CENWW-ODH FONE 20 January 2023

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

FOR Chief, Operations Division
ATTN: Chris Peery / Scott St. John

SUBJECT: Submission of 2020 Adult and Juvenile Fish Facility Monitoring Report, Ice Harbor Dam.

1. Enclosed is the 2020 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.

Kenneth R. Fone
Fisheries Biologist, Ice Harbor Dam

Enclosure

2020 ADULT AND JUVENILE FISH FACILITY MONITORING REPORT

ICE HARBOR DAM

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January 2023

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List of Acronyms

BPA – Bonneville Power Administration
CFS – Cubic feet per second
FPC – Fish Passage Center
FPP – Fish Passage Plan
JCC – Juvenile Collection Channel
JFF – Juvenile Fish Facility
KCFS – kilo cubic feet per second
NFL – North shore fish ladder
OOS – Out of service
PDS – Primary dewatering structure
PLC – Programmable logic controller
SFL – South shore fish ladder
STS – submersible traveling screens
RSW – removable spill weir
USDA-WS – United States Department of Agriculture-Wildlife Services
VBS – vertical barrier screen

Summary

This report summarizes the operation and maintenance of the adult and juvenile fish passage facilities at Ice Harbor Dam in 2020. Submersible traveling screens (STSs) for all operating units were installed between March 24 and March 26 and were removed between November 16 and November 18, which was a month early to accommodate for the intake crane upgrade. The Juvenile Fish Facility (JFF) was operated for juvenile fish bypass and fallbacks from March 23 to November 23. Fish condition monitoring began on April 2 and continued through July 16, occurring on Mondays and Thursdays. The JFF was dewatered on November 23.

Total smolts sampled in the 2020 season was 3,518. This seasons sample by species group included: 1,025 clipped and 279 unclipped yearling Chinook salmon (*Oncorhynchus tschawytscha*), 356 clipped and 598 unclipped subyearling Chinook salmon, 1,022 clipped and 229 unclipped steelhead salmon (*Oncorhynchus mykiss*), 7 clipped sockeye salmon (*Oncorhynchus nerka*) and 2 coho salmon (*Oncorhynchus kisutch*) combined.

The removable spillway weir (RSW) was operated for juvenile fish passage from April 3 to August 10. The RSW was closed before the end of the summer spill season on August 3 due to low river flows. The RSW was periodically opened from October 1 to November 15 for the downstream passage of adult steelhead. During that period, the RSW was operated from approximately 0500 hours to 0900 hours on Sundays, Wednesdays, and Fridays.

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Facility Introduction and Description

The juvenile fish passage facility at Ice Harbor Dam consists of standard-length submersible traveling screens, vertical barrier screens, 36 12-inch diameter orifices, a collection channel and dewatering structure, fish sampling facilities and a transportation flume 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 Dam are comprised of separate north and south shore systems. The north shore facilities include a fish ladder with an adult 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 dame and one side entrance, which is closed off via bulkhead 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 an adult 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 on 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 orifice gates. Eight electric pumps are available to supply the auxiliary water for fish attraction, of which five to eight pumps are used during normal operation.

Facility Modification, Maintenance, and Improvements

Throughout 2019-2020, five of the deteriorating water regulating weirs and associated connection brackets in the juvenile fish channel were replaced with newly fabricated weirs. Another weir that was fabricated and installed a few years ago was modified to enable it to move in the guide slot. The remaining four weirs have stem connection brackets that operate but are deteriorating from electrolysis and will be replaced next winter. Also, one of the horizontal linkages that serve to operate the weirs in unison was broken and was replaced.

The replacement of Unit 3 runner with a fish-friendly runner was occurring during the 2020 season.

Finally, the south fish ladder upper diffuser #12 grating supporting substructure and grating was replaced.

River Conditions

During the 2020 season (April 1 to September 30), the average monthly flow was less than the 5-year average (2015-2019) during the months of April and May (Table 1). The highest daily average flow for the season was 163.7 kilo cubic feet per second (kcfs) on June 1, Figure 1 below. The lowest daily average flow for the season occurred on September 15 with a flow of 16.7 kcfs. The average flow for the season was 61.4 kcfs.

Monthly average spill during the 2020 season (April 1 to September 30), was less than the 2015-2019 average for all months except for May and June. In May the average spill was 6.8 kcfs high and in June the average spill was 24.5 kcfs higher in the 2020 season than then 5-year monthly average, respectively, (Table 1).

Table 1. Comparison of monthly average flow and spill at Ice Harbor Dam, 2015-2020 and the 5-year average.

Flow (kcfs)							
Month	**2015**	**2016**	**2017**	**2018**	**2019**	**2015-2019 Avg**	**2020**
April	51.5	90.7	142.0	98.6	126.0	101.8	57.0
May	60.9	90.5	142.3	139.2	122.5	111.1	107.8
June	41.1	54.7	134.2	85.9	90.5	81.3	100.4
July	27.5	33.1	53.7	40.1	38.8	38.6	50.6
August	20.9	25.4	31.3	30.1	28.3	27.2	30.1
September	17.6	18.7	25.6	22.1	24.6	21.7	23.0
Spill (kcfs)							
Month	**2015**	**2016**	**2017**	**2018**	**2019**	**2015-2019 Avg**	**2020**
April	34.3	55.0	92.5	78.6	83.6	68.8	34.4
May	36.3	50.6	93.3	93.3	85.5	71.8	78.6
June	20.6	29.0	85.1	60.2	53.7	49.7	74.2
July	16.5	19.1	33.8	25.1	11.7	21.2	16.5
August	10.9	14.6	21.4	20.2	8.7	15.1	9.0
September	0.0	0.4	1.4	0.8	0.0	0.5	0.3

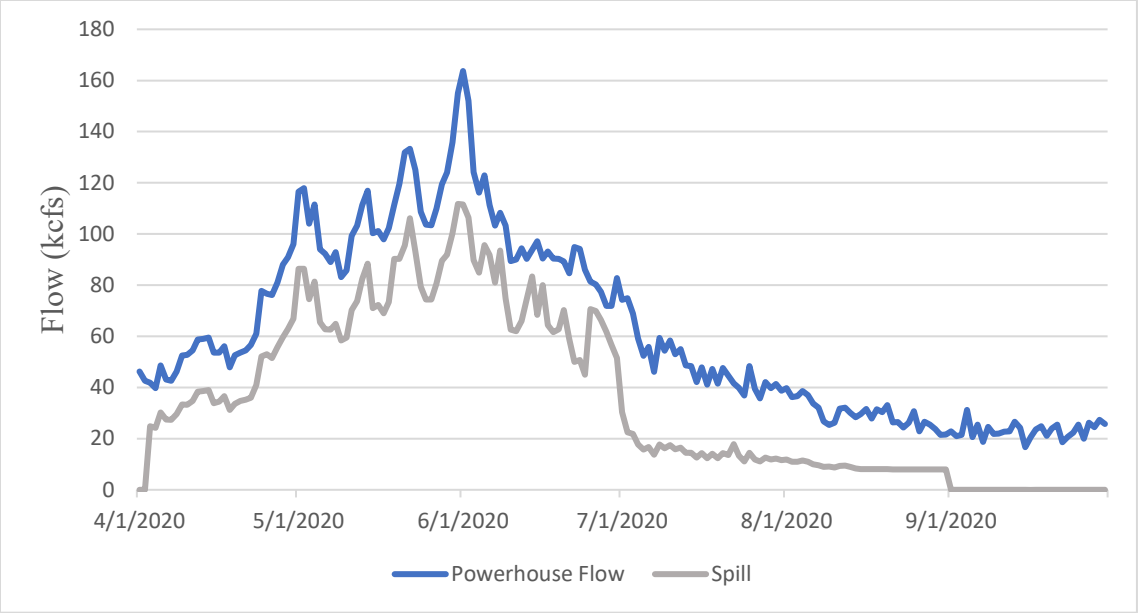

Figure 1. Comparison of daily flow and spill at Ice Harbor Dam, 2020.

River Temperature

Water temperatures were recorded from the Army Corps of Engineers hydrologic data web site, https://www.nwd-wc.usace.army.mil/dd/common/projects/www/ihr.html. The monthly average water temperatures for the 2020 season (April 1 to September 30) were lower than the 5-year average for all months, (Table 2). The maximum water temperature for the 2020 season (April 1 to September 30) of 71.1°F was recorded on August 4.

Table 2. Monthly average river temperatures at Ice Harbor Dam 2015-2020 and 5-year average.

