CENWW-ODH FONE 30 March 2023

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

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

SUBJECT: Submission of 2017 Adult and Juvenile Fish Facility Monitoring Report, Ice Harbor Dam.

1. Enclosed is the 2017 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

2017 ADULT AND JUVENILE FISH FACILITY MONITORING REPORT

ICE HARBOR DAM

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February 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 2017. Submersible traveling screens (STSs) for all operating units were installed between March 27-29. The Juvenile Fish Facility (JFF) was watered up at on March 22 and fish condition monitoring began on April 3 and continued through July 13. The JFF was dewatered on December 20.

Total smolts sampled in the 2017 season was 3, 485. This season's sample by species group included: 845 clipped and 335 unclipped steelhead *Oncorhynchus mykiss*, 747 clipped and 489 unclipped yearling Chinook salmon *O. tschawytscha*, 386 clipped and 624 unclipped subyearling Chinook salmon *O. tschawytscha*, 34 clipped and unclipped coho salmon *O. kisutch*, and 13 clipped and 12 unclipped sockeye/kokanee *O. nerka*.

The removable spillway weir (RSW) was operated for juvenile fish passage from April 3 to August 17. The RSW was closed before the end of the summer spill season on August 17 due low river flows.

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 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 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

River Conditions

During the 2017 season, the average daily project outflow and spill was higher than the 2012-2016 monthly average during all months, except for spill for September. The monthly spill average for September of 2012-2016 was 5.6 kcfs, while the monthly average spill for September of 2017 was 1.4 kcfs. The average outflow for 2012-2016 was 48.7kcfs and the average outflow from April through September of 2017 was 88.1 kcfs (Table 1).

The highest daily outflow for the season was 214.0 kilo cubic feet per second (kcfs) on March 18. The lowest daily outflow for the season occurred October 23 with an outflow of 12.0 kcfs. The average flow for the season was 54.6 kcfs, (Figure 1).

The highest daily project spill of 155.0 kcfs occurred on March 18. The lowest spill above 0, for the season occurred on September 8 at 0.008 kcfs. The average spill for the season was 88.2 kcfs.

Table 1. Comparison of average monthly project outflow (kcfs) and Spill (kcfs) at Ice Harbor Dam,2012-2017 and the 5-year average.

Project Outflow (kcfs)							
Month	**2012**	**2013**	**2014**	**2015**	**2016**	**2012-2016 Avg**	**2017**
April	110.3	60.0	77.6	51.5	90.7	69.9	142.0
May	145.3	83.4	105.3	60.9	90.5	85.0	142.3
June	177.7	56.6	86.7	41.1	54.7	59.8	134.2
July	96.8	34.1	46.9	27.5	33.1	35.4	53.7
August	41.2	23.4	27.8	20.9	25.4	24.4	31.3
Sept.	34.0	19.2	19.8	17.6	18.7	18.8	25.6
Spill (kcfs)							
Month	**2012**	**2013**	**2014**	**2015**	**2016**	**2012-2016 Avg**	**2017**
April	67.7	0.0	92.0	34.3	55.0	45.3	92.5
May	78.7	0.2	92.0	36.3	50.6	44.8	93.3
June	95.9	32.9	22.9	20.6	29.0	26.3	85.1
July	57.7	45.4	16.5	16.5	19.1	24.4	33.8
August	31.1	32.6	10.9	10.9	14.6	17.2	21.4
Sept.	0.0	21.9	0.0	0.0	0.4	5.6	1.4

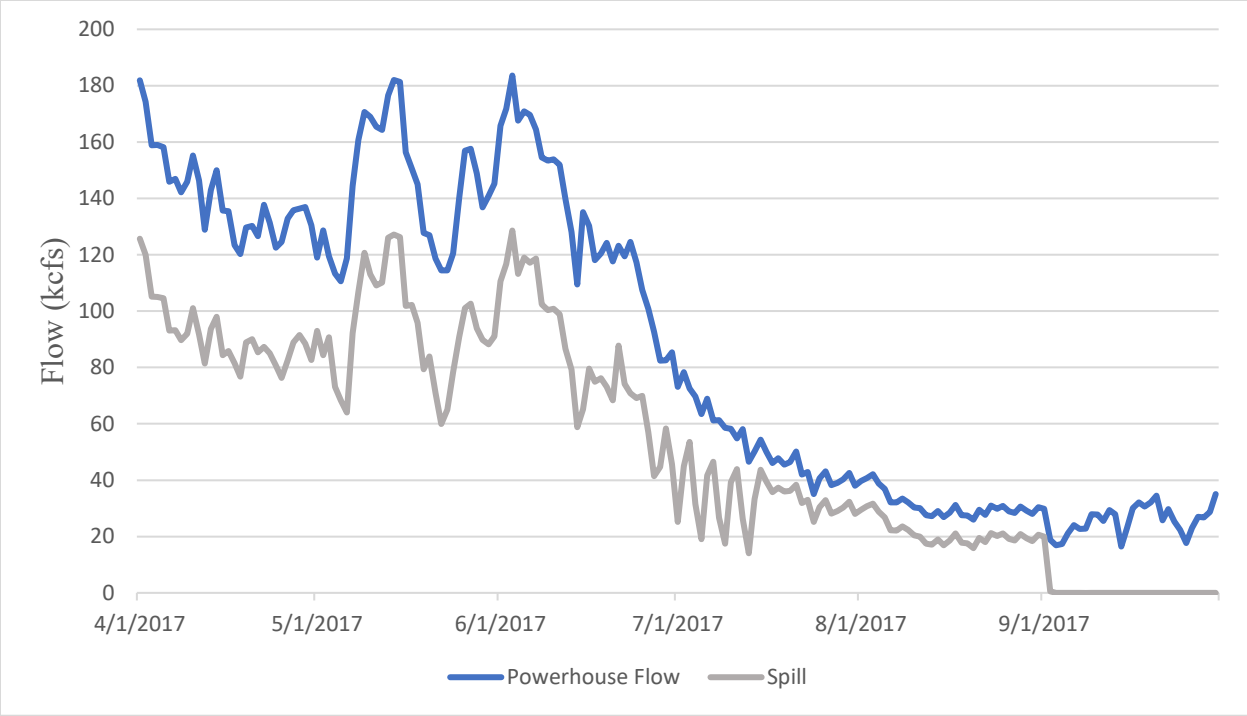

Figure 1. Comparison of daily project outflow and spill at Ice Harbor Dam, 2017.

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 2012-2016 average monthly temperature were lower than the 2017 monthly average temperatures (April 1 to September 30). The lowest temperature in 2017 occurred from January 19-20 at 33 °F. The highest temperatures occurred between July 22-August 26 at 71°F (Table 2).

Table 2. Monthly average river temperatures, 2012-2017 at Ice Harbor Dam and 5-year average.

Temperature (°F)							
Month	**2012**	**2013**	**2014**	**2015**	**2016**	**2012-2016 Avg**	**2017**
April	46.9	39.0	49.1	49.8	50.5	47.1	48.4
May	52.3	40.7	53.8	56.1	55.6	51.5	53.5
June	35.3	43.1	59.0	64.4	62.0	57.1	58.7
July	61.6	46.9	68.2	70.3	68.0	63.3	68.4
August	68.4	52.9	67.8	69.6	70.4	65.2	70.8
Sept.	67.4	57.0	63.0	67.0	66.9	63.5	67.6

Juvenile Fish Facility Operations and Maintenance

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. 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. During the beginning and the latter part of the season, migrating fish numbers can be low, so the target number of fish may not be collected during the four-hour period. Fish condition sampling began on April 3 and occurred on Mondays and Thursdays each week. The last sample of the season occurred on July 13.

A total of juvenile salmonids 3, 485 were sampled during the 2017 season, (Table 3). This is an increase from 2016 which sampled 3,180.

