2016 Annual Fishway Status Report for Bonneville Project

Bonneville Spillway, 1953

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1. INTRODUCTION

This 2016 Project Fisheries Annual Report for Bonneville Project summarizes activities occurring from **01 December 2015 through 30 November 2016** and is required by the Fish Passage Plan (FPP), per section 3.3.4.

The Project includes two powerhouses, a spillway and one operating navigation lock. There are four adult fish ladders for upstream migration, located at each powerhouse and the north and south ends of the spillway. There are three Juvenile Bypass Systems (JBS) for downstream migration: an Ice and Trash Sluiceway (ITS) at Powerhouse 1 (PH1), a downstream migration transportation channel (DSM) at Powerhouse Two (PH2), and the corner collector at PH2 (B2CC).

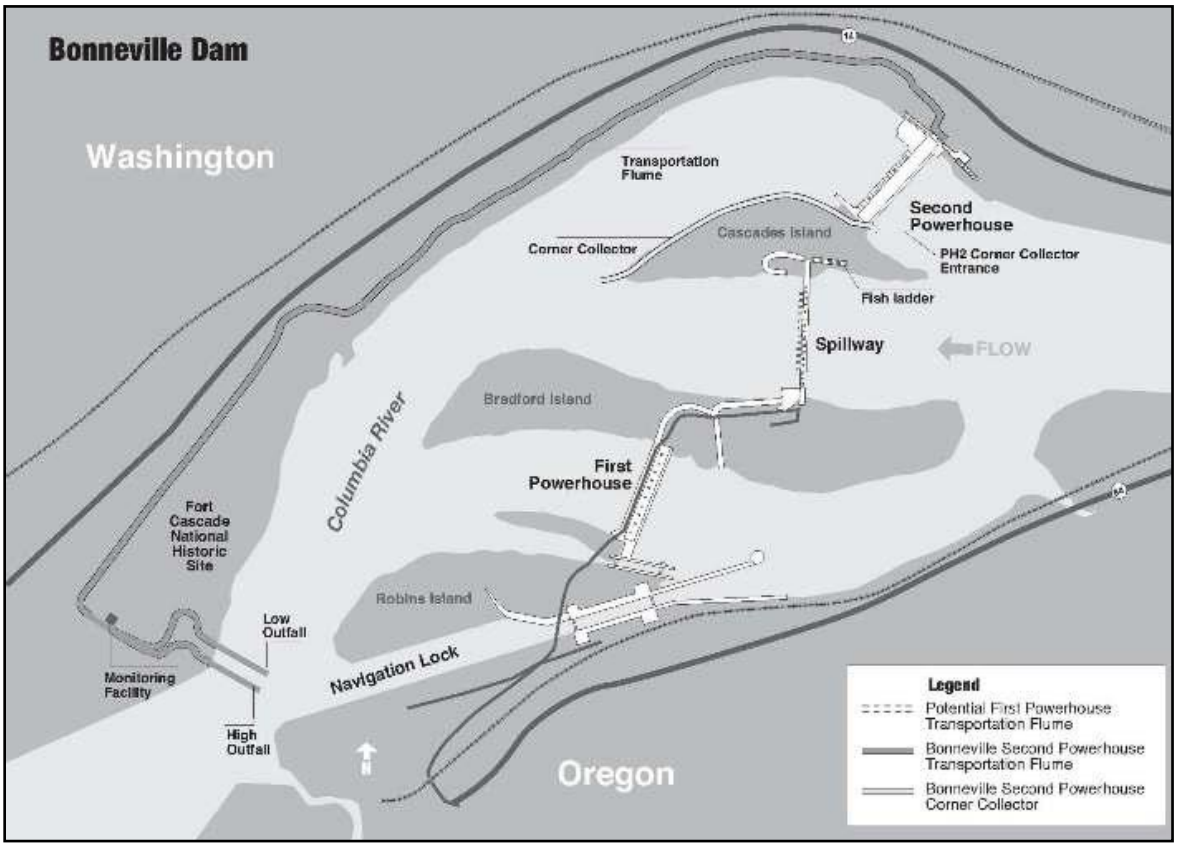

Figure 1. Bonneville Lock and Dam.

2. OPERATIONS

2.1 Fish Facility Outages

Table 1 shows the outage dates for Bonneville fishways, fish facilities, and lamprey passage structures.

Table 1. Seasonal fish facility outages.

