CENWW-ODH FONE 11 December, 2024

MEMORANDUM THRU:
Brian Vorheis, Operations Project Manager, Ice Harbor Dam

FOR Chief, Operations Division
ATTN: Chris Peery

SUBJECT: Submission of 2023 Adult and Juvenile Fish Facility Monitoring Report, Ice Harbor Dam.

1. Enclosed is the 2023 Adult and Juvenile Fish Facility Monitoring Report for Ice Harbor Dam as requested.

2. If you have any questions contact Ken Fone at Ice Harbor Dam, (509) 544-3137.

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2023 ADULT AND JUVENILE FISH FACILITY MONITORING REPORT

ICE HARBOR DAM

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INTRODUCTION

This report summarizes the operation and maintenance of the adult and juvenile fish passage facilities at Ice Harbor Dam in 2023. The juvenile fish passage facility at Ice Harbor Dam consists of standard length submersible traveling screens (STSs), vertical barrier screens (VBSs), 12-inch diameter orifices (36 orifices), a collection channel and dewatering structure, fish sampling facilities, and a transportation flume/pipe to the tailrace downstream from the dam. The juvenile fish collection channel is operated with approximately 300 cubic feet per second (cfs) flow (forebay head-dependent), which is the design operating flow produced by 20 of the juvenile fish passage orifices open. All but 30 cfs of the flow is removed at the primary dewatering structure and utilized as adult fish attraction water. The remaining 30 cfs flow and fish are routed through a transport pipe and flume to the fish sampling facility or directly to the tailwater.

The adult fish passage facilities at Ice Harbor are comprised of separate north and south shore systems. The north shore facilities include a fish ladder with a counting station, an adult fish collection channel, and a pumped auxiliary water supply system. The collection system includes two downstream entrances near the navigation lock wall at the base of the dam and one side entrance (which is bulkheaded off) from the spillway basin. The downstream entrance nearest the navigation lock wall is normally open for fish passage. Three electric pumps supply the auxiliary water for fish attraction flow. Two of the three pumps operate continuously during normal operation. The third pump serves as a backup in the case of a pump failure.

The south shore facilities are comprised of a fish ladder with a counting station, two south shore entrances, a powerhouse collection system, and a pumped auxiliary water supply system. The powerhouse collection system includes two downstream entrances and one side entrance (which is bulkheaded off) from the spillway basin at the north end of the powerhouse, twelve floating orifices, and a common fish transportation channel. The fishway entrances used during normal operation include: one south shore entrance nearest the powerhouse, one downstream north powerhouse entrance, and four floating orifices. Eight electric pumps are available to supply the auxiliary water for fish attraction, of which five to eight pumps are used during normal operation. Excess water from the juvenile fish bypass system (approximately 200-270 cfs depending on forebay head) was added to the south shore fish pump discharge chamber from March 23 through December 13, 2023.

RIVER CONDITIONS

Daily Ice Harbor outflows averaged 41.9 thousand cubic feet per second (kcfs) in 2023, with a peak outflow of 183.2 kcfs occurring on May 23, compared to a peak of 212.4 kcfs occurring in 2022. Spill for juvenile fish passage began April 3 and continued through August 31. The daily spill during that period averaged 18.5 kcfs, with a maximum daily spill of 116.24 kcfs occurring on May 23. River temperatures taken from unit 1 scroll case ranged from 38 °F in early March to 73 °F in early August. Raw water temperatures taken from the Juvenile Fish Facilty Laboratory (JFF) during the juvenile fish sampling period of April 3rd to July 10 ranged from 45.0 °F to 68.9 °F.

JUVENILE FISH FACILITY OPERATIONS AND MAINTENANCE

Sampling Summary

The Juvenile Fish Bypass was operated from March 23 to December 13, 2023. Normal operation of the facilities is to bypass all collected fish directly to the river, except when routine sampling is conducted for monitoring fish condition. Sampling for fish condition in 2023 began on April 3 and ended on July 10. The sampling season ended a week early due to river temperatures being above 70.0 °F. Fish were sampled twice a week. The goal of a sampling event is to collect 100 fish of the predominant species within a four-hour period. Fish are visually counted as they come into the fish separator structure.

A total of 2,418 juvenile salmon and steelhead were sampled at the Ice Harbor JFF in 2023 (Table 1), which was a 31% decrease in comparison to 2022 sampling season (Table 2). Subyearling Chinook fry in the sample are not examined, but are included in the total number of fish sampled. A total of 93 non-target fish (incidental species) were released off of the separator or sampled in 2023 (Table 3). These incidental fish were identified, recorded, and released back into the river via the bypass. Juvenile Pacific lamprey and Siberian prawns were the most commonly encountered incidental species during sampling events in 2023. Occassionally, there were juvenile lamprey observed in the separator and sample holding tank that did not show up in the lab. These lamprey most likely escaped out of the tank through holes of the water-regulating perforated plates.

Juvenile Fish Condition

The juvenile fish bypass and sampling facility are routinely inspected for debris obstructions, and operational and maintenance problems that could cause descaling and injury to fish. Areas that are periodically or annually unwatered are inspected more closely during the fish passage season and/or during the winter maintenance period.

The numbers of salmon and steelhead of each species group sampled by day in 2023 that were observed with descaling (at least 20% of surface area of one side of fish with missing scales), and the associated descaling rates (percent of fish sampled of each species group with descaling), are shown in Tables 4A and 4B. The combined annual descaling rate for all salmon and steelhead sampled in 2023 was 0.9%, with the highest daily descaling rate being 6.2% on July 10. The annual descaling rate has decreased each year since 2019 (Table 5).

A variety of other injuries were observed in sample fish. In general, the incidence, rate, and location of injuries on fish throughout the sampling season appeared to be random, that is, there did not appear to be a specific cause or source of injuries observed.

Total juvenile facility percent mortality for all salmon and steelhead groups combined was 0.2% in 2023, compared to 0.1% in 2022 (Table 6). Fish that are dead prior to coming into the lab are not examined for condition, but are included in the number of fish sampled.

Table 1. Number of juvenile salmon and steelhead sampled per day at Ice Harbor Dam, 2023.

