May 5, 2020

MEMORANDUM

TO: **Council Members**

FROM: **Leslie Bach**

SUBJECT: **Briefing on recent structural modifications for fish passage at Corps of Engineers' dams**

BACKGROUND:

Presenter: Tim Dykstra, U.S. Army Corps of Engineers and Gordon Axel, NOAA-Fisheries

Summary: The presenters will report on structural upgrades at Federal Columbia River Power System dams designed to benefit fish passage and survival.

Relevance: The "mainstem flow and passage operations" strategy in the 2014 Fish and Wildlife Program calls for the Corps of Engineers to implement structural improvements to benefit fish passage and survival and to report to the Council on progress.

Background: Over the last five years the Corps of Engineers, in collaboration with Bonneville Power Administration, NOAA-Fisheries, Pacific States Marine Fisheries Commission and other state and federal agencies and tribes have completed major structural upgrades on both Columbia and Snake River dams. These upgrades are designed to improve juvenile and adult passage and survival, as well as monitoring and evaluation. Some of the specific projects they will cover include: Adjustable weir at Little Goose dam; Lower and Little Goose ladder modifications for temperature management; Lower Granite dam Juvenile Bypass System upgrades; Ice Harbor dam turbine replacement; Lower Granite juvenile bypass system upgrades and Lower Granite dam spillway PIT-tag detection.

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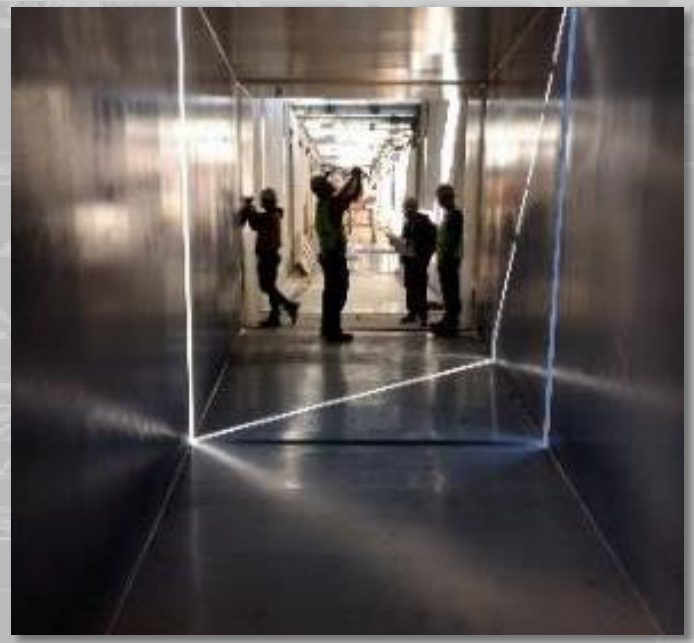
RECENT FISH PASSAGE IMPROVEMENTS AT COLUMBIA RIVER SYSTEM DAMS

Tim Dykstra
Fish Program Manager
Corps of Engineers

Gordon Axle
Fisheries Research Biologist
National Marine Fisheries Service

6 February 2020



U.S.ARMY

US Army Corps of Engineers®

PRESENTATION OUTLINE

- Lower Granite and Little Goose Fish Ladder Cooling
- Lower Granite Juvenile Bypass System Upgrade
- Little Goose Adjustable Spillway Weir
- Ice Harbor Test Turbine Units 1-3
- Lower Granite Spillway PIT Detection

LOWER GRANITE AND LITTLE GOOSE FISH LADDER COOLING

- Installed due to elevated ladder temperatures and ladder temperature differentials
- Lower Granite completed in 2016.
- Little Goose completed in 2018.
- Designed to cool the ladder and the immediate forebay area outside of the ladder exits with water drawn from depth.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LOWER GRANITE LADDER COOLING

- Average surface temperatures representing historical ladder temperatures were recorded in 2019 in June and September.
- The mean temperature of the near surface forebay water surface was 68.2 degrees F at Lower Granite.
- The ladder exit was cooled to an average temperature of 66.2 degrees F resulting in a 2.0 degree F cooling of the ladder.
- The mean tailwater temperature over the same period was 65.0 degrees resulting in an average temperature differential of 1.2 degrees F.