Fish Facility	OOS Date 2015	In Service Date 2016	OOS Date 2016	Reason for Outage
BI Lamprey Passage Structure	29 Oct 15	05 Apr 16	27 Oct 16	Winter maintenance
CI Lamprey Passage Structure	30 Sep 15	08 Apr 16	27 Oct 16	Winter maintenance
WS Lamprey Passage Structure	29 Oct 15	05 Apr 16	27 Oct 16	Winter maintenance
NDE Lamprey Flume System	31 Aug 15	N/A	N/A	OOS for LFS hatch and air turbulence repairs
Bradford Island Ladder	08 Dec 15	25 Feb 16	N/A	Winter maintenance
A-branch Ladder	08 Dec 15	26 Feb 16	N/A	Winter maintenance
B-branch Ladder	08 Dec 15	27 Feb 16	N/A	Winter maintenance
Cascades Island ladder	N/A	N/A	N/A	Winter maintenance
UMT	N/A	N/A	28 Nov 16	Winter maintenance
WA Shore Ladder	N/A	N/A	28 Nov 16	Winter maintenance
DSM	23 Dec 15	14 Jan 16	TBD	Pipe inspection, maint.
B2CC	01 Sep 15	05 Mar 16	01 Sep 16	Opens with spill
AFF	03 Dec 15	06 Apr 16	01 Nov 16	Winter maintenance
SMF	30 Oct 15	01 Mar 16	31 Oct 16	Winter maintenance

2.2 Turbine Outages

Table 2 shows turbine outages that lasted longer than 24 hours. Note that turbine outages lasting less than 24 hours did occur but are not included for the sake of brevity. Lengthier unit outages at PH1 were due to main unit breaker replacement, at PH2 they were due to T11 and T12 outages.

Table 2. Turbine Outages of at least 24 hours.

Turbine Unit	Date Out	Date In	Reason for Outage
10	16 Nov 15	09 Feb 16	Annual maintenance, bank 9/10
9	17 Nov 15	11 Feb 16	5-year overhaul, bank 9/10
4	01 Feb 16	05 Feb 16	Replace turbine bearing pipe
7	22 Feb 16	---	Bank 7/8, annual maintenance, MU breaker replcmt

8	23 Feb 16	---	Bank 7/8, annual maintenance, MU breaker replcmt
12	24 Feb 16	25 Feb 16	Servo leak repair
17	29 Feb 16	24 Mar 16	Wicket gate seal replacement
3	17 Mar 16	18 Mar 16	Breaker cubicle measurements
4	17 Mar 16	18 Mar 16	Breaker cubicle measurements
12	19 Mar 16	22 Mar 16	North servo leak
12	04 Apr 16	04 May 16	Wicket gate seal replacement
1	11 Apr 16	12 Apr 16	Breaker cubicle measurements
2	11 Apr 16	12 Apr 16	Breaker cubicle measurements
5	14 Apr 16	15 Aug 16	Breaker cubicle measurements, 230 kV disconnect broken
6	14 Apr 16	10 Aug 16	Breaker cubicle measurements, 230 kV disconnect broken
15	09 May 16	11 May 16	Thrust bearing inspection
14	13 Jun 16	28 Jul 16	4-year overhaul, T11 outage
9	20 Jun 16	21 Jun 16	Upper guide drain line replacement
11	11 Jul 16	20 Jul 16	T11 outage
12	11 Jul 16	21 Jul 16	T11 outage
13	11 Jul 16	30 Aug 16	T11 outage, shaft alignment
15	01 Aug 16	05 Aug 16	EAL (Environ. acceptable lubricant) testing
2	15 Aug 16	18 Aug 16	Annual maintenance
3	22 Aug 16	25 Aug 16	Annual maintenance
1	29 Aug 16	01 Sep 16	Annual maintenance
15	06 Sep 16	17 Nov 16	T12 outage
18	06 Sep 16	17 Nov 16	T12 outage, 4-year overhaul
16	07 Sep 16	18 Nov 16	T12 outage
17	07 Sep 16	17 Nov 16	T12 outage
12	12 Sep 16	---	Exciter ground
1	19 Oct 16	20 Oct 16	Breaker racking
11	14 Nov 16	16 Nov 16	T11/T12 testing
13	14 Nov 16	16 Nov 16	T11/T12 testing
14	14 Nov 16	16 Nov 16	T11/T12 testing
11	20 Nov 16	23 Nov 16	LFS dive work
13-18	20 Nov 16	23 Nov 16	LFS dive work

