CENWW-ODH FONE 20 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 2016 Adult and Juvenile Fish Facility Monitoring Report, Ice Harbor Dam.

1. Enclosed is the 2016 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

2016 ADULT AND JUVENILE FISH FACILITY MONITORING REPORT

ICE HARBOR DAM

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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 2016. Submersible traveling screens (STSs) for all operating units were installed between March 28 and March 29 and were removed between December 19 and December 21. The Juvenile Fish Facility (JFF) was operated for juvenile fish bypass and fallbacks from March 24 to December 21. Fish condition monitoring began on April 4 and continued through July 14.

Total smolts sampled in the 2016 season was 3,180. This seasons sample by species group included: 641 clipped and 278 unclipped yearling Chinook salmon (*Oncorhynchus tschawytscha*), 321 clipped and 620 unclipped yearling Chinook salmon, 966 clipped and 296 unclipped steelhead salmon (*Oncorhynchus mykiss*), 27 clipped and 18 unclipped sockeye salmon (*Oncorhynchus nerka*) and 25 coho salmon (*Oncorhynchus kisutch*) combined.

The removable spillway weir (RSW) was operated for juvenile fish passage from April 3 to July 29. The RSW was closed before the end of the summer spill season due to low river flows. The RSW had no operational problems in 2016.

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

During the 2016 year, no major modifications were completed.

River Conditions

During the 2016 season (April 1 to September 30), the average monthly flow was less than the 5-year average (2011-2015) monthly flow during all months except April (Table 1). The highest monthly average flow for the season was 90.7 kilo cubic feet per second (kcfs) occurring in April (Figure 1). The lowest average flow for the season occurred in September with an average monthly flow of 18.7 kcfs.

Average monthly spill during the 2016 season (April 1 to September 30), was less than the 2011-2015 average for all months except April. In April the average spill was 0.6 kcfs higher than the 5-year monthly average. (Table 1).

Table 1. Comparison of average monthly flow and spill and the 5-year average (2011-2015) at Ice Harbor Dam.

Flow (kcfs)							
Month	**2011**	**2012**	**2013**	**2014**	**2015**	**2011-2015 Avg**	**2016**
April	123.5	110.3	60.0	77.6	51.5	84.6	90.7
May	104.6	145.3	83.4	105.3	60.9	99.9	90.5
June	89.9	177.7	56.6	86.7	41.1	90.4	54.7
July	46.4	96.8	34.1	46.9	27.5	50.4	33.1
August	28.1	41.2	23.4	27.8	20.9	28.3	25.4
Sept.	21.5	34.0	19.2	19.8	17.6	22.4	18.7
Spill (kcfs)							
Month	**2011**	**2012**	**2013**	**2014**	**2015**	**2011-2015 Avg**	**2016**
April	78.1	67.7	0.0	92.0	34.3	54.4	55.0
May	54.3	78.7	0.2	92.0	36.3	52.3	50.6
June	59.4	95.9	32.9	22.9	20.6	46.3	29.0
July	31.0	57.7	45.4	16.5	16.5	33.4	19.1
August	17.7	31.1	32.6	10.9	10.9	20.6	14.6
Sept.	0.0	0.0	21.9	0.0	0.0	4.4	0.4

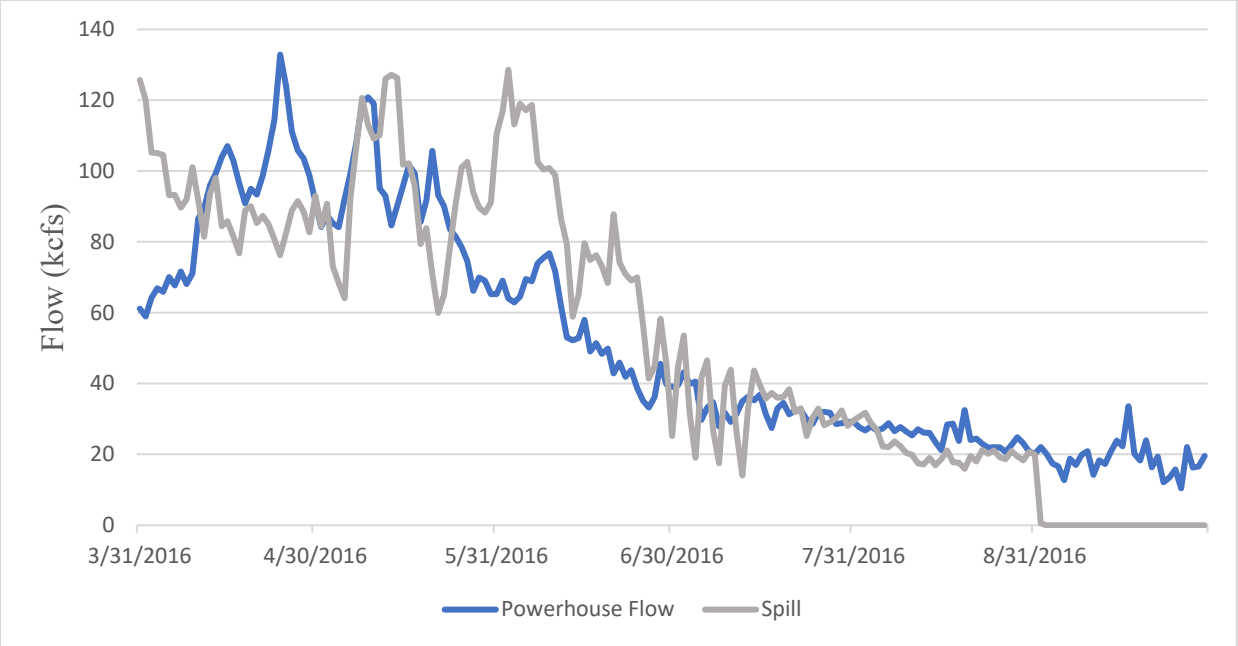

Figure 1. Comparison of daily flow and spill at Ice Harbor Dam, 2016.

