

Study 7.11

# ASSESSMENT OF NARROWS 2 POWERHOUSE FACILITIES AS A BARRIER TO ANADROUMOUS FISH UPSTREAM MIGRATION<sup>1</sup>

August 2011

## 1.0 Project Nexus

Yuba County Water Agency's (Licensee or YCWA) continued operation and maintenance (O&M) of the Yuba River Development Project (Project) has the potential to affect salmonid fish species in the Yuba River downstream of United States Army Corps of Engineers' (USACE) Englebright Dam.<sup>2</sup>

This study focuses on the anadromous salmonid species listed as threatened under the federal Endangered Species Act (ESA) - spring-run Chinook salmon (*Oncorhynchus tshawytscha*) and Central Valley steelhead (*Oncorhynchus mykiss*), as well as fall-run Chinook salmon (*O. tshawytscha*), a federal species of concern.

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

YCWA believes that four agencies have jurisdiction over fish that could be potentially affected in the geographic area included in this study proposal: 1) United States Department of Interior, Fish and Wildlife Service (USFWS); 2) United States Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service (NMFS); 3) California Department of Fish and Game (CDFG); and 4) State Water Resources Control Board, Division of Water Rights (SWRCB). Each of these agencies and their jurisdiction and management direction, as understood by YCWA at this time, is discussed below.

### USFWS

USFWS's jurisdiction and goals and objectives are described by USFWS on pages 1 through 3 of USFWS's March 7, 2011 letter to FERC that provided USFWS's comments on YCWA's Pre-Application Document, or PAD (YCWA 2010). USFWS's jurisdiction, goals and objectives are not repeated here.

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<sup>1</sup> Where this study proposal states that information for the study is being developed by the Lower Yuba River Accord River Management Team (RMT), if the RMT does not develop the information as described in this study proposal, YCWA will develop the information. Also, all information developed as part of the relicensing, whether it is developed in the relicensing process or developed in the RMT process and brought into the relicensing, will be made public when YCWA files its final study report. Further, if this study relies on information from RMT data, report or analytics, YCWA will attach the relevant RMT work product to the relicensing report for this study.

<sup>2</sup> Englebright Dam was constructed by the California Debris Commission in 1941; is owned, operated and maintained by the United States Army Corps of Engineers and is not included as a Project facility in FERC licenses for the Yuba River Development Project.

### NMFS

NMFS's statutory authorities and responsibilities are described by NMFS in Section 2.0 of Enclosure A in NMFS's March 7, 2011 letter to FERC providing NMFS's comments on YCWA's PAD. NMFS's jurisdiction and responsibilities are not repeated here.

### CDFG

CDFG's jurisdiction is described by CDFG on page 1 of CDFG's March 2, 2011 letter to FERC providing CDFG's comments on YCWA's PAD. CDFG's goal, as described on page 2 of CDFG's letter is to preserve, protect, and as needed, to restore habitat necessary to support native fish, wildlife and plant species within the FERC boundaries and downstream of the Project as resources are affected by ongoing facility operations.

### SWRCB

SWRCB has authority under the federal Clean Water Act (33 U.S.C. §11251-1357) to restore and maintain the chemical, physical and biological integrity of the Nation's waters. Throughout the relicensing process the SWRCB maintains independent regulatory authority to condition the operation of the Project to protect water quality and the beneficial uses of stream reaches consistent with Section 401 of the federal Clean Water Act, the Regional Water Quality Control Board Basin Plans, State Water Board regulations, CEQA, and any other applicable state law.

## **3.0 Study Goals and Objectives**

The overall goal of this study plan is to identify and assess conditions in the immediate vicinity of the Narrows 2 powerhouse, and how the facilities and operations impact anadromous fish. The objectives of the study are to: 1) evaluate whether or not the various lifestages of anadromous fish are affected by Narrows 2 Powerhouse during operations – including transient operations involving start ups or shut downs; 2) describe existing information regarding the presence, absence, timing and abundance and migration behaviors of anadromous fish in the vicinity of Narrows 2 Powerhouse draft tube and outfall structure; 3) characterize physical aspects of Narrows 2 facilities, including hydraulic characterization in the vicinity of Narrows 2 facilities that may affect anadromous fish behavior (e.g., water velocity, turbulence, and water temperature), particularly whether operations affect fish passage past the facility; 4) define channel characteristics (e.g., widths, depths, velocities, and temperatures) to enable an assessment as to whether or not operation of the facility inhibits the continuity of upstream fish passage; and 5) describe the historical incidence, or potential future likelihood, of fish stranding, mortality, or injury resulting from “false attraction” into the powerplant structure.

