

# Lower Columbia River Forebay Temperature Monitoring – Phase 1 and Phase 2 Scope of Work

## Purpose

There is regional interest in more rigorous monitoring of water temperatures in the forebays and within the fish ladders of the three Lower Columbia River (LCR) Dams - John Day, The Dalles and Bonneville. This stems from concerns regarding fish ladder water temperature differentials and subsequent delayed migration of adult salmonids. A water temperature data collection effort is currently being carried out by the Walla Walla District to monitor conditions at the lower four Snake River Dams and McNary Dam; efforts should be standardized across both Districts to the extent possible.

## Current Water Temperature Monitoring

Water temperatures are currently monitored at the LCR dams mid-fish ladder as well as upstream and downstream of each dam at the Total Dissolved Gas (TDG) Fixed Monitoring Stations (FMS) (Table 1).

**TABLE 1. CURRENT WATER TEMPERATURE MONITORING LOCATIONS, LCR DAMS**

<b>ID</b>	<b>Monitor Type</b>	<b>Location</b>
JDAAN1	Hobo Temperature Monitor	North Exit Pool
JDAAN2	Hobo Temperature Monitor	North Entrance Pool
JDAAS1	Hobo Temperature Monitor	South Exit Pool
JDAAS2	Hobo Temperature Monitor	South Entrance Pool
JDY	TDG Temperature Monitor	Forebay Temperature
JHAW	TDG Temperature Monitor	Tailwater Temperature
TDAAN1	Hobo Temperature Monitor	North Ladder Count Station
TDAAE1 (TDA)	TDG Temperature Monitor	Forebay Temperature
TDDO	TDG Temperature Monitor	Tailwater Temperature
TDAAE2	Hobo Temperature Monitor	East Ladder Count Station
BONAB1	Temperature Monitor	Bradford Island Count Station
BONAN1	Temperature Monitor	Washington Shore Count Station
BONAN2	Temperature Monitor	Washington Shore Adult Fish Facility downstream return pool
BONAL1	Temperature Monitor	Bradford Island Lamprey Passage Structure, near exit
BONAL2	Temperature Monitor	Cascade Island Lamprey Passage Structure
BONAL3	Temperature Monitor	Washington Shore Auxiliary Water Supply Lamprey Passage Structure
BONAL4	Temperature Monitor	Washington Shore North Downstream Entrance Lamprey Flume/Passage System
BON	TDG Temperature Monitor	Forebay Temperature
CCIW	TDG Temperature Monitor	Tailwater Temperature
WRNO	TDG Temperature Monitor	Tailwater Temperature

Thermal profile data is not currently monitored in the LCR dam forebays. Past data indicates that there is a lack of reservoir thermal stratification at Bonneville and The Dalles, and very little at John Day, so instead, hourly point measurements collected by each FMS has been used to track forebay water temperature conditions at the dams.

## Proposed Water Temperature Monitoring

There has been a resurgence in tracking forebay water temperatures, especially as they relate to potential water temperature problems within the fish ladders at the LCR dams. For that reason, additional water temperature probes will be added to the entrances and exits of each fish ladder located at Bonneville, The Dalles and John Day dams. These instruments will be deployed, maintained and downloaded by project staff. Data will be submitted to the Fish Passage Center (FPC) for upload onto their publically accessible website ([http://www.fpc.org/river/Q\\_ladderwatertempgraph.php](http://www.fpc.org/river/Q_ladderwatertempgraph.php)).

The forebay water temperature monitoring is expected to be more involved and will therefore be done by the Corps water quality experts. Option 2 (from original Scope) was chosen from three options of data collection methods for the Bonneville, The Dalles and John Day Dams. This is the most practical choice with more flexibility for relocating the temperature profile strings if needed. However, the Regional participants of the Fish Passage Operations and Maintenance (FPOM) coordination team concluded that a study should be conducted first to determine the most suitable locations for the temperature profile monitoring (Phase 1). The Phase 1 portion of the water temperature monitoring shall be conducted during the summer of 2018 (postponed from late August 2017); Phase 2, the installation of the real – time data collection temperature strings (TempLine) and floating platforms may occur the following year or two (2019-2020). The study should be conducted for at least two months during the hotter portion of the summer, possibly from July - August; however, it may be conducted longer (June through September), depending upon FPOM consensus. The Corps will perform the work in-house and utilize the Walla Walla District Water Quality staff. The IGE for Phase 2 will need to be updated. The IGE does not include annual maintenance for subsequent years.