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 water temperatures for the 2016 season (April 1 to September 30) were higher than the 5-year average for all months, (Table 2). The maximum water temperatures for the 2017 season (April 1 to September 30) occurred in August.

Table 2. Average monthly river temperatures at Ice Harbor Dam 2011-2016 and 5-year average.

Temperature (°F)							
Month	**2011**	**2012**	**2013**	**2014**	**2015**	**2011-2015 Avg**	**2016**
April	47.5	46.9	39.0	49.1	49.8	46.5	50.5
May	52.3	52.3	40.7	53.8	56.1	51.1	55.6
June	56.8	55.3	43.1	59.0	64.4	55.7	62.0
July	66.6	61.6	46.9	68.2	70.3	62.7	68.0
August	69.7	68.4	52.9	67.8	69.6	65.7	70.4
Sept.	66.6	67.4	57.0	63.0	67.0	64.2	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 2016 season began on April 4 and ended with the last sample on July 14. Sampling was conducted twice a week during this time frame had the goal of collecting 100 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 3,180 juvenile salmonids were sampled during the 2016 season, (Table 3). This is an increase from the 2015 season which sampled 2,606 juvenile salmonids, (Table 4).

Table 3. Number of juvenile salmonids sampled per day by species at Ice Harbor Dam, 2016.

Date	Yearling Chinook		Subyearling Chinook		Steelhead		Sockeye/Kokanee		Coho	Daily Total
	Clipped	Unclip	Clipped	Unclip	Clipped	Unclip	Clipped	Unclip	Clip/Unclip	
4-Apr	1	11	0	1	1	5	0	0	0	19
7-Apr	11	6	0	0	3	10	0	0	0	30
11-Apr	55	44	0	0	8	2	0	0	0	109
14-Apr	50	43	0	0	23	7	0	0	0	123
18-Apr	58	42	0	0	18	5	0	0	0	123
21-Apr	58	40	0	0	27	4	0	0	0	129
25-Apr	60	23	0	0	32	7	0	0	0	122
28-Apr	55	17	0	0	57	4	0	0	0	133
2-May	67	12	0	0	67	15	0	2	2	165
5-May	85	17	0	0	91	11	0	0	1	205
9-May	60	6	0	0	88	20	0	0	0	174
12-May	40	7	0	3	99	19	0	0	2	170
16-May	16	1	0	5	90	37	0	0	4	153
19-May	4	3	0	4	66	31	0	1	3	112
23-May	5	1	0	14	45	26	21	1	3	116
26-May	11	2	0	8	71	30	4	2	6	134
30-May	1	1	0	10	4	7	2	0	0	25
2-Jun	3	1	8	25	79	24	0	0	0	140
6-Jun	1	1	14	27	74	28	0	0	4	149
9-Jun	0	0	27	15	12	2	0	0	0	56
13-Jun	0	0	50	27	3	2	0	0	0	82
16-Jun	0	0	38	65	1	0	0	0	0	104
20-Jun	0	0	9	19	1	0	0	0	0	29
23-Jun	0	0	28	71	1	0	0	0	0	100
27-Jun	0	0	28	80	0	0	0	0	0	108
30-Jun	0	0	29	64	2	0	0	0	0	95
4-Jul	0	0	18	36	3	0	0	0	0	57
7-Jul	0	0	24	66	0	0	0	0	0	90
11-Jul	0	0	32	65	0	0	0	0	0	97
14-Jul	0	0	16	15	0	0	0	0	0	31
Totals	641	278	321	620	966	296	27	6	25	3,180
% Totals	20.16%	8.74%	10.09%	19.50%	30.38%	9.31%	0.85%	0.19%	0.79%	***

Table 4. Number of juvenile salmonids sampled at Ice Harbor Dam, 2012-2016.

Year	Yearling Chinook		Subyearling Chinook		Steelhead		Sockeye/Kokanee		Coho	Total
	Clipped	Unclip	Clipped	Unclip	Clipped	Unclip	Clipped	Unclip	Clip/Unclip	
2012	639	631	240	494	586	327	0	18	35	2,970
2013	327	271	338	525	676	260	10	12	9	2,428
2014	477	484	465	676	763	243	10	86	38	3,242
2015	274	212	381	549	925	234	5	2	24	2,606
2016	641	278	321	620	966	296	27	6	25	3,180

Within each species group the number and percent sampled of those collected in that group was: 641 clipped yearling Chinook salmon (20.2%), 278 unclipped yearling Chinook salmon (8.7%), 321 clipped subyearling Chinook salmon (10.1%), 620 unclipped subyearling Chinook salmon (19.5%), 966 clipped steelhead (30.4%), 296 unclipped steelhead (9.3%), 27 clipped sockeye/kokanee salmon (0.8%), 18 unclipped sockeye/kokanee salmon (0.2%), and 25 clipped/unclipped coho salmon (0.8%), (Table 4) and (Table 5).

Table 5. Annual percentage sampled of each juvenile salmonid species group at Ice Harbor Dam, 2012-2016.

Year	Yearling Chinook		Subyearling Chinook		Steelhead		Sockeye/Kokanee		Coho
	Clipped	Unclip	Clipped	Unclip	Clipped	Unclip	Clipped	Unclip	Clip/Unclip
2012	21.5%	21.2%	8.1%	16.6%	19.7%	10.9%	0.0%	0.6%	1.2%
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%

In 2016, the peak daily collection total and date for each species group were: 85 clipped yearling Chinook salmon (May 5), 44 unclipped yearling Chinook salmon (April 11), 50 clipped subyearling Chinook salmon (June 13), 80 unclipped subyearling Chinook salmon (June 27), 99 clipped steelhead (May 12), 37 unclipped steelhead (May 16), 21 clipped sockeye/kokanee salmon (May 23), 2 unclipped sockeye/kokanee salmon (May 26), and 6 coho salmon (May 23), (Table 6).

