RECLAMATION
Managing Water in the West

U.S. Department of the Interior
Bureau of Reclamation

The Helix: Collaborative Approach, Revolutionary Design

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Narrator: Anadromous fish passage at reservoirs in the Yakima River Basin has been a major hurdle for fish returning to upper basin habitat and a challenge for tribal leaders, water managers, and area residents who are trying to restore healthy fish runs.

The question has been how to do this? In the 1900s, Yakima area settlers built their futures on a regular irrigation supply provided by federal and private dams. Yet their success had a price: the loss of historic fish runs that numbered into the hundreds of thousands.

Now a team of researchers, engineers and biologists have developed a unique and innovative approach to outgoing juvenile fish passage.

The idea, though not a new one, is called the Helix.

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This approach may mean juvenile fish looking to out-migrate to the ocean could leave the reservoirs earlier than ever before. And more importantly, their release would not depend on high reservoir levels. When installed at Cle Elum Dam northwest of Yakima, Washington, the Helix design, used in combination with traditional trap and haul operations, will open fish passage in and out of the reservoir.

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But this story began in 2009 when a basin-wide partnership called the Yakima River Basin Water Enhancement Project Workgroup was formed. This progressive partnership developed the Yakima River Basin Integrated Water Resource Management Plan, or Integrated Plan for short.

As a whole, Integrated Plan activities benefit fish and irrigation and offer a synergy that would otherwise be unattainable without the plan. It contains a balanced menu of seven elements that seek to resolve the Yakima River basin's water problems, among these, reservoir fish passage.

Walt: The Integrated Plan, one of its major components is fish passage at all the reservoirs. So we quickly decided that Cle Elum would be the first spot that we would try this.

Narrator: To demonstrate the Bureau of Reclamation's commitment to this goal, an interim fish passage facility was constructed on the spillway of Cle Elum Dam in 2005. The experimental design was successful, showing that juvenile fish passage was possible while meeting the existing water delivery obligations of the Cle Elum Reservoir.

[water flowing]

This step opened the door for fish managers with the Yakama Nation and the State of Washington to reintroduce adult sockeye salmon to Cle Elum Reservoir. This provides almost 30 miles of cool, protective tributary habitat above the reservoir to spawn.

Dave: What we're doing is bringing adults up, releasing them in the lake. They spawn naturally in the river, the juvenile's rear naturally in the lake, and then migrate out as smolts two years after they were brought back as eggs to the basin.

Walt: So we tested this. We worked with Yakama Nation closely. They did experiments with the Coho, juvenile Coho salmon, and we've been very successful in proving that salmon will find this small outlet and leave the lake at the appropriate time.

Joel: This year, in 2014, we had about 2,700 fish come back off of 2,500 fish that were put into the reservoir. That's a one-to-one, a little better than a one-to-one ratio, which in the biologic world is real good.

Narrator: Since 2009, the number of Sockeye returns surpassed expectations each year, proving the Cle Elum Interim Fish Passage design worked, but it had limits. The design team knew the passage was only effective in late May when reservoir levels were high enough to carry the fish over the spillway.

Walt: The interim passage only worked at one elevation, one reservoir elevation, and that was full. It only worked at the top 3 to 10 feet. We proved that technique worked. If you could have the top of your spill going out the fish passage, fish left.

Joel: Our fish passage criteria is April 1st to have that be operational. Because that's when most of the fish are going to want to start moving out, the 1st of April, opposed to later in May or beyond. That's the downfall of the existing flume that we have.

Narrator: To tackle this issue, water managers needed to take another look at fish passage. They sought an efficient method that protects irrigation water supply but moves out-migrating juveniles by April 1. Further, reservoir pool fluctuations at Cle Elum posed additional challenges.

Walt: But the real issue is our reservoir fluctuates over a hundred feet up and down, so we're not always at that surface where the interim fish passage was. The real issue was, can we design a fish passage that would get fish out at all reservoir elevations? As the reservoir came up and as the reservoir went down, we could get fish out on the surface.

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Narrator: A technical team of designers and biologists from tribal, state, irrigation districts and federal agencies was formed. Work began to build scale models and find a solution. Success was slow to come.

[rushing water]

Joel: Our first design basically looked like a conventional adult fish ladder, except for the fish were, instead of moving up the ladder, they were spilling down the ladder, the juveniles.

Jason: With the old model, all the energy dissipation was taking place in one small area. It was sloshing and churning. It was way too turbulent. Any fish that went downstream in the model was going to get disoriented or hurt or beat up pretty badly.

Joel: That idea was put on the scrap pile, and we started thinking about other ways of doing fish passage and came up with this helix design.

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Narration: The team took advantage of Reclamation's Hydraulic Lab resources in Denver, Colorado and created 15 or more computer generated model or physical scaled model designs.

Joel: They tested different shapes of the helix, from round pipes to rectangular pipes, and tilted, angled, and came up with a design that minimized the amount of rotation of the water molecules as they move down this helix.

Narrator: After much intensive Computational Fluid Dynamics modeling, the design team found success. Instead of using a half pipe, they squared it off, allowing the tiny smolts to escape with minimum disorientation and maximum survival.

Leslie: This has been a really exciting project because we were able to take it from concept level and develop a design that would successfully pass fish without injury.

Narrator: At the same time, the design team engineered a way to attract fish into the helix at any reservoir level.

Jason: So the intake into the helical fish passage system allows fish to enter at different levels in the reservoir. And it does that by having 6 different intakes in there that each operate over a 10 and a half foot range. So as the water goes up, it'd switch from one intake to the next.

Leslie: One of the primary things we were trying to accomplish with this project was to develop a design that would allow fish to self-guide into a structure that would carry them around the dam into the downstream river channel, and what that means is there's no human handling.

Dave: We've got a design which we feel will much improve the success in getting more juveniles out of the basin.

Narrator: The Helix design shows great promise. It represents a collaborative achievement among the Yakama Nation fish managers and a diverse group of scientists, water managers and irrigators. Also, it meets the needs of the Yakima basin community.

Moreover, the Helix can weather the effects of climate change in two ways: by adjusting to varying reservoir levels and giving fish safe harbor to cooler habitat above the reservoir.

Dave: This design, we hope, will allow us to get smolts out on a more timely basis.

Walt: It's one of our very first Integrated Plan projects. It's unique in its design with the helix. That we can get fish out and we don't disrupt the irrigation system, water management system. It fits all these components, and it is the very first fish passage project of the Integrated Plan that we feel will be a success and move the integrated plan on into other successful projects.

[water flowing]