Evaluation of a Fish Passage Site in the Walla Walla River Basin, 2009

Annual Report

September 2008 - August 2009

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Prepared for

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Bonneville Power Administration
Division of Fish and Wildlife
Portland, Oregon

Project Number 2007-396-00
Contract Number 26934 Rel. 17

August 2009

Summary

In 2009, Pacific Northwest National Laboratory (PNNL) evaluated the Touchet Consolidated Facility to determine if it is designed, constructed, operated, and maintained to effectively provide juvenile salmonids with safe passage past the diversion and back to the Touchet River.

Completed in 2008, the Touchet Consolidated Facility combined two irrigation diversions with an existing intake for the Touchet Acclimation Facility. The consolidated facility includes a separate fish screen and intake for each user, a pool and chute fishway, and an adult fish trap. The fish screens portions of the facility were evaluated on April 20, 2009, using underwater videography, acoustic Doppler velocimeter measurements, and visual observations while water was diverted to the acclimation facility alone and again as water was diverted to the irrigation system and pond together.

The facility is in good condition and is well maintained, although water velocities within the site do not meet the criteria set by the National Marine Fisheries Service (NMFS). Approach velocities above 0.4 ft/s at the upstream end of the facility and decreases in sweep velocity toward the bypass are likely caused by the proximity of the upstream screen to the spill over stoplogs that control flow at the upstream end of the forebay. We recommend working with Touchet Acclimation Facility staff to try different configurations and heights of forebay stoplogs while PNNL staff measure water velocities, allowing real-time monitoring of changes in approach and sweep velocities resulting from the configuration changes. It may be possible to bring approach and sweep velocities more in line with the NMFS criteria for juvenile fish screens. We also recommend evaluating the facility later in the year when river levels are low and the irrigation district is the only water user.

During the site visit, it was noted that the upstream end of the fishway has relatively closely spaced louvers that point downstream. During higher river levels such as on April 20, the orientation of the louvers causes a headloss of up to 1 ft or more. Fish must maneuver through this hydraulic jump and between the louvers. The Washington Department of Fish and Wildlife is considering alternatives to this configuration; if needed, we would be available to offer technical assistance.

Acknowledgments

I'd like to thank the following people for their help and cooperation. Sarah Branum, Bonneville Power Administration, provided valuable support and directed the project. Glen Mendel and Doug Maxie of the Washington Department of Fish and Wildlife provided needed information on the operation and maintenance of the site and help during the evaluation. Jessica Carter's knowledge of and assistance with the performance of the evaluation were greatly appreciated. Andrea Currie and Lila Andor provided essential editing and formatting.

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1.0 Introduction

The Northwest Power and Conservation Council (NPCC) Columbia River Basin Fish and Wildlife Program lists fish protection through effective screening of irrigation diversions as an essential element in its plan to restore declining steelhead and salmon runs (NPPC 1984, 1987, 1994, 2000). Evaluation of new sites as they become operational confirms that site design, construction, and operation allow juvenile salmonids to pass the diversion smoothly and rapidly without entrainment or impingement. Data collected at sites designed to protect juvenile salmonids passing irrigation diversions are compared to draft criteria for juvenile salmonid fish screen facilities released by the National Marine Fisheries Service (NMFS 1995).

One new site, the Touchet Consolidated Facility, was evaluated in 2009. The new facility consolidates two irrigation intakes (Hern and West End) with the existing intake for the Touchet Acclimation Facility (TAF). The TAF includes a pool and chute fishway and fish trap, all designed to provide safe passage for salmonids and other native species. Completed in 2008, the Touchet Consolidated Facility is located about three-quarters of a mile south of Dayton on the Touchet River's west shore and immediately upstream of a diversion dam (Figure 1).

Figure 1. Location of the Touchet Consolidated Facility in the Walla Walla basin

Two traveling belt screens, 8 ft long and 5 ft high, prevent fish from entering either the TAF or the irrigation pipelines (Figure 2). The upstream screen is run when the TAF needs water in March and April; the second, downstream screen is run when the irrigation district needs water, primarily in April to October but occasionally throughout the year. The aftbay is separated into two sections, one for each user,

Figure 2. Touchet Consolidated Facility, looking at both screens, Touchet River on the left

separated by a wall containing boards that can be removed to allow water to move between the two aftbay sections if one of the screens is not operational. Each aftbay section has its own headgate controlling water to the user's pipeline.