2.3 Fish Removal

Fish passage facilities and turbine units are taken out of service and dewatered to allow for inspection, preventative maintenance, repairs, and modifications. As facilities and turbine units are dewatered, project biologists, outside agency personnel, and other project personnel follow procedures outlined in the FPP and detailed in the Fish Salvage Plan to minimize impacts on fish. Adult fish recovered are typically released into the forebay above the new navlock with the exception of sturgeon which are usually released below the dam at Hamilton Island. Juvenile salmonids are also released below the dam at Hamilton Island. The following is a summary of the number of fish that were removed during facility and turbine unit dewaterings. All fish were recovered in good condition unless otherwise noted.

Bradford Island fishways (12/8/15): ~19 salmonids, ~135 White Sturgeon, 1 Pacific Lamprey, ~50 resident

fish (Cyprinids, Catastomids, Clupeids).

Bradford Island junction pool (12/12/15): 5 Steelhead Trout.

B-branch diffuser pits (1/6/16): 12 Pacific Lamprey, 11 sculpin spp., 4 juvenile salmonids, numerous suckers and peamouth.

A-branch fishway (2/2/16): 1 Steelhead Trout.

Unit 10 tail logs (2/3/16): 1 White Sturgeon.

Unit 5 draft tube (6/7/16): ~20 Pacific Lamprey.

Unit 6 draft tube (6/8/16): ~45 Pacific Lamprey, 1 catfish, 1 sucker.

Unit 14 draft tube (6/14/16): 7 Pacific Lamprey, 1 catfish, 1 juvenile salmonid.

Unit 13 draft tube (7/18/16): 3 White Sturgeon, 3 catfish, 2 Pacific Lamprey

Unit 14 tail logs (7/20/16): ~30 sculpin spp., 4 Smallmouth Bass, 1 Pacific Lamprey

Unit 14 tail logs (8/3/16): 1 Smallmouth Bass

Unit 5 tail logs (8/09/16): ~20 sculpin spp., 12 crawfish

Unit 13 tail logs (8/29/16): 13 sculpin spp., 1 Pacific Lamprey macrophalmia, 1 Smallmouth Bass

Unit 18 draft tube (9/7/16): ~80 White Sturgeon, 6 Pacific Lamprey

Unit 15 draft tube (9/7/16): 1 White Sturgeon, 3 Pacific Lamprey

Unit 15 tail logs (10/25/16): ~15 crayfish, 12 sculpin spp., 1 Smallmouth Bass, 1 bluegill, 1 sucker

AFF (11/01/16): 3 adult salmonids, 2 White Sturgeon, 6 Pacific Lamprey, 1 sculpin spp, ~400 American Shad, ~100 resident fish (pikeminnow, suckers) and bass

Unit 18 tail logs (11/8/16): ~20 sculpin spp., ~6 Smallmouth Bass

WA shore to tailwater (11/28/16): ~20 Steelhead Trout, 4 Chinook Salmon adults, 1 White Sturgeon, ~50 Pacific Lamprey, ~400 suckers and minnows

PH2 South Monolith (11/30/16): ~ 6 sculpin spp.

UMT (11/30/16): ~6 Steelhead Trout, 4 adult salmon, ~300 suckers and minnows

WA shore to tailwater (12/1/16): 1 Pacific Lamprey, ~50 suckers and minnows

2.4 Fish Unit Outages

A list identifying every closure for fish units 1 and 2 is shown in Table 4. Throughout the year, the fish units are cleaned using a crane-operated trash rake during working hours. On weekends when personnel are unavailable to operate the trash rake, debris accumulation may occur to the point of causing excessive drawdowns (head differential as measured on either side of the trash rack), requiring the units to be floated to prevent potential trash rack or unit damage. During high debris loading, this may also occur overnight between daytime trash raking. When floating, the units may be placed in standby between the hours of 2200 and 0500

to minimize impact on adult fish passage. An adjacent unit is then operated to pull trash away from the fish unit trashracks.

Table 3. List of fish unit outages. Durations are for floating the units for debris unless specified otherwise. Total floating times do not include the highlighted events.

