

Use study methods generally accepted in the scientific community to determine channel hydraulics (depth, velocity, shear stress), determine sediment mobilizing flows, and establish sediment transport characteristics and approximate sediment loads based on sediment transport capacity methods for representative channel reaches upstream, at and downstream from the proposed diversion structure and power house.

Proposed Methods and Task Descriptions:

1. Perform Study Area Cross Section Surveys; Locate and Survey High Water Marks:
    a. Survey channel cross sections upstream, at and downstream from the proposed diversion structure: Three (3) surveyed channel cross sections will be located upstream, two cross sections (2) at, and three cross sections (3) downstream from the proposed location of the diversion structure. Survey channel thalweg profile from upstream most cross section to downstream most cross section.

b. Survey channel cross sections upstream, at and downstream from the proposed power house: Three (3) surveyed channel cross sections will be located upstream, two cross sections (2) at, and three cross sections (3) downstream from the proposed location of the power house. Survey channel thalweg profile from upstream most cross section to downstream most cross section.
c. During the field surveys, the survey team will locate and survey high water marks at the two proposed project sites (the diversion site and the power house site) that are suitable for hydraulic model calibration.
d. During the field surveys, the survey team will also survey edge-of-water elevations at each cross section and estimate (where possible) approximate flows associated with those water levels.

2. Collect Representative Sediment Bed Material Samples; Estimate Reach Average "n" Values: Collect surface and subsurface bed sediment materials at or near the selected surveyed cross section locations at the (a) diversion structure and the (b) power house during the channel cross section surveys. Bed surface armor material grain size distributions will be determined by pebble count method. Subsurface sediment material characteristics (grain size distribution) will be determined by pebble count and, if significant sand and fine gravels are present in the subsurface materials, laboratory sieve analyses of bucket samples will be conducted. During the sediment sampling program, approximate reach average "n" values required for hydraulic modeling and sediment calculations at both sites will be visually estimated and photo-documented for the proposed study reaches upstream, at, and downstream from the proposed diversion structure and power house sites. Representative channel slopes along the proposed diversion structure and power house study subreaches will be determined using GPS methods and surveyed cross section and thalweg data.

3. Prepare 1-Dimensional Steady State HEC-RAS Model for both Study Reaches: Use standard model preparation and testing procedures to "build and test" a HEC-RAS hydraulic model for the (a) diversion structure study reach and (b) the power house study reach. Surveyed channel cross sections, bed slope, high water mark elevations, along with visual estimates of reach average channel "n" values and published "n" value data from other steep-gradient mountain streams similar to South Fork Battle Creek, will be used to calibrate the hydraulic models. Standard model sensitivity assessments will be performed to test and confirm model reliably.

4. Identify Key Flows Needed for Hydraulic and Sediment Analyses: Applicant will consult with interested agencies to identify minimum in-stream flow (Q_{misf}), range of expected project operational flows (Q_{ops}) and flow split scenarios (total bypass flow vs. flow through the penstock), the 2-year flow (Q_2) and 5-year flow (Q_5) needed for these analyses. The HEC-RAS model will be applied with these flows to compute hydraulic properties (D, V, hydraulic gradient, and shear stress) for both representative study reaches. Tables of hydraulic results needed for sediment analyses will be prepared for both subreaches.

5. Determine *Baseline* Sediment Mobilization Flows for Both Study Reaches: Determine threshold flows (Q_{cr}) required to mobilize important sediment material sizes in the channel at both study reaches without the project in place (e.g., baseline condition) at three locations along the channel: (1) in the representative reach upstream from the proposed diversion or power house structures, (2) the area affected by the proposed diversion or power house structures, and (3) the representative reach located downstream from the diversion and power house structures. Use this information to define baseline (no project) threshold pass-through flows required to mobilize and move sediments past the proposed structures for the range of flows listed in Task 4, above. Compute baseline sediment transport capacity and sediment load estimates for the study reach based on transport capacity and representative grain size being transported for each flow scenario. Prepare baseline transport capacity and load rating curves (sediment transport capacity-based load vs. pass through flow) for the study reach.

6. Determine *With-Project* Sediment Mobilization Flows for Both Study Reaches: Next, assume the project is in place and determine if important sizes of sediment materials are still mobilized and moving in suspension or along the bed by the same flows in the same representative channel subreaches (upstream, at and downstream from both structures) considered for the Baseline Condition. If sediment materials are determined to be moving through the natural channel flow bypass reach during project operations, compute with-project sediment transport capacity and sediment load estimates for the total estimated bypass flow based on diversion structure designs and resulting bypass hydraulics and sediment transport capacity for each flow scenario at both structure locations. Estimate the representative grain size and sediment load moving downstream with the design bypass flows associated with the expected range of operating (diversion and bypass) scenarios. Summarize with-project sediment mobilization thresholds, transport capacity and sediment load estimates passing the diversion structure for each flow scenario.

7. Compare *Baseline* to *With-Project* Results for Both Study Reaches: Compare baseline results (Task 5) to the with-project results (Task 6). Prepare tables of results.

8. Prepare Draft Report that Summarizes Responses to SWRCB and FERC Questions and Requests for Additional Information Related to Effects the Project Operations may have on Flow and Sediment Transport. Provide Applicant and their Study Team with an Internal DRAFT report that summarizes possible effects that proposed project Operations may have on flow (discharge), current in-stream hydraulics (D, V, hydraulic gradient, shear stress), project design sediment and flow bypass hydraulics, and associated sediment transport processes. Discuss review comments with Applicant and Study Team and revise draft report accordingly.

9. Prepare Draft Summary Report for Review by Agencies: Applicant will prepare and provide a Draft Summary Report to FERC and the reviewing Agencies for comment.