Table 6. Annual peak dates for sampling at Ice Harbor Dam, 2012-2016.

Year	Yearling Chinook		Subyearling Chinook		Steelhead		Sockeye/Kokanee		Coho
	Clipped	Unclip	Clipped	Unclip	Clipped	Unclip	Clipped	Unclip	Clip/Unclip
2012	7-May 89	12-Apr 83	21-Jun 45	9-July 84	26-Apr 63	2-Apr 44	-- --	4-Jun 4	4-Jun 12
2013	6-May 43	16-Apr 43	17-Jun 70	15-July 90	16-May 81	16-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

-- 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 was in the samples taken on May 16 and mostly consisting of steelhead, both clipped and unclipped, (Table 7).

Table 7. Number of salmonids sampled with descaling at Ice Harbor Dam, 2016.

Date	Yearling Chinook		Subyearling Chinook		Steelhead		Sockeye/Kokanee		Coho	Total
	Clipped	Unclip	Clipped	Unclip	Clipped	Unclip	Clipped	Unclip	Clip/Unclip	
4-Apr	0	0	---	0	1	0	---	---	---	1
7-Apr	0	0	---	---	0	0	---	---	---	0
11-Apr	0	0	---	---	0	0	---	---	---	0
14-Apr	0	0	---	---	1	0	---	---	---	1
18-Apr	0	0	---	---	0	0	---	---	---	0
21-Apr	0	0	---	---	0	0	---	---	---	0
25-Apr	0	0	---	---	0	0	---	---	---	0
28-Apr	1	1	---	---	1	0	---	---	---	3
2-May	0	1	---	---	4	2	---	0	0	7
5-May	0	0	---	---	1	0	---	---	0	1
9-May	1	0	---	---	2	0	---	---	---	3
12-May	0	0	---	0	5	0	---	---	0	5
16-May	1	0	---	0	7	2	---	---	0	10
19-May	0	1	---	0	0	0	---	0	0	1
23-May	0	0	---	0	1	1	0	0	0	2
26-May	0	0	---	0	5	2	0	0	0	7
30-May	0	0	---	0	1	0	0	---	---	1
2-Jun	0	0	0	0	1	0	---	---	---	1
6-Jun	0	0	0	0	2	0	---	---	0	2
9-Jun	---	---	0	0	3	0	---	---	---	3
13-Jun	---	---	1	0	0	1	---	---	---	2
16-Jun	---	---	0	0	0	---	---	---	---	0
20-Jun	---	---	0	0	1	---	---	---	---	1
23-Jun	---	---	1	2	0	---	---	---	---	3
27-Jun	---	---	1	1	---	---	---	---	---	2
30-Jun	---	---	0	0	0	---	---	---	---	0
4-Jul	---	---	0	0	1	---	---	---	---	1
7-Jul	---	---	0	0	---	---	---	---	---	0
11-Jul	---	---	0	1	---	---	---	---	---	1
14-Jul	---	---	0	0	---	---	---	---	---	0
Totals	3	3	3	4	37	8	0	0	0	58

-- No fish of this species sampled

The descaling rate for all fish sampled in 2016 was 1.8% (Table 8). The annual descaling rate by species group was clipped yearling Chinook salmon (0.5%), unclipped yearling Chinook salmon (1.1%), clipped subyearling Chinook salmon (0.9%), unclipped subyearling Chinook salmon (0.6%), clipped steelhead (3.8%), unclipped steelhead (2.7%), clipped and unclipped sockeye salmon (0.0%), and coho salmon (0.0%), (Table 8).

Table 8. Percent descaled of salmonids at Ice Harbor Dam, 2016.

Date	Yearling Chinook		Subyearling Chinook		Steelhead		Sockeye/Kokanee		Coho	Total
	Clipped	Unclip	Clipped	Unclip	Clipped	Unclip	Clipped	Unclip	Clip/Unclip	
4-Apr	0.0%	0.0%	---	0.0%	100.0%	0.0%	---	---	---	5.3%
7-Apr	0.0%	0.0%	---	---	0.0%	0.0%	---	---	---	0.0%
11-Apr	0.0%	0.0%	---	---	0.0%	0.0%	---	---	---	0.0%
14-Apr	0.0%	0.0%	---	---	4.3%	0.0%	---	---	---	0.8%
18-Apr	0.0%	0.0%	---	---	0.0%	0.0%	---	---	---	0.0%
21-Apr	0.0%	0.0%	---	---	0.0%	0.0%	---	---	---	0.0%
25-Apr	0.0%	0.0%	---	---	0.0%	0.0%	---	---	---	0.0%
28-Apr	1.8%	5.9%	---	---	1.8%	0.0%	---	---	---	2.3%
2-May	0.0%	8.3%	---	---	6.0%	13.3%	---	0.0%	0.0%	4.2%
5-May	0.0%	0.0%	---	---	1.1%	0.0%	---	---	0.0%	0.5%
9-May	1.7%	0.0%	---	---	2.3%	0.0%	---	---	---	1.7%
12-May	0.0%	0.0%	---	0.0%	5.1%	0.0%	---	---	0.0%	2.9%
16-May	6.3%	0.0%	---	0.0%	7.8%	5.4%	---	---	0.0%	6.5%
19-May	0.0%	33.3%	---	0.0%	0.0%	0.0%	---	0.0%	0.0%	0.9%
23-May	0.0%	0.0%	---	0.0%	2.2%	3.8%	0.0%	0.0%	0.0%	1.7%
26-May	0.0%	0.0%	---	0.0%	7.0%	6.7%	0.0%	0.0%	0.0%	5.3%
30-May	0.0%	0.0%	---	0.0%	25.0%	0.0%	0.0%	---	---	4.0%
2-Jun	0.0%	0.0%	0.0%	0.0%	1.3%	0.0%	---	---	---	0.7%
6-Jun	0.0%	0.0%	0.0%	0.0%	2.7%	0.0%	---	---	0.0%	1.3%
9-Jun	---	---	0.0%	0.0%	25.0%	0.0%	---	---	---	5.4%
13-Jun	---	---	2.0%	0.0%	0.0%	50.0%	---	---	---	2.4%
16-Jun	---	---	0.0%	0.0%	0.0%	---	---	---	---	0.0%
20-Jun	---	---	0.0%	0.0%	100.0%	---	---	---	---	3.4%
23-Jun	---	---	3.6%	2.8%	0.0%	---	---	---	---	3.0%
27-Jun	---	---	3.6%	1.3%	---	---	---	---	---	1.9%
30-Jun	---	---	0.0%	0.0%	0.0%	---	---	---	---	0.0%
4-Jul	---	---	0.0%	0.0%	33.3%	---	---	---	---	1.8%
7-Jul	---	---	0.0%	0.0%	---	---	---	---	---	0.0%
11-Jul	---	---	0.0%	1.6%	---	---	---	---	---	1.1%
14-Jul	---	---	0.0%	0.0%	---	---	---	---	---	0.0%
Total Examined	641	278	321	620	966	296	27	600.0%	25	3,180
% Descaled	0.5%	1.1%	0.9%	0.6%	3.8%	2.7%	0.0%	0.0%	0.0%	1.8%