F1					F2				
OOS (Time/Date)		RTS (Time/Date)		Duration (HR:MM)	OOS (Time/Date)		RTS (Time/Date)		Duration (HR:MM)
1:04	11/29/15	3:43	11/29/15	2:39	12:34	11/29/15	14:04	11/29/15	1:30
12:34	11/29/15	14:07	11/29/15	1:33	23:20	11/29/15	2:33	11/30/15	3:13
23:20	11/29/15	2:31	11/30/15	3:11	16:30	11/30/15	2:05	12/1/15	9:35
16:34	11/30/15	2:04	12/1/15	9:30	18:57	12/1/15	21:16	12/1/15	2:19
19:33	12/1/15	21:13	12/1/15	1:40	18:52	12/2/15	21:02	12/2/15	2:10
18:52	12/2/15	21:01	12/2/15	2:09	9:30	12/3/15	13:42	12/3/15	4:12
9:32	12/3/15	13:40	12/3/15	4:08	16:45	12/3/15	18:38	12/3/15	1:53
17:03	12/3/15	18:39	12/3/15	1:36	20:41	12/3/15	3:02	12/4/15	6:21
20:41	12/3/15	3:02	12/4/15	6:21	4:18	12/4/15	6:00	12/4/15	1:42
4:18	12/4/15	6:01	12/4/15	1:43	8:12	12/4/15	8:46	12/4/15	0:34
8:12	12/4/15	8:48	12/4/15	0:36	13:35	12/4/15	14:14	12/4/15	0:39
18:54	12/4/15	20:17	12/4/15	1:23	22:17	12/4/15	4:27	12/5/15	6:10
22:17	12/4/15	4:20	12/5/15	6:03	23:28	12/7/15	3:10	12/8/15	3:42
23:29	12/7/15	3:13	12/8/15	3:44	0:05	12/9/15	2:58	12/9/15	2:53
0:04	12/9/15	2:58	12/9/15	2:54	18:53	12/9/15	21:05	12/9/15	2:12
18:52	12/9/15	21:03	12/9/15	2:11	15:25	12/10/15	18:14	12/10/15	2:49
15:40	12/10/15	22:11	12/10/15	6:31	6:20	12/11/15	9:01	12/11/15	2:41
6:56	12/11/15	8:50	12/11/15	1:54	19:08	12/11/15	1:09	12/12/15	6:01
4:47	12/12/15	7:57	12/12/15	3:10	0:01	12/15/15	17:00	2/17/16	2 yr overhaul
23:59	12/15/15	4:41	12/16/15	4:42	18:50	2/21/16	4:13	2/22/16	9:23
21:18	12/22/15	4:19	12/23/15	7:01	15:32	2/22/16	16:49	2/22/16	1:17
18:51	12/25/15	0:13	12/26/15	5:22	22:06	3/11/16	2:33	3/12/16	4:27
21:59	12/28/12	4:43	12/29/15	6:22	12:57	3/14/16	14:46	3/14/16	1:49
20:18	12/31/15	3:28	1/1/16	7:10	18:40	3/18/16	19:39	3/18/16	0:59
21:33	1/2/16	0:09	1/3/16	2:36	3:29	3/22/16	13:07	3/23/16	C5 diffuser work
0:03	1/5/16	3:01	1/5/16	2:58	22:18	4/17/16	3:58	4/18/16	5:40
22:00	1/14/16	3:57	1/15/16	5:57	20:31	10/24/16	12:00	10/25/16	15:29
8:30	2/16/16	10:40	2/16/16	2:10	18:48	11/18/16	0:06	11/19/16	5:18
22:10	2/21/16	0:01	2/22/16	1:51	12:05	11/20/16	22:54	11/22/16	LFS dive

0:09	3/12/16	2:25	3/12/16	2:16	3:00	11/25/16	---	---	Winter maint.
12:56	3/14/16	14:46	3/14/16	1:50					
3:32	3/22/16	13:07	3/23/16	C5 diffuser work					
0:04	4/18/16	3:57	4/18/16	3:53					
13:37	10/13/16	16:41	10/18/16	Flooded bearing					
20:31	10/24/16	12:00	10/25/16	15:29					
18:47	11/18/16	0:02	11/19/16	5:15					
12:04	11/20/16	22:11	11/22/16	LFS dive					
3:00	11/25/16	---	---	Winter maint.					
Total floating time (d:hr:min):				15:17:48	Total floating time (d:hr:min):				8:08:58

3. FISH PASSAGE PLAN COMPLIANCE

3.1 Fish Passage Plan Violations

Project Fisheries and the control room operators conduct inspections each day during fish passage season, and at least 3 days per week during winter maintenance. Project Biologists conducted 308 daily fishway inspections. Listed below are the FPP violations and the percentage of days the item was **in** criteria based on Project Biologist's inspections only (Table 4). Items in criteria 100% of the time are not listed. Explanations for items that were in criteria less than 90% of the reporting year, or having unusual circumstances, are given below.

