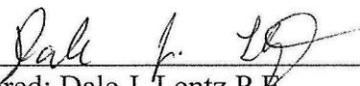


# RECLAMATION

*Managing Water in the West*

## **Underwater Curtain Technology for Enhancing Downstream Fish Passage in Storage Reservoirs**

Bureau of Reclamation, Research and Development Office, Science and  
Technology Project ID: 6884

  
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Fish Passage is an issue both for upstream migrants (usually adult fish) and downstream or out migrants (usually juveniles). To access habitat above the reservoir, upstream migrants must locate the fishway, pass through the fishway and over the dam, and then pass through the reservoir. Out migrants on the other hand tend to be weaker swimming fish that must pass through the reservoir, locate downstream passage routes around or through the dam, and then pass through those routes to the tailwater. Juvenile out migrants are susceptible to predation that may be aggravated by exposure to turbulent flow conditions that yield injury or disorientation. Large reservoirs with confused current patterns (as influenced by temperature stratification, wind, inflows, and outflows) can pose a significant migration barrier. The challenge with reestablishing runs lies with collecting and passing the out-migrant juveniles. There are many natural lakes through which smolts migrate with little apparent disorientation or delay. The goal of this scoping project was to research different reservoir fish collection facilities and at the feasibility of using the existing upstream under water curtain at Wiskeytown reservoir to test and demonstrate the ability to guide and catch downstream migrants so they could be transported downstream past the reservoir.

Three notable reservoir collection facilities are briefly discussed below:

Round Butte Dam on the Deschutes River in Oregon has a selective withdrawal intake tower that collects both warmer surface water and colder deep water. Most of the water that is withdrawn is used to generate hydropower. This also provides a large attraction flow for the 2 large “V” screens that are used to collect fish at the facility. This facility has been very successful at collecting out migrants and transporting them downstream of the dam.

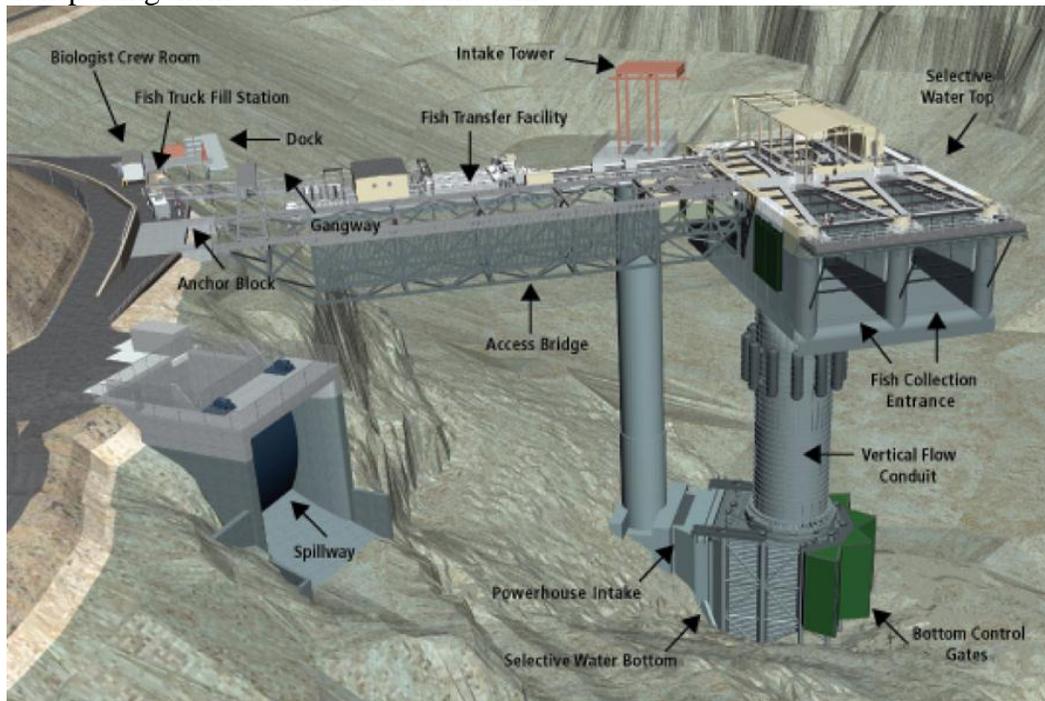


Figure 1. Rendering of the Round Butte underwater tower.