Within each species group the number and percent sampled of those collected in that group was: 845 clipped steelhead, *Oncorhynchus mykiss* (24.2%), 747 clipped yearling Chinook salmon, *O. tschawytscha* (21.4%), 624 unclipped subyearling Chinook salmon (17.9%), 386 clipped subyearling Chinook salmon (11.1%), 489 unclipped yearling Chinook salmon (14.0%), 335 unclipped steelhead (9.6%), 14 clipped/unclipped coho salmon, *Oncorhynchus kisutch* (1.0%), 12 unclipped sockeye/kokanee salmon, *Oncorhynchus nerka*, (0.3%), and 13 clipped sockeye/kokanee salmon (0.4%), (Table 4 and Table 5).

Table 3. Number of juvenile salmonids sampled per day at Ice Harbor Dam, 2017.

Date	Yearling Chinook		Subyearling Chinook		Steelhead		Sockeye/Kokanee		Coho	Daily Total
	Clipped	Unclip	Clipped	Unclip	Clipped	Unclip	Clipped	Unclip	Clip/Unclip	
3-Apr	10	12	0	0	74	29	0	0	0	125
6-Apr	41	51	0	0	25	8	0	0	0	125
10-Apr	37	49	0	0	31	2	0	0	1	120
13-Apr	50	40	0	0	24	4	0	1	0	119
17-Apr	41	46	0	0	28	4	0	1	0	120
20-Apr	45	48	0	0	49	10	0	1	0	153
24-Apr	41	45	0	0	55	8	0	0	0	149
27-Apr	52	20	0	0	89	15	0	1	0	177
1-May	56	32	0	0	57	15	0	1	0	161
4-May	66	27	0	1	38	7	0	1	0	140
8-May	60	26	0	0	51	16	0	1	0	154
11-May	22	5	0	1	79	19	0	0	0	126
15-May	67	14	0	4	25	8	2	0	6	126
18-May	64	16	0	3	23	33	0	0	6	145
22-May	49	18	0	1	54	36	2	1	13	174
25-May	21	12	0	9	72	56	4	0	7	181
29-May	18	15	2	19	52	47	3	0	1	157
1-Jun	2	9	19	60	5	9	0	1	0	105
5-Jun	0	1	55	47	1	2	0	0	0	106
8-Jun	0	0	44	58	2	2	1	0	0	107
12-Jun	0	0	67	55	1	2	0	0	0	125
15-Jun	0	0	45	34	0	1	0	0	0	80
19-Jun	0	0	53	55	0	0	0	1	0	109
22-Jun	0	2	18	39	4	2	0	1	0	66
26-Jun	3	1	41	79	6	0	1	1	0	132
29-Jun	1	0	3	7	0	0	0	0	0	11
3-Jul	0	0	11	24	0	0	0	0	0	35
6-Jul	0	0	3	7	0	0	0	0	0	10
10-Jul	1	0	3	23	0	0	0	0	0	27
13-Jul	0	0	22	98	0	0	0	0	0	120
Totals	747	489	386	624	845	335	13	12	34	3,485
% Totals	21.43%	14.03%	11.08%	17.91%	24.25%	9.61%	0.37%	0.34%	0.98%	***

Table 4. Number of juvenile salmonids sampled at Ice Harbor Dam, 2013-2017

Year	Yearling Chinook		Subyearling Chinook		Steelhead		Sockeye/Kokanee		Coho	Total
	Clipped	Unclip	Clipped	Unclip	Clipped	Unclip	Clipped	Unclip	Clip/Unclip	
2013	327	271	338	525	676	260	10	12	9	3,485
2014	477	484	465	676	763	243	10	86	38	3, 242
2015	274	212	381	349	925	234	5	2	24	2, 606
2016	1025	279	356	598	1022	229	7	0	2	3,180
2017	747	489	386	624	845	335	13	12	34	3, 485

Table 5. Annual percentage sampled of each juvenile salmonid species at Ice Harbor Dam, 2013-2017.

Year	Yearling Chinook		Subyearling Chinook		Steelhead		Sockeye/Kokanee		Coho
	Clipped	Unclip	Clipped	Unclip	Clipped	Unclip	Clipped	Unclip	Clip/Unclip
2013	13.5%	11.2%	13.9%	21.6%	27.8%	10.7%	0.4%	0.5%	0.4%
2014	14.7%	14.9%	14.3%	20.9%	23.5%	7.5%	0.3%	2.7%	1.2%
2015	10.5%	8.1%	14.6%	21.1%	35.5%	9.0%	0.2%	0.1%	0.9%
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%

In 2017, the peak daily collection total and date for each species group were: 98 unclipped subyearling Chinook salmon (June 13), 89 clipped steelhead (April 27), 67 clipped subyearling Chinook salmon (June 12), 63 clipped yearling Chinook salmon (May 15), 56 unclipped steelhead (May 25), 51 unclipped yearling Chinook salmon (April 6), 4 clipped sockeye/kokanee salmon, (May 25), and 13 coho salmon (May 22). The largest daily number collected was 177 fish occurring on April 27, (Table 6).

Table 6. Annual peak collection dates at Ice Harbor Dam, 2013-2017.

Year	Yearling Chinook		Subyearling Chinook		Steelhead		Sockeye/Kokanee		Coho
	Clipped	Unclip	Clipped	Unclip	Clipped	Unclip	Clipped	Unclip	Clip/Unclip
2013	6-May 43	6-Apr 16	11-Jun 67	15-Jul 90	14-May 67	19-Jun 70	22-May 5	22-May 9	3-Jun 5
2014	6-May 69	28-Apr 57	25-Jun 64	11-Jun 66	12-May 97	30-May 30	22-May 7	2-Apr 9	20-May 10
2015	14-Apr 55	14-Apr 55	9-Jun 69	23-Jun 86	30-Apr 103	14-May 34	20-May 2	18-May 1	20-May 8
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

Descaling

The descaling rate for all fish sampled in 2017 was 3.8%, (Tables 7 and 8). The highest descaling by day was the samples on May 11 and mostly consisted of clipped and unclipped steelhead. The descaling rate continually increased after April 27. On May 17, debris was raked from unit 1 and 3 trash racks, in case debris was causing the fish descaling observed in the juvenile fish observed in the samples. Approximately 2 cubic yards of debris was removed from unit 1 trash racks. No debris was found on unit ‘s 3 trash racks. The descaling rate decreased following the racks being

rake. The descaling rate decreased to 5.2% on May 22, and 0.6% on May 25. The majority of fish found with descaling were Coho salmon (Table 7).

Table 7. Number of salmonids sampled with descaling at Ice Harbor, 2017.

Date	Yearling Chinook		Subyearling Chinook		Steelhead		Sockeye/Kokanee		Coho	Total
	Clipped	Unclip	Clipped	Unclip	Clipped	Unclip	Clipped	Unclip	Clip/Unclip	
3-Apr	1	1	---	---	7	0	---	---	---	9
6-Apr	0	1	---	---	1	0	---	---	---	2
10-Apr	2	0	---	---	1	0	---	---	0	3
13-Apr	0	0	---	---	0	0	---	---	---	0
17-Apr	2	0	---	---	0	1	---	0	---	3
20-Apr	3	1	---	---	2	1	---	0	---	7
24-Apr	2	3	---	---	1	0	---	---	---	6
27-Apr	3	0	---	---	2	0	---	0	---	5
1-May	3	0	---	---	4	2	---	0	---	9
4-May	10	1	---	0	1	0	---	0	---	12
8-May	6	4	---	---	3	2	---	0	---	15
11-May	1	0	---	0	17	1	---	---	---	19
15-May	5	1	---	0	3	0	0	---	1	10
18-May	5	0	---	0	1	3	---	---	1	10
22-May	0	0	---	0	4	5	0	0	0	9
25-May	0	0	---	0	0	1	0	---	0	1
29-May	1	0	0	0	3	3	0	---	0	7
1-Jun	0	0	0	1	0	0	---	0	---	1
5-Jun	---	0	0	0	0	0	---	---	---	0
8-Jun	---	---	0	0	0	0	0	---	---	0
12-Jun	---	---	0	0	0	0	---	---	---	0
15-Jun	---	---	1	0	---	0	---	---	---	1
19-Jun	---	---	0	0	---	---	---	0	---	0
22-Jun	---	0	0	1	0	0	---	0	---	1
26-Jun	0	0	1	0	1	---	0	0	---	2
29-Jun	0	---	0	0	---	---	---	---	---	0
3-Jul	---	---	0	1	---	---	---	---	---	1
6-Jul	---	---	0	0	---	---	---	---	---	0
10-Jul	0	---	0	0	---	---	---	---	---	0
13-Jul	---	---	0	0	---	---	---	---	---	0
Totals	44	12	2	3	51	19	0	0	2	133

-- No fish of this species sampled

The annual descaling rate by species group was clipped yearling Chinook salmon (5.9%), unclipped yearling Chinook salmon (2.5%), clipped subyearling Chinook salmon (0.5%), unclipped subyearling Chinook salmon (.5%), clipped steelhead (6.0%), unclipped steelhead (5.7%), and coho salmon (5.9%), (Table 8).