Table 4. Fish Passage Plan violations and percent in criteria.

VIOLATIONS	***Occurrences***	***In Criteria (%)***
No inspections by Project Biologists	4 out of 312	97.1%
Calibration once a week	9	97.1%
PH1 Violations		
PH1 S differential	8	97.4%
PH1 N differential	1	99.7%
Gate Position: PH1 gate 1	1	99.7%
Depth over weir at A-branch	77	75.0%
A-branch diffusers	22	92.9%
Depth over weir at B-branch	2	99.4%
B branch entrance differential	2	99.4%
PH2 Violations		
Cascades Island diffusers	2	99.4%
Cascades Island entrance differential	5	98.4%
Depth over weir at UMT	7	97.7%
Head or depth: PH2 NUE	11	96.4%
Head or depth: PH2 NDE	14	95.5%
Head or depth: PH2 SUE	16	94.8%

Head or depth: PH2 SDE	19	93.8%
PH2 diffuser positions	254	17.5%
Depth over PH2 weir 37	51	83.4%
Depth over PH2 weir 38	27	91.2%
DSM channel elevation	1	99.7%

A-branch diffuser FG 3-3 experienced mechanical trouble in March 2016. The diffuser was set to the open position and unplugged to prevent further damage. It should be closed below tailwaters of 8.2' msl. Repairs are scheduled for the 2017/18 winter maintenance.

PH2 diffuser B5 had a badly deteriorated diffuser gate, which was removed to facilitate repairs and is therefore open. Diffuser A2 is stuck in the closed condition. Both diffusers are in the correct position when tailwater is between 12 and 13' msl. Repairs to these diffusers will occur during the 2016/17 winter maintenance period.

The water depth over the A-branch weir often reads 1.2', which is higher than the 1.1' maximum prescribed in the FPP. The cause is thought to be leakage from the FV3-7 conduit into the ladder near the staff gauge, as water frequently upwells between the gravel and concrete margin of the fishway in that vicinity. Repairs to the conduit are being planned for the winter of 2017/18.

Weir 37 in the WA shore ladder contains a water bleed-off valve that maintains water levels at that weir. The blow-off air supply for that valve had mechanical trouble which is believed to have caused the bleed-off valve to become clogged and no longer maintain correct water levels. Parts were ordered and the valve was repaired; however the valve is hitting its torque limits when opening and requires maintenance during the 2016/17 winter maintenance.

The times the PH2 fish entrances did not maintain entrance differentials was due to varying reasons, including the C5 diffuser grating work, low tailwater later in the year making operating both fish units problematic, and sensors needing calibration.

3.2 STS/VBS Inspections

Submersible traveling screens (STS) and vertical barrier screens (VBS) are typically inspected once a month. Each STS has a timer that automatically shows elapsed time of operation, with one month of continuous operation equaling 720 hours. Bonneville uses an underwater video camera to inspect STSs and VBSs, allowing inspection of the screens while they are installed and while the unit is running. PH2 STSs are generally installed in operational units from the end of February until December 15 for juvenile fish passage and for adult fallbacks. PH1 screens have been permanently removed.

STSs were briefly pulled from the 'A' and 'B' slots of units 16-18 during the T12 outage to allow FGE (fish guidance efficiency) plate installation. All STSs were removed for the winter maintenance period on 16 – 17 December prior to the DSM coming out of service, to allay concerns that fish would be directed into a gatewell with no means of egress. Unit 11 STSs remain installed as the unit was taken out of service; STSs will be removed before the unit is operated.

Table 5. STS and VBS inspections for 2016.

