McNary Site Visit
March 30, 2009
Trip Report

Purpose - To investigate the effect of lowering the McNary SSE and NFE weir gates on fishway entrance hydraulics.

Background - As part of the NWW-NWP Lamprey program, NWW has been tasked with investigating operational measures to reduce the velocity of flow through the McNary south shore fishway entrances (SSE). It is believed that lamprey passage efficiency may be improved at McNary by reducing the entrance velocities during nighttime operations. The velocity of flow is primarily driven by the head differential across the control weirs. The head differential is determined by the difference in water surface elevation between that of the entrance channel and the tailwater. This head differential, and subsequently the velocity, can be reduced by decreasing flow and/or increasing the depth of flow over the weir. An evaluation of reducing velocity by reducing flow has recently been completed. Flow to the South shore fishway system can be reduced by: 1) shutting off or reducing flow from one or all three of the fishway supply pumps, 2) partially or completely closing the tainter valve which supplies gravity flow from the forebay to the fishway diffusers, and/or 3) raising the control weirs at the upper end of the fish ladder near the fishway exit. None of these alternatives were found to be desirable, either because of operational difficulties and/or ineffectiveness (reference by title and date Simeon's report).

A brief analysis of the system operations and system hydraulics was conducted to determine the feasibility of lowering the entrance weir gates to achieve lower velocities. It was estimated that entrance velocities could be reduced to 4 to 5 fps depending on tailwater elevations. A field test of lowering the weir gates to the lowest possible position was recommended. The goal of this test was to verify the expected response and to work through the process of lowering the gates to clearly identify any logistical and hydraulic concerns. This recommendation was presented by Tim Dykstra to the FPOM committee for approval. The test was approved for March 31st, prior to adult passage counting at McNary, which was to begin on April 1.

Departure and Attendance - Martin Ahmann, Derick Fryer, Simeon Francis and Brett Morris left the NWW District office at 9:30 and arrived at McNary around 10:45

Activities - The NWW team met with Brad Eby (McNary Project Biologist) to discuss the objectives of the study. The study team then met with the Project Operators to coordinate the lowering of the SSE gates followed by lowering the NFE gates. It was decided to manually lower the weir gates at the gate hoist rather than from the control room. This precaution would be taken to prevent a slack cable situation.

The study team returned to the SSE gates for pre-test conditions (condition 1), photographed the exit flow, recorded the gate position, channel water surface elevation, and tailwater surface elevation; differential across the weir gates was calculated (see table 1.)

The SSE gates were lowered to elevation 251.0 fmsl. The top of the weir gate at elevation 251.0 is level with the top of the segmental gate and is the lowest possible effective gate position. Photographs of the exit flow were taken and the water surface elevations were again recorded and the head differential determined (condition 2).

The study team was driven to the north end of the powerhouse where the NFE gates would be lowered in an effort to further reduce the flow and head across the SSE gates (condition 3). Initial gate position and water surface elevations were recorded and the head differential determined (table 1). Photographs were also taken. The NFE gates were then lowered and the fishway system was allowed to stabilize for approximately 15 minutes. The NFE 2-3 gates position and the water surface elevations were recorded; the head differential for the NFE gates in the lowered position was then determined. It should be noted that the NFE conditions prior to lowering the SSE gates were not recorded. However the study team did observe and photograph the exit conditions of the NFE gates prior to lowering the SSE gates.

The study team was then driven back to the South end of the powerhouse where the effect of lowering the NFE gates on head and flow across SSE gates was observed. The water surface elevations were recorded and the head differential across the SSE gates was determined.

Water surface elevations, gate positions and head differentials determined for all conditions are provided in Table 1.