Temperature°F							
Month	**2015**	**2016**	**2017**	**2018**	**2019**	**2015-2019 Avg**	**2020**
April	49.8	50.5	48.4	48.4	48.6	49.2	48.3
May	56.1	55.6	53.5	54.5	55.3	55.0	53.2
June	64.4	62.0	58.7	61.1	60.9	61.4	58.0
July	70.3	68.0	68.4	67.4	67.4	68.3	65.4
August	69.6	70.4	70.8	70.1	70.1	70.2	69.7
Sept.	67.0	66.9	67.6	66.7	68.5	67.3	66.9

Juvenile Fish Facility Operations

Juvenile Fish Conditioning

Sampling

Sampling is defined as diverting and segregating groups of fish in a consistent fashion so data collected from those segregated groups will accurately represent all fish collected. Fish were sampled at Ice Harbor to monitor fish condition. This type of sampling is called sampling for

condition. Sampling for the 2020 season began on April 2 and ended with the last sample on July 16. Sampling conducted twice a week had the goal of collecting 100 fish of the predominant species within a four-hour period. Fish are visually counted as they come into the separator. During the beginning and latter part of the season, migrating fish numbers tended to be lower and the target number of fish may not always be collected during the four-hour period.

A total of 3,518 juvenile salmonids were sampled during the 2020 season, (Table 3). This is a decrease from the 2019 season which sampled 3,771 juvenile salmonids, (Table 4).

Table 3. Number of juvenile salmonids sampled per day by species at Ice Harbor Dam, 2020.

Date	Yearling Chinook		Subyearling Chinook		Steelhead		Sockeye/Kokanee		Coho	Daily Total
	Clipped	Unclip	Clipped	Unclip	Clipped	Unclip	Clipped	Unclip	Clip/Unclip	
2-Apr	82	17	0	0	1	3	0	0	0	103
6-Apr	75	5	0	0	43	1	0	0	0	124
9-Apr	63	4	0	0	13	1	0	0	0	81
13-Apr	77	4	0	0	30	3	0	0	0	114
16-Apr	63	18	0	0	53	11	0	0	0	145
20-Apr	45	16	0	0	83	8	0	0	0	152
23-Apr	25	8	0	0	88	19	0	0	0	140
27-Apr	79	19	0	0	48	5	0	0	0	151
30-Apr	76	25	0	0	52	6	0	0	0	159
4-May	38	13	0	0	86	23	0	0	0	160
7-May	22	7	0	0	80	13	0	0	0	122
11-May	91	7	0	0	57	17	0	0	0	172
14-May	51	20	0	0	78	15	0	0	0	164
18-May	64	11	11	6	64	19	3	0	0	178
21-May	62	14	10	13	34	13	2	0	2	150
25-May	37	22	15	20	57	15	2	0	0	168
28-May	36	19	1	4	60	26	0	0	0	146
1-Jun	9	8	30	46	43	6	0	0	0	142
4-Jun	1	1	16	30	33	12	0	0	0	93
8-Jun	0	0	19	19	8	5	0	0	0	51
11-Jun	3	2	19	14	2	2	0	0	0	42
15-Jun	0	0	1	4	0	0	0	0	0	5
18-Jun	1	2	35	45	2	0	0	0	0	85
22-Jun	1	7	55	66	1	1	0	0	0	131
25-Jun	0	2	11	16	1	3	0	0	0	33
29-Jun	0	0	7	2	1	1	0	0	0	11
2-Jul	0	0	33	69	1	1	0	0	0	104
6-Jul	7	5	25	65	2	0	0	0	0	104
9-Jul	7	13	28	66	0	0	0	0	0	114
13-Jul	10	10	20	46	1	0	0	0	0	87
16-Jul	0	0	20	67	0	0	0	0	0	87
Totals	1025	279	356	598	1022	229	7	0	2	3,518
% Totals	29.14%	7.93%	10.12%	17.00%	29.05%	6.51%	0.20%	0.00%	0.06%	***

Table 4. Number of juvenile salmonids sampled at Ice Harbor Dam, 2016-2020.

Year	Yearling Chinook		Subyearling Chinook		Steelhead		Sockeye/Kokanee		Coho	Total
	Clipped	Unclip	Clipped	Unclip	Clipped	Unclip	Clipped	Unclip	Clip/Unclip	
2016	641	278	321	620	966	296	27	6	25	3,180
2017	747	489	386	624	845	335	13	12	34	3,485
2018	619	333	363	545	948	264	31	18	38	3,159
2019	748	331	552	680	1082	270	71	5	32	3,771
2020	1025	279	356	598	1022	229	7	0	2	3,518

Within each species group the number and percent sampled of those collected in that group was: 1,025 clipped yearling Chinook salmon (29.1%), 1,022 clipped steelhead (29.1%), 598 unclipped subyearling Chinook salmon (17.0%), 356 clipped subyearling Chinook salmon (10.1%), 279 unclipped yearling Chinook salmon (7.9%), 229 unclipped steelhead (6.5%), 7 clipped sockeye/kokanee salmon (0.2%), and 2 clipped/unclipped coho salmon (0.1%). There were no unclipped sockeye/kokanee salmon observed in the 2020 sample, Table 4 above and Table 5 below.

Table 5. Annual percentage sampled of each juvenile salmonid species group at Ice Harbor Dam, 2016-2020.

Year	Yearling Chinook		Subyearling Chinook		Steelhead		Sockeye/Kokanee		Coho
	Clipped	Unclip	Clipped	Unclip	Clipped	Unclip	Clipped	Unclip	Clip/Unclip
2016	20.2%	8.7%	10.1%	19.5%	30.4%	9.3%	0.8%	0.2%	0.8%
2017	21.4%	14.0%	11.1%	17.9%	24.2%	9.6%	0.4%	0.3%	1.0%
2018	19.6%	10.5%	11.5%	17.3%	30.0%	8.4%	1.0%	0.6%	1.2%
2019	19.8%	8.8%	14.6%	18.0%	28.7%	7.2%	1.9%	0.1%	0.8%
2020	29.1%	7.9%	10.1%	17.0%	29.1%	6.5%	0.2%	0.0%	0.1%

In 2020, the peak daily collection total and date for each species group were: 91 clipped yearling Chinook salmon (May 11), 25 unclipped yearling Chinook salmon (April 30), 55 clipped subyearling Chinook salmon (June 22), 69 unclipped subyearling Chinook salmon (July 2), 88 clipped steelhead (April 23), 26 unclipped steelhead (May 28), 3 clipped sockeye/kokanee salmon (May 18), and 2 coho salmon (May 21) with a maximum daily collection of 178 fish occurring on May 18 (Table 6).

Table 6. Annual peak dates for sampling at Ice Harbor Dam, 2016-2020.

Year	Yearling Chinook		Subyearling Chinook		Steelhead		Sockeye/Kokanee		Coho
	Clipped	Unclip	Clipped	Unclip	Clipped	Unclip	Clipped	Unclip	Clip/Unclip
2016	5-May 85	11-Apr 44	13-Jun 50	27-Jun 80	12-May 99	16-May 37	23-May 21	26-May 2	23-May 6
2017	15-May 67	6-Apr 51	12-Jun 67	13-Jul 98	27-Apr 89	25-May 56	25-May 4	-- --	22-May 13
2018	7-May 65	9-Apr 61	31-May 51	1-Jun 76	10-May 90	24-May 39	24-May 15	21-May 7	24-May 10
2019	29-Apr 81	4-Apr 46	8-Jul 58	3-Jun 73	22-Apr 137	22-Apr 26	23-May 39	27-May 2	27-May 13
2020	11-May 91	30-Apr 25	22-Jun 55	2-Jul 69	23-Apr 88	28-May 26	18-May 3	-- --	21-May 2

-- No fish of this species sampled

Descaling

All sampled salmonid smolts greater than 60 millimeters in total length were examined for descaling. A smolt with descaling greater than or equal to 20% of the area on one side of its body was recorded at descaled. The highest descaling by day were in the samples taken on May 18, 25 and 28 and mostly consisting of steelhead, both clipped and unclipped, Table 7 below.

Table 7. Number of salmonids sampled with descaling at Ice Harbor Dam, 2020.

Date	Yearling Chinook		Subyearling Chinook		Steelhead		Sockeye/Kokanee		Coho	Total
	Clipped	Unclip	Clipped	Unclip	Clipped	Unclip	Clipped	Unclip	Clip/Unclip	
2-Apr	0	1	---	---	0	0	---	---	---	1
6-Apr	0	0	---	---	0	0	---	---	---	0
9-Apr	0	0	---	---	0	0	---	---	---	0
13-Apr	0	0	---	---	0	0	---	---	---	0
16-Apr	0	0	---	---	4	1	---	---	---	5
20-Apr	0	0	---	---	1	0	---	---	---	1
23-Apr	0	0	---	---	1	1	---	---	---	2
27-Apr	1	0	---	---	3	0	---	---	---	4
30-Apr	2	0	---	---	0	1	---	---	---	3
4-May	0	0	---	---	0	0	---	---	---	0
7-May	0	0	---	---	2	4	---	---	---	6
11-May	5	0	---	---	2	0	---	---	---	7
14-May	5	0	---	---	4	0	---	---	---	9
18-May	0	0	0	0	6	3	1	---	---	10
21-May	2	1	0	0	3	2	0	---	0	8
25-May	0	1	0	1	7	0	1	---	---	10
28-May	1	1	0	0	6	2	---	---	---	10
1-Jun	1	0	0	0	6	0	---	---	---	7
4-Jun	---	---	---	---	2	0	---	---	---	2
8-Jun	---	---	0	1	1	0	---	---	---	2
11-Jun	0	0	0	0	0	0	---	---	---	0
15-Jun	---	---	0	0	---	---	---	---	---	0
18-Jun	0	0	0	0	0	---	---	---	---	0
22-Jun	0	0	1	1	1	0	---	---	---	3
25-Jun	---	0	0	0	0	1	---	---	---	1
29-Jun	---	---	0	0	0	0	---	---	---	0
2-Jul	---	---	0	0	0	0	---	---	---	0
6-Jul	0	0	0	1	0	---	---	---	---	1
9-Jul	1	1	0	2	---	---	---	---	---	4
13-Jul	0	0	0	0	0	---	---	---	---	0
16-Jul	---	---	0	0	---	---	---	---	---	0
Totals	18	5	1	6	49	15	2	0	0	96