## **4.0 Existing Information and Need for Additional Information**

Water from Englebright Dam and Reservoir is released either through the Narrows 1 Powerhouse, the Narrows 2 Powerhouse, or, if Englebright Reservoir is full, the dam spillway (FERC 1992). Controlled releases are made through the Narrows 1 and Narrows 2 powerhouses up to about 4,200 cfs; above that amount, releases are made via the spillway at the top of Englebright Dam and are essentially uncontrolled.

The Narrows 2 powerhouse incorporates a vertical-axis Francis-type turbine and draft tube. Flow through the turbine exits downward through a draft tube, thence out to the Yuba River via a tailrace. The inside dimensions of the draft tube gradually increase as the flow path approaches the river; thus the velocity of flow through the tailrace decreases as flow nears the river. When the unit is started, flow changes are fairly gradual as the various start-up sequences, paralleling with the electrical grid, and unit loading take place. Once the unit is connected to the electrical grid, unit loading (and flow increase) are ramped up gradually.

Annual maintenance requires the Narrows 2 Powerhouse to be shut down for a 2- to 3-week period, or longer if major maintenance is performed. Maintenance is typically conducted during mid-September. YCWA's maintenance activities at Narrows 2 Powerhouse include generator brush replacement, which requires a 6-hour shut down 2 to 3 times per year, and annual maintenance, which typically requires a 2 to 3 week shut down, but may be longer if major maintenance is needed (NMFS 2005). During brush maintenance prior to 2006, the 650 cfs bypass valve at Narrows 2 could be opened, because that work did not involve working near the bypass valve itself. During annual maintenance prior to 2006 however, the Narrows 2 bypass valve usually could be operated, and Narrows 1 Powerhouse was used to maintain instream flows in the lower Yuba River. Consequently, in the absence of water spilling over the top of Englebright Dam, flows in the lower Yuba River were reduced to a maximum of 650 cfs for several days to several weeks, depending on the type of maintenance (NMFS 2005). YCWA schedules annual maintenance activities at Narrows 2 during periods when the potential for redd dewatering and fish stranding is the lowest (late August to mid-September), as determined by redd and fish stranding surveys (NMFS 2005).

In 2006, YCWA constructed a full-flow bypass on the Narrows 2 Powerhouse which allows approximately 3,000 cfs (or 88 percent), of the full 3,400 cfs capacity of the powerhouse to be bypassed around the power generation facilities to maintain river flows during emergencies, maintenance, and accidental shut-downs of the powerhouse (NMFS 2007). This bypass minimizes the possibility that emergencies or other events requiring that the Narrows 2 Powerhouse be taken offline will cause significant flow fluctuations in the lower Yuba River, and thereby minimizes the possibility that such fluctuations will strand juvenile spring-run Chinook salmon and steelhead, or dewater redds of those species (NMFS 2005). In the event of an emergency shutdown of the Narrows 2 turbine, the full-flow bypass automatically opens to the same flow rate as had been present through the powerhouse.

Before this bypass was completed, flow reductions resulting from emergency and accidental shutdowns of the Narrows 2 Powerhouse were a major concern due to adverse flow and water temperature effects on listed spring-run Chinook salmon and steelhead. The ability to manage releases from Englebright Dam during maintenance and emergency operations was limited by the design of Englebright Dam and the bypass capability of the Narrows 2 Powerhouse, which was previously only able to bypass 650 cfs (or approximately 20 percent) of the 3,400 cfs capacity of the powerhouse. In the past, uncontrolled flow reductions due to unexpected outages at Narrows 2 adversely affected spawning redds and fry/juvenile rearing areas (FERC 2001). However, with the completion of the full-flow bypass in 2006, adverse effects to listed species due to emergencies, maintenance, and accidental shut-downs of the powerhouse have been virtually eliminated.

Previously, it has been reported that spring-run Chinook salmon in the lower Yuba River hold over during the summer in the deep pools and cool water downstream of the Narrows I and Narrows 2 powerhouses, or further downstream in the Narrows Reach (CDFG 1991; SWRCB 2003), where water depths can exceed 40 feet (YCWA et al. 2007). Congregations of adult Chinook salmon (approximately 30 to 100 fish) have been observed in the outlet pool at the base of the Narrows 2 Powerhouse, generally during late August or September when the powerhouse is shut down for maintenance. During this time period, the pool becomes clear enough to see the fish (M. Tucker, NMFS personal observation, September 2003; S. Onken, YCWA, pers. comm., 2004, both as cited in NMFS 2007). While it is difficult to visually distinguish spring-run from fall-run Chinook salmon in this situation, the fact that these fish are congregated this far up the river at this time of year indicates that some of them are likely to be spring-run Chinook salmon (NMFS 2007).