	Yearling Chinook		Subyearling Chinook		Steelhead		Sockeye/Kokanee		All	Daily
Date	Clipped	Unclipped[1]	Clipped	Unclipped[1]	Clipped	Unclipped[1]	Clipped	Unclipped[1]	Coho	Total
3-Apr	0	0	0	0	0	0	0	0	0	0
6-Apr	3	3	0	0	0	0	0	0	0	6
11-Apr	18	0	0	0	0	0	0	0	0	18
13-Apr	31	0	0	0	2	0	0	0	0	33
17-Apr	45	1	0	0	8	0	0	0	0	54
20-Apr	37	13	0	0	17	0	0	0	0	67
24-Apr	33	12	0	0	58	8	0	0	0	111
27-Apr	73	29	0	0	49	11	0	0	0	162
1-May	32	2	0	0	123	5	0	0	0	162
4-May	43	4	0	0	56	9	0	0	0	112
8-May	64	10	0	0	47	12	0	0	0	133
11-May	72	16	0	1	29	9	0	0	0	127
15-May	59	8	9	18	49	10	2	0	1	156
18-May	62	7	6	16	17	7	22	0	2	139
22-May	27	3	17	28	19	9	1	0	1	105
25-May	31	13	13	29	36	10	1	0	3	136
29-May	7	0	24	45	9	3	0	0	0	88
1-Jun	1	1	5	30	7	1	1	0	0	46
5-Jun	2	1	8	15	3	1	0	0	0	30
8-Jun	0	0	5	5	3	0	0	0	0	13
12-Jun	0	0	8	9	0	0	0	0	0	17
15-Jun	1	0	18	15	0	1	0	0	0	35
19-Jun	0	0	20	15	0	1	0	0	1	37
22-Jun	1	0	18	65	6	2	0	0	6	98
26-Jun	0	1	36	62	0	0	0	0	2	101
29-Jun	0	0	68	72	1	0	0	0	3	144
3-Jul	0	0	45	55	0	0	0	0	0	100
6-Jul	0	0	32	57	0	0	0	0	1	90
10-Jul	0	1	29	68	0	0	0	0	0	98
Totals	642	125	361	605	539	99	27	0	20	2,418
% Totals	26.6	5.2	14.9	25.0	22.3	4.1	1.1	0.0	0.8	---

[1]Includes unclipped hatchery reared fish

However, mortalities are checked for obvious signs of physical trauma that could have contributed to their death. One of the subyearling mortalities was observed as almost dead when it passed through the separator, but no obvious injuries were noted. The second was observed to be descaled and most likely died while being anesthetized. All other mortalities observed during fish sampling appeared to have been dead for several days prior to entering the separator.

Table 2. Number of juvenile salmon and steelhead sampled at Ice Harbor Dam, 2019-2023.

	Yearling Chinook		Subyearling Chinook		Steelhead		Sockeye/kokanee		All	
Year	Clipped	Unclipped[1]	Clipped	Unclipped[1]	Clipped	Unclipped[1]	Clipped	Unclipped[1]	Coho	Total
2019	748	331	552	680	1,082	270	71	5	32	3,771
2020	1,025	279	356	598	1,022	229	7	0	2	3,518
2021	1,050	210	369	524	875	166	7	19	29	3,249
2022	717	121	433	730	1,187	269	8	12	13	3,490
2023	642	125	361	605	539	99	27	0	20	2,418

[1]Includes unclipped hatchery reared fish

Table 3. Collection of incidental species during sampling at Ice Harbor Dam, 2023.

Common Name	Scientific Name	Number of Fish
Pacific lamprey	*Lampetra tridentatus*	48
Walleye	*Sander vitreus*	5
Sculpin	*Cottoidea sp.*	1
Siberian Prawn	*Exopalaemon modestus*	23
Yellow Perch	*Perca flavescens*	1
Smallmouth Bass	*Micropterus dolomieu*	8
American Shad	*Alosa sapidissima*	5
Bluegill	*Lepomis macrochirus*	2
Total		93

Adult Salmonid Fallbacks

Typically, there are few adult fish that fall back and are released from the separator at Ice Harbor, because of the limited operation of the separator and juvenile fish sampling. All of the 2023 fallbacks were in good condition (Table 7).

Main Turbine Unit Cooling Water Strainer Inspections

In 2023, the main unit turbine cooling water strainers were inspected monthly for the presence of lamprey, from February to July. Additionally, strainers were cleaned when debris or fish created a pressure differential across the strainers in November and December. Juvenile shad filled the strainers quite frequently in November. The total number of each species group removed were approximately: two clipped juvenile Chinook, four adult Pacific lamprey, 846 juvenile Pacific lamprey, one adult American shad, 6,080 juvenile American shad, 648 Siberian prawns, two adult yellow perch, and four decomposed fish that could not be identified. All fish were found dead, except as noted below for juvenile lamprey.

The total number of juvenile Pacific lamprey that were found in the turbine cooling water strainers in each of the last five years is shown in Table 8. The vast majority of the lamprey were dead, and any surviving lamprey were released into the tailrace.

One important factor that affects whether fish go into the unit cooling water is how the cooling water system is operated. At Ice Harbor, the cooling water intake remains open when a unit is not running, so fish that are in the scroll case when a unit is turned off may be more likely

Table 4a. Number of sampled salmon and steehead with descaling at Ice Harbor Dam, 2023.

	Yearling Chinook		Subyearling Chinook		Steelhead	Steelhead	Sockeye/Kokanee		All	Total
Date	Clipped	Unclipped[1]	Clipped	Unclipped[1]	Clipped	Unclipped[1]	Clipped	Unclipped[1]	Coho	Facility
3-Apr	---	---	---	---	---	---	---	---	---	0
6-Apr	0	0	---	---	---	---	---	---	---	0
11-Apr	0	---	---	---	---	---	---	---	---	0
13-Apr	1	---	---	---	0	---	---	---	---	1
17-Apr	0	0	---	---	0	---	---	---	---	0
20-Apr	0	0	---	---	0	---	---	---	---	0
24-Apr	1	0	---	---	1	0	---	---	---	2
27-Apr	0	2	---	---	0	0	---	---	---	2
1-May	0	0	---	---	0	0	---	---	---	0
4-May	0	0	---	---	0	0	---	---	---	0
8-May	0	0	---	---	0	0	---	---	---	0
11-May	1	0	---	0	0	0	---	---	---	1
15-May	1	0	0	0	1	1	0	---	0	3
18-May	0	0	0	0	0	0	0	---	0	0
22-May	0	0	0	0	0	0	0	---	0	0
25-May	0	0	0	0	0	0	0	---	0	0
29-May	0	---	0	0	0	0	---	---	---	0
1-Jun	0	0	0	0	0	0	---	---	---	0
5-Jun	0	0	0	0	0	0	---	---	---	0
8-Jun	---	---	0	0	0	---	---	---	---	0
12-Jun	---	---	0	0	---	---	---	---	---	0
15-Jun	0	---	0	1	---	---	---	---	---	1
19-Jun	---	---	0	0	---	0	---	---	0	0
22-Jun	0	---	0	1	1	0	---	---	1	3
26-Jun	---	0	0	0	---	---	---	---	0	0
29-Jun	---	---	2	0	0	---	---	---	0	2
3-Jul	---	---	0	0	---	---	---	---	---	0
6-Jul	---	---	0	0	---	---	---	---	0	0
10-Jul	---	0	1	5	---	---	---	---	---	6
Totals	4	2	3	7	3	1	0	0	1	21

--- No fish of this species sampled

[1]Includes unclipped hatchery reared fish

to get drawn into the cooling water intake (in the wall of the scroll case) than if the cooling water were shut off. Turbine units that are started and stopped frequently may be prone to attracting fish into the cooling water intake. This is why juvenile shad frequently clog the strainers at Ice Harbor.