LITTLE GOOSE LADDER COOLING

- The mean (June – September) temperature of the near surface forebay water surface was 67.7 degrees F at Little Goose.
- The ladder exit was cooled to an average temperature of 66.0 degrees F resulting in a 1.7 degree F cooling of the ladder.
- The mean tailwater temperature over the same period was also 66.0 degrees resulting minimal temperature differentials.
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L0WER GRANITE JUVENILE BYPASS UPGRADE

Issue

– Original JBS outdated: small orifices, pressurized downwell and pipe, outfall close to shore

New System

- Better meets current NMFS criteria
- Improved survival through JBS (>99.6% for all species)
  – Dam Survival: Yearling Chinook >97%; Steelhead >99%
- Passage and Survival testing completed in 2018
- System continues to be refined by Operations
- Some additional work necessary to complete project

LGR JBS UPGRADE PROJECT SCOPE

Juvenile Bypass System Upgrades:

- 14” Orifices (Enlarged from 10”)
- Juvenile Collection Channel widening
- New transportation channel and flume
- Emergency Bypass
- New dewatering system
- New Primary and Facility Bypass System
- Outfall moved further offshore into deeper, faster flow

LOWER GRANITE DAM JUVENILE FISH BYPASS

LGR JBS - COLLECTION CHANNEL

LOWER GRANITE DAM AND JUVENILE BYPASS SURVIVAL

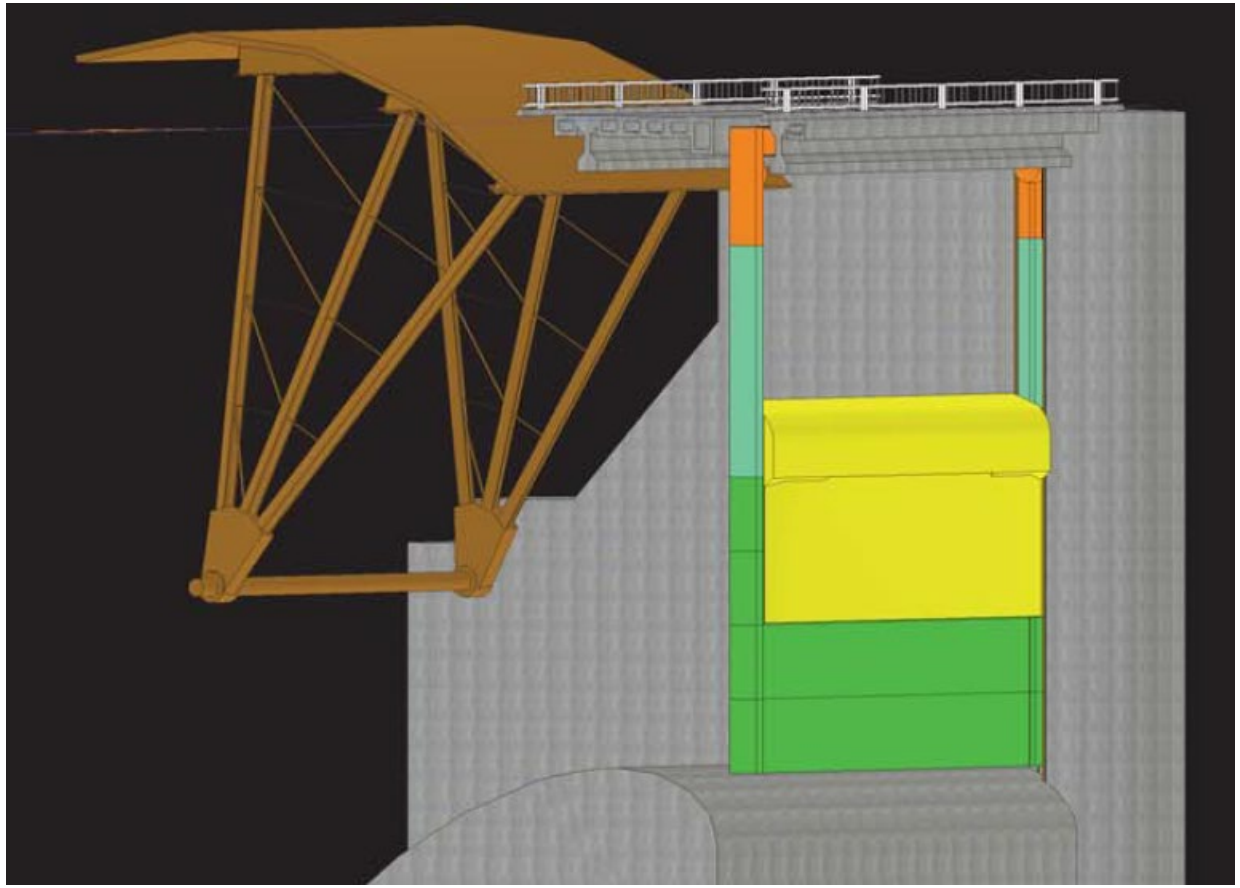
Survival rates of yearling Chinook, steelhead, and subyearling Chinook following completion of juvenile bypass system improvements at Lower Granite Dam.