A 30-in.-wide bypass leading to a 70-ft-long pipe 12 in. in diameter returns fish to the river. Forebay levels are controlled by three sets of stoplogs that can be adjusted by adding or removing boards as necessary. Washington Department of Fish and Wildlife (WDFW) staff operates the facility during March and April when the TAF needs water; during the remainder of the operating season, personnel from the West End Irrigation District operate the site. The two agencies coordinate operation if irrigation starts before the TAF shuts down in April.

The fish trap is separated from the screen facility forebay by a cement wall. The fishway is on the river side of the fish trap (Figure 3). Attraction water for the pool and chute fishway is provided by water moving through an opening to the river just downstream of the intake for the screen facility. Fish cannot pass from the forebay to the fishway or fish trap unless they swim upstream from the bypass outfall into the fishway entrance.

On April 20, 2009, Pacific Northwest National Laboratory (PNNL) staff measured water velocities and inspected the fish screen portion of the facility. Underwater videography and acoustic Doppler velocimeter measurements were used to determine whether the site is designed, constructed, and operated to meet the draft NMFS criteria and provide juvenile salmonids safe passage past the diversion without delay. Results of the evaluation are provided in this report.

Figure 3. Touchet Consolidated Facility, looking upstream, with the fish trap, fishway, and Touchet River to the left

2.0 Equipment and Methods

Pacific Northwest National Laboratory researchers developed the methods currently used for evaluating screening facilities while conducting similar studies at fish screen facilities in the Yakima River basin (Blanton et al. 1998, 1999, 2000; McMichael et al. 2004; Chamness et al. 2007). The following is a brief discussion of the equipment and techniques used in 2008; a more detailed description of the equipment and techniques is provided in Chamness et al. (2007).

Underwater videography was accomplished using a digital deep-sea camera (DeepSea Power and Light, Inc., Model MULTI-SEACAM 1050) mounted on a long pole and connected to a digital video recorder (Sony Video Walkman, Model GV-D800), which was connected in turn to a pair of video glasses (Olympus Eye-Trek, Model FMD-200). This setup allowed the operator to observe in real time what the camera encountered and provided good control over what was recorded digitally. This system improves the potential to identify problems, such as debris buildup or the presence of fish.

Water velocities were measured using a SonTek acoustic Doppler velocimeter (ADV; SonTek/YSI, Inc., San Diego, California). The ADV probe emits sound at 10 kHz and measures the difference in the frequency of sound waves reflected from particles in the water to determine the water velocity. Return times to each of three receivers extending out at an angle from the transmitter are used to calculate the

three-dimensional water velocity at a point 4 in. below the probe. Water velocity data were collected at each location for 30 s at a rate of 2/s and stored directly onto a computer. PNNL protocols for measuring water velocities in front of a fish screen set the probe pointing down and oriented to simultaneously measure the velocity of water flowing past the screen face (sweep) and the velocity of water flowing perpendicular to the screen face (approach). When forebay water depths are greater than 48 in., velocity measurements are taken at both high and low positions in front of the screens, corresponding to 20% and 80% of the measured depth. If water depths are less than 48 in., measurements are made at a middle depth corresponding to 60% of the measured forebay depth.

There are three operating conditions at the Touchet Consolidated Facility:

- water withdrawals for the Touchet Acclimation Facility only, with upstream screen running
- water withdrawals for both the TAF and irrigation, with both screens running
- water withdrawals for irrigation purposes only, with the downstream screen running.

We hoped to measure water velocities under the first two operating conditions listed above (i.e., with both users withdrawing water and with just the TAF withdrawing water), to determine how the site functioned under single and multiple use. However, cool spring weather meant irrigation water was not being withdrawn on that day. Irrigation district personnel were present and opened the irrigation headgates and turned on the second traveling belt screen, allowing water to move through the screens and through a return pipe back to the river about 1800 ft downstream of the screen site. This approximated water use by the irrigation district and allowed us to obtain measurements with both water users withdrawing water at the same time.

Criteria for the design of Yakima Phase II fish screen facilities were developed by the National Marine Fisheries Service (NMFS 1995). These criteria provide guidelines for determining whether a site is constructed, operated, and maintained in a way that protects juvenile salmonids (McMichael et al. 2004). PNNL staff compared evaluation results with these draft criteria in analyzing the water velocity measurements at the Touchet Consolidated Facility fish screens.