In 2017, the descaling of 3.8 % for all fish examined was lower than the descaling rates in 2014 and 2015, but higher than 2013 and 2016. Steelhead had the highest amount of descaling observed in 2015-2017. Clipped sockeye/kokanee salmon had the highest amount in 2013 and 2014 (Table 9). Due to increasing rates of descaling a video camera was inserted into the separator juvenile fish exit on May 9 to check for any obstructions or rough surfaces which could be causing the descaling. No problems were found. In addition, on May 11 back flushing was increased to four times a day to try to decrease descaling rates.

Table 8. Percent of descaled salmonids at Ice Harbor Dam, 2017.

Date	Yearling Chinook		Subyearling Chinook		Steelhead		Sockeye/Kokanee		Coho	Total
	Clipped	Unclip	Clipped	Unclip	Clipped	Unclip	Clipped	Unclip	Clip/ Unclip	
3-Apr	10.0%	8.3%	---	---	9.5%	0.0%	0.0%	0.0%	---	7.2%
6-Apr	0.0%	2.0%	---	---	4.0%	0.0%	0.0%	0.0%	---	1.6%
10-Apr	5.4%	0.0%	---	---	3.2%	0.0%	0.0%	0.0%	0.0%	2.5%
13-Apr	0.0%	0.0%	---	---	0.0%	0.0%	0.0%	0.0%	---	0.0%
17-Apr	4.9%	0.0%	---	---	0.0%	25.0%	0.0%	0.0%	---	2.5%
20-Apr	6.7%	2.1%	---	---	4.1%	10.0%	0.0%	0.0%	---	4.6%
24-Apr	4.9%	6.7%	---	---	1.8%	0.0%	0.0%	0.0%	---	4.0%
27-Apr	5.9%	0.0%	---	---	2.2%	0.0%	0.0%	0.0%	---	2.8%
1-May	5.4%	0.0%	---	---	7.0%	13.3%	0.0%	0.0%	---	5.6%
4-May	15.2%	3.7%	---	0.0%	2.6%	0.0%	0.0%	0.0%	---	8.6%
8-May	10.0%	15.4%	---	---	5.9%	12.5%	0.0%	0.0%	---	9.7%
11-May	4.5%	0.0%	---	0.0%	21.5%	5.3%	0.0%	0.0%	---	15.1%
15-May	7.5%	7.1%	---	0.0%	12.0%	0.0%	0.0%	0.0%	16.7%	7.9%
18-May	7.9%	0.0%	---	0.0%	4.3%	9.1%	0.0%	0.0%	16.7%	6.9%
22-May	0.0%	0.0%	---	0.0%	7.4%	13.9%	0.0%	0.0%	0.0%	5.2%
25-May	0.0%	0.0%	---	0.0%	0.0%	1.8%	0.0%	0.0%	0.0%	0.6%
29-May	5.6%	0.0%	0.0%	0.0%	5.8%	6.4%	0.0%	0.0%	0.0%	4.5%
1-Jun	0.0%	0.0%	0.0%	1.7%	0.0%	0.0%	0.0%	0.0%	0.0%	1.0%
5-Jun	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
8-Jun	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
12-Jun	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
15-Jun	0.0%	0.0%	2.2%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	1.3%
19-Jun	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
22-Jun	0.0%	0.0%	0.0%	2.6%	0.0%	0.0%	0.0%	0.0%	0.0%	1.5%
26-Jun	0.0%	0.0%	2.4%	0.0%	16.7%	---	0.0%	0.0%	---	1.5%
29-Jun	0.0%	---	0.0%	0.0%	---	---	---	---	---	0.0%
3-Jul	---	---	0.0%	4.2%	---	---	---	---	---	2.9%
6-Jul	---	---	0.0%	0.0%	---	---	---	---	---	0.0%
10-Jul	0.0%	---	0.0%	0.0%	---	---	---	---	---	0.0%
13-Jul	---	---	0.0%	0.0%	---	---	---	---	---	0.0%
Total Examined	747	489	386	624	845	335	13	0	34	3,485
% Descaled	5.9%	2.5%	0.5%	0.5%	6.0%	5.7%	0.0%	0.0%	5.9%	3.8%

-- No fish of this species sampled

Table 9. Annual descaling rates in percent for juvenile fish sampled at Ice Harbor Dam, 2013-2017.

Year	Yearling Chinook		Subyearling Chinook		Steelhead		Sockeye/Kokanee		Coho	Total
	Clipped	Unclip	Clipped	Unclip	Clipped	Unclip	Clipped	Unclip	Clip/Unclip	
2013	3.7%	3.3%	1.5%	2.5%	3.4%	2.7%	30.0%	0.0%	0.0%	3.0%
2014	5.9%	6.0%	5.0%	3.4%	6.7%	4.9%	10.0%	10.5%	7.9%	5.5%
2015	4.0%	4.2%	2.6%	1.6%	6.5%	8.1%	0.0%	0.0%	4.2%	4.6%
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%

-- No fish of this species sampled

Mortality

There was a total of 20juvenile facility mortalities for all salmonids for 2017, (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. Annual percent mortality for all groups combined was 0.2% in 2017. Only 3 species groups had mortalities in 2017. The mortalities and percentages were 14 clipped yearling Chinook salmon (0.4%), 3 unclipped subyearling Chinook salmon (0.3%), 2 unclipped yearling Chinook salmon (< 1%), and 1 clipped Steelhead (8.3%) (Table 11).

Table 10. Total sample mortality at Ice Harbor Dam, 2017.

	Yearling Chinook		Subyearling Chinook		Steelhead		Sockeye/Kokanee		Coho	Total
	Clipped	Unclip	Clipped	Unclip	Clipped	Unclip	Clipped	Unclip	Clip/ Unclip	
1-Apr	0	0	0	0	0	0	0	0	0	0
5-Apr	1	0	0	0	0	0	0	0	0	1
8-Apr	0	0	0	0	0	0	0	0	0	0
12-Apr	0	0	0	0	0	0	0	0	0	0
15-Apr	0	0	0	0	0	0	0	0	0	0
19-Apr	0	0	0	0	0	0	0	0	0	0
22-Apr	1	0	0	0	0	0	0	0	0	1
26-Apr	0	0	0	0	0	0	0	0	0	0
29-Apr	0	0	0	0	0	0	0	0	0	0
3-May	2	0	0	0	0	0	0	0	0	2
6-May	0	0	0	0	0	0	0	0	0	0
10-May	5	1	0	0	0	0	0	0	0	6
13-May	5	0	0	0	0	0	0	0	0	5
17-May	0	0	0	0	0	0	0	0	0	0
20-May	0	0	0	0	0	0	0	0	0	0
24-May	0	1	0	0	0	0	0	0	0	1
27-May	0	0	0	0	0	0	0	0	0	0
31-May	0	0	0	1	1	0	0	0	0	2
3-Jun	0	0	0	0	0	0	0	0	0	0
7-Jun	0	0	0	0	0	0	0	0	0	0
10-Jun	0	0	0	0	0	0	0	0	0	0
14-Jun	0	0	0	0	0	0	0	0	0	0
17-Jun	0	0	0	0	0	0	0	0	0	0
21-Jun	0	0	0	0	0	0	0	0	0	0
24-Jun	0	0	0	0	0	0	0	0	0	0
28-Jun	0	0	0	1	0	0	0	0	0	1
1-Jul	0	0	0	1	0	0	0	0	0	1
Totals	14	2	0	3	1	0	0	0	0	20

Table 11. Annual mortality in percent at Ice Harbor Dam, 2013-2017.