Unit	STS Install Dates	STS Removal Dates	STS and VBS Inspection Dates and Run Hours Between Inspections								
11	24 Feb 2016	--- (OOS)	4/4/16	5/2/16	6/6/16	7/5/16	8/3/16	9/12/16	10/4/16	11/14/16	12/6/16
			941	671	827	688	427	1030	478	1054	374
12	23 Feb 2016	16 Dec 2016	4/4/16	5/2/16	6/6/16	7/5/16	8/3/16	9/12/16	10/4/16	11/14/16	12/6/16
			870	3	789	670	210	384	35	14	OOS
13	23 Feb 2016	16 Dec 2016	4/4/16	5/2/16	6/6/16	7/5/16	8/3/16	9/12/16	10/4/16	11/14/16	12/6/16

			977	673	819	499	OOS	331	480	1033	274
14	23 Feb 2016	16 Dec 2016	4/4/16	5/2/16	6/6/16	7/5/16	8/3/16	9/12/16	10/4/16	11/14/16	12/6/16
			979	675	758	OOS	177	255	480	1033	222
15	24 Feb 2016	16 Dec 2016	4/4/16	5/2/16	6/6/16	7/5/16	8/3/16	9/12/16	10/4/16	11/14/16	12/6/16
			981	678	640	299	OOS	OOS	OOS	232	115
16	22 Feb 2016	16 Dec 2016	4/4/16	5/2/16	6/6/16	7/5/16	8/3/16	9/12/16	10/4/16	11/14/16	12/6/16
			999	667	622	159	94	OOS	27	OOS	82
17	22 Feb 2016	16 Dec 2016	4/4/16	5/2/16	6/6/16	7/5/16	8/3/16	9/12/16	10/4/16	11/14/16	12/6/16
			422	674	839	615	350	OOS	OOS	187	298
18	22 Feb 2016	17 Dec 2016	4/4/16	5/2/16	6/6/16	7/5/16	8/3/16	9/12/16	10/4/16	11/14/16	12/6/16
			1002	674	841	698	645	OOS	OOS	851	326

3.3 Avian Abatement Measures

USDA Wildlife Service's avian hazing occurred from April through July 2016. This was done from the tailrace side of the powerhouses, the spillway, and the shoreline.

3.4 Fish Counts

The Corps of Engineers contracted with Normandeau Associates, Inc. for all fish counting during the 2015-2016 fish passage season. The fish count season is year round with visual counts from March until December and video counts during the rest of the year. All fish count numbers may be found at Fish Counts and Reports.

4. WATER QUALITY MONITORING

4.1 Zebra/Quagga Mussels

Through monthly inspections of the monitoring station at PH1 and of all dewatered fishways, no indication of zebra or quagga mussel colonization was found. It is widely believed that their arrival is inevitable. The Project stays involved in regional preparation for zebra/quagga mussel arrival by sending project personnel to training and seminars to stay abreast of the latest information concerning these invasive species. Monitoring will continue with hopes that control programs can be initiated at the first indication of the mussel's arrival in the Pacific Northwest.

4.2 Fishway Temperature Monitoring

Project biologists monitor fishway temperatures throughout the fish passage season, from March through November. Temperature probes are installed in the upper Bradford Island and WA shore fishways, the Adult Fish Facility (AFF), and the Juvenile Monitoring Facility (JMF). Probes are also installed in rest boxes of all four lamprey passage structures (LPS), which are located at Bradford Island, Cascades Island, the Washington shore auxiliary water supply channel, and at the PH2 north downstream entrance (NDE). Additionally, the Technical Management Team (TMT) tracks BON forebay temperature on their website. The TMT temperature is publically accessible real-time, and is the standard utilized per the FPP to determine when high-temperature fish sampling restrictions are operative in BON facilities. In 2016, these temperatures were available from 16 March - 13 September. Detailed daily temperatures can be found in the weekly reports and are available upon request.