-- No fish of this species sampled

In 2016, the descaling of 1.8% for all fish examined was lower than the 4.6% observed in 2015 and 5.5% observed in 2014 (Table 9). During 2012-2016, steelhead tended to have the highest descaling rates of observed of all salmonids.

Table 9. Annual descaling rates in percent for fish sampled at Ice Harbor Dam, 2012-2016.

Year	Yearling Chinook		Subyearling Chinook		Steelhead		Sockeye/Kokanee		Coho	Total
	Clipped	Unclip	Clipped	Unclip	Clipped	Unclip	Clipped	Unclip	Clip/Unclip	
2012	2.7%	3.2%	4.2%	2.0%	5.5%	3.7%	0.0%	0.0%	0.0%	3.5%
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%

Mortality

Total juvenile facility mortality for all salmonids were a total of 8 fish for the 2016 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.

Table 10. Total sample mortality from the sample days at Ice Harbor Dam, 2016.

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

Annual mortality for all groups combined was 0.3% in 2016 and totaled 8 fish. Within each species group, the number of mortalities and percent of those collected in that group was: 1 unclipped yearling Chinook salmon (0.4%), 3 clipped yearling Chinook salmon (0.9%), and 4 unclipped subyearling Chinook salmon (0.6%), (Table 11).

Table 11. Annual mortality in percent at Ice Harbor Dam, 2012-2016.

Year	Yearling Chinook		Subyearling Chinook		Steelhead		Sockeye/Kokanee		Coho	Total
	Clipped	Unclip	Clipped	Unclip	Clipped	Unclip	Clipped	Unclip	Clip/Unclip	
2012	0.2%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
2013	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
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%

Maladies

Maladies are recorded for each sample and sent to the Fish Passage Center (FPC) after the sample is completed. For the 2016 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, Columnaris, parasites, and fin discoloration. The highest maladies from all species groups combined were eye hemorrhage, operculum, body injury and fin injury. Most of the maladies came from clipped and unclipped steelhead, consisting of operculum damage, fin injury and body injury. The maladies found withing yearling Chinook salmon, were eye injury, fin injury and fungus. 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 2016 included: Siberian prawn, *Exopalaemon modestus* (26), yellow perch, *Perca flavescens* (6) and bluegill, *Lepomis macrochirus* (4).

Table 12. Incidental fish species from the sample/separator for Ice Harbor Dam, 2016.

Common Name	Scientific Name	Sample
American Shad (Adult)	*Alosa sapidissima*	1
Bluegill	*Lepomis macrochirus*	4
Pacific Lamprey (Adult)	*Lampetra tridentatus*	1
Pacific Lamprey (Juvenile)	*Lampetra tridentatus*	2
Carp	*Cyprinus carpio*	1
Crappie	*Pomoxis* spp.	3
Peamouth	*Mylocheilus caurinus*	1
Redside Shiner	*Richardsonius balteatus*	1
Siberian Prawn	*Exopalaemon modestus*	26
Smallmouth Bass	*Micropterus dolomieu*	3
Largemouth Bass	*Micropterus salmoides*	1
Walleye	*Stizostedion vitreum*	1
Yellow Perch	*Perca flavescens*	6
Total		51

Adult Salmonid Fallbacks

A total of 11 adult salmonids fell back through the juvenile bypass system in the 2016 season (Table 13). The condition of the adult salmonids were evaluated as the fish were released from the separator. The adults examined in 2016 were found to be in good and fair condition.

Table 13. Daily totals of adult salmonids released from the separator and condition at Ice Harbor Dam, 2016.

Date	Chinook	Chinook Jack	Steelhead Clipped	Steelhead Unclip	Sockeye	Coho	Condition
4-Apr				1			Good
2-May			1				Good
19-May	1						Good
23-May		1					Good
26-May	1						Good
2-Jun				1			Fair
30-Jun		1	1				Good
4-Jul					2		Good
11-Jul	1						Good
Total	3	2	2	2	2	0	

The annual totals of adults released from the separator from 2014 to 2016 are provided in Table 14. The adult released from the separator for the 2012 and 2013 year were not included in this report. The primary species released from the separator during the 2014 to 2016 time period were adult Chinook salmon and steelhead salmon.

Table 14. Annual totals of adult salmonids released from the separator at Ice Harbor Dam, 2014-2016.

Year	Chinook	Chinook Jack	Steelhead Clipped	Steelhead Unclip	Sockeye	Coho	Total
2012	-	-	-	-	-	-	-
2013	-	-	-	-	-	-	-
2014	4	1	2	8	0	0	15
2015	0	1	0	1	0	0	2
2016	3	2	2	2	2	0	11

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. Table 15 below provides a summary of unit outages and causes.

Table 15. Unit outages and causes at Ice Harbor Dam, 2016.