-- No fish of this species sampled

The descaling rate for all fish sampled in 2020 was 2.7% (Table 8). The annual descaling rate by species group was clipped yearling Chinook salmon (1.8%), unclipped yearling Chinook salmon (1.8%), clipped subyearling Chinook salmon (0.3%), unclipped subyearling Chinook salmon (1.0%), clipped steelhead (4.8%), unclipped steelhead (6.6%), clipped sockeye salmon (28.6%), and coho salmon (0.0%). In 2020, the highest daily descaling rate for all species combined was

6.8% for the sample taken on May 28, while the lowest rate (0.0%) occurring several days the sample was taken during the season (Table 8).

Table 8. Percent descaled of salmonids at Ice Harbor Dam, 2020.

Date	Yearling Chinook		Subyearling Chinook		Steelhead		Sockeye/Kokanee		Coho	Total
	Clipped	Unclip	Clipped	Unclip	Clipped	Unclip	Clipped	Unclip	Clip/Unclip	
2-Apr	0.0%	5.9%	--	--	0.0%	0.0%	--	--	--	1.0%
6-Apr	0.0%	0.0%	--	--	0.0%	0.0%	--	--	--	0.0%
9-Apr	0.0%	0.0%	--	--	0.0%	0.0%	--	--	--	0.0%
13-Apr	0.0%	0.0%	--	--	0.0%	0.0%	--	--	--	0.0%
16-Apr	0.0%	0.0%	--	--	7.5%	9.1%	--	--	--	3.5%
20-Apr	0.0%	0.0%	--	--	1.2%	0.0%	--	--	--	0.7%
23-Apr	0.0%	0.0%	--	--	1.1%	5.3%	--	--	--	1.4%
27-Apr	1.3%	0.0%	--	--	6.3%	0.0%	--	--	--	2.6%
30-Apr	2.7%	0.0%	--	--	0.0%	16.7%	--	--	--	1.9%
4-May	0.0%	0.0%	--	--	0.0%	0.0%	--	--	--	0.0%
7-May	0.0%	0.0%	--	--	2.5%	30.8%	--	--	--	5.0%
11-May	5.5%	0.0%	--	--	3.6%	0.0%	--	--	--	4.1%
14-May	9.8%	0.0%	--	--	5.1%	0.0%	--	--	--	5.5%
18-May	0.0%	0.0%	0.0%	0.0%	9.4%	15.8%	33.3%	--	--	5.7%
21-May	3.2%	7.1%	0.0%	0.0%	8.8%	15.4%	0.0%	--	0.0%	5.4%
25-May	0.0%	4.5%	0.0%	5.0%	12.3%	0.0%	50.0%	--	--	6.0%
28-May	2.8%	5.3%	0.0%	0.0%	10.0%	7.7%	--	--	--	6.8%
1-Jun	11.1%	0.0%	0.0%	0.0%	14.0%	0.0%	--	--	--	4.9%
4-Jun	--	--	--	--	6.1%	0.0%	--	--	--	2.2%
8-Jun	--	--	0.0%	5.3%	12.5%	0.0%	--	--	--	3.9%
11-Jun	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	--	--	--	1.9%
15-Jun	--	--	0.0%	0.0%	--	--	--	--	--	0.0%
18-Jun	0.0%	0.0%	0.0%	0.0%	0.0%	--	--	--	--	0.0%
22-Jun	0.0%	0.0%	1.8%	1.5%	100.0%	0.0%	--	--	--	2.3%
25-Jun	--	0.0%	0.0%	0.0%	0.0%	33.3%	--	--	--	3.0%
29-Jun	--	--	0.0%	5.9%	0.0%	0.0%	--	--	--	4.2%
2-Jul	--	--	0.0%	0.0%	0.0%	0.0%	--	--	--	0.0%
6-Jul	0.0%	0.0%	0.0%	1.5%	0.0%	--	--	--	--	1.0%
9-Jul	14.3%	7.7%	0.0%	3.0%	--	--	--	--	--	3.5%
13-Jul	0.0%	0.0%	0.0%	0.0%	0.0%	--	--	--	--	0.0%
16-Jul	--	--	0.0%	0.0%	--	--	--	--	--	0.0%
Total Examined	1,025	279	356	598	1,022	229	7	--	2	3,518
% Descaled	1.8%	1.8%	0.3%	1.0%	4.8%	6.6%	28.6%	--	0.0%	2.7%

-- No fish of this species sampled

In 2020, the descaling of 2.7% for all fish examined was lower than the 4.2% observed in 2019 and 7.0% observed in 2018 (Table 9). During 2016-2020, steelhead tended to have the highest descaling rates observed of all salmonids.

Table 9. Annual descaling rates in percent for fish sampled at Ice Harbor Dam, 2016-2020.

Year	Yearling Chinook		Subyearling Chinook		Steelhead		Sockeye/Kokanee		Coho	Total
	Clipped	Unclip	Clipped	Unclip	Clipped	Unclip	Clipped	Unclip	Clip/Unclip	
2016	0.5%	1.1%	0.9%	0.6%	3.8%	2.7%	0.0%	0.0%	0.0%	1.8%
2017	5.9%	2.5%	0.5%	0.5%	6.0%	5.7%	0.0%	0.0%	5.9%	3.8%
2018	4.4%	6.0%	2.5%	4.0%	10.7%	12.5%	16.1%	16.7%	5.3%	7.0%
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%

Mortality

Total juvenile facility mortality for all salmonids were a total of 13 fish (0.4%) for the 2020 season, (Table 10). Fish that are dead prior to coming into the lab are not examined for condition but are included in the sample number of fish. Within each species group, the number of mortalities and percent of those collected in that group was: 6 clipped yearling Chinook salmon (0.6%), 1 unclipped yearling Chinook salmon (0.4%), 3 unclipped subyearling Chinook salmon (0.0%), and 3 clipped steelhead (0.3%, Table 11).

One of the clipped yearling Chinook salmon mortalities in the April 16 sample appeared to have gotten stuck under the sample tank crowder as it was lowered down. From that sample forward, two fish facility personnel were present during the process and both used nets to scare fish away from the crowder before it was lowered. The other mortality on April 16 occurred when fish were being flushed out of the anesthetizing basket into the sampling trough, and the fish became stranded on the unwatering screen in the pipe. The sampling contractor personnel were informed and altering protocol to ensure personnel double check the unwatering screen during each flushing event to confirm there were no stranded fish.

Table 10. Total sample mortality from the sample days at Ice Harbor Dam, 2020.

Date	Yearling Chinook		Subyearling Chinook		Steelhead		Sockeye/Kokanee		Coho	Total
	Clipped	Unclip	Clipped	Unclip	Clipped	Unclip	Clipped	Unclip	Clip/Unclip	
2-Apr	0	0	0	0	0	0	0	0	0	0
6-Apr	1	0	0	0	0	0	0	0	0	1
9-Apr	0	0	0	0	0	0	0	0	0	0
13-Apr	0	0	0	0	0	0	0	0	0	0
16-Apr	2	0	0	0	0	0	0	0	0	2
20-Apr	0	0	0	0	0	0	0	0	0	0
23-Apr	0	0	0	0	0	0	0	0	0	0
27-Apr	0	0	0	0	0	0	0	0	0	0
30-Apr	1	0	0	0	0	0	0	0	0	1
4-May	1	0	0	0	1	0	0	0	0	2
7-May	0	1	0	0	0	0	0	0	0	1
11-May	1	0	0	0	1	0	0	0	0	2
14-May	0	0	0	0	0	0	0	0	0	0
18-May	0	0	0	0	0	0	0	0	0	0
21-May	0	0	0	0	1	0	0	0	0	1
25-May	0	0	0	0	0	0	0	0	0	0
28-May	0	0	0	0	0	0	0	0	0	0
1-Jun	0	0	0	0	0	0	0	0	0	0
4-Jun	0	0	0	0	0	0	0	0	0	0
8-Jun	0	0	0	0	0	0	0	0	0	0
11-Jun	0	0	0	0	0	0	0	0	0	0
15-Jun	0	0	0	0	0	0	0	0	0	0
18-Jun	0	0	0	0	0	0	0	0	0	0
22-Jun	0	0	0	0	0	0	0	0	0	0
25-Jun	0	0	0	0	0	0	0	0	0	0
29-Jun	0	0	0	0	0	0	0	0	0	0
2-Jul	0	0	0	0	0	0	0	0	0	0
6-Jul	0	0	0	3	0	0	0	0	0	3
9-Jul	0	0	0	0	0	0	0	0	0	0
13-Jul	0	0	0	0	0	0	0	0	0	0
16-Jul	0	0	0	0	0	0	0	0	0	0
Totals	6	1	0	3	3	0	0	0	0	13

Table 11. Annual mortality in percent at Ice Harbor Dam, 2016-2020.