3.0 Results

Measurements were first made when only the TAF screen was turning and the facility was withdrawing approximately 6 cfs, somewhat higher than its normal 4.5–5 cfs. Forebay stoplogs were set as usual for the river level that day, with the same number of boards and spill in each of the three slots. Velocity measurements were made at three positions in front of both screens and in the bypass entrance at 20% and 80% of the forebay depth.

The irrigation district screen was then turned on, its headgate opened to allow water to flow about 1800 ft through a pipe back to the river, and one stoplog was removed from each of the forebay slots to increase flow into the forebay. Maximum water rights for both irrigation ditches combined is roughly 3.8 cfs, but the actual amount being withdrawn during our evaluation is unknown because neither irrigation ditch was taking water that day. Forebay water levels dropped 9 in. before reaching equilibrium, and velocity measurements were made at 60% of forebay depth at the same positions as the first set of measurements.

As can be seen in Figure 4, the upstream slot is close to the first screen (below the person with the white shirt), and there is a lot of turbulence as the water drops into the forebay. The ADV operates by measuring the speed of particles moving past, and in very turbulent areas, too many particles go in too many directions for a valid measurement to be made. We were unable to get good velocity measurements in the most upstream position during all attempts and in the high position; i.e., 20% of forebay depth, in the middle of the upstream screen when only the TAF was withdrawing water.

Figure 4. Forebay stoplogs set for Touchet Acclimation Facility water withdrawals

Sweep velocities did not increase toward the bypass, although bypass velocities were higher than the closest screen sweep velocity measurement under both operating conditions (Figure 5). When only the TCF was running, sweep velocities were higher near the bottom of the forebay in front of the running upstream screen and higher near the surface in front of the downstream screen, which was not running. When both screens were running and both users were withdrawing water, sweep velocities generally were more moderate but decreased at the downstream end of each screen. The draft NMFS criterion suggests a smoothly increasing flow toward the bypass to encourage fish to pass through the site quickly.

Approach velocities were below the NMFS draft criterion of 0.4 ft/s in 8 of 9 good velocity measurements made with only the TAF withdrawing water, and 4 in 5 good measurements with both users withdrawing water (Figure 6). In both cases, high approach values were measured in the middle of the upstream screen where the spill over the stoplogs is closest to the screens. When both users were withdrawing water, water was moved from the aftbay to the forebay at the downstream end of the second screen, indicated by the negative approach velocity.

Figure 5. Sweep velocities in front of screens at the Touchet Consolidated Facility. Error bars represent turbulence.

Figure 6. Approach velocities in front of screens at the Touchet Consolidated Facility. Error bars represent turbulence.

Screens and seals appeared to function properly and be in good condition, and no sediment or debris was noted in front of the screens. A small amount of sediment had accumulated in the bypass but was not a problem. No fish were seen in the forebay or aftbay, although adult steelhead and other fish were actively migrating upstream through the fishway.

We halted our evaluation while Snake River Laboratory staff closed off the fish trap to check captured adult fish for tags before releasing them back to the fishway. They blocked water from the fish trap and lowered the water levels until fish could be easily captured. The effect of blocking the water from the fish trap was quickly evident in the screen facility, where the water level rose nearly 1 ft.

Although not part of our evaluation, we noted that the upstream end of the fishway has relatively closely spaced louvers that point downstream. During higher river levels such as occurred on April 20, the orientation of the louvers causes a headloss of up to 1 ft or more. Fish must maneuver through this hydraulic jump and between the louvers. The WDFW is considering alternatives to this configuration.

4.0 Conclusions and Recommendations

The Touchet Consolidated Facility is a multipurpose facility that is well-maintained. Turbulence in the upstream end of the forebay prevented accurate measurements of water velocities at the upstream end, but it appears approach velocities exceed NMFS draft criteria in more than 10% of the measurements we made under both operating conditions. Sweep did not increase toward the bypass, although bypass flow was strong and moved freely. It may be worthwhile trying different configurations of the forebay stoplogs to see if turbulence and high approach velocities at the upstream end of screen 1 can be reduced without causing a back eddy in that area or inordinately increasing the approach velocities at screen 2.

We propose working with WDFW staff at the Touchet Acclimation Facility to try different stoplog configurations and different gradational heights of stoplogs while water velocities are measured using a velocimeter to immediately measure effects of the changes in configuration. In addition, evaluation of the site when only the irrigation district is using water would determine whether there are any issues for safe fish passage related to low river levels later in the year.

The WDFW is considering alternatives to the louver configuration in the fishway attraction water entrance; we would be available to offer technical assistance, if needed.

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