Year	Yearling Chinook		Subyearling Chinook		Steelhead		Sockeye/Kokanee		Coho	Total
	Clipped	Unclip	Clipped	Unclip	Clipped	Unclip	Clipped	Unclip	Clip/Unclip	
2013	0.0%	0.0%	0.0%	0.0%	0.4%	0.0%	0.0%	0.0%	0.0%	0.4%
2014	0.4%	0.0%	0.2%	0.1%	0.1%	2.3%	0.0%	1.2%	0.0%	0.2%
2015	0.0%	0.0%	0.0%	0.2%	0.0%	0.4%	0.0%	0.0%	0.0%	0.1%
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%

-- No fish of this species sampled

Maladies

Maladies are recorded for each sample and sent to the Fish Passage Center (FPC) after the sample is completed. For the 2017 season, maladies found within all species groups included body injury, head injury, eye injury, eye hemorrhage, popeye, operculum injury, fin injury, fungus, fin hemorrhage, fin deformity, parasites, *Columnaris*, and fin discoloration. The most

common maladies from all species groups combined were, operculum injury, body injury and fin injury. The majority of the maladies came from clipped yearling Chinook salmon and clipped steelhead. The most common maladies from clipped yearling Chinook salmon included eye hemorrhage and operculum injury. The most maladies among clipped steelhead were operculum injury, fin injury, and body injury. Diseases that were the most prevalent were fin hemorrhage and pink fin. Fin hemorrhage was the most prominent in Chinook salmon and pink fin was most common in the steelhead population. 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 were counted and then released at the separator or with the sample fish. The most common incidental species group for 2017 were Siberian prawn, *Exopalaemon modestus* (33). Species that were also prominent were carp*, Cyprinus carpio* (5) and smallmouth and largemouth bass, *Micropterus dolomieu/salmoides* (6), (Table 12).

Table 12. Incidental species collected during sampling at Ice Harbor Dam, 2017.

Common Name	Scientific Name	Sample
American Shad (Adult)	*Alosa sapidissima*	2
Common Carp	*Cyprinus carpio*	5
Crappie	*Pomoxis* spp.	1
Pacific Lamprey (Juvenile)	*L. tridentatus*	2
Peamouth	*Mylocheilus caurinus*	1
Sculpin	*Cottus* spp.	1
Siberian Prawn	*Exopalaemon modestus*	33
Largemouth & Smallmouth Bass	*Micropterus dolomieu/salmoides*	6
Sucker	*Catostomus* spp.	1
Sunfish	*Lepomis* spp.	2
Whitefish	*Prosopium* spp.	1
White Sturgeon	*Acipenser transmontanus*	0
Walleye	*Stizostedion vitreum*	2
Warmouth	*Lepomis gulosus*	0
Yellow Perch	*Perca flavescens*	2
Total		59

Adult Salmonid Fallbacks

A total of 12 salmonids were released from the separator in 2017. The salmonids consisted of 6 Chinook salmon, 2 Jack Chinook salmon, 3 clipped steelhead, and 1 unclipped steelhead. All the salmonids were classified in good condition except for a clipped steelhead on April 10 and an unclipped steelhead on April 24. The clipped steelhead found on April 10 was classified in poor condition and the one released on April 24 was classified in fair condition (Table 13).

Table 13. Daily totals of adult salmonids released from the separator and condition at Ice Harbor Dam, 2017.

Date	Chinook	Chinook Jack	Steelhead Clipped	Steelhead Unclip	Sockeye	Coho	Condition
3-Apr	0	0	1	0	0	0	Good
10-Apr	0	0	1	0	0	0	Poor
24-Apr	0	0	0	1	0	0	Fair
25-May	1	0	0	0	0	0	Good
29-May	2	0	0	0	0	0	Good
5-Jun	1	0	0	0	0	0	Good
8-Jun	0	0	1	0	0	0	Good
15-Jun	1	1	0	0	0	0	Good
26-Jun	0	1	0	0	0	0	Good
26-Jun	1	0	0	0	0	0	Dead
Total	6	2	3	1	0	0	

The annual totals of adults released from the separator for 2017 was more than the previous years, however, only one more salmonid was released in 2017 than 2016. The majority of fish released in 2017 were Chinook salmon (Table 14).

Table 14. Annual totals of adult salmonids released from the separator at Ice Harbor Dam, 2013-2017.

Year	Chinook	Chinook Jack	Steelhead Clipped	Steelhead Unclip	Sockeye	Coho	Total
2013	3	1	1	0	0	0	5
2014	4	1	2	8	0	0	15
2015	0	1	0	1	0	0	2
2016	3	2	1	2	2	0	10
2017	6	2	3	1	0	0	12

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. Between March 31 to April 6 turbines switched to hard restraint. Unit priority was in effect from March 1 to November 30. Units were taken out of service one at a time for trash rack raking and STS inspections. Unit 3 was routinely operated slightly below the 1% peak operating efficiency range during the reporting period, due to the GDACS program needing to be updated with the narrower operating efficiency range since it became a fixed-blade unit. Units 1-6 were operated above the 1% peak efficiency range between March 10-16 due to a request by BPA. Unit 5 was operated out of priority, ahead of unit 6, from 1355 hours to 1425 hours on September 1, before unit 6 was declared out of service to fix the tripping problem. (See Table 15) Unit 1 was operated outside

of the 1% peak operating efficiency range at 0210 hours on October 1 for approximately 1 hour to meet BPA load requirements.

Units were taken out of service (OOS) for various reasons throughout the year. (Table 15) provides a summary of unit outages and causes.

Table 15. Unit outages and return to service dates for Ice Harbor Dam, 2017.

Date Out of Service (OOS)	Unit	Outage Description
14 Mar 2016- 2 Mar 2017	5	Oil leak from blade packing
23 Apr	2	Runner replacement
6 March- August 3	4	Annual maintenance
6 March	5	Oil leak
7 March	3	Accommodated repair of section 2 bus
21-22 March	1, 3, 5, 6	Raked trash racks
27-29 March	1, 3, 5, 6	STSs installed
19-20 April	3	Repair head covers, remove water from turbine bearings
2 May	3	Reduce water leaking into turbine pit
4 May	1	Lightening striking line 1
11-12 May	3	Accommodate BPA work
24 May	5,6	Raked trash racks
5-6 Jun	1	STS tripped off
6 July	6	Replace stator air cooler
10 July	3	Annual maintenance
28 July – 26 October	4	Annual maintenance
7-31 August	5	Annual maintenance
14-23 August	3	Oil found in governor sump
1 September	6	Unit tripped off
5 September - 18 October	6	Annual maintenance
3 November	1,5	Remove debris from gatewell slot
27 November-15 December	1	Annual maintenance
21 December	1	Oil sheen observed in tail race

Removable Spillway Weir

Spring spill for fish passage started occurring on April 3. Spring spill ended June 20 and summer spill started on June 21. The RSW (spill gate #2) was closed on August 17 at 1345 hours, due to decreasing river flows Voluntary spill for fish passage ended at 0001 hours on September 1. The tri-annual dive-inspection of the RSW occurred on September 26. There were no significant problems found.