Year	Yearling Chinook		Subyearling Chinook		Steelhead		Sockeye/Kokanee		Coho	Total
	Clipped	Unclip	Clipped	Unclip	Clipped	Unclip	Clipped	Unclip	Clip/Unclip	
2016	0.0%	0.4%	0.9%	0.6%	0.0%	0.0%	0.0%	0.0%	0.0%	0.3%
2017	0.4%	0.0%	0.0%	0.3%	0.0%	0.0%	0.0%	8.3%	0.0%	0.2%
2018	0.3%	0.9%	0.3%	0.0%	0.0%	0.4%	3.2%	0.0%	0.0%	0.3%
2019	0.0%	0.0%	0.0%	0.3%	0.1%	0.0%	0.0%	0.0%	0.0%	0.1%
2020	0.6%	0.4%	0.0%	0.5%	0.3%	0.0%	0.0%	--	0.0%	0.4%

Maladies

Maladies are recorded for each sample and sent to the Fish Passage Center (FPC) after the sample is completed. For the 2020 season, maladies found within all species groups included body injury, head injury, eye injury, eye hemorrhage, popeye, operculum, fin injury, fungus, fin hemorrhage, fin deformity, Columnaris, parasites, and fin discoloration. The most common maladies from all species groups combined were eye hemorrhage, operculum injury, body injury and fin injury. The majority of the maladies came from clipped yearling Chinook salmon and clipped steelhead. The highest maladies from clipped yearling Chinook salmon included eye hemorrhage and body injury. The highest maladies from clipped steelhead were operculum damage, fin injury and body injury. No exact counts are listed within this report for maladies, only general observation of the data provided from the samples was used.

Incidental Species

Non-target fish species, otherwise known as incidental species, were counted and then released at the separator or with the sample fish (Table 12). The most common incidental species groups for 2020 included: Siberian prawn, *Exopalaemon modestus* (128), larvel Pacific lamprey ammocoete, *Lampetra tridentatus*, (28), adult American shad, *Alosa sapidissima,* and largemouth bass, *Micropterus salmoides* (5).

Table 12. Incidental fish species from the sample/separator for Ice Harbor Dam, 2020.

Common Name	Scientific Name	Sample
American Shad (Adult)	*Alosa sapidissima*	7
Channel Catfish	*Ictalurus punctatus*	1
Pacific Lamprey (Adult)	*Lampetra tridentatus*	1
Pacific Lamprey (Juvenile)	*L. tridentatus*	2
Pacific Lamprey (larval)	*L. tridentatus*	28
Sculpin	*Cottus* spp.	1
Siberian Prawn	*Exopalaemon modestus*	128
Largemouth	*Micropterus salmoides*	5
Sucker	*Catostomus* spp.	1
Sunfish	*Lepomis* spp.	1
Whitefish	*Prosopium* spp.	1
Walleye	*Stizostedion vitreum*	2
Yellow Perch	*Perca flavescens*	2
Total		180

Siberian prawns were collected in the sample at the Juvenile Fish Facility and were humanely euthanized by fish condition personnel, frozen and properly disposed of in a landfill.

Adult Salmonid Fallbacks

A total of 1 adult salmonids, an adult Chinook salmon, fell back through the juvenile bypass system in the 2020 season (Table 13). The condition of adult salmonids was evaluated as the fish were released from the separator. The 1 Chinook examined in 2020 was found to be in good condition.

Table 13. Daily totals of adult salmonids released from the separator and condition at Ice Harbor Dam, 2020.

Date	Chinook	Chinook Jack	Steelhead Clipped	Steelhead Unclip	Sockeye	Coho	Condition
8-Jun	1	0	0	0	0	0	Good
Total	1	0	0	0	0	0	

The annual totals of adults released from the separator from 2016 to 2020 are provided in Table 14. The total adults released from the separator in 2020 was less than all the years from 2016-2019. The primary species released from the separator during the 2016 to 2020 time period were adult Chinook salmon.

Table 14. Annual totals of adult salmonids released from the separator at Ice Harbor Dam, 2016-2020.

Year	Chinook	Chinook Jack	Steelhead Clipped	Steelhead Unclip	Sockeye	Coho	Total
2016	3	2	2	2	2	0	11
2017	6	2	3	1	0	0	12
2018	4	0	1	0	0	0	5
2019	1	0	3	2	0	0	6
2020	1	0	0	0	0	0	1

Facility Operations and Maintenance

Turbine Operations

Efforts were made to operate all turbine units within 1% of peak efficiency from April 1 to October 31, inclusive. Deviations were infrequent and brief. The project ran outside the constraint at the request of the Bonneville Power Administration (BPA). Unit priority was in effect from March 1 to November 30. Units were taken out of service (OOS) for various reasons throughout the year. During trash rack and STS inspections, units were taken OOS one at a time. Table 15 below provides a summary of unit outages and causes.

Table 15. Unit outages and causes at Ice Harbor Dam, 2020.

Dates out of service (OOS)	Unit	Reason out of service (OOS)
3 May 2019	Unit 3	Turbine runner replacement and stator rewind
4 March	Unit 2	Model validation testing
5 March	Unit 5	Model validation testing
16-17 March	All Units, except 3	Trash rack raking
24-26 March	All Units, except 3	STS installation
3 April	Unit 6	BPA line switching
7 April	Unit 2	STS 2A replacement
21-22 April	All Units, except 3	STS inspections
19-20 May	All Units, except 3	STS inspections
28 May	Unit 5	Faulty power system stabilizer circuit
2-3 June	Unit 5	Excitation issues and faulty control power breaker
22-24 June	All Units, except 3	STS inspections
6-30 July	Unit 4	Annual maintenance
14-15 July	All Units	STS inspections
27 July	Unit 1	Governor blade response issue
31 July 31	Unit 6	Tripping on reverse power
7 August	Units 5 & 6	BPA line outage
9-11 August	Unit 1	Governor response issue
10-26 August	Unit 6	Annual maintenance
13 August	Unit 1	XJO breaker replacement
1-19 August	All Units, except 3	STS inspections
1-2 September	Unit 1	Governor blade response issue
21 September -5 December	Unit 5	Annual maintenance
21-24 September	All Units, except 3	STS inspections
25 September	Unit 6	Governor oil pump did not start
27-28 October	All Units, except 3	STS inspections
2-12 November	Unit 2	Replace 2A head gate cylinder
16-18 November	Units 1, 2, 4, 5, 6	Raise STSs

Removable Spillway Weir

The RSW went into service at 0001 hours on April 3 with the start of the spring spill program. The RSW was operated until August 10, due to low river flows. The RSW had no operational problems in 2020.

The RSW was operated periodically for downstream passage of adult steelhead from 0500 hours to 0900 hours on Sundays, Wednesdays, and Fridays, from October 1 to November 15.

Finally, the periodic 3-year inspection of the RSW by divers was conducted on November 17 and no significant problems were found.

Debris and Trash Racks

In 2020, forebay debris accumulation began in mid-March. Spill that was occurring helped direct debris over the RSW. Forebay debris accumulated again in the middle of May and tapered

off in mid-June. Main unit trash rack raking was completed the week of March 19. No fish mortalities were found on the trash racks.

Gatewells

During the season, gatewell slots were checked daily. Small amounts of woody material were noted in gatewell slots and never approached the 50% coverage criteria point for mandatory cleaning. Slots were dipped for debris removal as needed prior to installing STSs.

An oil sheen was observed in the 2A slot on April 7. Approximately one cup of oil was suspected to have leaded from the STS motor. Oil absorbent socks were deployed in the slot and appropriate agencies were notified.

A light oil sheen was observed in the 5C gatewell and headgate slots on September 24. Unit 5 headgates were lowered down to sill on September 21 and believed to be the source of approximately 1 ounce of residual hydraulic oil released into the slots. Oil absorbent socks were deployed in the slot and appropriate agencies were notified.

On October 31, an operator noticed oil leaking out of the gearbox of the STS stored in the 2C slot. The gearbox seal had ruptured due to the temperature change from the water to the air. The pressure in the gearbox was mistakenly not equalized with the pressure in the air after the STS was raised out of the water from the 2A slot for repairs. Approximately three-quarters of a cup of oil had dripped into the 2C slot. Oil absorbent socks were deployed in the slot and appropriate agencies were notified.

