What is a Spillway Weir?

Spillway weirs are large structures that help fish pass through dams more safely and provide a more efficient and less stressful dam operation. Spillway weirs at Ice Harbor, Lower Granite and Lower Monumental dams are huge structures that are attached to a manufactured in Monumetal, an alloy of copper and zinc. Many Columbia River Basin dams are designed to be ‘removable,’ by the ability to change the amount of water flowing over the weir. For example, at Lower Granite Dam on the lower Snake River, a prototype Removeable Spillway Weir was installed in 2005 and the Lower Monumental Dam Spillway Weir in 2007. The next generation of weirs is the Adjustable Spillway Weir (ASW). The ASW has a more portable design, with all the integral components that slide into position inside the spillway. The biggest difference is the ASW has two pre-fabricated and self-contained hoist mechanisms installed at the top of the weir. They are a change from the removable weir design because the hoists were not on-gate fish.
Fish Survival trending upwards

By Brad Trumbo

To improve the effectiveness of spillway operations for fish passage, Walla Walla District biologists and engineers came together to design and install spillway weirs at the District’s lower Snake River and McNary dams. The District’s first permanent spillway weir was installed at Lower Granite in 2001.

Juvenile anadromous salmonids (i.e. salmon and steelhead [smolts]), in the Columbia River Basin generally migrate in the upper 10 to 20 feet of the water column. However, passage routes at dams on the lower Columbia and Snake Rivers require smolts to dive to depths of 45 to 60 feet to enter a passage route, such as a powerhouse intake.

Differences between the depth of migrating smolts and the depth of traditional dam passage routes can result in delays in migration and increased exposure to predators as smolts search for a passage route. Generally, spillway weirs draw spill from the top 10 to 15 feet of the water column providing a constant velocity draw with a hydraulic signature extending upstream to 400 feet into the forebay encompassing the depth of out-migrating smolts.

The hydraulic influence of a spillway weir provides significant attraction flow for smolts, thus increasing the proportion of smolts passing a dam via spillway compared to powerhouse and generally decreasing passage and migration delays. A removable spillway weir (RSW) was installed in spillway 2 at Ice Harbor Dam in 2005. As with all new construction and configuration changes for fish passage, District biologists evaluated injury and survival of smolts passing the new RSW.

Study results estimated smolt injury rates at two percent for fish released at mid-depth and nearly 16 percent for fish released near the RSW crest. The injury rates for fish at the mid depth were similar to post-construction evaluation results for other spillway weirs; however, the injury rates for smolts passing close to the crest were much higher than expected relative to spillway weirs at other projects.

Forty eight hour survival was estimated at approximately 96 percent and the high injury rate for smolts passing close to the crest may translate to delayed mortality and increased predation in the tailrace. Approximately 25 percent to 75 percent of out-migrating smolts pass Ice Harbor Dam via the RSW, thus identifying the cause of and addressing the high injury rates for smolts passing near the RSW crest is important to improving survival for Snake River fish.

District hydraulic engineers compared Ice Harbor Dam RSW passage data from sensors and hydraulic modeling to spillway weir conditions at other projects. These comparisons indicated that the RSW flow was separating from the ogee above the deflector due to the steep slope of the Ice Harbor Dam spillway chute resulting in an increased injury rate for fish passing close to the RSW crest.

To address the high injury result from the 2005 study, District engineers designed a new ogee and deflector shape for Ice Harbor’s spillbay 2 in 2014.

The new shape included decreasing the slope of the ogee and providing a gentler transition into the deflector and tailrace. Spillbay 2 construction was complete in March, 2015 and biological testing occurred in April.

Yearling Chinook salmon supplied by Dworsbak National Fish Hatchery were balloon and radio tagged and directly released into spillway 2 to pass the RSW at one and a half feet above the crest, identical to the 2005 study. Researchers recaptured 335 fish resulting in estimated 48 hour survival of approximately 98 percent and only one and a half percent injury. Relative to the 2005 study results, it is clear that the redesign and reshaping of spillway 2 was a tremendous success and will provide a substantial fish passage benefit for out-migrating smolts passing Ice Harbor’s most effective fish passage route.