**STUDY CODE: JPL-XX-21**

***TITLE: Foster Interim Operation for Upstream Fish Passage: Interim Measure #10***

**MANAGEMENT APPLICATION:** Interim Measure #10 (Willamette Valley Project Interim Measures Implementation Plan 2020) prescribes operating the fish weir at 300 cfs flow and the turbines at Foster Dam during summer months (approximately July – August; actual dates to be determined) to optimize downstream river water temperatures for returning adult salmon. This Interim Measure #10 will commence in 2020 and continue until a long-term solution is implemented.

**FUNDING SOURCE:** CRFM

**BIOLOGICAL OPINION ACTION:** RPAs, 4.8, 9.3, 9.4.

**BACKGROUND:** This concept paper is a research summary documenting the results from studies conducted at Foster Dam, which informed Interim Measure #10 (Willamette Valley Project Interim Measures Implementation Plan 2020).

The new Foster Adult Fish Facility (AFF) went into operation in 2014. The AFF functioned well for collecting wild winter steelhead annually during spring months. However, Oregon Department of Fish and Wildlife (ODFW) staff who operate the facility observed delays in the collection of adult Chinook salmon at the AFF during summer months, usually from May through September each year from 2014 to present. Adult Chinook salmon returning to Foster Dam (Foster) generally hold and mill in the tailrace of the dam instead of migrating up the AFF ladder. Some fish eventually migrated up the ladder to the pre-sort pool of the facility, while other fish that entered the ladder remained in the lower ladder and eventually returned to the river. It appears these fish were rejecting the ladder, causing a delay to the collection of Chinook salmon at the AFF. Research conducted during 2016 and 2017 identified cooler water temperatures in the fish ladder compared to the water temperatures in the South Santiam river above Foster, therefore the adult fish are rejecting the ladder (Clabough et al 2017; Keefer et al 2018). A Corps Foster AFF Ladder Improvements engineering team is working on design improvements to increase the water temperatures in the ladder to make it suitable for adult salmon and prevent any delays in upstream migration to the pre-sort pool for collection.

During the summer of 2019, ODFW staff observed very few adult Chinook salmon returning to the Foster Dam tailrace compared to previous years. After some investigations, ODFW staff and Corps Willamette Valley Project Biologists determined the river temperatures downstream of Foster remained cool (cooler than river temperatures in the South Santiam river above Foster), therefore adult fish were holding downstream of the dam. The river temperatures downstream of Foster remained cold because the fish weir was not operated for downstream fish passage in 2019. When in operation, the weir passes warm surface water from the Foster reservoir, which warms the river downstream of the dam. An ad hoc test was conducted in early September 2019 with the fish weir. The fish weir was operated to pass warm surface water from the reservoir and this operation warmed up the river downstream of the dam. Adult Chinook salmon returned to the AFF in large number within a few days of the fish weir operation. This ad hoc fish weir operation informed that without a source of warm water from the Foster reservoir, the river downstream of the dam will remain cool in summer months, which will delay upstream adult salmon migration.

Interim Measure #10 (Willamette Valley Project Interim Measures Implementation Plan 2020) prescribes operating the fish weir at 300 cfs flow and the turbines at Foster during summer months (approximately July – August; actual dates to be determined) to optimize downstream water temperatures for returning adult salmon. This Interim Measure #10 will commence in 2020 and continue until a long-term solution is implemented. Additionally, this Interim Measure #10 will be coordinated with Interim Measure #9 to ensure the operations are balanced for both juvenile downstream and adult upstream passage at Foster Dam (Willamette Valley Project Interim Measures Implementation Plan 2020).

Research was conducted during 2016 through 2017 to evaluate the influence of Foster operations (turbine, spill and fish weir) on total dissolved gas (TDG) on river environment and fish habitat downstream of the dam. Arntzen et al (2018) found that TDG levels in the river downstream of the dam were highest (exceeding 110%) during periods when the spillway was operated by itself (i.e. with no turbine operation). However, TDG levels decreased (less than 110%) during periods of spillway, fish weir, and turbine operations (turbines were operated at 200 cfs for Station Service only). The TDG levels, even when they exceeded 110% saturation for short durations, did not appear to affect adult and juvenile salmon in the river (Arntzen et al 2018). Both of these life stages are able to seek refuge in deeper pools during periods of high TDG levels (Arntzen et al (2018). Arntzen et al (2018) suggest juvenile steelhead may be impacted because of their life stage during periods of elevated TDG levels (during periods of spillway operations without turbine operations). The results of this study informed Interim Measure #10; operate the Fish Weir at 300 cfs flow to pass surface water to warm up the river downstream of the dam in conjunction with turbine operations, which will reduce TDG levels in the river.

According to Interim Measure #10, the effectiveness of this fish weir and turbine operation to aid in upstream migrating adult salmon returns to the AFF will be evaluated by the collection rates at the AFF (Willamette Valley Project Interim Measures Implementation Plan, Interim Measure #9 2020). No additional RM&E for this Interim Measure #10 is identified at this time.

**REFERENCES**

Arntzen EV, RJ Flaherty, AH Colotelo, RA Harnish, J Varrinec, SA Zimmerman, JD Tagestad, and K Sertz. 2018. *Assessment of the Effects of Total Dissolved Gas Exposure of Upper Willamette River Chinook Salmon and Steelhead Below Foster Dam*. PNNL-27325. Final report submitted to the U. S. Army Corps of Engineers, Portland, Oregon. Pacific Northwest National Laboratory, Richland, WA.

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Clabough, TS, ML Keefer, T Blubaugh, GP Naughton, CC Caudill, and D Thompson. 2017. *Evaluation of Adult Chinook Salmon Behavior at the Foster Adult Fish Facility on the South Santiam River – 2016*. Technical Report 2017-3 of University of Idaho to U.S. Army Corps of Engineers, Portland District.

ML Keefer, TS Clabough, MA Jepson,T Blubaugh, G Brink, GP Naughton, GP Boggs and CC Caudill. 2018. *Evaluation of Adult Chinook Salmon Behavior at the Foster Dam Adult Fish Facility and in Foster Dam Reservoir on the South Santiam River, 2017*. Technical Report 2018-3 of University of Idaho to U.S. Army Corps of Engineers, Portland District.

NMFS Comments:

**NMFS Comment:** Helpful to see the results of spill and weir operations following 2020 adult migration. No new RME proposed. Will be evaluated by collection rate at FOS AFF. F5