Dates out of service (OOS)	Unit	Reason out of service (OOS)
14 March – 2017	Unit 5	Blade packing oil leak
22 March – 23 March	All Units	Rake trash
19 April – April 20	Units 1,2,3,4,6	STS inspections
25 April - 2017	Unit 2	Runner replacement
17 May – 18 May	Units 1,3,4,6	STS inspections
14 June – 25 August	Unit 1	Tripped off for protective relay action
21 June – 22 June	Units 1,3,4,6	STS inspections
19 July – 20 July	Units 3,4,6	STS inspections
16 August – 18 August	Units 3, 4, 6	STS inspections
18 August – 19 August	Unit 4	Lucky bushing on output breaker
29 August – 16 September	Unit 3	Annual maintenance
7 September	Unit 6	Spillway bridge inspection
20 September – 21 September	Units 1, 3, 4, 6	STS inspections
3 October – 28 October	Unit 4	Annual maintenance
18 October – 19 October	Units 3,4,6	STS inspections
31 October – 23 November	Unit 6	Annual maintenance
2 November	Unit 3, 4	BPA outage
19 November – 20 November	Units 3,4,6	STS inspections
21 December	Units 1, 3	Accommodate divers working to fix leakage unit 2

Removable Spillway Weir

The RSW went into service at 0000 hours on April 3 with the start of the spring spill program. In mid-May, deep furrows were observed in the surface of the water flowing over the RSW causing turbulence and splashing in the otherwise laminar flow. On May 17, spillgate 2 was completely closed from 1010 hours to 1014 hours to free up any submerged debris that could have possibly caused turbulence in the water flowing over the RSW. After the gate was reopened the turbulent conditions continued and it was determined to be caused by certain hydraulic conditions from further upstream of in the forebay. The turbulent conditions were monitored by fish facility and project operations staff. The RSW was operated until July 29, before the end of the spill season due to low river flows. Spill for fish passage began on April 3 at midnight and ended on September 1 at midnight. The RSW had no operational problems in 2016.

Debris and Trash Racks

In 2016, forebay debris accumulation began in mid-March. Main unit trash rack raking was completed March 22 to 23. No fish mortalities were found on the trash racks.

Gatewells

During the season, gatewell slots were checked during ladder inspections, approximately three times per week. 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 prior to installing STSs.

An oil sheen was observed in unit 5 gatewell slot that was believed to be residual oil from the unit 5 blade packing oil leak. Oil absorbent pads were deployed in the slot. The maintenance bulkhead was installed on May 20 in the gatewell slot 5B and the slot was dewatered to reduce the water leakage into unit 5. On July 5, the maintenance bulkhead was removed from the 5B gatewell slot.

Gatewell slot 2C was dipped for fish on July 6 and the slot was dewatered to facilitate the unit 2 headgate sill plate repair. No fish were recovered during the dewater.

Submersible Traveling Screens

Installation of the STSs was completed from March 28-29 of all units, except for the STS in the 5B slot. An underwater video camera was used to conduct monthly inspections of all installed STSs.

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 29. The STSs were changed to continuous-run mode on April 6 due to the average subyearling Chinook salmon and/or sockeye salmon lengths being less than 120 mm. The STSs were switched back to cycle mode of April 14. The STSs were switched to continuous run mode on May 3, due to the presence of a few sockeye under 120 mm in the May 2 sample. Unit 2 STSs were raised up and stored in their gatewell slots on May 24 and 25, since unit 2 will not be operated for the remainder of the year. They cycle was changed back to cycle-run mode on July 12 when the average length of collected fish were greater than 120 mm.

All STS were raised on December 19, 20 and 21.

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 channel was watered up on March 24 and 20 orifices were opened.

The collection channel was typically operated with 20 orifices open. At least one orifice was open in each gatewell slot, except for unit 5 which remained closed because the unit was OOS until May. 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.

Issues with the orifices were found throughout the season and listed in Table 17. On the morning of June 13, the orifices for gatewell slots 3B and 3C were found to be found closed. It was believed to be from human error when backflushing orifices from the day before. The orifices were reopened that morning. On December 21, orifices were closed, and the juvenile fish channel was dewatered for winter maintenance.

Table 16. Issues with orifices at Ice Harbor Dam, 2016.

Orifice	Date Found	Date Replaced	Action Taken
1CN	29 March	7 April	Makeup orifices used till light bulb replaced
2AN	29 March	7 April	Makeup orifices used till light bulb replaced
5AN	5 May	9 May	Makeup orifices used until light bulb replaced
2BN	19 July	20 July	Makeup orifices used until light bulb replaced
3CN	5 October	5 October	Makeup orifices used until light bulb replaced

Primary Dewatering Structure (PDS)

The juvenile fish collection channel, including the PDS was watered up on March 24.

The mechanical screen cleaner was taken OOS on May 26 when the brush lift cable was found broken. Personnel monitored the water level in the PDS and kept the downstream section clean using a squeegee and the air burst system until the screen cleaner was repaired and RTS on May 31.

The cold weather adversely affected the accuracy of the water level alarm sensors in the PDS on December 6, triggering the screen cleaner to repeatedly cycle. To save the wear and tear on the screen cleaner, it was operated manually. On December 7, it was discovered that the gear linkage that operates the primary dewatering weirs was broken and only two-thirds of the overflow weirs were adjustable. The main water level in the PDS was adequately controlled until the PDS was dewatered.

The juvenile fish channel, including the PDS was dewatered for winter maintenance on December 21.

Juvenile Fish Facility

The raw water supply lines at the fish facility were watered up on March 28 and were drained for winterization on October 26. The juvenile fish facility was dewatered for winter maintenance on December 21.

Fish Salvage

The fish rescue or the JCC occurred on December 21. The species composition of the recovered fish were 39 clipped adult steelhead, 10 unclipped adult steelhead, 4 clipped juvenile steelhead, 3 channel catfish, 1 juvenile American shad and 20 dead juvenile American shad. The fish were released to the river in good condition.