Submersible Traveling Screens

Installation of the STSs was completed from March 24-26 of all units except for Unit 3 which was OOS all year. An underwater video camera was used to conduct monthly inspections of all installed STSs. STS problems found and repaired are shown in Table 16.

Table 16. STS problems found during inspections at Ice Harbor Dam, 2020.

Dates	Slot	Screen Location	Problem	Remedy
22-Apr	2A	Seam	6” of the seam was separated	Replaced with spare STS
20-May	2A	Seam	One seam separated halfway across	Repaired
23-Sep	2A	Fastening strip	Two 4” X 6” holes in mesh	Replaced with spare STS
27-Oct	2A	Seam	Seam separated entire length creating two 10’ X 6” gaps in the mesh	Replaced with spare STS

STSs are usually operated in cycle mode when the average fork length of subyearling Chinook salmon and/or sockeye salmon is greater than 120 mm, and in continuous run mode when either

is less than 120 mm. The STSs were placed in cycle-run mode when first deployed on March 26. The STSs were changed to continuous-run mode on May 18 due to the average subyearling Chinook salmon and/or sockeye salmon lengths being less than 120 mm. The STSs were changed back to cycle-run mode on July 27 when the average length of collected fish was greater than 120 mm.

All STS were raised on November 16-18, a month early to accommodate the contractor for the intake crane upgrade.

Vertical Barrier Screens

Project personnel inspected the vertical barrier screens (VBSs) while conducting STS inspections. A different turbine unit's VBSs were inspected each month until they were all inspected. No problems were found with the VBSs this season.

Juvenile Collection Channel (JCC) Orifices

The JCC was watered up on March 23, and just before watering up, the overflow weirs in the primary dewatering system were found to raise only about halfway up. The upper limit setting of the actuator had to be reset to fix the problem.

The collection channel was typically operated with 20 orifices open. At least one orifice was open in each gatewell slot with some 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 or STS repair. Gatewell 3B had no orifices open from August 6-10 when the orifice was closed because the burned-out light and an orifice in a different slot was mistakenly opened in its place. Unit 3 was OOS for a prolonged period and few fish are migrating in August. Impact on fish was presumed to be low.

Issues with the orifices were found throughout the season and listed in Table 17. On November 23, orifices were closed, and the juvenile fish channel was dewatered for winter maintenance.

Table 17. Issues with orifices at Ice Harbor Dam, 2020.

Orifice	Date Found	Date Replaced	Action Taken
6BS	23-Mar	25-Mar	Electricians replaced solenoid for the orifice switch
1CN	23-May	26-May	Cover for orifice coming loose
3 BN	6-Aug	10-Aug	Replaced burned out light
1CN	20-Sep	21-Sep	Light burnt out
5AN	5-Oct	6-Oct	Light burnt out/replaced

Primary Dewatering Structure (PDS)

The juvenile fish collection channel, including the PDS was watered up on March 23.

The primary dewatering mechanical screen cleaner performed fairly well in 2020. On April 7 the mechanical screen cleaner was found to be nonfunctional. Electricians worked on the controls for the brush lifting mechanism and restored it to normal operation on April 9. The mechanical screen cleaner was turned off on the morning of June 22, due to a frayed traveling cable that slipped off two of its sheaves. The frayed cable was replaced with a new cable and the screen cleaner was returned to service the morning of June 23. The mechanical screen cleaner in the PDS was found to be broken the night of June 30. The travel cable was observed to be jammed up on the drive pulley and two rollers were broken off. The cable and rollers were replaced, and electrical work was conducted to energize the motor and return the screen cleaner to service on July 1.

The power to the water regulating weirs in the PDS was found to be off on August 4. The weirs probably lost power several weeks before when the station service from unit 1 was lost. Although the weirs were immobile, they did function to help maintain the normal water level in the flume and there were no noted water level alarms during that period. The weirs were returned to automatic operation on August 5.

On August 22, the automated control system for the juvenile fish channel malfunctioned causing the regulating weirs to raise all the way up and the mechanical screen cleaner to stop working. Despite the problems, safe fish passage conditions were maintained through the juvenile fish bypass.

On September 21 the water regulating weirs were discovered to be without power. The power to the weirs probably went out when station service through unit 1 was lost on September 16. The weirs were placed back in automatic control on September 21. However, the downstream five weirs were found to be disconnected from the actuator because of a loose coupling. The coupling was repaired on September 22 and all weirs were returned to automatic operations. There were no known extreme water level fluctuation that impacted fish in the primary dewatering structure while the weirs were stationary.

The juvenile fish channel, including the PDS was dewatered for winter maintenance on November 23.

Juvenile Fish Facility

On March 17, the main fish collection/bypass drop gate was being operated to diagnose problems with associated unwatering valves, when the lifting mechanism for the gate broke. Repairs to the gate lifting mechanism and unwatering valves were completed on March 20.

The raw water supply lines at the fish facility were watered up on March 26 and were drained for winterization on October 8.

The juvenile fish facility was dewatered for winter maintenance on November 23.

Fish Salvage

The fish rescue at the JCC occurred on November 23. The species composition of the recovered fish were 16 clipped adult steelhead, 8 unclipped adult steelhead, 1 adult coho, 13 channel catfish, and 10 adult American shad. The fish were released to the river in good condition.

Cooling Water Strainers

In 2020, turbine cooling water strainers were inspected monthly for the presence of juvenile lamprey and other fish from January to June and again in December. In addition, strainers were cleaned when debris or fish created a pressure differential across the strainers. Juvenile shad clogged up the strainers frequently in November and December. The total number of each species group removed were: 1 juvenile clipped steelhead, 435 live juvenile Pacific lamprey, 3,310 dead juvenile Pacific lamprey, 9,738 juvenile American shad, and 8 Siberian prawns. The live Pacific lamprey recovered from the strainers were released back to the river.

The total number of juvenile Pacific lamprey removed, dead or alive, from the turbine cooling water strainers for the past 5 years are listed in Table 18. In 2020, there was a higher number of lamprey removed from the strainers than the previous years.

Table 18. Pacific lamprey removed from turbine cooling water strainers from Ice Harbor Dam, 2020-2016.

Pacific lamprey (Juvenile)			
Year	Live	Dead	Total
2016	0	105	105
2017	6	470	476
2018	57	213	270
2019	28	152	180
2020	435	3310	3,745

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 is left on when a unit is not running, so fish that are in the scroll case when a unit is turned off may be more likely to get drawn into the cooling water intake than if the cooling water was shut off. Consequently, a unit that is started and stopped frequently may be prone to attracting fish into the cooling water intake. This could explain why juvenile shad tend to clog the strainers.

Research

No research occurred during the 2020 fish season.

Avian Predation

Avian Predation-General

Bird monitoring occurred from April 1 to July 31. Gulls, Double-Crested cormorants, Caspian terns, Western grebes and American white pelicans were counted once per day, 6 or 7 days a week from April 1 to June 30 and 4 days (Monday to Thursday) from July 1 to July 31. Areas of avian predation monitoring included: forebay, powerhouse tailrace (two areas), spillway tailrace (three areas), and Eagle Island. Deterrent measures include bird deterrent hydro cannon, bird wire array across the tailrace and hazing with pyrotechnics (April 1 to June 30) under the nuisance animal management contract with United States Department of Agriculture-Wildlife Services (USDA-WS).

Gulls and cormorants were abundant during the smolt run in April and May, then the bird numbers decreased in June (Figure 2). However, in July their numbers increased again. It appeared that the gulls and cormorants returned with the juvenile shad run in the late summer through the end of the year. American white pelicans were often the most numerous piscivorous bird observed around the dam from April to July. Terns and grebes were only occasionally spotted in low numbers.

The highest daily count during April 1 to July 31 of each species occurred on the following days: gulls occurred on July 27 with a count of 40 birds, cormorants occurred on May 23 with a count of 51 birds, terns occurred on July 27 with a total of 15 birds, and pelicans occurred on May 5 with a count of 291 birds. There were no Western grebes during this same time period. The average daily count during this same time period of each species was gulls with 3.3 birds, cormorants with 6.7 birds, terns with 0.4 birds and pelicans with 29 birds.