Table 4b. Sampling event descaling rates (%) within salmon and steelhead species groups at Ice Harbor Dam, 2023.

	Yearling Chinook		Subyearling Chinook		Steelhead	Steelhead	Sockeye/Kokanee		All	Total
Date	Clipped	Unclipped[1]	Clipped	Unclipped[1]	Clipped	Unclipped[1]	Clipped	Unclipped[1]	Coho	Facility
3-Apr	---	---	---	---	---	---	---	---	---	---
6-Apr	0.0	0.0	---	---	---	---	---	---	---	0.0
11-Apr	0.0	---	---	---	---	---	---	---	---	0.0
13-Apr	3.2	---	---	---	0.0	---	---	---	---	3.0
17-Apr	0.0	0.0	---	---	0.0	---	---	---	---	0.0
20-Apr	0.0	0.0	---	---	0.0	---	---	---	---	0.0
24-Apr	3.0	0.0	---	---	1.7	0.0	---	---	---	1.8
27-Apr	0.0	6.9	---	---	0.0	0.0	---	---	---	1.2
1-May	0.0	0.0	---	---	0.0	0.0	---	---	---	0.0
4-May	0.0	0.0	---	---	0.0	0.0	---	---	---	0.0
8-May	0.0	0.0	---	---	0.0	0.0	---	---	---	0.0
11-May	1.4	0.0	---	0.0	0.0	0.0	---	---	---	0.8
15-May	1.7	0.0	0.0	0.0	2.0	10.0	0.0	---	0.0	1.9
18-May	0.0	0.0	0.0	0.0	0.0	0.0	0.0	---	0.0	0.0
22-May	0.0	0.0	0.0	0.0	0.0	0.0	0.0	---	0.0	0.0
25-May	0.0	0.0	0.0	0.0	0.0	0.0	0.0	---	0.0	0.0
29-May	0.0	---	0.0	0.0	0.0	0.0	---	---	---	0.0
1-Jun	0.0	0.0	0.0	0.0	0.0	0.0	---	---	---	0.0
5-Jun	0.0	0.0	0.0	0.0	0.0	0.0	---	---	---	0.0
8-Jun	---	---	0.0	0.0	0.0	---	---	---	---	0.0
12-Jun	---	---	0.0	0.0	---	---	---	---	---	0.0
15-Jun	---	---	0.0	6.7	---	0.0	---	---	---	2.9
19-Jun	---	---	0.0	0.0	---	---	---	---	0.0	0.0
22-Jun	0.0	---	0.0	1.5	16.7	0.0	---	---	16.7	3.1
26-Jun	---	0.0	0.0	0.0	---	---	---	---	0.0	0.0
29-Jun	---	---	2.9	0.0	0.0	---	---	---	0.0	1.4
3-Jul	---	---	0.0	0.0	9.1	---	---	---	---	0.0
6-Jul	---	---	0.0	0.0	---	---	---	---	0.0	0.0
10-Jul	---	0.0	3.4	7.5	---	---	---	---	---	6.2
Totals	0.6	1.6	0.8	1.2	0.6	1.0	0.0	---	5.0	0.9

--- No fish of this species sampled. [1]Includes unclipped hatchery reared fish

Table 5. Annual descaling rates (%) for salmon and steelhead species groups sampled at Ice Harbor Dam, 2019–2023.

Year	Yearling Chinook		Subyearling Chinook		Steelhead		Sockeye/Kokanee		All	Overall
	Clipped	Unclipped[1]	Clipped	Unclipped[1]	Clipped	Unclipped[1]	Clipped	Unclipped[1]	Coho	
2019	3.7	2.4	3.6	2.5	5.5	8.9	1.4	0.0	3.1	4.2
2020	1.8	1.8	0.3	1.0	4.8	6.6	28.6	---	0.0	2.7
2021	2.7	1.0	0.8	1.9	3.4	4.8	0.0	0.0	3.4	2.5
2022	0.4	3.3	1.6	1.0	1.9	3.0	0.0	0.0	0.0	1.5
2023	0.6	1.6	0.8	1.2	0.6	1.0	0.0	---	5.0	0.9

-- No fish of this species sampled. [1]Includes unclipped hatchery reared fish

Table 6. Annual mortality numbers and total mortality rate for salmon and steelhead sampled at Ice Harbor Dam, 2019-2023.

Year	Yearling Chinook		Subyearling Chinook		Steelhead		Sockeye/Kokanee		All	% of Sample
	Clipped	Unclipped[1]	Clipped	Unclipped[1]	Clipped	Unclipped[1]	Clipped	Unclipped[1]	Coho	
2019	0	0	0	2	1	0	0	0	0	0.1
2020	6	1	0	3	3	0	0	0	0	0.4
2021	14	2	0	3	1	0	0	0	0	0.6
2022	2	0	1	0	0	0	0	0	0	0.1
2023	2	0	0	2	1	0	0	0	0	0.2

[1]Includes unclipped hatchery reared fish

Table 7. Condition of adult salmonids released from the juvenile fish separator at Ice Harbor Dam, 2023.

Date	Species Group	Condition
19-Jun	Clipped Chinook	Good
22-Jun	Clipped Chinook Jack	Good
10-Jul	Clipped Chinook Jack	Good

Table 8. Yearly total number of Pacific Lamprey removed from turbine unit cooling water strainers at Ice Harbor Dam, 2019-2023.

Pacific Lamprey (Juvenile)			
Year	Live	Dead	Total
2019	**	**	152
2020	**	**	3,310
2021	8	410	418
2022	1	229	230
2023	9	837	846

** Condition breakdown was not accurately recorded in those years

Debris/Trash Racks

A daily maximum of 162 square yards of forebay debris was observed on Mach 22, 2023, compared to a maximum of 355 square yards observed on March 29, 2022. Main unit trash rack raking was completed the week of March 20. No fish mortalities were found on the trash racks.

Submersible Traveling Screens

Installation of the STSs was completed on all available units (1, 2, 4, 5, and 6) on March 27, 28, and 29. An underwater video camera was used to conduct monthly inspections of STSs that ran since the previous inspection occurred. Screens were examined for any issues that could injure fish. The STS problems found and fixed during the season are shown in Table 9. Unit 3 STSs were installed in June, prior to returning unit 3 to service following turbine runner replacement. Unit 1 STSs were removed for the season in June, after taking the unit out of service for turbine runner replacement. The other STSs were removed for winter maintenance on December 11 and 12.

Table 9. STS problems found during inspections at Ice Harbor Dam in 2023.