Unit 5 scroll case was dewatered on March 15 to investigate the oil leak. During unwatering, personnel entered the scroll case for fish recovery operations. The only fish observed were two juvenile shad mortalities.

The water in the area between the unit 5 maintenance bulkhead and head gate was released into unit 5 scroll case on March 30. Afterwards, a total of 34 juvenile chinook and 1 juvenile steelhead were recovered from the scrollcase and released to the river.

Unit 2 scroll case and draft tube were dewatered on April 29 and May 3, respectively. Five to ten Siberian prawn mortalities (already dead) were observed in the scroll case, and 23 live channel catfish were recovered from the draft tube and released in the river in good condition.

Unit 5 and unit 2 draft tubes were dewatered on December 6 and 8, respectively. A total of 6 channel catfish were recovered and released in the river in good condition. There were approximately 5 decayed, unidentifiable adult fish mortalities in unit 5 draft tube.

Cooling Water Strainers

In 2016, turbine cooling water strainers were inspected monthly for the presence of lamprey in all months. 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: 2 juvenile Chinook, 1 juvenile channel catfish, 105 dead juvenile Pacific Lamprey, 36,819 juvenile American Shad, and 40 Siberian prawns. Only 1 live Pacific lamprey was recovered from the strainers and 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 2016, there was a lower number of lamprey removed from the strainers than the previous years.

Table 17. Pacific lamprey removed from turbine cooling water strainers from Ice Harbor Dam, 2012-2016.

Pacific lamprey (Juvenile)			
Year	Live	Dead	Total
2012	12	608	620
2013	2	290	292
2014	0	483	483
2015	8	105	113
2016	1	105	106

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 were 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

Researchers collected tissue samples from juvenile salmonids obtained from the smolt monitoring sample to study the relationship of physiological condition and the incidence of delayed mortality. The research began April 21.

From May to early July, researchers released acoustic-tagged dead juvenile salmonids through the RSW for an assessment of whether dead tagged fish are falsely recorded as live fish downstream at the detection station.

Avian Predation

Avian Predation-General

Bird monitoring occurred from April 1 to July 31. 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).

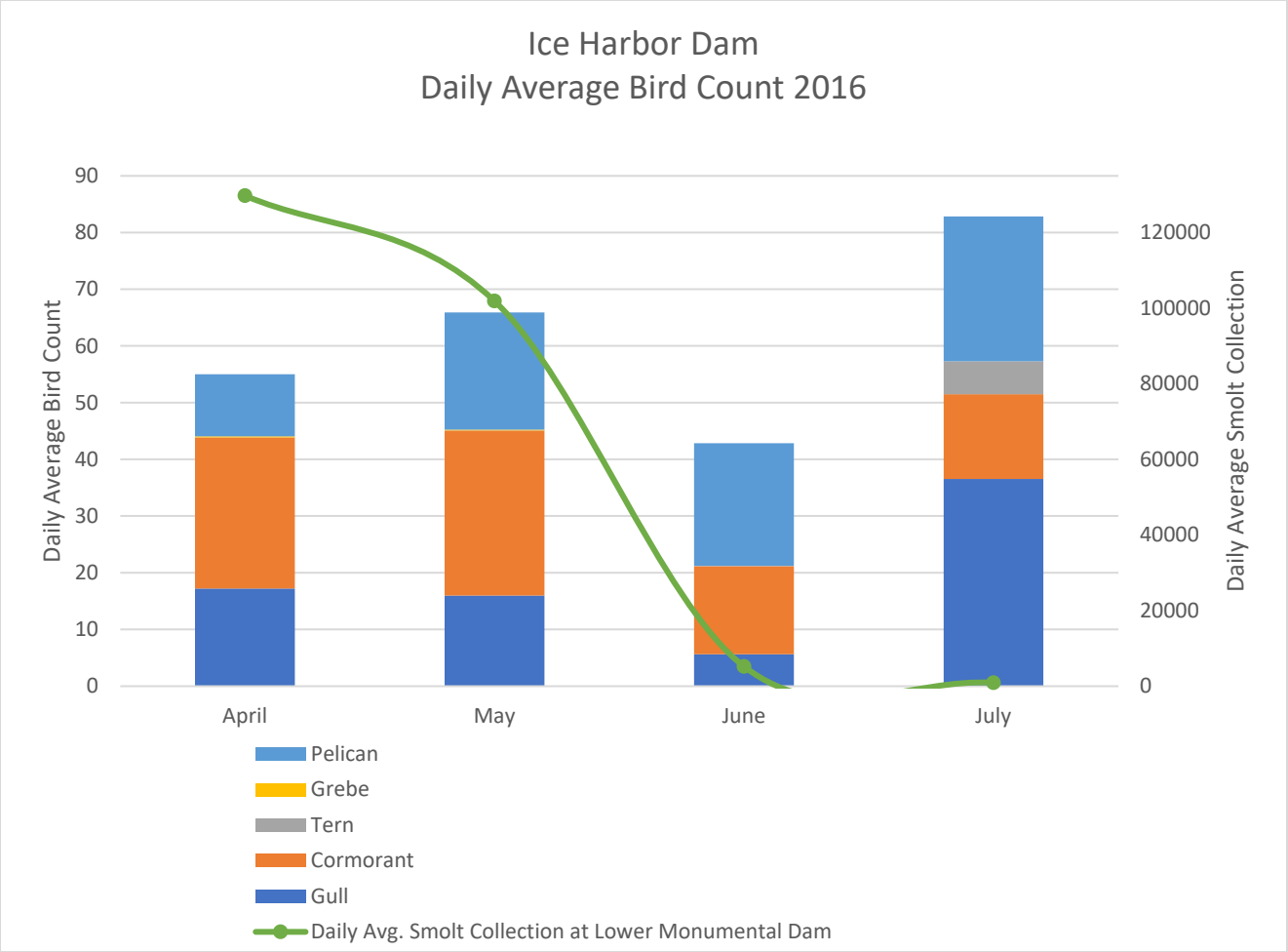

Figure 2. Daily average bird count by species at Ice Harbor Dam, 2016.