In 1998, a large Behavioral Guidance System (BGS) was installed in the forebay of Lower Granite Dam on the Snake River in Washington. This was an underwater steel curtain (non mesh) over 1000 ft. long, ranging in depth from 55 to 78 ft deep. Studies show that this curtain was successful at diverting fish to a more suitable location in the reservoir where they could be collected.

Bonneville Dam on the Columbia River installed a 700 ft. long by 10 ft. deep underwater water curtain upstream of the Bonneville second powerhouse. The curtain was placed on an angle to the normal flow direction in hopes that out migrants would be guided to a collection device. A study with results for the first year in operation shows limited improvement in fish collection depending on the species (Faber, 2010). This is only the results from the first year of implantation. Explanations of these results and further testing are underway.



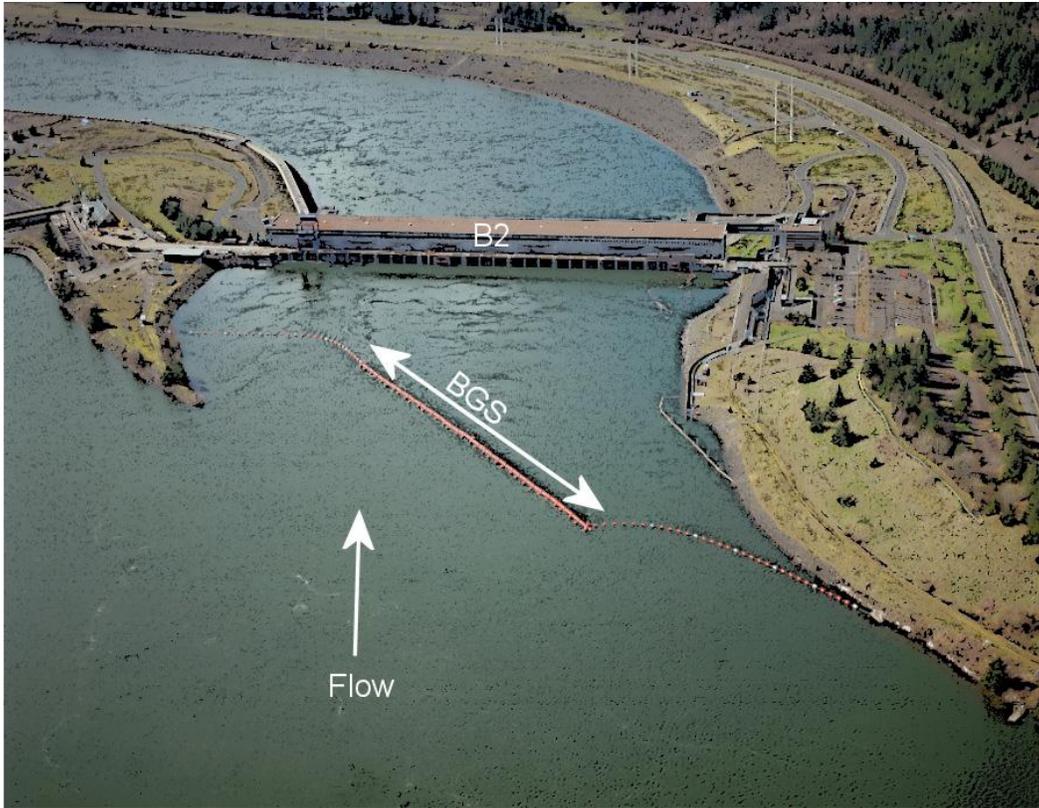


Figure 2. The Behavioral Guidance Structure (BGS) with One Section Shown out of the Water (above); and Shown Deployed in the Forebay of the Bonneville Dam Second Powerhouse (B2; below).