Date	Unit & Slot	Location on Screen	Problem	Remedy
19 July	3B	Edge of seam	3.5’ separation	Replaced with spare STS
20 July	2A	Center of seam	9” separation	Replaced with spare STS
16 Aug	3B	Center of seam	Worn seam	Screen lifted on 30 Aug, verified to be 18” rip
16 Oct	6B	Seam	Separated nearly entirely across	Replaced with spare
15 Nov	2A	Edge of seam	2’ separation	Repaired same day

Vertical Barrier Screens

Project personnel inspected the VBSs while conducting STS inspections. Different turbine unit’s VBSs were inspected each month until they were all inspected. A roughly 2” x 3” hole with fraying was found in the bottom section of the 2A VBS mesh on May 16. The damaged section of mesh was removed as there was only solid frame behind it. A pair of similar holes (one 1”x 2”, the second 1.5” x 4”) were found in the lower section of 4A VBS mesh but will be left as is due to the area behind them being a solid frame.

Gatewells

Gatewell slot debris was low to moderate at Ice Harbor Dam in 2023 and never approached the 50% coverage criteria point for mandatory cleaning. Slots were dipped for debris removal as needed prior to installing the STSs.

An oil sheen was observed in gatewell slot 2A and 6C on May 15 and September 20, respectively. The oil in 2A was estimated to be approximately 1-2 ounces of hydraulic oil that came off of the headgate cylinder shaft. The oil in 6C was presumed to be about 1 ounce of hydraulic oil that washed off the deck and nearby equipment during rain. In each case, oil absorbent socks were deployed into the slot and the appropriate state and federal agencies were notified of the oil spill.

Orifices/Collection Channel

The juvenile fish channel was watered up and orifices were opened on March 23. The collection channel is typically operated with 20 orifices open. At least one (the north) orifice is open in each gatewell slot, with the following exceptions. Both orifices were closed in individual gatewells for brief periods during the season to accommodate routine maintenance and repair, such as backflushing, STS inspections, and STS/VBS repair.

Shortly after watering up, false readings from the new water level transducers in the juvenile fish channel triggered alarms for high differentials across the channel to the overflow section, causing unit 2 through unit 6 gatewell orifices to automatically close on two occasions. This happened again on June 17. The operator and/or fish facility personnel were present when these events happened and promptly re-opened the orifices. The automatic orifice closure was

disabled each time until electricians recalibrated the transducers or fixed a voltage problem to the transducers.

Orifices were routinely cycled and backflushed by powerhouse operators and fish facility personnel. Backflushing three times per day was maintained from late March through July 31, Backflushing occurred once per day for the remainder of the year. There were no clogged orifices noted by fish facility personnel. Orifice lights were checked daily, and if a orifice light was found to be not working, the orifice was closed and the other orifice in that gatewell slot was opened until the light was fixed. Bad orifice lights were reported to electricians for replacement or repair.

When the power to the STS breaker was shut off on May 3, to replace the breaker, power to the orifices was inadvertently shut off, causing the solenoid-controlled orifices in units 2 through unit 6 gatewells to automatically close. As a result, the water depth in the bypass flume dropped to a few inches. The powerhouse operator and fish facility personnel quickly investigated and got power restored and the orifices reopened.

On December 12, orifices valves were opened and closed to facilitate removal of STSs and to support other on-going maintenance. During this time, the juvenile fish collection channel high differential alarm sounded and units 2 through 6 orifices automatically shut. This was caused by rapid water level fluctuations from opening and closing orifices. The operator immediately responded to the alarms and opened orifices to bring the water level back up in the bypass flume.

Primary Dewatering Structure

After the system was watered up on March 23, the actuator for the water regulating weirs in the collection channel was kept in local control due to a problem with the automatic control function that occurred in 2022. The weirs are being operated at the actuator to adjust the water level as needed until the problem can be fixed. Repair is scheduled for the 2024-2025 winter maintenance cycle.

The juvenile fish channel, including the primary dewatering structure, was unwatered for winter maintenance on December 13, 2023. The composition of fish recovered was 25 clipped adult steelhead, 15 unclipped adult steelhead, and 4 channel catfish and 34 adult Pacific lamprey. One sculpin was also recovered from the juvenile fish bypass flume. Fish were released in good condition at the Levey Park boat ramp.

Sampling System

During Ice Harbors 2023 sampling season, the system functioned well with no maintenance problems associated with sampling equipment.

Removable Spillway Weir

The spill for juvenile fish passage occurred from April 3 to August 31, 2023. In accordance with 2023 Fish Passage Plan, the removable spillway weir (RSW) was closed on August 1 (instead of August 31), when the daily average project outflow decreased below 30 kcfs and the inflow was forecasted to stay below 30 kcfs for three consecutive days. Additionally, seasonal spill through the RSW for steelhead overshoots occurred from March 1 to April 2 and from September 1 to November 15. Spill for steelhead overshoots occured three times per week on non-consecutive days for 4 hours in the morning.

The RSW 3-year inspection was conducted by divers on November 16. There were no significant problems in need of immediate attention. The RSW had no operational problems in 2023.

Avian Predation

The U.S. Department of Agriculture, Wildlife Services, utilized pyrotechnics to conduct land-based hazing of piscivorous birds from April 1 to June 30, 2023. In addition, boat-based hazing occurred from April 9 to June 10, and July 17 to July 31. Bird deterrent structures at the project include roosting deterrents, a water cannon at the juvenile fish bypass outfall pipe, and a wire array in the tailrace. Propane cannons are available to deploy as additional aids to harass birds in areas where there are continual predation problems. Piscivorous bird counts were conducted daily from April 1 to June 30, and four days per week in July (Figure 1), to track whether the harassment/deterrent program remained effective at reducing bird abundance around the dam. Land-based hazing was effective at pushing birds away from the immediate vicinity of the dam. The boat-based hazing was particularly effective at further removing birds from the downstream spillway and powerhouse tailrace zones. Double-crested cormorants were usually the most abundant piscivorous bird species observed during daily bird counts in early April, with gulls and American white pelicans becoming the predominant species for the next several months. There were more terns observed than other birds in July. Total bird numbers dipped in June, then increased again in July. Birds may have keyed in on the juvenile shad run in the late summer through the end of the year.

Pelicans were the most abundant birds counted in previous years (Table 10), but there numbers decreased below that of gulls this year. The number of gulls held fairly steady each year, except there was a drop in 2020. Pelicans and cormorants numbers are lower than they were four years ago while terns numbers are higher.

The average daily total number of cormorants, gulls, and terns counted per week in 2023 was usually within the range of the averages for the same weeks over the previous four years, but higher than the averages for the last three weeks in July (see Table 11). Since 2019, there has been a significant bird presence at the project in the month of July, after active bird hazing ended for the season. In 2023, boat-based hazing was requested for the latter half of July to deal with the terns. The avian abundance action trigger for increasing hazing efforts (see the Ice Harbor section of Appendix L of the Fish Passage Plan) was reached on a total of 24 days, eight days

Figure 1. Daily number of piscivorous birds counted at Ice Harbor Dam, 2023.