	YEARLING CHINOOK	STEELHEAD	SUBYEARLING CHINOOK
JUVENILE BYPASS	99.6%	100%	100%
DAM	97.3%	99.6%	94.2%

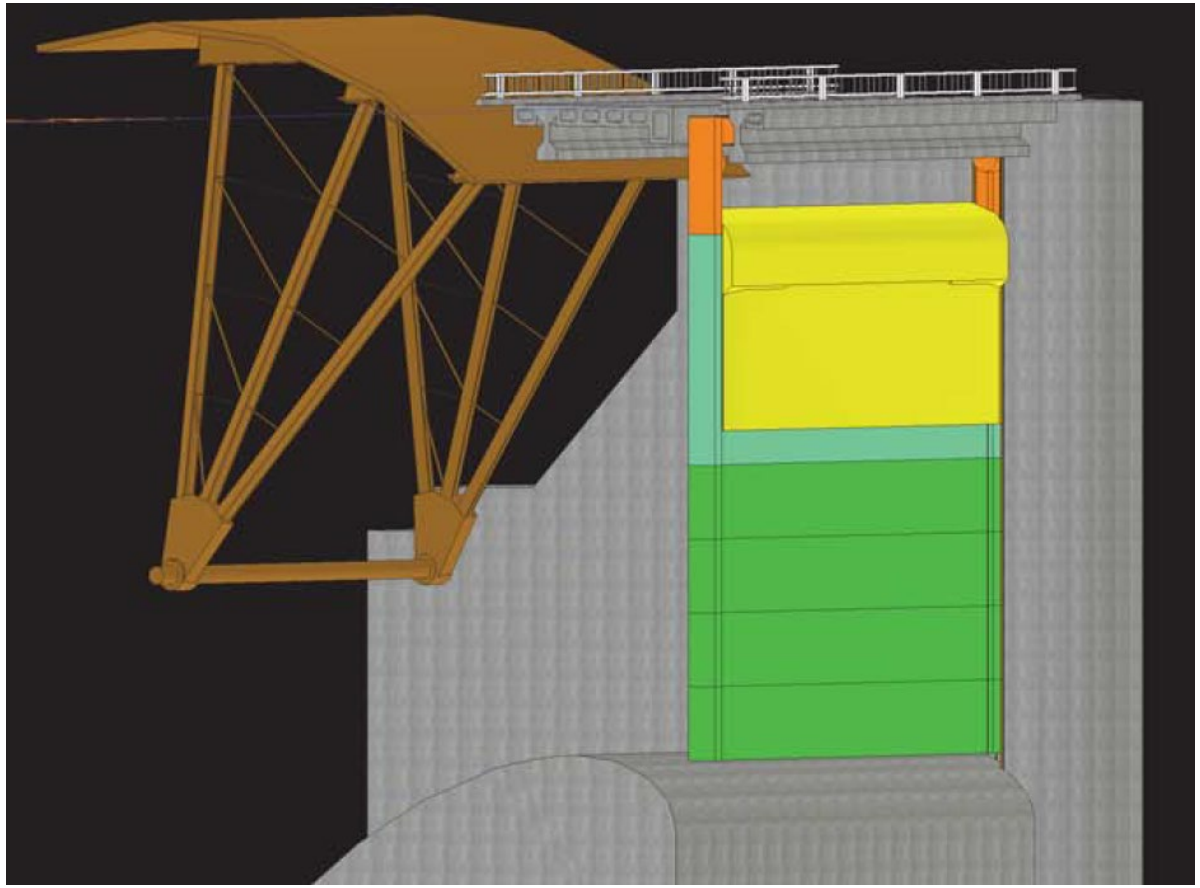
LITTLE GOOSE ADJUSTABLE SPILLWAY WEIR (ASW)

- Issue
  - Original Little Goose Adjustable TSW could not be closed or changed from the control room
  - Required a crew of at least 3 to make close or change height
  - Took a minimum of 3 days for changes
  - Required the use of projects gantry crane
- New design - ASW
  - Eliminated the closure gate
  - Crest section design moves vertically for crest height changes & closure
  - Dedicated hoist
  - Controlled from the control room
  - Height changes and closure ≤ 30 minutes
- Construction Completed 2017 & Operational Spring 2018

LITTLE GOOSE ADJUSTABLE SPILLWAY WEIR (ASW)



Low Crest



High Crest

LITTLE GOOSE ADJUSTABLE SPILLWAY WEIR (ASW)

Hoist Assembly

Adjustable Crest Section

Stop Log Section

IHR TEST TURBINES
UNITS 1 - 3

PROJECT GOALS

Develop a turbine that is safer for fish and more efficient in electrical power generation.