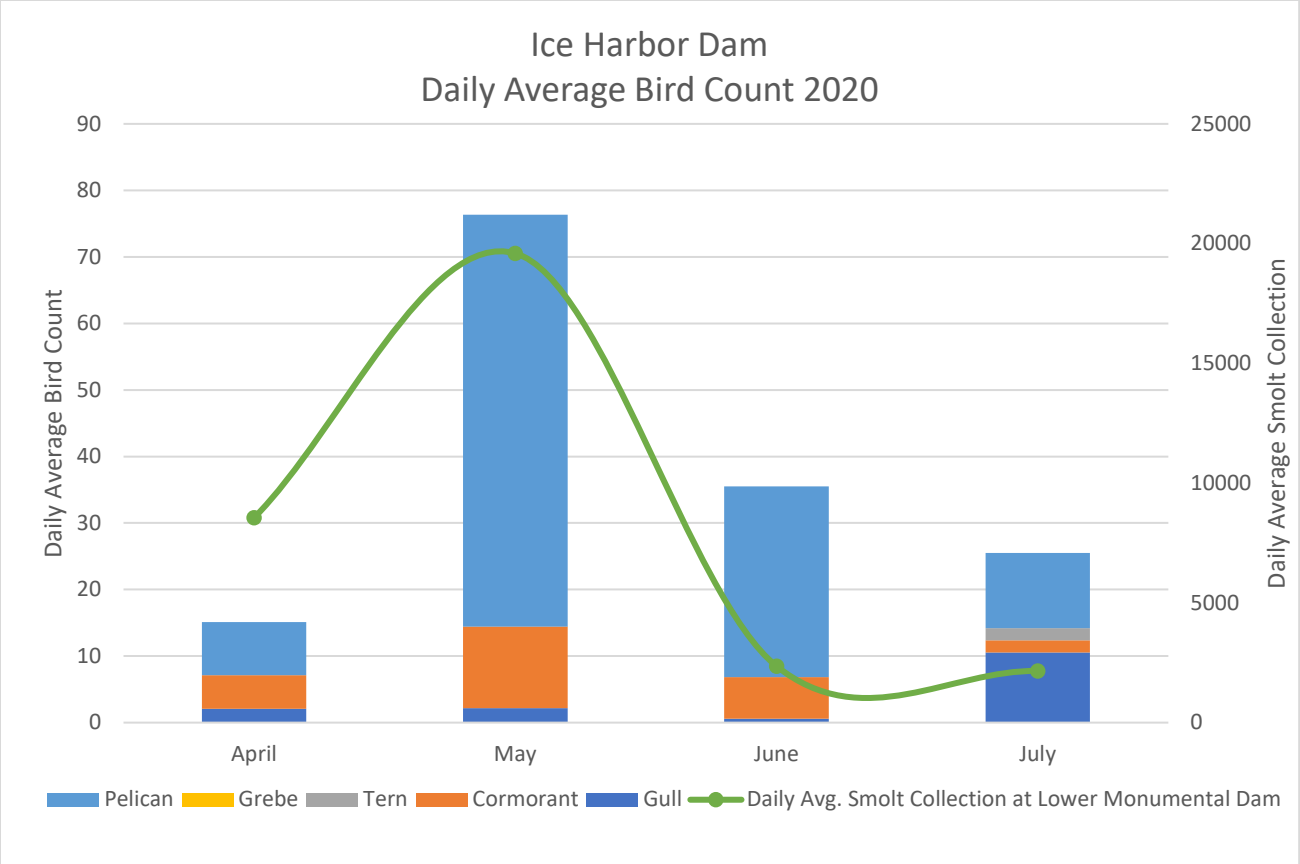

Figure 2. Daily Average Bird Count by Species at Ice Harbor Dam, 2020.

American white pelican numbers are prevalent in all months in the 2016-2020 daily average bird count. In addition, gull numbers are higher in the months of April, May, and July in the 2016-2020 daily average bird count, Figure 3 below.

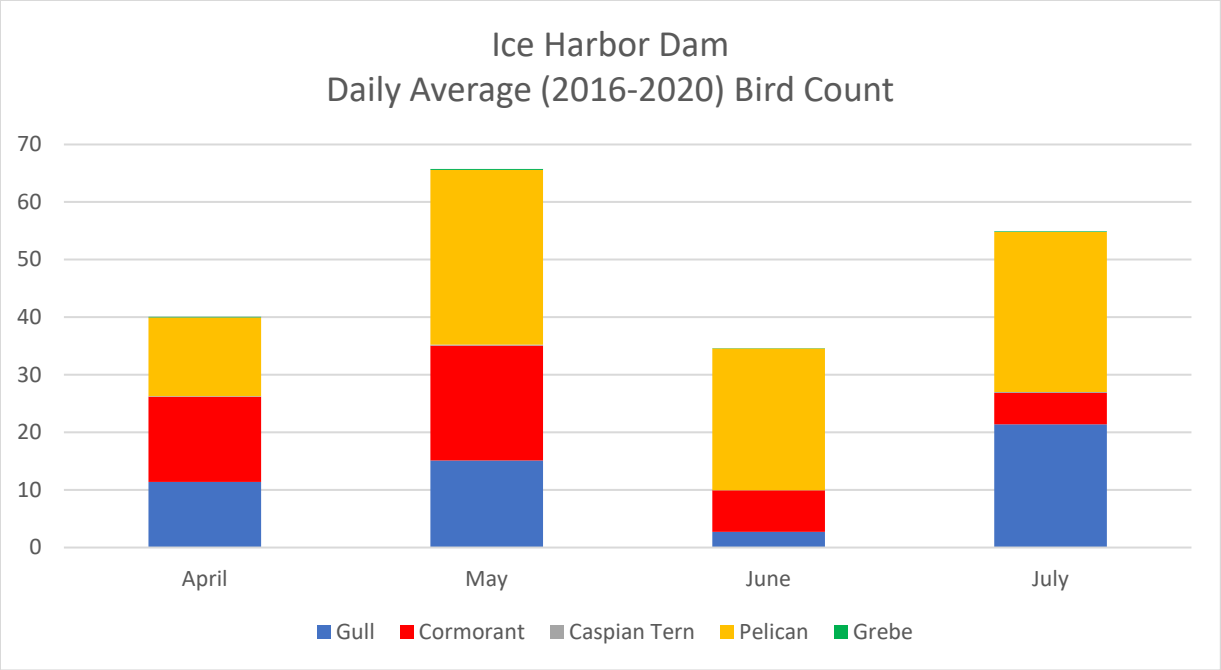

Figure 3. Daily Average Bird Count at Ice Harbor Dam, 2016-2020.

During the 2020 season the hydrocannon had a few issues that were dealt with throughout the season. A leaky coupling on the water line that was only accessible by boat was replaced on March 4. The hydrocannon pump was tripping the disconnect switch, so it was pulled out of the water on April 6. A used spare pump was tested but was found to be seized up. Unused spare pumps were located in the warehouse, and one was installed. The hydrocannon returned to service on April 14. The hydrocannon was found to be tripped off on August 4. The water line for the hydrocannon had sizeable water leaks, at locations difficult to access, for several months, which had diminished the spray for the hydrocannon. Since there were very few piscivorous birds seen at the end of the outfall pipe for some time, the Project Biologist decided to leave the pump off. The water line leak was repaired on November 4 by replacing the two leaky couplings with new couplings. The pump was pulled out of the water to prevent freezing of water in the outlet line from the pump and it was not reinstalled the rest of the 2020 season.

Gulls

The highest number of gulls observed in a month during the 2020 bird count season in the month of July with a total of count of 221. The highest amount observed on one day was 40 on July 27. Gull counts were lower in the previous month, and the counts may have increased in later July due to the decrease of WS-APHIS staff working. The number of gulls observed in the FB ranged from 0 to 26, while the number observed in the tailrace ranged from 0 to 40.

Gull numbers overall decrease considerably from 2019 to 2020. The total amount of gulls observed in the combined total of the tailrace and forebay was 367 birds. July appears to have the highest count of gulls in 2018, 2019 and 2020.

Cormorants

The highest number of cormorants observed in a month during the 2020 bird count season occurred during May with a total of count of 380. The highest amount observed on one day was 51 on May 23. Cormorant counts were high in April and then higher in May, before decreasing in June and July. The number of cormorants observed in the FB ranged from 0 to 29, while the number observed in the tailrace ranged from 0 to 23.

Cormorant numbers overall decreased from 2019 to 2020. The total amount of cormorants observed in the combined total of the tailrace and forebay was 752 birds. May appears to have had the highest count of cormorants in 2018, 2019 and 2020.

Terns

The highest number of terns observed in a month during the 2020 bird count season was in the month of July with a total of count of 38. The highest amount observed on one day was 15 on July 27. Tern counts were relatively low until the month of July during the 2020 bird count season. The number of terns observed in the FB was 0, while the number observed in the tailrace ranged from 0 to 15. The total amount of terns observed in the combined total of the tailrace and forebay was 39 birds. July appears to have the highest count of terns in 2018, 2019 and 2020.

Grebes

Grebes were not observed during the 2020 bird count season.

Pelicans

The highest number of pelicans observed in a month during the 2020 bird count season occurred during the month of May with a total of count of 1918. The highest amount observed on one day was 291 birds on May 9. Pelican counts were higher in the months of May and June during the 2020 bird count season. The number of pelican observed in the FB ranged from 0 to 14, while the number observed in the tailrace ranged from 0 to 291.

Pelican numbers have increased considerably from 2019 to 2020. The total number of pelicans observed in the tailrace and forebay combined was 3228 birds. May and June appear to have the highest count of pelicans in 2018, 2019 and 2020.

Wildlife Services

The USDA-WS utilized pyrotechnics to conduct land-based hazing of piscivorous birds from April 1 to June 30. In addition, boat-based hazing occurred from April 5 to June 6.

Land based hazers worked eight-hour shifts for seven days a week. Start and end times varied to reduce habituation of birds. The USDA-WS hazing program is outlined in Table 19.