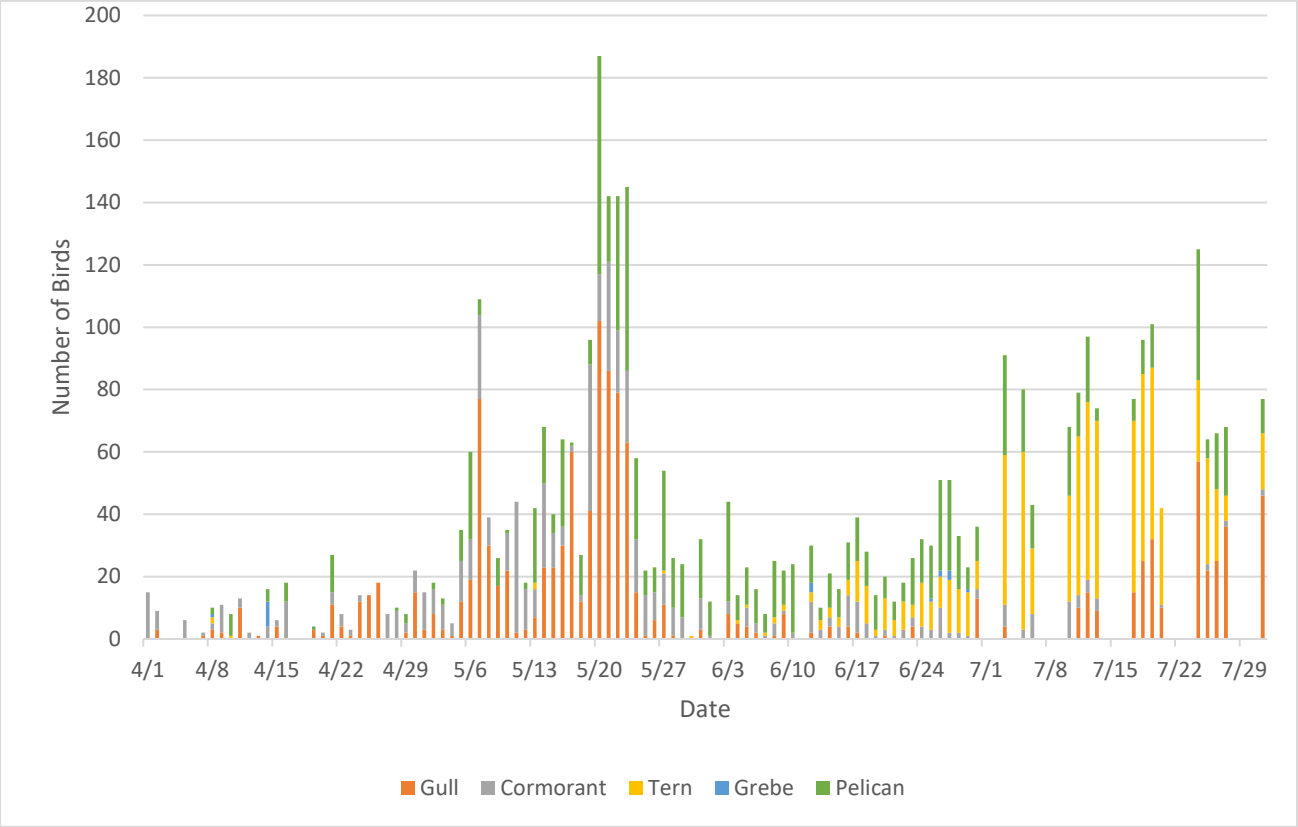

Table 10. Total numbers of gulls, cormorants, terns, grebes, and pelicans counted at Ice Harbor Dam, 2019-2023.

Year	Gulls	Cormorants	Terns	Grebes	Pelicans
2019	1,173	1,419	104	12	2,758
2020	348	762	43	0	3186
2021	1468	594	242	9	2139
2022	1394	923	428	16	1469
2023	1229	686	808	19	1143

during the spring, and 16 additional times thoughout the summer. However, bird counts on most of those days occurred when boat-based hazing was not actively occuring. Foraging birds were spread out in different observation zones during these events and were not targeting a specific fish passage route. Boat-based hazing was effective at reducing spikes in bird numbers to below the avian abundance trigger.

The bird abatement hydrocannon at the end of the outfall pipe developed a leak from one of the sprinkler head assemblies in mid-April. Consequently, the jet of water shooting from the heads was much reduced for the rest of the year. The hydrocannon was inspected on October 24 via boat and ladder, when it could be safely inspected with no spill occurring. The hydrocannon

Table 11. Average daily counts of gulls, cormorants, and terns per week at Ice Harbor Dam, 2019-2023.

Week	2019	2020	2021	2022	2023
April 1-7	15	2	4	14	5
April 8-14	31	10	4	25	6
April 15-21	26	10	10	19	6
April 22-28	16	9	13	9	11
Apr 29-May 5	34	8	12	7	14
May 6-12	41	16	34	18	40
May 13-19	71	6	67	93	42
May 20-26	26	23	25	58	69
May 27- June 2	15	19	22	35	8
June 3- 9	7	9	16	26	9
June 10-16	4	6	12	10	10
June 17-23	5	3	13	7	12
June 24-30	5	0	17	4	18
July 1-7	9	0	48	12	49
July 8-14	39	22	44	37	64
July 15-21	16	21	36	33	71
July 22-28	44	32	31	38	58

water lines below the sprinkler heads were rusting out and leaking, and the sprinkler heads were clogged. The water lines and sprinkler heads will need to be replaced, but currently the work platform is too slick from water, moss, and ice for personnel to safely work off it. Materials to fix the hydrocannon will be procured, but further access to the outfall pipe is dependent on safe weather and river conditions.

The bird-deterrent hydrocannon at the juvenile fish bypass outfall pipe was turned off and the hyrdrocannon pump was removed on November 22 to prevent ice accumulation.

Recommendations for the Juvenile Fish Facility

1. Repaint the interior of the juvenile fish bypass pipe/flume. The inside surfaces of the pipe and flumes have peeling paint and corroded areas, which create rough spots that could possibly descale or injure fish.
2. Extend the air bubbler screen cleaning system under the entire unwatering floor screen in the primary dewatering structure. This system would serve as a reliable extra cleaning system in the event of failure of aging components of the mechanical screen cleaner.
3. Replace the undersized actuator that operates the water regulating weirs in the juvenile fish channel to restore automatic control of the weirs.
4. Replace the black iron water line for the outfall pipe hydrocannon with stainless steel to prevent corrosion. Install a walkway alongside the outfall pipe to provide access to the outfall pipe and hyrocannon water line to conduct inspections and maintenance.