– Becomes the model for future FCRPS turbine replacements within fish passage corridors
– Develops specific design features that could be incorporated into other turbine replacements
– New turbines become a safe fish passage route that will increase operational flexibility of the individual Projects and of the hydropower system

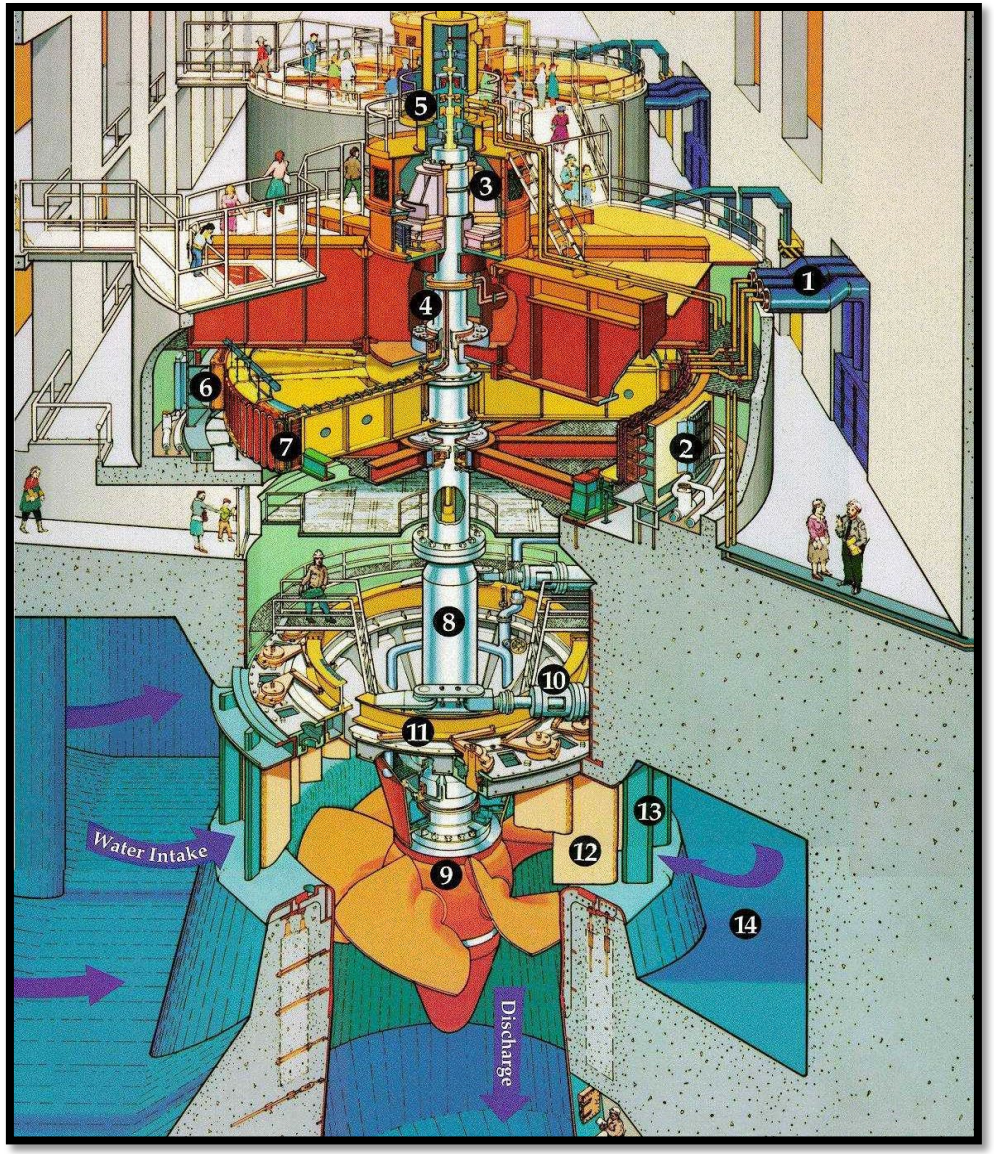
Refurbish Main Units 1, 2 and 3 with new turbine runners and generator rewinds.