### **Phase 1: Temperature Depth Profile Monitoring Study (manually collected data) - 2018**

To help determine the most suitable location of the water temperature monitoring equipment platforms for the following summer, the contractor shall first install four temporary temperature depth profile sites at both the John Day and The Dalles forebays, and up to eight sites at the Bonneville forebay (four near two different fish ladder exists). One set of thermistors (Onset Hobos<sup>®</sup> or similar) will be used at each site with a yellow buoy marking the location of this temperature string. One of the four sites shall be mounted on the dam structure or within an existing Trolley pipe if possible. Water temperature data shall be monitored at 1 ft, 5 ft, 10, ft, 20 ft, 40 ft, and 60 ft from surface, on an hourly time interval. The data will be manually downloaded and analyzed at the end of the study.

Resulting temperature data analyses will be provided to FPOM Regional members. The analyses will determine if there are locations that are thermally stratified with cooler water that could potentially be pumped to the fish ladder exist. The goal is to install the study sites during the hotter portion of the summer, about July through August, when the fish ladder temperatures are the warmest. The start date will also depend on the approval from the projects for BRZ access and staff availability; however, July is the latest it should begin. The length of this study will likely be for two months or longer with the goal of capturing the effects of warmer ambient temperatures and variable wind conditions on water temperatures at various depths.

Ideally, the monitoring sites should be located where the coolest water resides and preferably closer to the following main fish ladder exists (but at least 100 feet from exist and away from main migration path) and within ten feet or so from the dam or on the actual dam where possible:

- John Day - South fish ladder
- The Dalles – East fish ladder

- Bonneville - Washington shore and Bradford Island (include both for study).

If this study shows that temperatures do not vary laterally, next summer the temperature strings will be placed closer to the main fish ladder exists (outside of 100 feet) or on the dam structure if possible. There can be significant fluctuations in temperatures near the powerhouse and inlets, so these areas will be avoided. The costs for both Phase 1 and 2 could be significantly lower if the temperature strings were at or upstream of the boat restriction zone (BRZ); however, it is important to have them near the fish ladder exists and potentially cooler water. The following is a web link to the BRZ access requirements and restrictions: <http://www.nwd-wc.usace.army.mil/tmt/documents/FPOM/2010/NWP%20Research/Research.html>

All necessary equipment required for the temporary deployment of water temperature equipment - including boats, trailers and deployment materials (stainless steel cables, cable clamps, buoys, etc.) - shall be supplied by the Corps since work will be performed in-house by the Corps water quality specialist and limnologist.

All visits to reservoirs and thermistor deployment locations shall be coordinated with the respective project staff. All safety training and requirements shall be completed prior to deployment of equipment.

**Phase 1 Study - Estimated Cost within BRZ: \$75,500 (outside of BRZ would be less).**

**Phase 2 - Option 2: Floating Platform with (Real-time) Data Collection – 2019 or 2020**

Permanent water temperature monitoring equipment will be installed in the forebays of The Dalles and Bonneville dams using real-time water temperature equipment (NexSens® or similar), along with one set of back-up thermistors (Onset Hobos® or similar) in case of temp line failure. Water temperature instrumentation will be deployed on platform buoys built by the Corps or contractors. Location of deployment will depend on the Phase 1 study results. Originally they were going to be installed immediately upstream of BRZ of the reservoir; however, closer to the fish ladders is preferred (Figure 1).



**FIGURE 1. PHOTOGRAPHS OF THE WATER QUALITY PLATFORMS LOCATED IN THE WILLAMETTE BASIN.**

Water temperature data shall be monitored at 1 ft, 5 ft, 10, ft, 20 ft, 40 ft, 60 ft, and possibly 80 ft from surface, on an hourly time interval. Data will be collected real-time and broadcasted via GOES satellite to the Portland District’s Corps Water Management System (CWMS) database that is maintained by the Portland District Reservoir Regulation & Water Quality Section.

Data transmission equipment, including the DCP, GOES link, and antennae will be provided by Portland District. Deployment, programming and ensured functionality will be the responsibility of either the Contractor or the Corps, depending if the work is done in-house. Water temperature equipment shall be checked and calibrated at least twice during the year, preferably in the fall and again in the spring before the spill season begins. All services

to the templines should be completed on site, as feasible, as these are permanent temperature monitoring locations. Thermistor strings will be downloaded manually at the same time the templines are being serviced.

Temperature data that is transmitted to the Portland District via GOES will be shared with the FPC for upload onto their publically accessible website; this is the District's responsibility. Any data manually downloaded should be emailed to both the FPC and the Portland District water quality staff for upload onto respective websites. All field notes and meta data such as site location, site name and latitude/longitude shall also be emailed as well.

All necessary equipment required for the deployment of water temperature equipment - including boats, trailers and deployment materials (stainless steel cables, cable clamps, buoys, etc.) - shall be supplied by the contractor or in-house, depending on who conducts this work.

All visits to reservoirs and thermistor deployment locations shall be coordinated with the respective project staff. All safety training and requirements shall be completed prior to deployment of equipment.

**Phase 2 - Option 2 - Estimated Cost: \$165,000 (will be less if done in-house); cost will be updated.**