Table 19. USDA-WS hazing program schedule for Ice Harbor Dam, 2020.

Personnel	Days	Dates	Shift
WS Hazer	Monday - Sunday	4/1/2020 – 6/30/2020	Regular Coverage
WS Hazer	Monday - Sunday	4/5/2020 – 6/6/2020	Peak Season
Boat Hazer	3 days a week	4/5/2020– 4/18/2020 5/24/2020 – 6/6/2020	Regular Coverage
Boat Hazer	5 days a week	4/19/20 – 5/23/2020	Peak Season

Recommendations for the Juvenile Fish Facility

1. Repaint the interior of the juvenile fish bypass pipe/flume and separator exit flume. The inside surfaces of the pipe and flumes have peeling paint and corroded areas, which created 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. Install a crowding mechanism in the juvenile collection channel that would encourage adult fish to exit.
4. Replace the outfall pipe hydrocannon black iron water line with stainless steel to prevent corrosion. Install a walkway alongside the outfall pipe to provide access to the outfall pipe and hydrocannon water line to conduct inspections and maintenance.
5. Install a fish release chute connecting to the main bypass pipe downstream 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.

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 dewatered one at a time for annual winter maintenance in January and February. In 2020, adult fish counting occurred from March 1 to October 31. The number of adult salmonids and adult lamprey counted passing Ice Harbor Dam, for each fish ladder is show in Table 20. For all species groups the SFL was used much more than the NFL. The total counts for Chinook, steelhead and lamprey were well below the previous ten years' average. The counts for sockeye, coho and shad were above the 10-year average.

Table 20. Number of adult fish passing Ice Harbor Dam in 2020 and average of previous ten years.

	Chinook	Chinook Jack	Steelhead Clipped	Steelhead Unclip	Sockeye	Coho	Coho Jack	Shad	Lamprey
SFL	44,908	10,321	48,820	32,442	1,910	6,486	2,679	286,162	105
NFL	14,393	2,263	7,390	4,736	420	470	107	14,793	56
Total (SNL + NFL)	59,301	12,584	56,210	19,032	2,330	6,956	2,786	300,955	161
10 YR-Avg (SNL + NFL)	118,044	24,750	118,990	32,232	923	4,458	398	275,735	629

The upper SFL was dewatered for inspection and maintenance from January 6 to January 31. Three steelhead were removed from the fish count station during unwatering (Table 21) and released in good condition into the river off of the tailrace deck. Other fish were evacuated down to tailwater level in the ladder. There were two clipped juvenile steelhead that became stranded on exposed diffuser grating (diffuser 7) just above tailwater level. A long-handled net was used unsuccessfully from the parking lot above the fish ladder to try to push the fish to tailwater level. In future unwatering events, personnel will need to be lowered down into the ladder to rescue fish at this location. Fish facility personnel used a boat to inspect the lower SFL diffuser grating with a video camera. There were no problems found,

The NFL was dewatered from February 4 to March 2, with no problems encountered during unwatering and fish evacuation down to tailwater level. The NFL was not returned to service by the end of February because dredging was taking place for the replacement of the navigation lock floating guide wall cables. The environmental compliance requirement to have turbidity monitoring equipment installed in the fish ladder would not have been met if the ladder had reopened on time. A ROV inspection showed the lower NFL diffuser grating to be in relatively good condition,

Winter maintenance work performed on both ladders included: debris removal, cleaning picketed leads and staff gauges, adult fish counting/viewing window cleaning and maintenance of auxiliary water supply pumps. Some of the tailwater staff gauges are in disrepair and replacement of these gauges may require divers to install. 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. All of the SFL upper diffuser 12 grating was replaced with spare galvanized grating. The diffuser 12 grating had been rusting out over the last several years with numerous holes that were patched with pieces of perforated plate. The north shore entrance NEW-1 weir was replaced with the weir that was in NEW-2. The weir that was in NEW-1 was stuck up in the guide slot for the latter half of 2019. NEW-1 functioned normally throughout the season, and NEW-2 was closed with bulkheads. The damaged rollers on the problem weir were replaced during the season.

Summary of Fish Recovery Operations

Areas that were dewatered in 2020 that required fish facility personnel presence for possible fish rescue/evacuation are listed in Table 21. The total number of fish handled during unwatering events in 2020 was 56.

Table 21. Areas at Ice Harbor Dam dewatered in 2020.

Date	Unwatering Activity	Fish Removed and Released in the River
7 January	Upper south fish ladder	1 clipped adult steelhead 1 clipped juvenile steelhead 1 unclipped juvenile steelhead
4 February	Upper north fish ladder	None
8 February	Unit 2 scroll case	None
8 February	Unit 2 draft tube	2 juvenile white sturgeon 2 adult suckers 1 adult channel catfish
23 November	JCC dewater	1 clipped adult steelhead 8 unclipped adult steelhead 1 adult coho salmon 13 channel catfish 10 adult American shad

Auxiliary Water Supply

The auxiliary water supply (AWS) pumps were operating or available for operation to help maintain fish entrance criteria in 2020, with the exceptions listed in Table 22. AWS pumps were turned off, taken OOS, or forced OOS during the fish passage season to facilitate maintenance, operations, or emergency repairs. Five to eight AWS pumps were operated to maintain criteria in the SFL 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 pump operates at 350 cfs and each south shore 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.

Table 22. AWS pump outages and significant events requiring pumps to be shut off at Ice Harbor in 2020.

Date	Pump Number or How Many Pumps Affected	Pump Outage Description or Reason for Turning Off	Results/Duration OOS
2-16 March	NFL #1	Replaced worn bearings in the motor	In criteria
4 March	3 south shore pumps, all north shore pumps OOS	Station service breaker tripped. Loss of power	5 minutes-south shore 55 minutes-north shore
16 June	Two north shore pumps	Turned off to allow debris to fall off NFL AWS pump intake trash rack	134 minutes
27 July	2 south shore pumps, all north shore pumps OOS	Loss of power	6 minutes-south shore 16 minutes-north shore
9 August	3 south shore pumps, all north shore pumps OOS	Tripped off due to governor blade response problem	28 minutes-south shore 48 minutes-north shore
1 September	Three south shore pumps, two north shore pumps	Unit 1 tripped off. Loss of power	20 minutes-south shore 45 minutes-north shore
3 September	NFL #3	OOS for repair	In criteria
16 September	3 south shore pumps, all north shore pumps OOS	Loss of power	5 minutes-south shore 7 minutes-north shore

Adult Fishway Inspections

Visual Inspections

Ice Harbor Dam project fisheries personnel conducted visual inspections of the fish ladders during the adult fish passage season of March 1 to December 31. In addition, powerhouse operators conducted daily limited inspections of the fishways. Fish facility staff averaged 3 fishway inspections per week with 131 inspections completed. The inspections were conducted by visually inspecting various areas of the fishways and recording reading from staff gauges, fishway entrance hoist motors, meters and tape measures. The data was subsequently transferred to a computer spreadsheet, see Appendix 1. Fisheries staff also collected data on flow discharge, AWS pump 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 any needed adjustments to the fishway control system or arrange for repairs. The combined fish passage data collected was used to compose weekly reports on the status of the fish facility operation and maintenance. Table 23 below shows inspection results for the 2020 inspection season.

Automated Fishway Control System

In the 2020 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 Controller (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, Juvenile Fish Facility lab, PDS and motor control center building at the north fish entrance desk displayed 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. Time difference between reading a staff gage and checking the PLC display may have been as much as 120 minutes. 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

Channel Velocity

The water velocity in the south shore channel junction pool was below criteria [criteria of 1.5-4.0 feet per second (fps)] on 20.0% of the inspections. When the tailwater and channel elevations are higher during periods of high river flows, more of the stationary weirs in the fish ladder are submerged, slowing the velocity of the water coming down the ladder into the junction pool. The out of criteria readings ranged from 0.7-1.4 fps (feet per second) and occurred in between April 28 and July 1.

On June 9 and 10 the south channel velocity was below the 1.5 fps criteria which may have been caused by the higher tailwater levels. On June 10, personnel tried to open three diffuser valves that are upstream of the velocity meter from 25% open to 100% open, to observe if the velocity increased. The diffuser valves do not function electronically and must be opened manually, however because the hand wheels require so much torque to turn, the effort was deemed difficult. Subsequently an adapter was fabricated to use a pneumatic impact driver to open the diffuser valves all the way. Unfortunately, there was no noticeable increase in the velocity.

Ladder Exits

The north and south fish ladder exit head differentials were in criteria ($\leq$0.3 feet) during all inspections. There were no significant debris accumulations on the ladder exit trash racks causing the differentials to get above 0.2', and they were typically 0.1' or less.

The trash rack at the south shore fish ladder exit was cleaned on October 20 due to excessive debris accumulating causing the forebay/ladder exit differential to be 0.2'. Maintenance staff used a boat to get close enough to the ladder exit to remove several long branches and milfoil.

The picket leads were raised after the end of the fish counting season on November 2.