– Unit 2 replaced with a Fixed Blade Runner
– Units 1 and 3 replaced with MGR Adjustable Blade Runners

ICE HARBOR IMPROVED FISH PASSAGE TURBINE

Turbine Design Goals:

- Design Fixed and Adjustable Blade Runners, with modifications to the distributor and draft tubes, utilizing the best tools and technology available to:
  - Reduce risk of injury caused by strike and shear.
  - Reduce pressure differentials to minimize risk of barotrauma.
  - Reduce turbulence to minimize disorientation
  - Eliminate risk of oil leakage (Fixed Blade) Reduce risk of oil leakage through new and redundant sealing technologies (Adjustable Blade)

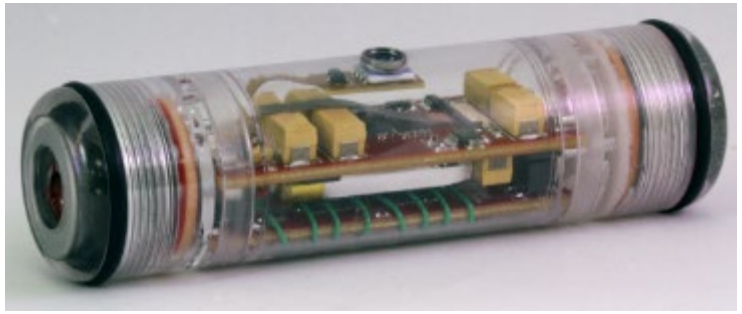


Species Focus: Chinook and Sockeye Salmon, Steelhead, Lamprey

ICE HARBOR IMPROVED FISH PASSAGE TURBINE

Survival and Passage Conditions

- Unit 2 Fixed Blade:



- Direct 48 h survival was > 98% for the new turbine runner.
- 1.5% of fish had visible injuries compared to 3.8% from the previous Kaplan runner.
- The percentages sensor fish exposed to nadir pressures below 14.7 and 12.5 psia were low (Kaplan):
  - Lower 1%: 0.4% and 0.0% (0.5%,0.0%)
  - Peak: 1.4% and 0.5% (1.6%,0.0%)
  - Upper 1% - Gen. Limit: 2.7% and 0.0% (35.2%, 19.2%)
- Significantly less Runner Strike events at Lower 1% (P=0.031) and Peak Efficiency (P=0.00)

SCHEDULE AND COST

- Unit 2 Fixed Blade Runner – Commissioned May 2019
- Unit 3 Adjustable Blade Runner – Installation underway and planned for completion Fall 2021
- Unit 1 Adjustable Blade Runner – Installation planned to begin fall 2021 and planned for completion Fall 2023
- Design, Fabrication and Supply Contract Costs (Total for 3 Units) $41.3M
- Current Contract Turbine Installation Costs anticipated (funded through Units 2 and 3) including stay vane modifications, new runner with discharge ring, draft tube modifications and generator rewinds - $50M

LOWER GRANITE SPILLWAY PIT TAG

Goal – determine the feasibility of detecting PIT-tagged fish at CRS dam spillways

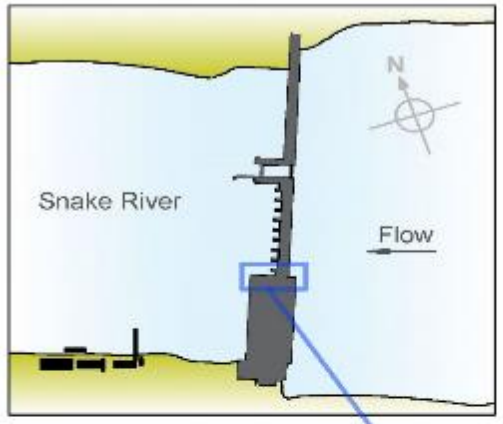
- Project Completed January 2020
- Installed in Lower Granite Spillbay 1 (RSW bay)
- System spans the entire width of the 50 ft wide spillbay
- Design Challenges
  - Read range minimum of 36 inches
  - Velocity 75 ft/second
  - Antennas protected from debris
  - Ability to change out capacitors and cables if needed

GRANITE SPILLWAY PIT TAG MONITORING

PTAGIS PIT Tag Information System
Columbia Basin | ptagis.org

Lower Granite Dam Spillway (GRS)