TABLE 1

Condition	Entrance Gates	Gate Position	Channel WSE	Tailwater WSE	Gate Depth	Differential
Condition 1	SSE 1-2	Raised (258.3)	268.3	267.4	9.1	0.9
Condition 1	NFE 2-3	Raised (257.3)	N/A	266.6	9.3	N/A
Condition 2	SSE 1-2	Lowered (251.0)	267.8	267.4	16.4	0.4
Condition 2	NFE 2-3	Raised (257.3)	267.4	266.6	9.3	0.8
Condition 3	NFE 2-3	Lowered (253.5)	266.9	266.5	13.0	0.4
Condition 3	SSE 1-2	Lowered (251.0)	267.7	267.4	16.4	0.3

Photographs of each condition are provided in the attachments. The reduction in velocity is apparent from these photos.

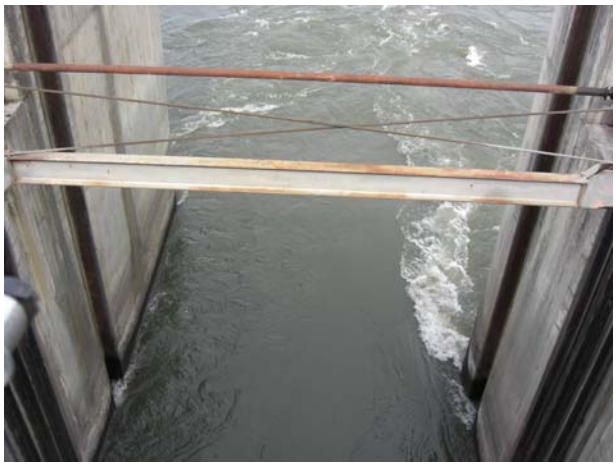
Conclusions - There were no problems observed when lowering or raising the weir gates. Project Operators are able to lower the gates manually at the gate hoist or from the Operators' control room. Although some concern was expressed with the lowering of gates below their limits, this was not a problem during the test and would not appear to be an un-resolvable problem should lowering of the weir gates during nighttime hours become a routine operation. It is possible the operation could be automated.

Lowering the SSE 1-2 weir gates is an effective means of reducing head and subsequently the velocity of flow through the entrance gates. The head and velocity of flow through the SSE 1-2 weir gates can be further reduced by lowering the NFE 2-3 gates. The velocity of flow through SSE 1-2 entrances was calculated from the measured head differentials, however the approach velocity to the entrances was not known, so the calculated values represent estimates only. The velocity was also calculated from estimates of discharge through the entrance and the depth of flow over the weir. The estimated velocity of flow through the SSE 1-2 gates using both methods is approximately 4 fps. Neither method was refined enough to accurately determine the difference in velocity of flow with and without the NFE 2-3 gates lowered; if necessary this could be determined.

The evaluation was conducted under one tailwater condition. The tailwater elevation measurements indicate a gradient in elevation from the South to North end of the Powerhouse. The tailwater elevation is dependent upon total river flow and control of the downstream pool elevation at the John Day Dam. The gradient in the tailwater elevation below the McNary powerhouse is driven by Project operation. Both the tailwater elevation and the gradient will influence the SSE 1-2 conditions. As the tailwater elevation drops the velocity of flow through the SSE 1-2 entrances will increase, if the tailwater elevation increases and the gates remain lowered the velocity of flow will decrease. If the gradient from South to North shifts, there is a possibility of reverse flow from the NFE 2-3 gates, which would increase flow out the SSE gates and could possibly increase the discharge and velocity through SSE 1-2 entrances. This test was conducted with the tailwater elevation at 267.4 below the SSE gates and 266.6 below the NFE gates; the tailwater elevation during the fish passage season at McNary ranges from a low of 262.5 to a high of 270.8 fmsl. If lowering the SSE and NFE weir gates becomes a routine operation, similar test should be conducted to assure acceptable conditions over this wide range of tailwater elevations.

Prepared by: Martin Ahmann, CENWW-EC-H
martin.l.ahmann@usace.army.mil
(509) 527-7538

Photos 1 & 2 Water velocity before test conditions



Photos 3 & 4 Water velocity under test conditions