American White Pelican numbers are prevalent in all months in the 2016 daily average bird count. In addition, gull numbers are higher in the months of April and July in 2016 (Figure 2).

During the 2016 season the hydrocannon had a few issues that were dealt with throughout the season. The season began with the hydrocannon OOS due to a leaking expansion joint in the hydrocannon water line. The hydrocannon was RTS on May 9 once the repairs were made. On June 22, the hydrocannon was not operating for unknown reasons, but the pump was restarted and was back in operation the same day. On September 2 at 0556 hours, the hydrocannon was placed OOS due to a power outage. It was RTS at 1100 hours on September 2. Due to diminished flow, the hydrocannon was placed OOS on November 5. The pump was cleaned of leaves on November 9 and was RTS. On December 4, the hydrocannon was shut off when the pump became plugged with leaves. The pump was placed OOS for the season. The hydrocannon water line was drained on December 5, since the subfreezing weather would lead to ice buildup at the end of the outfall pipe.

Wildlife Services

The USDA-WS utilized pyrotechnics to conduct land-based of piscivorous birds from April 1 through June 30, 7 days per week, and is focused on gulls, terns and cormorants observed to be feeding on passing fish. Land based hazing is conducted by a Wildlife Specialist 8 hours per day April 1–11 and June 21–30, and 16 hours per day April 12–June 20. Boat-based hazing is conducted 3 days per week April 12–25 and May 31–June 20, and 5 days per week April 26–May 30.

Recommendations for the Juvenile Fish Facility

1. Finish replacing the old deteriorating water regulating weirs and associated connection brackets in the primary dewatering structure.
2. 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.
3. 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.
4. Install a crowding mechanism in the juvenile collection channel that would encourage adult fish to exit.
5. 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.
6. 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.
7. Install stairs on the hillside to provide a direct and safe walking path between the JFF and tailrace deck level.
8. 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 2016, 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 each species group except sockeye, coho, coho jack, and shad, were well below the previous ten years' average.

Table 18. Number of adult fish passing Ice Harbor Dam in 2016 and average of previous ten years.

	Chinook	Chinook Jack	Steelhead Clipped	Steelhead Unclip	Sockeye	Coho	Coho Jack	Lamprey
SFL	80,065	17,767	69,392	16,454	739	1,797	218	170
NFL	31,600	5,883	24,804	5,363	285	1,005	271	70
Total (SNL + NFL)	111,665	23,650	94,196	21,817	1,024	2,802	489	240
10 YR-Avg (SNL + NFL)	117,133	34,780	185,121	49,794	1,019	4,438	604	138

Water temperatures were recorded hourly from both fish ladder exit pools, the downstream end of both upper diffuser pools, the south fish ladder junction pool, the first bend upstream of the north fish ladder collection channel, and the downstream end of the juvenile fish collection channel. Hourly readings were taken from 1 June to 5 October.

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.

The SFL was dewatered for inspection and maintenance from January 4 to February 4. The NFL was dewatered from February 6 to February 29.

Summary of Fish Recovery Operations

Areas that were dewatered in 2016 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 2016 was 275.

Table 19. Areas at Ice Harbor Dam dewatered in 2016.

Date	Unwatering Activity	Fish Removed and Released in the River
4-January	Upper south fish ladder	5 adult clipped steelhead 1 juvenile unclipped Chinook 4 juvenile unclipped steelhead 31 juvenile clipped steelhead 6 smallmouth bass 9 dead juvenile shad 3 juvenile shad
13-January	Lower south fish ladder	22 adult clipped steelhead 2 adult unclipped steelhead 1 channel catfish 150 dead juvenile shad
9-February	Upper north fish ladder	No fish removed
3-March	Unit 5 scrollcase	34 juvenile chinook 1 juvenile steelhead 2 dead juvenile shad
6-July	2C gatewell slot	No fish removed
8-December	Unit 2 draft tube	4 adult catfish

Auxiliary Water Supply

The auxiliary water supply (AWS) pumps were operating or available for operation to help maintain fish entrance criteria in 2016, 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. 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.

Table 20. AWS pump outages and significant events requiring pumps to be shut off at Ice Harbor Dam in 2016.

Date	Pump Number or How Many Pumps Affected	Pump Outage Description or Reason for Turning Off	Results/Duration OOS
3 March	North shore pump #2	Replaced bad relay switch	Returned 14 March at 1605
18 April	South shore pump #1	Broken conduit	53 minutes-south shore
17 May	5 of 8 south shore pumps operating	High channel/tailwater head differential	Maintained criteria
14 June	3 south shore 1 north shore	Power loss at station service	South-12 minutes North-12 minutes
2 September	3 south shore	FSP #1 BUS #1 feeder trip	South-2 hours 34 minutes
21 November	5 south shore	Decrease water pressure to correct SFE-1 issue	South-40 minutes

Adult Fishway Inspections

Visual Inspections

Ice Harbor project fisheries personnel conducted visual inspections of the fish ladders during the adult fish passage season of March 1 to December 31. In addition, powerhouse operators conducted daily limited inspections of the fishways. Fish facility staff averaged 3 fishway inspections per week with 132 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, 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 as needed. 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 2016 inspection season.

Automated Fishway Control System

In the 2016 fish season, 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. 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 below criteria [criteria of 1.5-4.0 feet per second (fps)] on 100.0% of the inspections.

Ladder Exits

The north and south fish ladder exit head differentials were in criteria ($\leq$0.3 feet) during most inspections. The south fish ladder exit was in criteria 100.0% of the inspections, while the south fish ladder exit was in criteria 99.2% of the inspections.

The south and north shore picketed leads were installed on March 31 for the beginning of adult fish counting on April 1.