Debris and Trash Racks

March 21- March 22, a total of 7 cubic yards of debris was raked from the trash racks prior to installing STSs. April 23, debris was cleaned from the north trash rack at north fish ladder. On May 17, debris was raked from unit 1 and 3 trash racks in case this debris was causing the increased descaling. The intake trash rack for north shore AWS pump 3 was cleaned on June 14, in response to debris clogging the pump and causing it to trip off on June 6. On May 17,

approximately 2 cubic yards of debris was removed from unit 1 trash racks. There was no debris found on unit 3 trash racks.

Gatewells

Gatewell slots were checked daily for debris. Amounts of woody material were noted in gatewell slots, but never approached the 50% coverage criteria point for mandatory cleaning. Debris ranged from 0-40%. The highest debris occurred April 5-May 31 ranging 0-25% and October 13-November 2, ranging from 30-40%. Gatewells were dipped as needed prior to installing STSs. In addition, they were dipped on November 3 due to the high percentage of debris occurring in the gatewells. The debris then ranged from 0-20% for the rest of the season.

An underwater video camera was used to conduct monthly inspections of all installed STSs. On March 6, a small oil sheen was observed in the ice/trash sluiceway from the unit 5 turbine bearing oil leak. The oil presumably drained out of the ice/trash sluiceway into the river, but there was no oil sheen observed in the river. This incident was reported through the proper channels. An oil sheen was observed in 5A head gate slot and 5A gatewell slot on August 10. Oil socks were deployed in the head gate slot. The oil sheen was most likely residual oil that came off the hydraulic lifts for the head gate.

May 15, an emergency spill was performed to clear out 350 square yards of debris in the vicinity of spillway 3 and 5 in the forebay. On June 7, an emergency spill occurred from 1037 hours to 1140 hours to push the tailrace debris downstream. See AWS section for more details. On June 15, an emergency debris spill occurred from 1010 hours to 1145 hours to clear out approximately 800 square yards of woody debris that had accumulated behind spill gates 3, 4, and 5. After backflushing due to plugged orifices on December 4, 5 to 10 dead juvenile shad were observed in gatewell 5C, indicating there were probably dead shad impinged on the orifice debris.

Submersible Traveling Screens

Submersible traveling screens (STSs) were installed on March 27-29 for units 1 and 3-6. Unit 2 was not installed because it was out of service for the season. They were removed on December 18-19. Inspections were done monthly from April 1 through November. No significant problems were found.

STSs were switched to continuous-run mode on April 4 due to the presence of small juvenile sockeye salmon in the fish sample. On July 18, the STSs were switched to cycle mode, since juvenile salmonids were measured with a fork length greater than 120 mm.

On June 6, the STS in slot 1A was replaced with a spare STS because of a faulty motor.

Vertical Barrier Screens

Project personnel inspected vertical barrier screens (VBS) while conducting STS inspections. All VBSs were inspected except for unit 2 which was out of service. No problems were found.

Juvenile Collection Channel (JCC) Orifices

The JCC channel was watered up on March 22 and dewatered December 20. The collection channel was typically operated with 20 orifices open. At least one orifice was open in each gatewell slot. Some exceptions to this were if 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. Starting April 1, orifices were backflushed once every 8 hours, through May 11. Due to a high descaling rate observed in the fish sample backflushing was increase to four times per day beginning May 11.

Five orifices were found to be partially to totally plugged with debris on the morning of June 26. Two Chinook salmon mortalities in the sample on June 26 were probably due to being caught in debris plugging those orifices. Unit 6 orifices were closed for the dive-inspection of the removable spillway weir on September 26, to provide safe underwater conditions for divers

A high-differential alarm across the primary dewaterer inclined screen occurred on October 21, triggering the open orifices from 2A through 6C to automatically shut. Upon immediate investigation, the water level in the channel and the differential were observed to be normal, so the orifices were reopened. The automated systems for the orifices were turned off to keep the orifices open. On October 24, electricians looked at the water level sensors and found that the cause of the problem was a dirty sensor giving a false reading. Electricians cleaned the probe, and the orifices were switched back to automatic operation on October 25.

On November 16 during the night shift a high differential alarm triggered the open orifices from 2A through 6C to close. The powerhouse operator checked the water levels and re-opened some of the orifices. The automated systems for the orifices were turned off to keep the orifices open. An electrician determined that the cause of the problem was a dirty water level sensor giving a false reading. The electrician cleaned the probe, and normal operations in the collection channel resumed later that day.

Orifice 3BN was found to have reduced flow on October 10. The orifice was cycled and backflushed to clear the obstruction. Orifice 5CN was observed to be plugged on the morning of December 4. The orifice was cycled and backflushed to clear out woody debris.

December 20, orifices were closed, and the juvenile fish channel was dewatered for winter maintenance. Record of when the orifice lights needed to be replaced during 2017 are in Table 16.

Table 16. Orifice lights replaced at Ice Harbor Dam, 2017.

Orifice	Issue	Date Found	Date Replaced	Actions Taken
1BN	Light burned out	5 Jul	10 Jul	1BS opened in place of 1BN until replaced
4AN	Light burned out	10 Jul	10 Jul	4AS opened in place of 4AN until replaced
1AN	Light burned out	8 Aug	14 Aug	1AS opened in place of 1AN until replaced
3CN	Light fixture hanging	2 Oct	3 Oct	3CS opened in place of 3CN until fixed
4BN	Light burned out	18 Dec		4BS opened in place of 4BN on December 19

Primary Dewatering Structure (PDS)

The juvenile fish collection channel, including the PDS was opened on March 22 and closed December 20. The PDS functioned well throughout the 2017 season although there were some problems were experienced with the mechanical screen cleaner.

The mechanical screen cleaner was not functioning properly in automatic mode and was operated in manual mode until the limit switches were electronically adjusted on March 23. The mechanical screen cleaner again was not functioning properly in automatic mode from March 26 to March 29, due to problems with the limit switches. During that period, it was operated in manual mode.

A high-differential alarm across the primary dewaterer inclined screen occurred on October 21, triggering the mechanical screen cleaner to cycle continuously. The automated systems for the screen cleaner were turned off to keep the orifices open and reduce the wear and tear on the screen cleaner. In the meantime, the screen cleaner was operated in manual mode as needed. On October 24, electricians looked at the water level sensors and found that the cause of the problem was a dirty sensor giving a false reading. Electricians cleaned the probe, and the systems was switched back to automatic operation on October 25.

A high-differential alarm across the primary dewaterer inclined screen occurred during the night shift on November 16, which triggered the mechanical screen cleaner to cycle continuously. The automated systems for the screen cleaner were turned off to reduce the wear and tear on the screen cleaner. An electrician determined that the cause of the problem was a dirty water level sensor giving a false reading. The electrician cleaned the probe, and normal operations in the collection channel and primary dewaterer resumed later that day.

Juvenile Fish Facility

The raw water supply lines at the fish facility were watered up on March 22. The raw water supply lines in the Fish Facility were drained and winterized on October 12.

Cooling Water Strainers

Turbine unit cooling water strainers were examined for biologic content at least once per month from January through July, except for unit 2 which was OOS during 2017. The strainers were also cleaned when accumulation of debris and fish resulted in a high-pressure differential or became clogged. On November 30, Unit 1 scroll case cooling water strainer hardware was replaced. 150 dead juvenile shad and 1 dead Channel catfish were found. Strainers were cleaned several times due to shad clogging the strainers. The dates where this occurred were November 14-15, November 25-28, November 29, December 2, December 4-8, December 15, December 26.

The species found in the strainers were: 31,099 American Shad totaling, 476 Pacific lamprey, 5 juvenile steelhead, 9 juvenile salmon, 1 clipped Chinook salmon, 2 Chinook salmon juveniles, and 10 Siberian Prawns. The percentage of American Shad found in the strainers versus all

species found in the strainers was 98%. All other species found in the strainers totaled less than 1%.