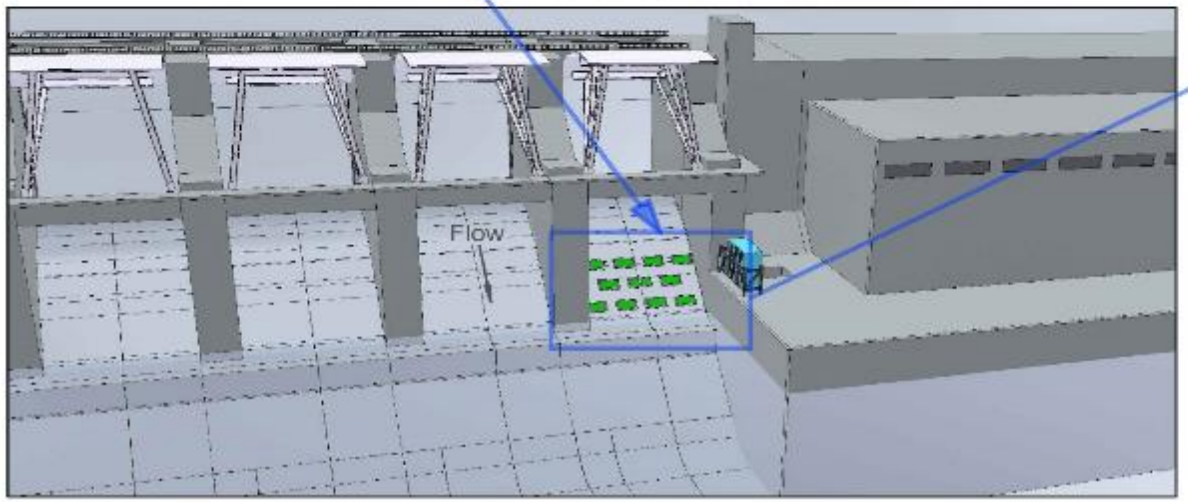
Interrogation Site Configuration 100. Drawing Rev 0.

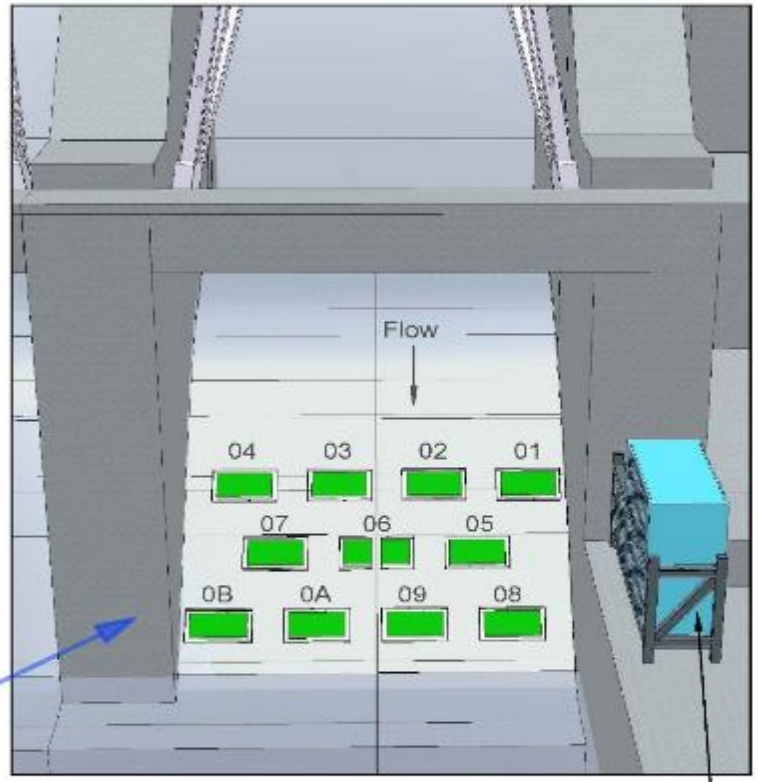


Site Overview

- Eleven flatplate antennas are buried in the concrete of Spillway 1. The graphic to the right shows the location of the antennas in the spillway.
- Antenna 06 is split into two sections to straddle the concrete expansion joint in the center of the spillway.
- The antennas measure 44.5" x 86.5".
- Each half of antenna 06 measures 44.5" x 44.5"