Wiskeytown Reservoir uses two underwater curtains that were installed in 1993 to pass cold water through the reservoir. The oak bottom curtain near the head of the reservoir causes inflowing cold water to sink to the bottom of the reservoir. The Spring Creek curtain located near the dam helps the intake withdraw colder water from deep within the reservoir. These temperature curtains successfully route cold water through the reservoir.

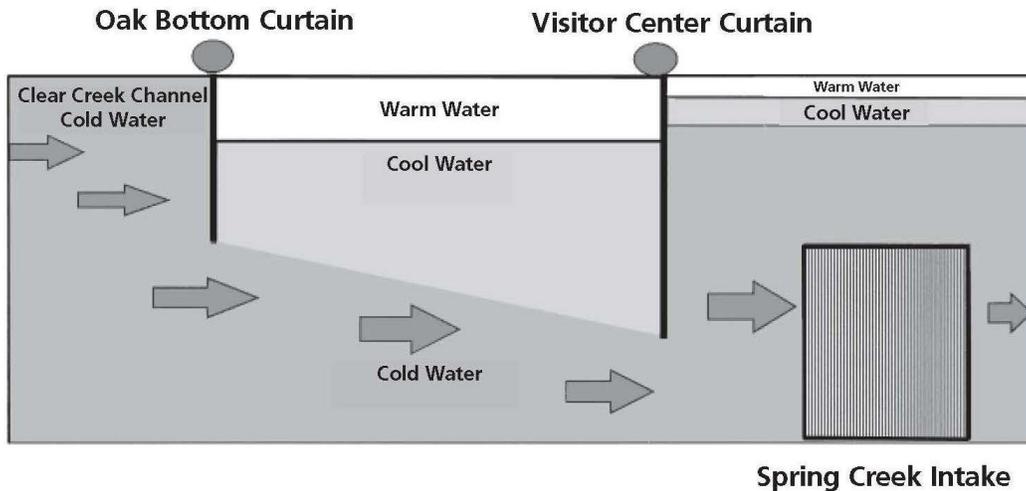


Figure 3. schematic showing how the temperature curtains in Wiskeytown Reservoir work.

The upstream Oak Bottom curtain would be an ideal location to test the collection on out migrants. Unlike other curtains that are used to guide fish at Bonneville and Lower Granite Dams the Oak Bottom curtain is relatively near the head of the Wiskeytown reservoir. Fish collection at this location would not require the fish to navigate through the reservoir before collection. The reservoir in this location is fairly shallow and pretty narrow. This test would involve releasing tagged fish at the head of the reservoir and using the curtain to direct the fish horizontally across the reservoir to a temporary collection facility on the bank.

The plan to use this site to test an underwater curtain to collect out migrants at the head of a reservoir is no longer feasible because, the Oak Bottom curtain has fallen into such disrepair that it is no longer deployed across the reservoir. The deteriorating Spring Creek curtain was replaced in 2011. There is a plan to replace the Oak Bottom curtain when funding becomes available; however the timeframe of this replacement is uncertain (Gee 2012).

From the literature search of fish collection facilities in reservoirs, the method of using an underwater curtain to direct fish to a collection facility appears to be a viable option worth more research. Given the mixed success of the cases reviewed there are many variables that need to be address for a given location. If the Oak Bottom curtain is replaced it is recommended that this site be used to test the functionality of an underwater curtain to direct out migrants.

## **References**

Faber, DM, et al, Evaluation of a Behavioral Guidance Structure at Bonneville Dam Second Powerhouse including Dam Passage Survival of Juvenile Salmon and Steelhead using Acoustic Telemetry 2008, PNNL-18753, Pacific Northwest National Laboratory, 2010

Gee, Robert, 2012, Personal communication