The total number of Pacific lampreys removed, dead or alive, from the water cooler strainers for the last 5 years are in Table 17. More Pacific lamprey were found in 2017 than in 2015, 2016, and 2013, however, more Pacific lamprey were found in 2014 than in 2017.
Probability of individuals being alive at the time of strainer cleaning was likely more related to time of entry rather than which unit's strainer it was found in.
Table 17. Pacific lamprey removed from turbine cooling water strainers from Ice Harbor Dam, 2013-2017.

Pacific lamprey (Juvenile)			
Year	Live	Dead	Total
2013	2	290	292
2014	0	483	483
2015	8	105	113
2016	1	105	106
2017	6	470	476

Research

No research occurred during the 2017 year.

Avian Predation

Avian Predation-General

Bird monitoring occurred from April 1 to July 31. A bar graph below illustrates the daily average bird count, (Figure 1). Gulls, 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), Eagle Island and JFF bypass outfall. Deterrent measures include bird deterrent hydro cannon, bird wires and hazing (April 1 to June 30) under the animal control contract with United States Department of Agriculture-Wildlife Services (USDA-WS). Three of the avian deterrent wires, which broke off during high flows earlier in the year, were replaced by APHIS Wildlife Services on September 13.

On March 23, the pump for the bird abatement hydrocannon at the bypass outfall pipe was installed and the hydrocannon was turned on. The bird-deterrent hydrocannon was observed to be off on the May 8 inspection, possibly due to the power outage that occurred on May 7. It was restarted on May 8. The water pump for the bird abatement hydrocannon was removed and the water line was drained on December 4, due to forecasted freezing weather.

Gulls

The highest number of birds observed from April 1 to the end of July were gulls totaling 1, 390. The highest average daily count of gulls observed for a month in 2017 was in July totaling 19.7. June came very close to July averaging 19.6. However, the highest amount observed in one day was 93 on May 8 (Figure 2).

Cormorants

Cormorants counts continued to climb in 2017 until May, which had the highest average count, (April 1- July 31). In the month of May the overall average daily count of cormorants was 17.6. The largest total for a day was on May 14 with a total count of 63 birds. In the months of June and July the average decreased.

Terns

July had the highest overall average daily count of terns, totaling 3.1 birds was in July. No terns were observed in the months of April, May, and June. The largest number of terns observed was on July 12 totaling 14 birds.

Grebes

Grebes were not observed except for May and July in 2017. The highest average daily count was for the month of May was .8. The highest count observed occurred on May 27, with a total of 4 birds counted.

Pelicans

In 2017, American white pelicans were often the most numerous piscivorous birds observed around the dam from April to July. The pelicans could not be targeted for hazing because they are a species of concern in Washington State.

The monthly average daily count of pelican counts in 2017 was the largest in July. However, the highest daily observed number pelicans occurred on April 30 totaling 113.

Land-based hazing of piscivorous birds for 8 hours per day began on April 1 and changed to 16 hours per day on April 9. However, from May 5-7, 8 to 12 hours of hazing per day occurred due to personnel shortages. It was decreased to 8 hours per day on June 18. The land-based hazing ended on June 30. Boat-based hazing for 8 hours per day, 3 days per week, began on April 9 and increased to 5 days per week between May5-May 11. It than was decreased to 3 days a week on May 28 and ended on June 17. Land-based hazing was generally effective at dispersing birds away from zones adjacent to the dam. Boat-based hazing has been effective at scaring birds out of zones further downstream of the dam. However, hazing was repeatedly necessary to keep a small number of cormorants and grebes out of the forebay area adjacent to the south fish ladder exit and a small number of birds below the juvenile fish outfall pipe several times during the

season. In addition, between April 21-May 4 frequent observations of up to several hundred foraging pelicans were seen in the evening and early morning hours, generally scattered in the river, downstream of the outfall pipe to the second island downstream of the dam.

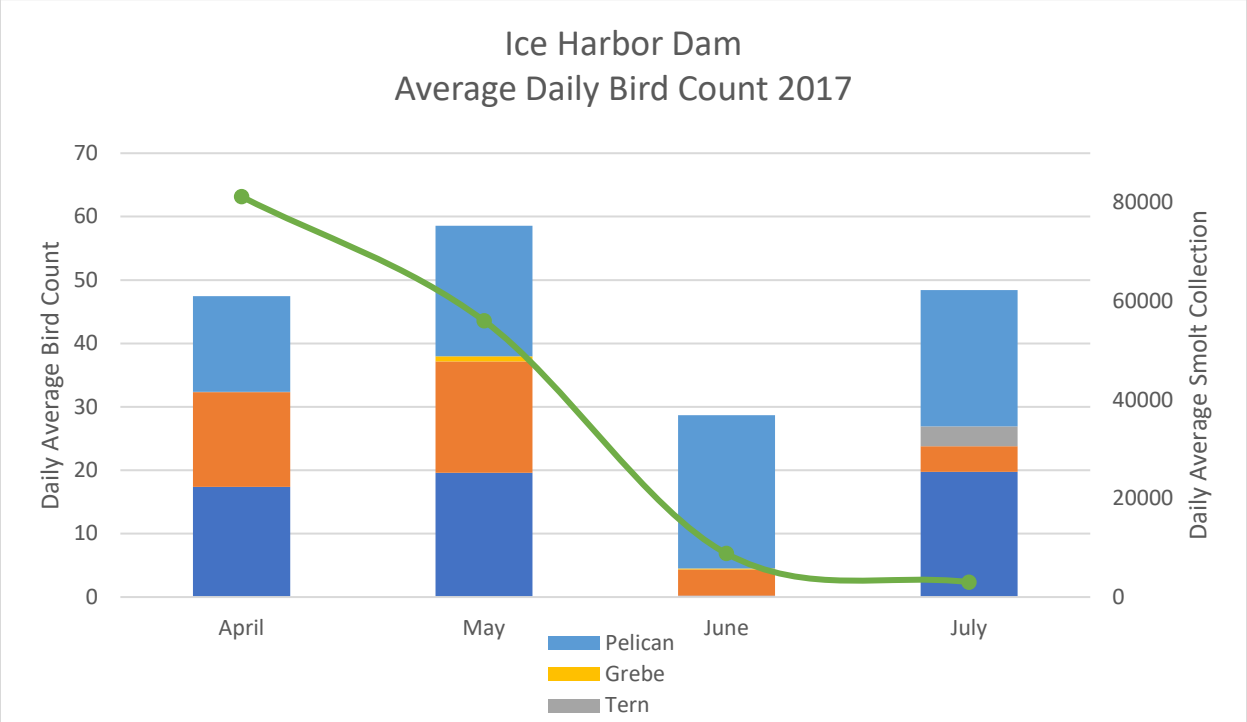

Figure 2. Daily average count at Ice Harbor Dam, 2013-2017.

Recommendations for the Juvenile Fish Facility

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.

1. Install a crowding mechanism in the juvenile collection channel that would encourage adult fish to exit.
2. 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.
3. Install stairs on the hillside to provide a direct and safe walking path between the JFF and tailrace deck level.
4. 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. Adult fish counting started April 1 and ended for the season on October 31. For all species groups the SFL was used much more than the NFL. The total counts for each species group except for Pacific lamprey and shad, were well below the previous ten years' average, (Table 18). American shad and Pacific lamprey were significantly higher than the ten years' average.

Table 18. Number of adult fish passing Ice Harbor Dam in 2017 and average of previous ten years.