The Yuba River downstream of Englebright Dam is one of the more thoroughly studied rivers in the Central Valley of California. A description of existing information regarding salmonid populations downstream of Englebright Dam is provided as Attachment 1 to Study 7.8 – ESA and CESA Listed Salmonids Downstream of Englebright Dam. The attachment describes available field studies and data collection reports, other relevant documents, and ongoing data collection, monitoring and evaluation activities including the Yuba River Accord Monitoring and Evaluation Program (M&E Program) and other data collection and monitoring programs. Specifically, Attachment 1 of Study 7.8 summarily describes 21 available field studies and data collection reports, 20 other relevant documents (e.g., plans, policies, historical accounts and regulatory compliance), 14 ongoing data collection, monitoring and evaluation activities for the Yuba River Accord Monitoring and Evaluation Program (M&E Program), and 4 other data collection and monitoring programs.

Some physical habitat information exists for the Englebright Dam Reach (EDR) in the immediate downstream vicinity of the Narrows 2 Outfall pool (Pasternack 2010). Key data include a bathymetric survey and digital elevation model of the reach, substrate pebble counts, water surface elevation observations, georeferenced historical aerial photos, and observations of Chinook salmon attempting to spawn on bedrock. At the time that Fulton (2008) performed his 2D modeling analysis in 2005-2006 to assess flow-habitat relations, sediment entrainment, and geomorphic processes, available data were limited to just the reach between the Narrows 2 pool and the Narrows I powerhouse. Subsequently, Pasternack (2008a) did do a few 2D model simulations of the EDR using a newer software program suitable for that length of canyon. Pasternack et al. (2010) reported a detailed historical aerial photo analysis of the EDR focusing on the history and status of Sinoro Bar in the vicinity of the confluence with Deer Creek. Finally, Pasternack (2009) did reconnaissance of the EDR to map the movement of injected gravel and cobble out of the Narrows 2 pool and quantify a sediment budget for that material. Additional information regarding physical habitat in the EDR is provided in Pasternack (2009).

Need for additional information includes characterization of cross-sectional water depth and velocity profile at the Narrows 2 Outfall location. Information regarding the burst and sustained swimming speeds of Chinook salmon and steelhead needs to be compiled. Additional

information needs include obtaining historical operational records of the Narrows 2 Powerhouse to characterize outfall flow rates during the migration periods of anadromous salmonids.

## **5.0 Study Methods and Analysis**

### **5.1 Study Area**

The study area includes the Yuba River from Englebright Dam downstream to approximately 200 ft downstream of the Narrows 2 Powerhouse.

### **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. Upon request, GIS maps will be provided to agencies in a form, such as ESRI Shapefiles, GeoDatabases, or Coverage with appropriate metadata, that is useful for interactive data analysis and interpretation. Metadata will be Federal Geographic Data Committee (FGDC) compliant.<sup>3</sup>

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<sup>3</sup> The Forest Service and CDFG each have requested that a copy of the GIS maps be provided to them when the maps are available.

- 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) moving between basins (e.g. Middle Yuba River, Yuba River, and North Yuba River); and 3) moving between isolated wetlands or ponds and river or stream environments.

### 5.3 Study Methods

This study will consist of the following four steps: (1) compile data from previously conducted and ongoing studies; (2) obtain physical habitat information (water depth and velocity profiles in the vicinity of the Narrows 2 Outfall); (3) conduct the analyses necessary to accomplish the previously stated goals and objectives; and (4) prepare report.

#### 5.3.1 Step 1 – Compile Data from Previously Conducted and Ongoing Studies

Information regarding salmonid populations in the Yuba River downstream of Englebright Dam will be obtained from previously conducted and ongoing studies, including the dates and locations of data collection to the extent possible. Examples of relevant fisheries information include adult anadromous salmonid upstream migration and holding lifestage periodicities and habitat utilization in the study area. Physical habitat information includes all available information associated with bathymetric maps, water depths and velocities, and applicable hydraulic model information.

Data compilation activities also will be undertaken to characterize the frequency of occurrence of flow rates emanating from the Narrows 2 Powerplant outfall during the upstream migration periods of spring-run Chinook salmon, steelhead, and fall-run Chinook salmon. Data will include available historic operational records at the Narrows 2 Powerplant, and determination of flow splits during this period between PG&E's Narrows I Powerplant and Narrows 2.

Typical unit operations for the Narrows 2 Powerplant (e.g., start up, ramp up, shut down) will be described, and the accompanying changes in rate of flow will be calculated. Similarly, the opening and closing sequence for the full-flow bypass will be described, along with changes in rates of flow.