5. Install a fish release chute connecting to the main bypass pipe donstream of the JFF lab. This would permit fish rescued during certain unwatering events to be more easily returned to the tailrace via the bypass pipe.
6. Install stairs on the hillside to provide a direct and safe walking path between the JFF and tailrace deck level.
7. Pave the road and parking area inside the JFF and provide curbing that would direct any water runoff away from the juvenile facility and the hillside. Pavement would provide stable ground for heavy equipment access and setup as needed to perform maintenance and repairs.

Research

Normandeau Associates and PNNL conducted an evaluation: Direct Survival and Injury of Juvenile Spring Chinook Salmon Passed through a Newly Installed Adjustable Blade Turbine at Ice Harbor Dam, 2023. Results showed an estimated 96.9% 48-hour survival rate and 97.3% malady-free rate through unit 3; these rates are slightly lower (~1%) than estimated rates for fixed blade unit 2.

ADULT FISH FACILITY

Operations and Maintenance

The south shore fish ladder (SFL) and north shore fish ladder (NFL) were operated for fish passage for most of the year. The fish ladders were unwatered one at a time for annual winter maintenance in January and February. In 2023, adult fish counting occurred from March 1 to December 31. The number of adult salmonids and adult lamprey counted passing Ice Harbor Dam is shown in Table 12 for each fish ladder. For all species except lamprey, the SFL was used more than the NFL. The total counts for Chinook, sockeye, coho, and lamprey were higher than the 10-year averages, while the totals for Chinook jack and steelhead (both clipped and unclipped) were lower than the 10-year averages.

The upper SFL was unwatered for inspection and maintenance from January 4 to February 1, 2023, and the upper NFL was unwated for inspection and maintenance from February 7 to February 28. Fish were evacuated down to tailwater level in the lower fish ladders, except for one crayfish that was removed from the flow control section of the upper north fish ladder (Table 13) and released in good condition into the forebay. Both lower fish ladders were not unwatered, and the channel diffuser grating was inspected with a remotely operated vehicle. The channel grating was observed to be intact, with corrosion buildup on the SFL channel grating. Diffuser #10 grating in the upper north fish ladder is badly corroded, but with no holes.

Winter maintenance conducted during the 2023 maintenance period included:

- There was a delay in returning to service the NFL auxiliary water supply pumps (Table 14) and diffuser #10 until the afternoon of March 1. The damaged coupling of diffuser #10 valve stem to

Table 12. Number of adult fish passing Ice Harbor Dam in 2023, and average for the previous ten years.

	Chinook	Chinook Jack	Steelhead Clipped	Steelhead Unclipped	Sockeye	Coho	Coho Jack	Lamprey
SFL	76,574	12,331	42,389	17,384	1,567	12,464	988	1,193
NFL	27,838	4,670	8,216	3,851	702	2,137	214	2,129
Total (SFL + NFL)	104,412	17,001	50,605	21,235	2,269	14,601	1,202	3,322
Ten-Year Avg. (SFL + NFL)	99,969	20,613	60,952	23,334	1,147	7,768	812	750

Table 13. Areas at Ice Harbor Dam unwatered in 2023 requiring possible fish removal.

Date	Unwatering Activity	Fish Removed and Released in the River[1]
1-Jan	Upper south fish ladder	None
7,8-Feb	Upper north fish ladder	1 crayfish
9-Feb	Diffuser #10 chamber, north fish ladder	2 smallmouth bass, 1 sucker, 1 northern pikeminnow, 1 bluegill, 1 cr 1 perch
5-Jul	Unit 1 scroll case	8 channel catfish
10-Jul	Unit 1 scroll case	None
10-Jul	Unit 1 draft tube	17 channel catfish, 7 white sturgeon, 1 burbot
3-Oct	Unit 4 scroll Case	3 channel catfish, 2 sturgeon, 4 yellow bullhead
24-Oct	Unit 4 draft tube	17 channel catfish, 1 white sturgeon juvenile
7-Dec	Gatewell slot 1C	1 steelhead (clipped), 3 steelhead (adipose fin not checked)
8-Dec	Unit 1 scroll case	1 Pacific lamprey, 2 juvenile shad 1 juvenile white crappie, 1 juvenile tench, 2 crayfish,
13-Dec	Juvenile fish channel	15 steelhead (unclipped), 25 steelhead (clipped), 34 lamprey, 4 channel catfish, 1 sculpin (in juvenile fish bypass flume)

[1]Fish were adults unless noted as juveniles

the actuator was replaced during the winter maintenance period, but electricians needed to set the operating limits of the actuator.

- Mechanics found numerous holes in diffuser #7 grating in the south fish ladder where the bars had rusted through. Diffuser #7 and #9 grating was also observed to be sagging down due to deteriorating metal support beams under the grating. Mechanics replaced the support beams and grating in-kind with spare material. These diffusers are not used during normal fish ladder operation, so stainless steel plates were re-installed onto diffuser #9 grating and added to diffuser #7 grating. The plates provide attachment points for adult lamprey and prevent fish from becoming stranded on exposed diffuser grating when unwatering the fish ladder.

- Deteriorated plastic fencing that serves as a fish jump barrier near the south fish ladder upper diffuser area was replaced with new plastic fencing material.

Table 14. AWS pump outages and significant events requiring pumps to be shut off at Ice Harbor Dam in 2023.

Date	Pump Number (#) or How Many Pumps Affected	Pump Outage Description or Reason for Turnin Off	Duration that entrance head/depth was out of criteria
March 1 to December 31	NS #1	Cylinder leak on the butterfly valve.	In criteria
March 1	NS #2, NS #3	Not starting due to low hydraulic pressure	15.6 hours
March 13	NS #2, NS #3	maintenance on breaker XP 212	11 minutes
March 17	All NS pumps	LSP-1 testing.	11.1 hours
March 18	All NS pumps	LSP-1 testing.	9.3 hours
June 7	NS #3	High amp reading/trash rack debris buildup	20 minutes
June 9	All SS pumps	SFE-1 weir gate stuck in guide slot	19 minutes
June 14	NS #3	High amp reading/trash rack debris buildup	5 minutes
June 14	Three to eight SS pumps	SFE-1 weir gate stuck in guide slot, Project Fish Biologist observation of weir gate operation. Several pumps failed to restart due to time delay safety feature.	1.9 hours
June 19	Seven SS pumps	SFE-1 weir gate stuck in guide slot	16 minutes
June 21	NS #3	High amp reading/trash rack debris buildup	13 minutes
July 1	Six SS pumps	SFE-1 weir gate stuck in guide slot	4 minutes
July 3	Five SS pumps	SFE-1 weir gate stuck in guide slot	10 minutes
October 18	NS #2	Tripped off (see MFR 23 IHR 10 for more detai	5.6 hours
November 15	Six SS pumps	SFE-1 weir gate stuck in guide slot	11 minutes

Some of the tailwater staff gauges are in disrepair, and replacing these gauges may require divers. The cleaning of dirty tailwater and channel staff gauges either require personnel access via a crane and man basket, or entry into the channel during the winter maintenance period. The Project Biologist is coordinating with maintenance staff at the dam for assistance with cleaning these staff gauges and replacement of damaged gauges.