	Chinook	Chinook Jack	Steelhead Clipped	Steelhead Unclip	Sockeye	Coho	Coho Jack	Shad	Lamprey
SFL	32, 311	8, 005	2, 415	1, 227	306	1	0	329, 174	608
NFL	6, 957	1, 193	596	294	86	0	0	39, 519	580
Total (SNL + NFL)	39, 268	9, 198	2, 709	1, 521	392	1	0	368, 693	1, 188
10 YR-Avg (SNL + NFL)	91, 739	17, 205	36, 418	10, 638	959	5	1	145, 565	346

Summary of Fish Recovery Operations

Fish recovery operations occurred in unit 1 scroll case while it was being dewatered on November 30. Approximately 150 juvenile shad and 1 channel catfish were observed to be already dead in the scroll case. No other fish were observed. A fish salvage operation occurred on January 30 for the upper south fish ladder while dewatering the ladder. All fish were evacuated down to the tailwater level in the lower south fish ladder. One juvenile steelhead was Found dead. An estimated 40 steelheads were observed during the operation. The north fish ladder was dewatered on January 1 three clipped steelhead were observed going down the ladder. Two other fish were seen between the upper diffuser and the exit pool. There was not enough daylight to safely recover the fish, therefore, they were netted and released the next day in good condition. During dewatering of juvenile fish channel and closing of the orifices thirty-two clipped adult steelhead, 15 unclipped adult steelhead, 2 unclipped juvenile steelhead, and 17 channel catfish were recovered and released to the river in good condition. On August 8 a fish recovery operation was initiated in Unit 4 draft tube during annual maintenance. During the fish recovery 1 dead channel catfish was found.

Auxiliary Water Supply

The auxiliary water supply (AWS) pumps were operating or available for operation to help maintain fish entrance criteria in 2017. 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. Zero to 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 30 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. Any outages or disruptions that occurred in 2017 are listed below or are cited in (Table 19)

Table 19. AWS pump outages and significant events requiring pumps to be shut off at Ice Harbor Dam, 2017.

Date	Pump Number or How Many Pumps Affected	Pump Outage Description or Reason for Turning Off	Results/Duration OOS
March 6	4	Replace oil	7 hours, 9 minutes
March 16-March 17	all south shore pumps	Tailwater elevation exceeded 353'	23 hours, 29 minutes
April 5-April 13	4	Tripped off from lubrication problem	
May 7	3 to 4 south shore pumps	Bus #2 Feeder tripped off	2 hours, 58 minutes
June 16	1	tripped off due to lubrication problem	Pump 3 started 30 minutes later in place of pump 1
November 7-November 20	4	Taken offline due to problems with oil pump	

Seven of the eight south shore AWS pumps were in service until April 27, when a second pump was turned off and only six pumps were needed to meet fish ladder criteria.

On March 3 at 1530 hours, the powerhouse operator found that SFE-1 had slack operating cables and could not be lowered down, due to the water pressure against the weir from the high tailwater. Three of the south shore auxiliary water supply pumps were turned off for a few minutes to reduce the water pressure against SFE-1, so the gate could be lowered down and operated normally

North shore pump #3 was taken out of service on May 20 at 1845 hours when it tripped off due to a gearbox high temperature alarm. North shore pump #2 was immediately started up in place of pump #3, until pump #3 returned to service on May 23 at 1015 hours. North shore AWS pump #3 tripped off at 1840 hours on June 6 when woody debris in the tailrace was sucked up by the pump and clogged the pump. Pump #2 was started in place of pump #3 at 1909 hours on June 6.

On the night of June 6 woody debris accumulating near the north shore AWS pumps began getting drawn into pump 3 intake and clogged the pump. This caused the pump to shut off. On June 7, an emergency spill occurred from 1037 hours to 1140 hours to push the tailrace debris downstream. The intake trash rack for north shore AWS pump 3 was cleaned on June 14, in response to debris clogging the pump and causing it to trip off on June 6.

All of the south shore AWS pumps had to be shut off on November 5 for 15 minutes at 1630 hours to relieve pressure against SFE-1 weir gate. The SFE-1 weir gate was undergoing gate testing and became stuck when the electricians tried to lower it down due to pressure against the weir gate.

Only three of the south shore AWS pump and one of the north shore AWS pumps were operating from approximately 0930 hours to 1000 hours on November 14 due to a tripped breaker.

Adult Fishway Inspections

Visual Inspections

Ice Harbor project fisheries personnel conducted visual inspections of the fish ladders during the adult fish passage season of April 1 to October 31. In addition, powerhouse operators conducted daily limited inspections of the fishways. Fish facility staff averaged 3 fishway inspections per week with 130 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 were 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 a fishway was out of criteria, the powerhouse operator was notified to make any needed adjustments to the fishway control system or arrange for repairs as needed. The combined fish passage data collected were used to compose weekly reports on the status of the fish facility operation and maintenance. The north ladder was dewatered from January 3 to January 27 and the south ladder was dewatered from January 30 to February 28. January 10 an inspection with the ROV was made of the lower north ladder diffuser grating. On February 25 an inspection with the ROV was made on the lower north ladder. The lower south ladder was inspected by ROV. No significant problems were found during any of the inspections.

Automated Fishway Control Systems

In the 2017 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 and Juvenile Fish Facility 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 operating within criteria. Any significant discrepancies between the readings were reported to the electricians for calibration. 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

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 88.5% 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 to 1.4 fps.

The south shore channel velocity was out of criteria on March 6, with a reading of 1.2 feet per second, but was in criteria on the subsequent two inspections. The south shore channel velocity was out of criteria on April 3-4, April 11, April 17, April 19-20, April 24-26, May 2, May 16, May 23, and May 30. These readings can most likely be attributed to the high channel water backing up into the fish ladder. The south fish ladder picketed leads were out of criteria on the August 16 inspection, with a differential of 0.4', caused by a buildup of filamentous algae on the leads. The picketed leads were cleaned to correct the differential. The south shore channel velocity was slightly below criteria on April 6. An additional south shore auxiliary water supply pump was turned on to increase the velocity.

Ladder Exits

The south fish ladder exit head differentials were in criteria (<0.3 feet) during all inspections. The north fish ladder exit was in criteria in 129 of 130 of the inspections (99.2%). Picketed leads were put down March 30. The south shore picketed leads were raised out of the water November 1 and the north shore picketed leads were raised out of the water November 2.

The south fish ladder picketed leads were out of criteria on the August 16 inspection, with a differential of 0.4', caused by a buildup of filamentous algae on the leads. The leads were cleaned shortly after the inspection. The leads required cleaning twice per day to keep the differential within criteria. Between June 16-22 a few sticks were visible at the water surface above the north fish ladder exit, against the bulkhead. Repairs were made to the lifting beam and the bulkheads and trash rack were removed for cleaning on September 14.

Ladder Weirs

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

Counting Stations

The counting stations were in criteria during all the inspections. On July 26 1 dead adult Pacific lamprey was found with its head lodged in the vertical bars of the upstream picketed leads. It was dead for up to a day. In addition, on August 7 a dead Pacific lamprey was found dead with its head and tail missing stuck in the downstream picketed leads. The lamprey was stuck in the leads for up to a day. To correct this problem the leads were checked and cleaned once a day and once a night beginning August 8. An adult Pacific lamprey that appeared to have been dead for at least a day was also observed floating in the south fish ladder just downstream of the ladder exit pool on August 9. The lamprey was missing its head and tail. The carcass most likely drifted into the ladder from the forebay.

South Shore Entrance

The SFE-1 weir gate depth was in criteria (> 8 feet or on sill) during 90.8% of the inspections. The weir gate was in sill criteria on 33.1% of inspections.

SFE-1 weir gate depth was out of criteria on the March 2, 13, 14, 20, 23, and April 5 inspections. The operating weir gates are in manual control to reduce the wear and tear on the gate machinery from trying to auto-adjust to the widely fluctuating tailwater levels from spill, and to prevent the gates from raising up too far and becoming stuck from the water pressure against the gates. With the gates in manual control, the operator must monitor the electronic readouts to detect any out of criteria readings and operate the gates to maintain criteria. The electronic readouts may differ from the staff gauge readings due to the difficulty in obtaining accurate readings with widely fluctuating water levels. On May 8, the SFE-1 weir gate depth was out of criteria. The weir depth criteria was monitored for out of criteria readings after the May 8 ladder inspection. On June 5, the SFE-1 weir gate depth was out of criteria. The gate is in manual control, and the gate depth came into criteria when the tailwater elevation came up shortly afterwards. On the June 13 inspection, the SFE-1 weir gate depths were out of criteria. The gate was lowered down to bring the depth into criteria. On the June 19 inspection, the SFE-1 weir gate depth was out of criteria. The operator was informed and the gate was lowered down to bring it into criteria. The south shore entrance weir depth was out of criteria on the July 10 and 11. The south shore entrance weirs were lowered down in manual control to bring the entrance back into criteria.

