EXHIBIT ARWA-800

TESTIMONY OF CHRISTOPHER HAMMERSMARK, Ph.D., P.E.

1. I am a registered civil engineer in the State of California and am employed by the firm of cbec, Inc. A copy of my resume, which accurately describes my education and experience, is Exhibit ARWA-801.

2. I have participated in a wide range of fisheries-related projects during my career including:

    a. The design and evaluation of salmonid spawning and rearing habitat enhancement projects within the lower American River and other Central Valley rivers, as well as along the California coast, including main channel, side channel, floodplain, ephemeral lakes and estuarine environments;

    b. Design and evaluation of salmonid passage projects (e.g., dam removal, barrier creation, channel modification, and critical riffle analyses);

    c. Evaluation of thermal suitability for salmonids, including water temperature monitoring and modeling;

    d. Potential redd dewatering assessments;

    e. Development of fine- and coarse-grain decision support models to guide resource allocation toward fisheries improvements (i.e., for the American River and for the Central Valley);

    f. Development of operational plans for water resource projects to minimize impacts and maximize benefits for fisheries.

3. I have been a part of the team that developed and analyzed the Water Forum's proposed Lower American River Modified Flow Management Standard (Modified FMS or MFMS). The Modified FMS is accurately described in Technical Memorandum 1, *Project Description - Lower American River Modified Flow Management Standard*, which is Exhibit ARWA-602. The proposed water-right terms and conditions that would be applied to the Bureau of Reclamation's (Reclamation) Permits Nos. 11315 and 11316 to implement the Modified FMS are Exhibit ARWA-502.

4. I participated in the development of the *Biological Rationale, Development and Performance of the Modified Flow Management Standard* (Biological Rationale), which describes the biological rationale for the Modified FMS. The Biological Rationale is Exhibit ARWA-702. In particular, I developed the daily flow disaggregation technique that is used as an input to several components of the fisheries analysis. Technical Memorandum 10, *Lower American River Flow Management Standard Daily Flow Disaggregation - Modified Flow Management Standard*, provides an explanation of the development and application of this tool. Technical Memorandum 10 is Exhibit ARWA-802.

5. I participated in the development of the Steelhead Redd Dewatering Protective Adjustments that are part of the Modified FMS. Further explanation of the Steelhead Redd Dewatering Protective Adjustments is provided in the Biological Rationale.

6. I have reviewed the lower American River temperature modeling. Those results are depicted in the Biological Rationale and in Exhibit ARWA-908, respectively. In my opinion, in comparison to existing conditions as represented by the 2006 Flow Management Standard that Reclamation currently implements under the National Marine Fisheries Service's 2011 Biological Opinion, the Modified FMS provides improved thermal conditions in the lower American River for steelhead, and similar thermal conditions for fall-run Chinook salmon in the lower American River.

7. My conclusions concerning the effect of the Modified FMS on steelhead and Chinook salmon in the lower American River are based on the following water temperature modeling results: examination of the water temperature exceedance distribution comparisons demonstrate that the Modified FMS would result in similar or cooler water temperature conditions during the months of the year of March through October, evaluated at all three locations (Hazel Ave, Watt Ave, and Paradise Beach).