Physical habitat data within and adjacent to the Narrows 2 Powerhouse and full-flow bypass will be compiled. Design data including draft tube and tailrace dimensions and river channel

dimensions in the river channel adjacent to the powerhouse and bypass will also be obtained from existing map data. Information obtained from secure drawings will be generally discussed and publicly available drawings will be presented within the report.

### **5.3.3 Step 2 – Obtain Physical Habitat Information**

A cross section(s) will be established in the immediate vicinity of the Narrows 2 Powerplant Outfall. Water depth and velocity data will be collected along the transect(s) when Narrows 2 is operating at rates characteristic of those during the upstream migration periods of spring-run Chinook salmon, steelhead, and fall-run Chinook salmon, to the extent possible, subject to safety considerations. It is presently anticipated that the data collection process will be initiated from the wetted perimeter located on the opposite side of the Narrows 2 Outfall, and continue as far as possible, subject to safety considerations. Water depths and velocities will be collected by a top-setting wading rod and electronic water velocity meter.

### **5.3.4 Step 3 - Conduct Analyses**

The analyses will consist of two principle components. One component will consist of comparison of water depths and velocities along the contiguous lateral distance at the location of the Narrows 2 Outfall compared with burst and sustained swimming speeds of anadromous salmonids to evaluate whether a functional migratory pathway exists over the range of Narrows 2 operational conditions during the appropriate temporal periodicities associated with upstream migration of each of the anadromous salmonid species.

The other component will consist of comparing water depths and velocities collected during the first component along the flow pathway from the Narrows 2 turbine and the full-flow bypass valve to proximally downstream. Water velocities for the flow pathway will be calculated under both steady state and flow change. Under a flow change, three measurements would be done to document the change (i.e., start up, ramp up and shut down). Flow pathway depth and velocity characteristics will be compared to burst and sustained swimming speeds of anadromous salmonids to evaluate the potential for injury to adult salmonids in the vicinity of the Narrows 2 powerhouse and bypass as a result of project operations.

### **5.3.4 Step 4 – Prepare Report**

YCWA will prepare a report that includes the following sections: 1) Study Goals and Objectives; 2) Methods and Analysis; 3) Results; 4) Discussion; and 5) Description of Variances from the FERC-approved study, if any. The report will contain relevant summary data, tables and graphs.

## **6.0 Study-Specific Consultation**

This study proposal includes the following study-specific consultation:

- Invite interested and available Relicensing Participants into the field to comment on selection of sampling sites.

- In addition, YCWA will consult with the Yuba Accord RMT to use data obtained by the RMT through implementation of the M&E Program, in support of this study plan.

## **7.0 Schedule**

YCWA anticipates the schedule to complete the study as follows assuming FERC issues its Study Determination by September 16, 2011 and the study is not disputed by a mandatory conditioning agency:

Compile Data from Previous and Ongoing Studies (Step 1) .....	October 2011 - January 2012
Obtain Physical Habitat Information (Step 2) .....	October 2011 - August 2012
Conduct Analysis (Step 3) .....	August - September 2012
Prepare Report (Step 4).....	September 2012

## **8.0 Consistency of Methodology with Generally Accepted Scientific Practices**

The methods presented in this study plan are consistent with other generally accepted scientific study methods concerning anadromous salmonid population assessments, including those conducted by the Resource Agencies in California.

## **9.0 Level of Effort and Cost**

YCWA estimates that the cost to complete this study in 2011 dollars is between \$35,000 and \$55,000.

## **10.0 References Cited**

- California Department of Fish and Game (CDFG). 1991. Lower Yuba River Fisheries Management Plan. Final Report. Stream Evaluation Report No. 91-1. February 1991.
- Federal Energy Regulatory Commission (FERC). 1992. Environmental Assessment for Hydropower License for the Narrows project. FERC Project No. 1403-004. Washington, D.C.
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- Fulton, A. A. 2008. Gravel for Salmon in Bedrock Channels: Elucidating Mitigation Efficacy Through Site Characterization, 2D-Modeling, and Comparison Along the Yuba River, CA. University of California.
- National Marine Fisheries Service. 2005. Biological Opinion Based on Review of the Proposed Yuba River Development Project License Amendment for Federal Energy Regulatory Commission License No. 2246, Located on the Yuba River in Yuba County, California, and Its Effects on Threatened Central Valley Spring-Run Chinook Salmon

(*Oncorhynchus tshawytscha*) and Central Valley Steelhead (*O. mykiss*), in Accordance With Section 7 of the Endangered Species Act of 1973, As Amended.

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- Yuba County Water Agency (YCWA). 2010. Yuba River Development Project relicensing Pre-Application Document. Yuba County Water Agency, Marysville, CA. <http://www.ycwa-relicensing.com>.

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