North Powerhouse Entrance

The NFE-2 weir gate was in criteria (>8 feet or on sill) on 99.2% of inspections. The weir gate was in sill criteria on 32.3% of inspections, primarily when tailwater was lower from mid-summer to the end of the year.

The north powerhouse entrance weir depth was below criteria on April 4. The powerhouse operator was informed.

North Shore Entrance

The was in criteria 85.4% of inspections. The weir gate was in sill criteria on 32.3% of inspections. NEW-1 weir gate depth was out of criteria on March 20. The operating weir gates were in manual control to reduce the wear and tear on the gate machinery from trying to auto-adjust to the widely fluctuating tailwater levels from spill, and to prevent the gates from raising up too far and becoming stuck from the water pressure against the gates. With the gates in manual control, the operator had to monitor the electronic readouts to detect any out of criteria readings and operate the gates to maintain criteria. The electronic readouts may have differed from the staff gauge readings due to the difficulty in obtaining accurate readings of widely fluctuating water levels. NEW-1 weir gate depth was out of criteria on March 27. The operator was informed, and he lowered the gate to bring it into criteria. The sensor selections for the automated control system readouts were switched to the sensor closest to each staff gauge for each inspection point. It was switched to automatic mode between June 30-July 6. A juvenile steelhead mortality on May 2 and a juvenile Chinook on April 12 were found on the north fish ladder entrance deck, adjacent to spillbay 10. Spillbay 10 was open almost all of the time while spill was occurring, and the tailwater level was higher than usual on both days. The fish probably washed up with a wave from the spillway that splashed over the handrail. The area was monitored each time to verify it was not a recurring problem. On May 18, the NEW-1 weir gate was out of criteria. The operator was informed, and he lowered the gate to bring both parameters into criteria. On May 25, the NEW-1 weir gate depth was out of criteria. The operator was informed, and he lowered the gate to bring the depth into criteria. The north shore entrance weir depth was out of criteria on the July 5- 6 inspections. The control room operator was notified. The automated control system readings in the control room showed the location to be in criteria. The discrepancy was partly due to the difficulty in obtaining accurate tailwater elevation readings while spill is occurring. The settings of the automated control system parameters may also have contributed to the magnitude of the discrepancies. The readings were monitored for further problems. The north shore entrance weir depth was out of criteria on July 10 and 11. The automated control system readings in the control room did not show the north shore entrance to be out of criteria on July 10. The discrepancy was partly due to the difficulty in obtaining accurate tailwater elevation readings while spill is occurring. The settings of the automated control system parameters for the north shore were adjusted and the north shore entrance weirs were lowered down in manual control to bring the entrance into criteria. The north shore entrance was out of criteria on September 5- 7, September 12, October 10, October 11, and October 12. This was mainly due to some of the electronic readings at the north shore entrance being out of calibration, which was reported to the electricians. NEW-1 weir depth was out of criteria on October 16, 24, and 30 ladder inspections while the weir gate was not on sill. This was partly due to the electronic readout of the north shore tailwater elevation being out of calibration. This was reported to the electricians for calibration.

Fish Collection Channel and Tailwater Head Differential

South Shore Entrance

The south shore channel/tailwater differential was out of criteria on the November 15 inspection. This differential may have resulted from inaccurate staff gage readings taken during poor light

conditions. The south shore channel/tailwater differential appeared to have been out of criteria on December 18. This was due to the electronic readout of the north shore tailwater and channel elevations needing calibration. This was reported to the electricians for calibration.

North Powerhouse Entrance

NFE-2 channel/tailwater differential was out of criteria on April 4. The operating weir gates were in manual control to reduce the wear and tear on the gate machinery from trying to auto-adjust to the widely fluctuating tailwater levels from spill, and to prevent the gates from raising up too far and becoming stuck from the water pressure against the gates. With the gates in manual control, the operator must monitor the electronic readouts to detect any out of criteria readings and operate the gates to maintain criteria. The electronic readouts may have differed from the staff gauge readings due to the difficulty in obtaining accurate readings of widely fluctuating water levels. The north powerhouse entrance weir depth was out of criteria on July 17. The control room operator was notified, and the entrance weir was lowered down in manual control to bring the depth into criteria.

North Shore Entrance

The north shore channel/tailwater differential was out of criteria on March 13,28, and April 4. The operating weir gates were in manual control to reduce the wear and tear on the gate machinery from trying to auto-adjust to the widely fluctuating tailwater levels from spill, and to prevent the gates from raising up too far and becoming stuck from the water pressure against the gates. With the gates in manual control, the operator must monitor the electronic readouts to detect any out of criteria readings and operate the gates to maintain criteria. The electronic readouts may differ from the staff gauge readings due to the difficulty in obtaining accurate readings of widely fluctuating water levels. On May 18 the channel/tailwater differential was out of criteria. The operator was informed, and he lowered the gate to bring it into criteria. The north shore channel/tailwater differential was out of criteria on July 5. The control room operator was notified. The settings of the automated control system parameters for the north shore were adjusted to reduce the magnitude of the discrepancy. The north shore and weirs were lowered down in manual control to bring the entrance into criteria. The north shore channel/tailwater differential was out of criteria on July 10. The north shore entrance channel/tailwater head differential was out of criteria on August 31. This was partly due to the difficulty in obtaining accurate tailwater elevation readings while spill is occurring, and the effect of certain spill patterns on drawing down the north shore tailwater level where the reading is taken.

Table 20. Adult Fishway Inspection Results at Ice Harbor Dam, 2017.

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	115	88.5	***	***	***	***	***	***
	***	***	***	***	***	***	***	***
	130							
Differentials								
South Fish Ladder								
Ladder Exit	130	100.0	***	***	***	0	0	0
	***	***	***	***	***	0.0	0.0	0.0
	130							
Ladder Weirs	130	100.0	0	0	0	0	0	0
	***	***	0.0	0.0	0.0	0.0	0.0	0.0
	130							
Counting Station	130	100.0	***	***	***	0	0	0
	***	***	***	***	***	0.0	0.0	0.0
	130							
North Fish Ladder								
Ladder Exit	129	99.2	***	***	***	0	0	1
	***	***	***	***	***	0.0	0.0	0.8
	130							
Ladder Weirs	130	100.0	0	0	0	0	0	0
	***	***	0.0	0.0	0.0	0.0	0.0	0.0
	130							
Counting Station		0.0	***	***	***	0	0	0
	***	***	***	***	***	0.0	0.0	0.0
	130							
Collection Channels								
South Shore	127	97.7	0	0	0	0	1	2
	***	***	0.0	0.0	0.0	0.0	0.8	1.5
	130							
North Powerhouse	129	99.2	0	0	0	1	0	0
	***	***	0.0	0.0	0.0	0.8	0.0	0.0
	130							
North Shore	122	93.8	0	0	3	0	0	5
	***	***	0.0	0.0	2.3	0.0	0.0	3.8
	130							
Weir Depths								
SFE 1	75	57.7	0	0	0	***	***	***
	43	33.1	0.0	0.0	0.0	***	***	***
	130							
NFE 2	87	66.9	0	1	0	***	***	***
	42	32.3	0.0	0.8	0.0	***	***	***
	130							
NSE 1	69	53.1	12	0	19	***	***	***
	42	32.3	9.2	0.0	14.6	***	***	***
	130							

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 detach 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.