Spillway 1





Antenna IDs

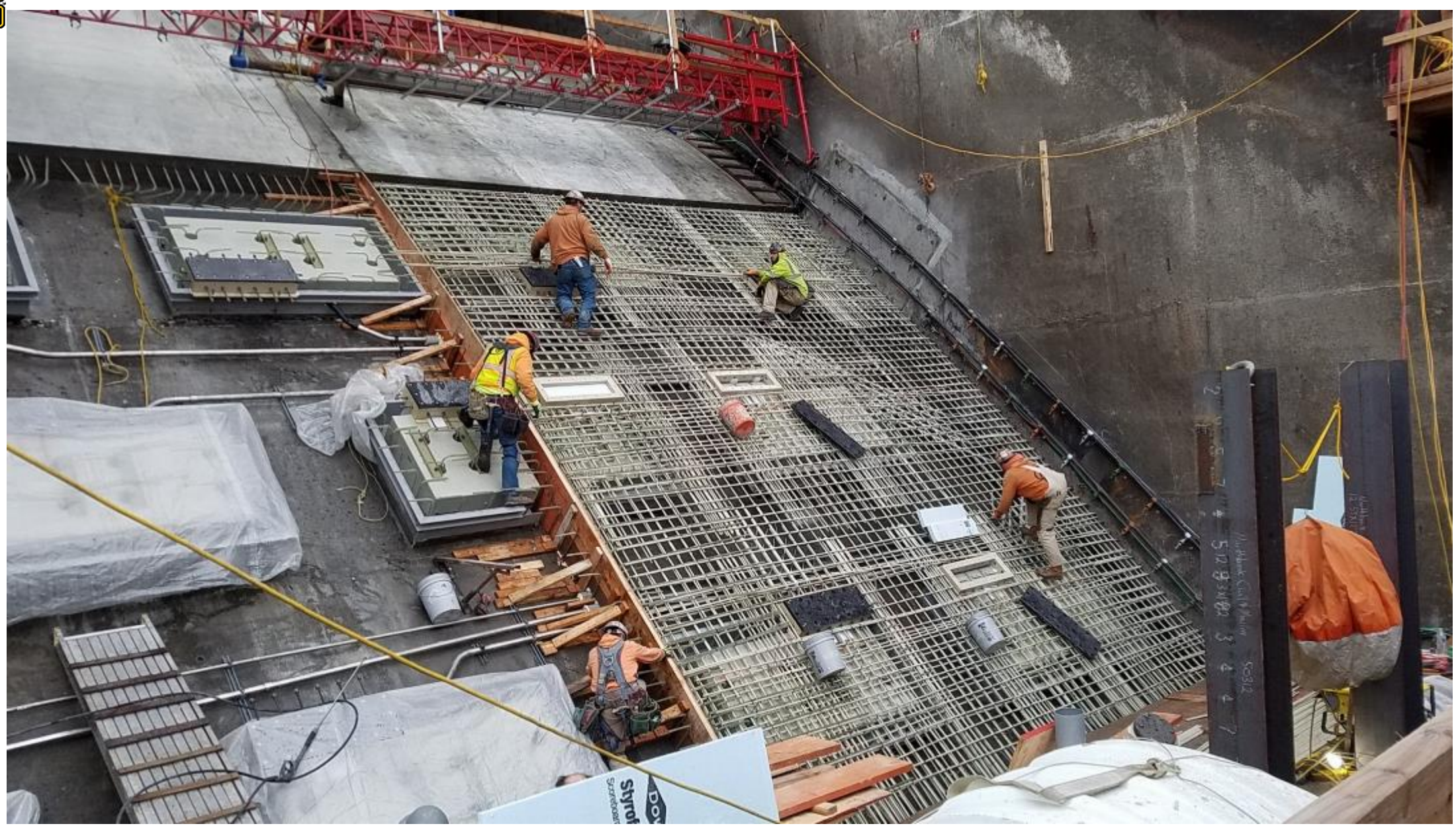
PIT Tag Electronics Enclosure

GRANITE SPILLWAY PIT TAG MONITORING

Looking down from the trunnion bridge

Flow direction

GRANITE SPILLWAY PIT TAG MONITORING



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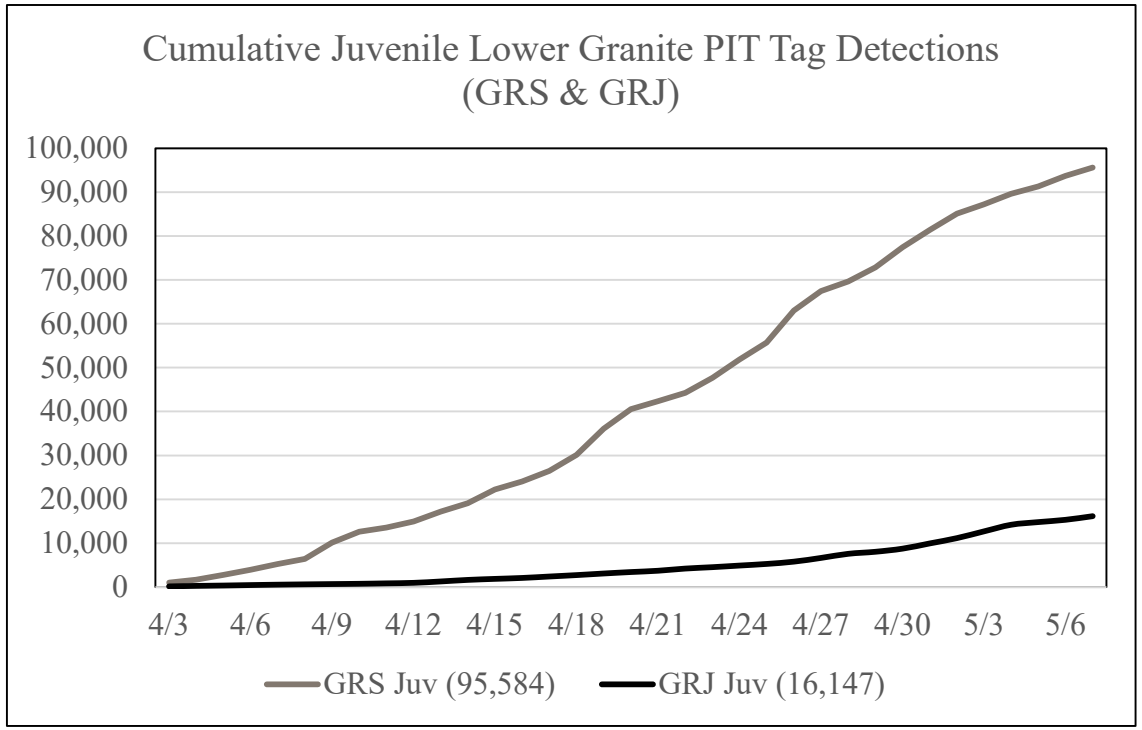