Ladder Weirs

The depth over the stationary weirs in both fish ladders were in criteria (1.0-1.3 feet) on all fishway inspections.

Counting Stations

The differential across the north and south shore picketed leads was in criteria (≤0.3 feet) on all inspections. From mid-summer to early fall, periodic cleaning of the south shore picketed leads up to several times a day was necessary to keep the differential in criteria.

South Shore Entrance

The SFE-1 weir gate depth was in criteria (≥ 8 feet or on sill) on 99.2% of inspections. The weir gate was in sill criteria on 51.9% of inspections, primarily when tailwater was lower, from mid-summer to the end of the year.

The south shore entrance weir depth was slightly below criteria on March 3 and the operator was informed. Immediately following the inspection, the tailwater elevation was lower with the weir on sill.

SFE-2 weir gate was opened for adult lamprey passage through the lamprey entrance structure on June 30. The lamprey entrance structure remained in operation until October 1.

North Powerhouse Entrance

The NFE-2 weir gate depth was in criteria (≥ 8 feet or on sill) on 88.5% of the inspections. The weir gate was on sill criteria for 47.3% of inspections.

The new mechanical dial on the NFE-2 weir selsyn motor which shows the weir elevation could not be calibrated during the winter maintenance period because the dial does not have the correct gear ratio for the application.

The north powerhouse entrance weir depth was below criteria on March 5 when NFE-2 was in manual control. The automated control system PLC was rebooted to perform maintenance on the system causing the weir controls to default to manual control. The operator switched NFE-2 back to automatic control. The north powerhouse entrance weir depth was slightly below criteria on March 10. By the time the weir elevation was from the control room PLC, the weir may have automatically adjusted upwards in response to an increase in tailwater elevation leading to a weir depth of 7.9’ when compared against the original tailwater reading.

The north powerhouse entrance weir was off sill and the entrance depth was out of criteria on April 6, April 15, April 27, May 6, June 29, July 28, August 3 and 4. The gates at the north powerhouse are in manual control to reduce the deterioration of the operating machinery from the gates constantly adjusting to fluctuating tailwater elevation caused by the spill, which has caused the weir gate depths to be out of criteria.

The gates at the north powerhouse were operated manual control to reduce the deterioration of the operating machinery from the gates constantly fluctuating with the spill, which caused the weir gates to be out of criteria. On June 29 NFE-2 weir gate depths were below criteria caused by rising tailwater elevation. The following day, the weir gate depths were back in criteria. On July 28, the operator was informed the north powerhouse entrance weir gate depth was out of criteria. The operator lowered the gate to meet the sill criteria. The gates were again out of criteria on August 3 and 4.

North Shore Entrance

The NEW-1 weir gate depth was in criteria ($\geq$ 8 feet or on sill) on 95.4% of inspections. The weir gate was in sill criteria on 52.7% of inspections.

The gates were in manual control to reduce the deterioration of the operating machinery from the gates constantly fluctuating caused by the spill, which caused the weir gates to be out of criteria. NEW-1 weir gate depth was out of criteria July 28, August 3 and 4. The operator was notified, and the gates were lowered to meet the criteria.

NEW-1 weir gate was discovered to be raised almost all the way up at 0830 hours on August 21, closing off fish entry into the north ladder. A failure of the PLC for the automated control system for the fish ladder caused the problem. NEW-1 gate operation was restored and the ladder was returned to full operation at 1335 hours.

Fish Collection Channel and Tailwater Head Differential

South Shore Entrance

The south shore entrance channel/tailwater head differential was in criteria (1 - 2 feet) on 93.9% of inspections.

The south shore entrance channel differential was observed to be 0.0’ on the August 5 inspection. The AWS pumps were noted to be operating normally during the inspection and the operator was not aware of any AWS pump failure. The cause of these reading is uncertain, but if any pumps did trip off, it was most likely of short duration. The entrance head differential was below criteria at 0.8’ on July 13, most likely because of higher tailwater.

The channel head differentials at the south shore entrance were above criteria on August 20, October 27 and 28, November 25, and December 17. The tailwater elevations and entrance weir gate depths were generally low during the inspections, probably causing the high entrance head differentials. From October 29 to the end of the season, five south shore AWS pumps were operated instead of six to help lower the differentials. The south shore entrance channel differential was above criteria on October 19. The differential readings from the PLC were in criteria, but the readings were jumping up and down, which was believed to be from the turbulent tailwater surface conditions caused by wind and waves.

North Powerhouse Entrance

The north powerhouse entrance head differential was in criteria (1-2 feet) on 96.9% of inspections.

The north powerhouse entrance channel differential was observed to be 0.0’ on the August 5 inspection under the same circumstances described for the south shore entrance above.

The entrance head at the north powerhouse entrance was above criteria on July 27, possibly due to an error in reading the channel staff gauge. The channel head differential at the north powerhouse entrance was above criteria on August 20, most likely because of low tailwater level. The north powerhouse entrance head differential was above criteria on October 19 because of turbulent conditions from the wind making it difficult to obtain accurate tailwater readings.

North Shore Entrance

The north shore powerhouse entrance head differential was in criteria (1-2 feet) on 93.9% of inspections.

The north shore entrance head was below criteria at 0.4’ on March 3. This may have resulted from a measuring error of the channel elevation, which was obtained using an electronic measuring tape. The head differential was below criteria on June 16 due to the entrance weir being on sill with higher tailwater.

The channel head differentials at the north shore powerhouse entrance were above criteria on April 6, August 20, 24, and 26. The tailwater elevations and entrance weir gate depths were low during the inspections, causing the high entrance head differentials. Only running one north shore AWS pump to lower the head differential is not normally an option, as two north shore AWS pumps need to be operated under most conditions to provide at least 1’ of entrance head. On July 14, the entrance weir was 0.5’ above sill, leading to a low weir gate depth and a high entrance head.

Table 23. Adult fishway inspection results at Ice Harbor Dam, 2020.

ICE HARBOR Criteria and Locations	No. in Criteria/ No. on Sill/ No. of Inspections	% In Criteria/ % On Sill	No./% Within 0.01-0.1 Foot	Not Enough Depth--- No./% Within 0.11-0.2 Foot	No./% >0.2 Foot	No./% Within 0.01-0.1 Foot	Too Much Depth--- No./% Within 0.11-0.2 Foot	No./% >0.2 Foot
Channel Velocities	104	80.0	***	***	***	***	***	***
	***	***	***	***	***	***	***	***
	130							
Differentials								
South Fish Ladder								
Ladder Exit	131	100.0	***	***	***	0	0	0
	***	***	***	***	***	0.0	0.0	0.0
	131							
Ladder Weirs	131	100.0	0	0	0	0	0	0
	***	***	0.0	0.0	0.0	0.0	0.0	0.0
	131							
Counting Station	131	100.0	***	***	***	0	0	0
	***	***	***	***	***	0.0	0.0	0.0
	131							
North Fish Ladder								
Ladder Exit	131	100.0	***	***	***	0	0	0
	***	***	***	***	***	0.0	0.0	0.0
	131							
Ladder Weirs	131	100.0	0	0	0	0	0	0
	***	***	0.0	0.0	0.0	0.0	0.0	0.0
	131							
Counting Station		0.0	***	***	***	0	0	0
	***	***	***	***	***	0.0	0.0	0.0
	131							
Collection Channels								
South Shore	123	93.9	0	1	1	0	2	4
	***	***	0.0	0.8	0.8	0.0	1.5	3.1
	131							
North Powerhouse	127	96.9	0	0	1	1	1	1
	***	***	0.0	0.0	0.8	0.8	0.8	0.8
	131							
North Shore	123	93.9	0	1	2	1	2	2
	***	***	0.0	0.8	1.5	0.8	1.5	1.5
	131							
Weir Depths								
SFE 1	62	47.3	1	6	0	***	***	***
	68	51.9	0.8	4.6	0.0	***	***	***
	131							
NFE 2	54	41.2	0	1	0	***	***	***
	62	47.3	0.0	0.8	0.0	***	***	***
	131							
NSE 1	56	42.7	0	8	6	***	***	***
	69	52.7	0.0	6.1	4.6	***	***	***
	131							

Recommendations for the Adult Fish Facility

1. Continue to repair south fish ladder mud valves in the auxiliary water supply conduit to facilitate unwatering the lower ladder for inspection and maintenance.
2. Remove the accumulated silt in the south shore AWS conduit that is clogging the mud valves and blocking access to some of the mud valves and sluice gates for inspection and maintenance.
3. Rehabilitate fish ladder entrance weir gates and hoisting equipment.
4. 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.
5. 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.
6. Proactively replace fish ladder diffuser grating as needed.
7. Replace broken/dirty staff gauges and guides so that the gauges are easier to clean and read.
8. Relocate staff gages and transducer units as needed so the staff gage and the automated fishway control system readings will be more precise.
9. Install an audible alert on the automated control system PLC when the fish ladder entrance criteria are not being met.
10. Initiate a contract to repair leaks in the fish ladder joints.