Power was shut off to the north side of the dam during working hours on March 17 and 18 to test the LSP-1 switchgear. There was no power to the north fish ladder during that time, but depth over the stationary weirs and entrance weir most likely remained in criteria. However, there was almost no channel/tailwater differential when the north shore auxiliary water supply (AWS) pumps were out of service. See the AWS section below and MOC 23IHR02 for more information. A portable generator was used to power the video camera and lights in the north fish count room. There was no video of the count slot from 1145 hours to 1227 hours on March 17 when the generator ran out of gas.

On June 18, an operator found that the north fish ladder exit debris boom was detached from its anchor point at one end. Later in the week, it also broke loose at the other end. Repair of the debris boom occurred on June 28. All spill was stopped on 28 June from 0704 hours to 1000 hours to allow the repairs to be made from a boat (MFR 23IHR06).

The lamprey passage structure at SFE-2 was opened on June 26 instead of at the end of the month, because of the presence of adult lamprey in some of the preceding juvenile fish samples.

Summary of Fish Recovery Operations

Areas that were unwatered in 2023 that required Fish Facility personnel presence for possible fish rescue/evacuation are listed in Table 13. The total number of fish handled during unwatering events in 2023 was approximately 184. The species composition of live fish handled is shown in Table 13.

Adult Fish Trap Operation

The adult fish trap was not used in 2023.

Auxiliary Water Supply

The auxiliary water supply (AWS) pumps were operating or available for operation to help maintain fish entrance criteria in 2023, with the exceptions listed in Table 14, when AWS pumps were turned off, taken out of service, or forced out of service during the fish passage season to facilitate maintenance, operations, or emergency repairs. Five to eight AWS pumps were operated to maintain criteria in the south fish ladder, depending on tailwater elevation. Two AWS pumps were operated to maintain criteria in the NFL. In-season maintenance and minor repairs can be performed on the pumps that are in standby. Each north shore (NS) pump operates at 350 cfs and each south shore (SS) pump operates at 300 cfs. In addition, approximately 270 cfs of excess water from the juvenile fish collection channel is added to the south shore AWS pump discharge chamber.

Adult Fishway Inspections

Ice Harbor project fisheries personnel conducted visual inspections of the fish ladders during the adult fish passage season of March 1 to December 31, 2023. In addition, the powerhouse operators conducted daily limited inspections of the fishways. Fish facility staff averaged 3.0 fishway inspections per week with 132 inspections completed. The inspections were conducted by visually inspecting various areas of the fishways and recording readings from staff gages, fishway entrance hoists motor selysns, meters, and tape measures. The data compiled was entered into an Excel spreadsheet (Appendix 1). Fisheries staff also collected data on flow discharge, AWS pump and turbine unit operation, and juvenile fish orifice operation. In addition, estimates of the amount of debris that accumulated in the forebay, fish ladder exits, and gatewells were made. When the fishway was out of criteria, the powerhouse operator was notified to make adjustments to the fishway control system or arrange for repairs as needed. The combined fish passage data collected was used to compose weekly reports on the status of the fish facility operations and maintenance (See Ice Harbor section 2.5.2 of the 2023 Fish Passage Plan).

Automated Fishway Control System

In the 2023 fish season, water levels were automatically measured with a sonar-based level sensing system manufactured by Milltronics using the Multi Ranger model. A Programmable Logic Control Center (PLC) processed the signals from the Multi Ranger and displayed the readings on a panel in the control room. The PLC interfaces with process level controllers to raise or lower the three entrance weir gates in service as needed. The remote terminal units control the fishway weir gates according to set points that either control the gates at a depth below tailwater or a channel to tailwater head differential. Panels in the control room, JFF, and north fish ladder entrance deck display the following information: channel and tailwater elevation in feet above mean sea level (MSL) for the north shore, north powerhouse, and south shore entrances; elevation in feet above MSL for the weir gates; water depth at the gates; channel/tailwater differential; and set points for the gate depths and the channel/tailwater differential.

The readings from the automated fishway control system were compared to the visual inspection results to ensure that the readings were comparable and the fishways were operated within criteria. Any significant discrepancies between the readings were reported to the electricians for calibration. However, tailwater transducers cannot be accurately calibrated when spill is occurring. The time difference between reading a staff gage and checking the PLC display may have been as much as 120 minutes. The time difference between the automated and visual readings may give different inspection results due to operational changes, such as changing spill volumes, switching units, and water elevation fluctuations.

Inspection Results

Adult fishway inspection results for 2023 are shown in Table 15. Deviations from criteria can be caused by fluctuating water elevation readings at the staff gages during spill. Observable water elevations during spill can vary as much as one foot on either side of the average elevation, which significantly contributes to incorrect visual readings falsely indicating an out of criteria event. Another contributor to out of criteria events are misread staff gauges that are difficult to read because they are dirty or damaged. When a staff gauges become unreadable or is missing, a tape measure is used to measure the distance to the water from the deck to calculate water elevations. The use of a tape measure increases the chances of human error to obtain the measurements. Another consideration is the location of the staff gages in relationship to the water level sensing transducer. Some staff gauges are located at least several feet from the corresponding transducers. This condition makes accurate calibration impossible due to the relationship between the sensing equipment and the staff gage not being linear. The suitability of the present locations of the staff gauges and transducers for providing representative water surface elevations will be further evaluated.

Channel Velocity: The water velocity in the south shore channel junction pool was in criteria [criteria of 1.5-4.0 feet per second (fps)] on 99.2% of the inspections, compared to 96.1% of inspections in 2022. The water velocity meter appeared to not be updating its display starting on April 25; the meter was rebooted on May 9. The meter was noted as out of service on August 28