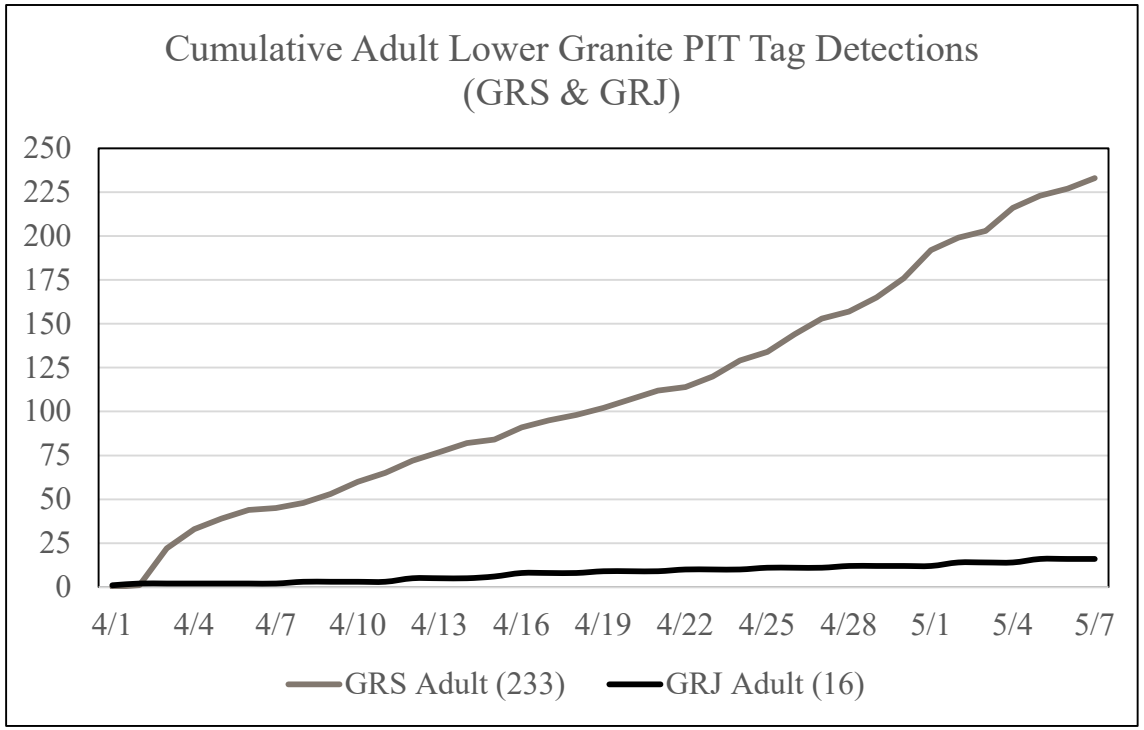

- Fully operational and working better than anticipated
- Static read range after install was 44 to 51 inches above the antennas
- Antenna row detection efficiency 45% to 65%
- Fish velocities measured at 79 fps
- Currently providing a 492% increase in overall project PIT tag detection

Questions?