The south shore picketed leads were out of criteria on July 21 with a differential of 0.6 feet. The south shore picketed leads required frequent cleaning of accumulated vegetation every 3-7 hours to keep the differential in criteria until September. Due to staffing and time constraint, the location was periodically out of criteria in later September.

The south shore picketed leads were raised for the end of the fish counting season on November 1. The north shore picketed leads were raised when the power to the fish count slot barrier gate was restored on November 16.

Ladder Weirs

The depth over the stationary weirs at the south fish ladder weirs were in criteria (1.0-1.3 feet) during 98.5% of the fishway inspections and the depth over the north fish ladder weirs were in criteria during 96.2% of the inspections.

The depth over the weirs at the north fish ladder was out of criteria at 1.4 feet on September 12 and 13, and 1.5 feet on September 14. The stilling well for the water level sensing float at the upper diffuser was cleaned out on September 14 in an attempt to solve the problem.

Counting Stations

The differential across the south shore picketed leads was in criteria ($\leq$0.3 feet) on 99.2% if 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. The differential across the north shore picketed leads was in criteria on 100.0% of the inspections.

South Shore Entrance

The SFE-1 weir gate depth was in criteria ($\geq$ 8 feet or on sill) on 96.2% of inspections. The weir gate was in sill criteria on 43.2% of inspections, primarily when tailwater was lower from mid-summer to the end of the year.

The electricians calibrated the fishway entrance weir gate elevation readouts during the week of March 18.

The south shore entrance depth (SFE-1) depth were out of criteria on May 31, June 6, 8, 13, 14, 20, 21. The readings were believed to be calibration issues and the difficulty of obtaining elevation reading of the fluctuating tailwater levels caused by project spill.

The south shore entrance (SFE-1) depth were out of criteria on November 21, when the gate was raised 6’ off sill at 1230 hours for 30-40 minutes to fix alignment issues.

North Powerhouse Entrance

The NFE-2 weir gate depth was in criteria ($\geq$ 8 feet or on sill) on 91.6% of the inspections. The weir gate was on sill criteria for 47.0% of inspections.

The north powerhouse entrance (NFE) depth was out of criteria caused by entrance gate calibration problems on March 1 and March 2. On March 9, NFE was out of criteria for calibration problems. On March 21, electricians calibrated the fishway entrance gate elevation readouts.

The north powerhouse entrance (NFE-2) depth was out of criteria on April 5, 7, and 11. The criteria reading results were from NFE-2 were in manual control and fluctuating tailwater from spill making it difficult to get an accurate tailwater reading. The NFE-2 gate elevation readout on the selsyn was calibrated on April 12.

The north powerhouse entrance criteria continued to be out of criteria due to the manual control of the weir due to tailwater elevations on May 31, June 15, and 20.

The north powerhouse entrance (NFE-2) depth were out of criteria on September 26, October 4 and November 28. This was believed to be related to calibration issues. A calibration check of the fishways was done on October 5.

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 49.2% of inspections.

The north shore entrance (NSE-1) depth was out of criteria on May 31. The again on June 7 it was out of criteria. The criteria point was the result of the entrance gate being set in manual control at too high of an elevation.

The north shore entrance (NSE-1) depth was out of criteria on October 4, October 28, and November 28. The criteria points issues could have been related to human error with measurements or calibration issues.

On December 5, NSE-1 was out of criteria. The reading was reported to the operator and was due to calibration issues. The entrance gate was slightly off of sill when it was in automatic control. The entrance gate was switched to manual and the gate was lowered to sill. The calibration issue was reported to electricians.

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 96.2% of inspections.

North Powerhouse Entrance

The north powerhouse entrance head differential was in criteria (1-2 feet) on 98.5% of inspections.

North Shore Entrance

The north shore powerhouse entrance head differential was in criteria (1-2 feet) on 99.2% of inspections.

Table 21. Adult fishway inspection results at Ice Harbor Dam, 2016.

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	Not Enough Depth: No./% >0.2 Foot	Too Much Depth: No./% Within 0.01-0.1 Foot	Too Much Depth: No./% Within 0.11-0.2 Foot	Too Much Depth: No./% >0.2 Foot
Channel Velocities	132	100.0	***	***	***	***	***	***
	***	***	***	***	***	***	***	***
	132							
Differentials								
South Fish Ladder								
Ladder Exit	132	100.0	***	***	***	0	0	0
	***	***	***	***	***	0.0	0.0	0.0
	132							
Ladder Weirs	130	98.5	0	0	12	0	0	0
	***	***	0.0	0.0	9.1	0.0	0.0	0.0
	132							
Counting Station	131	99.2	***	***	***	0	0	1
	***	***	***	***	***	0.0	0.0	0.8
	132							
North Fish Ladder								
Ladder Exit	131	99.2	***	***	***	0	0	1
	***	***	***	***	***	0.0	0.0	0.8
	132							
Ladder Weirs	127	96.2	0	0	10	3	2	0
	***	***	0.0	0.0	7.6	2.3	1.5	0.0
	132							
Counting Station	132	100.0	***	***	***	0	0	0
	***	***	***	***	***	0.0	0.0	0.0
	132							
Collection Channels								
South Shore	127	96.2	0	0	10	0	0	5
	***	***	0.0	0.0	7.6	0.0	0.0	3.8
	132							
North Powerhouse	130	98.5	0	0	12	0	0	0
	***	***	0.0	0.0	9.1	0.0	0.0	0.0
	132							
North Shore	131	99.2	0	0	10	0	0	1
	***	***	0.0	0.0	7.6	0.0	0.0	0.8
	132							
Weir Depths								
SFE 1	70	53.0	0	2	1	***	***	***
	57	43.2	0.0	1.5	0.8	***	***	***
	132							
NFE 2	59	44.7	0	1	2	***	***	***
	62	47.0	0.0	0.8	1.5	***	***	***
	132							
NSE 1	61	46.2	15	19	13	***	***	***
	65	49.2	11.4	14.4	9.8	***	***	***
	132							

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.