Table 15. Adult Fishway Inspection Results at Ice Harbor Dam, 2023

Inspection Point	In Criteria			Water Depth/Differential Over Criteria			Water Depth/Differential Under Criteria		
South Fish Ladder	**No. of Inspections**	**No. of Inspections in Criteria**	**% of Inspections in Criteria**	**Total No. 0.1' Over**	**Total No. 0.2' Over**	**Total No. ≥0.3' Over**	**Total No. 0.1' Under**	**Total No. 0.2' Under**	**Total No. ≥0.3' Under**
Channel Velocity	120	119	99.2	NA	NA	NA	NA	NA	NA
Ladder Exit Diff.	132	132	100.0	0	0	0	NA	NA	NA
Stationary Weir Depths	132	132	100.0	0	0	0	0	0	0
Counting Station Diff.	132	130	98.5	1	0	1	NA	NA	NA
North Fish Ladder	**No. of Inspections**	**No. of Inspections in Criteria**	**% of Inspections in Criteria**	**Total No. 0.1' Over**	**Total No. 0.2' Over**	**Total No. ≥0.3' Over**	**Total No. 0.1' Under**	**Total No. 0.2' Under**	**Total No. ≥0.3' Under**
Ladder Exit Diff.	132	132	100.0	0	0	0	NA	NA	NA
Stationary Weir Depths	132	131	99.2	0	0	0	1	0	0
Counting Station Diff.	132	132	100.00	0	0	0	NA	NA	NA
Entrance Head	**No. of Inspections**	**No. of Inspections in Criteria**	**% of Inspections in Criteria**	**Total No. 0.1' Over**	**Total No. 0.2' Over**	**Total No. ≥0.3' Over**	**Total No. 0.1' Under**	**Total No. 0.2' Under**	**Total No. ≥0.3' Under**
South Shore	132	103	78.0	9	8	12	0	0	0
North Powerhouse	132	119	90.2	2	1	0	2	3	5
North Shore	131	115	87.8	4	1	7	0	1	3
Entrance Weir Depths	**No. of Inspections**	**No. of Inspections in Criteria**	**% of Inspections in Criteria**	**Total No. ≥8'**	**Total No. <8' and on Sill**		**Total No. 0.1' Under and off Sill**	**Total No. 0.2' Under and off Sill**	**Total No. ≥0.3' Under and off Sill**
SFE-1	132	100	75.8	29	71		2	2	28
NFE-2	132	128	97.0	53	75		1	1	2
NSE-1	131	130	99.2	39	89		0	0	1

and was reported to electricians for repair, and was returned to service on September 6. During these periods, the velocity meter was declared out of service and velocity readings were not obtained.

Ladder Exits: The north and south fish ladder exit head differentials were in criteria (≤0.3 feet) during all inspections. There were no significant debris accumulations on the ladder exit trash racks and differentials that were typically 0.1' or less.

Ladder Weirs: The depth over the stationary weirs in the south fish ladder was in criteria (1.0-1.3 feet) on all fishway inspections. The depth over the stationary weirs in the north fish ladder was out of criteria once, at 0.9' depth. Diffuser #10 was opened to bring the depth into criteria. The diffuser had been in manual control because of problems with the automatic control function.

Counting Stations: The differential across the north shore picketed leads was in criteria (≤0.3 feet) on 100% of inspections. The differential across the south shore picketed leads was in criteria during 98.5% of inspections. The two out of criteria differentials were due to the buildup of filamentous algae on the leads. In both cases, the leads were cleaned shortly after the inspections. From mid-summer to early fall, periodic cleaning of the south shore picketed leads, up to several times a week, was necessary to keep the differential in criteria.

South Shore Entrance (SFE-1): The SFE-1 weir gate depth was in criteria (≥ 8 feet or on sill) on 75.8% of inspections, compared to 94.6% of inspections in 2022. In 2023, many of depths were under criteria when directly observed at the staff gauges, while values were in criteria on the PLC readout. These discrepancies were reported to electricians for calibration. The difficulty in obtaining accurate tailwater elevation readings with the turbulent conditions caused by spill made verification of transducer callibraton difficult. The other out of criteria depths occurred when the operator did not notice that the weir gate depth was below 8' when the tailwater level decreased. The weir gate was in manual control to reduce the wear and tear on the gate and hoist machinery constantly adjusting in automatic control to fluctuating tailwater levels, especially when spill was occurring. Manual control of the weir gate was also necessary because of the gate sometimes getting stuck in the guide slot and not lowering down until all of the SS AWS pumps were temporarily turned off. SFE-1 gate will be craned out and examined on the deck during the 2024 winter maintenance period.

SFE-1 weir gate depth was in sill criteria on 53.8% of inspections, compared to 41.1% of inspections in 2022.

North Powerhouse Entrance (NFE-2): The NFE-2 weir gate depth was in criteria (≥ 8 feet or on sill) on 97.0% of inspections. The weir gate depth was below criteria on four occasions when the weir was off of sill and the tailwater level dropped. NFE-2 is in manual control to reduce the wear and tear on the hoist machinery of operating in automatic control with fluctuating tailwater from spill.

NFE-1 weir gate was in sill criteria on 56.8% of inspections, compared to 43.4% of inspections in 2022.

North Shore Entrance (NSE-1): The NSE-1weir gate depth was in criteria (≥ 8 feet or on sill) on 99.2% of inspections. The NSE-1weir gate was in sill criteria on 67.9% of inspections, compared to 54.3% of inspections in 2022.

Fish Collection Channel/Tailwater Head Differential: The south shore entrance channel/tailwater head differential was in criteria (1 - 2 feet) on 78.0% of inspections, compared to 81.4% of inspections in 2022. All of the out of criteria differentials were high, mostly resulting from tailwater calibration issues and SFE-1 being in manual control as described for the South Shore Entrance results.

The north powerhouse entrance head differential was in criteria (1-2 feet) on 90.2% of inspections, compared to 97.7% of inspections in 2022. Most of the out of criteria differentials probably resulted from the difficulty in obtaining accurate tailwater elevation readings because of turbulence from spill. Two slightly low differentials occurred when five SS AWS pumps were operating instead of six.

The north shore powerhouse entrance head differential was in criteria (1-2 feet) on 87.8% of inspections, compared to 93.8% of inspections in 2022. Most of the out-of-criteria inspections occurring during spill, when turbulent tailwater made accurate physical measurements difficult and also preventing calibration of ultrasonic transducers to reduce any inaccuracy. Some of the high head differentials were also due to low tailwater levels, especially during the late summer and fall, when two NS AWS pumps still needed to be operated to meet minimum head criteria.

Recommendations for the Adult Fish Facility

1. Rehabilitate fish ladder entrance weir gates and hoisting equipment.
2. Install a handrail along the outside edge of the north and south shore fish ladders to allow routine in-season inspection of the entire fish ladders and to facilitate safer unwatering and fish evacuation procedures for personnel.
3. Replace the debris booms and attachment systems at the north and south shore fish ladder exits. The log booms are prone to detachment under high winds.
4. Proactively replace fish ladder diffuser grating as needed.
5. Replace broken/dirty staff gauges and guides so that the gauges are easier to clean and read.
6. Relocate staff gages and transducer units as needed so the staff gage and the automated fishway control system readings will be more precise.
7. Install a visual alert on the automated control system PLC when the fish ladder entrance criteria is not being met.
8. Replace fish jump barrier netting with higher quality material.
9. Remove the three sets of wing gates in the lower south fish ladder. The wing gates have been inoperable for many years are and are not needed for operation of the fish ladder. The gates are obstacles when rescuing fish during unwatering and when inspecting diffuser grating with the ROV.