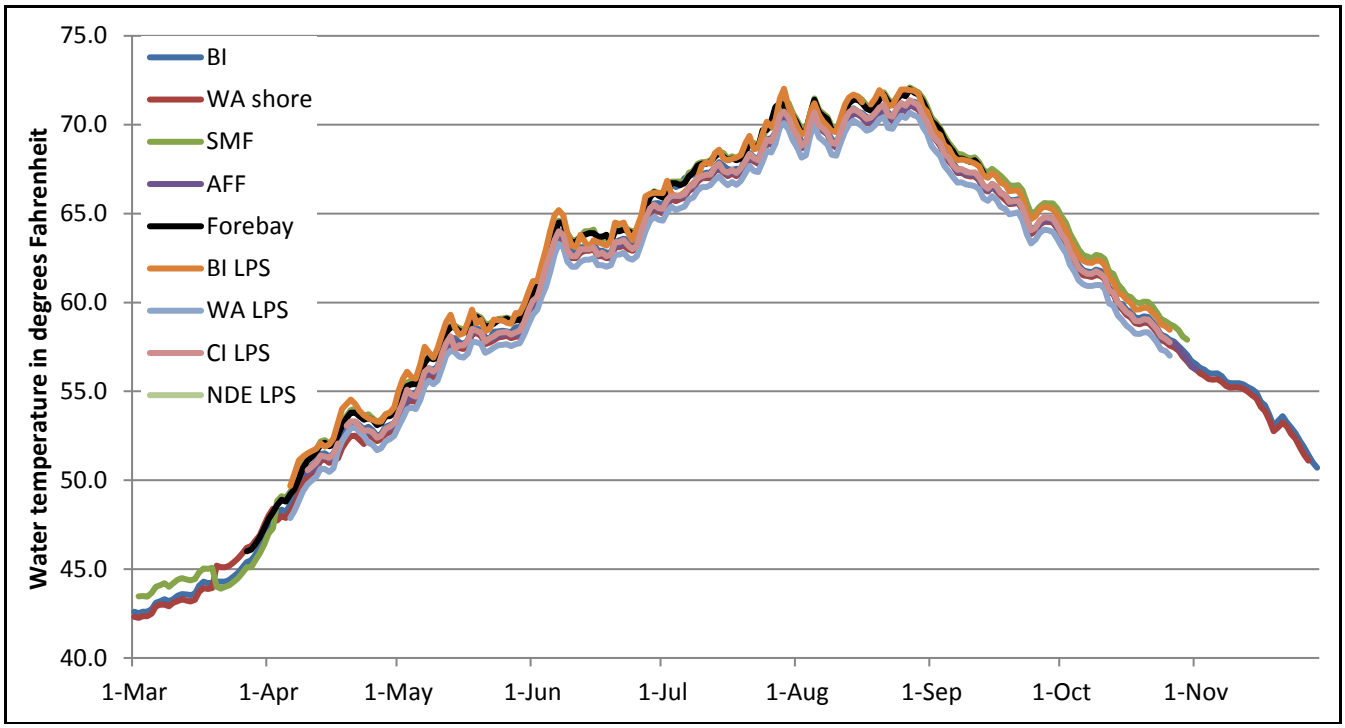

Figure 2. 2016 Bonneville temperatures.

5. FISHWAY MODIFICATIONS (1996 - present)

POWERHOUSE ONE ADULT

2012. Replaced PIT tag antenna in Bradford Island serpentine section.
2012. Dredged along the exit channel for the Bradford Island fish ladder.
2011. Repaired erosion cavities under the B-branch ladder of Bradford Island.
2006-present. Sea lion exclusion devices (SLEDs) are installed at the fishway entrances to prevent sea lion access to the fish ladder.
2005/06. Bulkheads were installed in the orifice gate and telescoping gate slots. Gates were removed along with the associated electronic and mechanical equipment.
2005/06. Passive Integrated Transponder (PIT) tag detectors installed in four serpentine weirs in the Bradford Island fishway.
2004-present.Utilize ROVs for fishway inspections instead of divers.
2003/04. Installed new electronic velocity meter at the north end of the PH1CC. No longer used.
2002/03. PH1CC orifice gates and telescoping gates are closed and disabled. Studies indicated more fish exited these gates than entered. Weir gates were left in service.
2001/02. Extra orifices in the overflow weirs were filled with concrete.
2000/01. PIT tag detectors installed in four orifice weirs in A-branch and four orifice weirs in B-branch.
1998/99. FG3-10 through 17 disabled and filled with concrete. FG3-14 (at the junction pool) covered with metal plates instead of concrete.

POWERHOUSE ONE JUVENILE

2013/14. ITS gate removed for repairs, gate slot plated for fish passage during removal.
2012/13. Spillway erosion hole and ogee repair.
2010/11. Welded elevation indicators on chain gates 3B, 6C, and 10B.
2010. PH1 JBS outfall pipe removed.

2009/10. Removal of the wall separating the Powerhouse 1 downstream migrant channel (DSM1) from the ITS completed to improve surface passage at PH1. The floor was raised and sloped.
2009. All remaining PH1 screens scrapped.
2008/09. ITS automated chaingates installed in 3B, 6C, and 10B.
2004-2007. The Powerhouse 1 downstream migrant channel (DSM1) is disabled as a juvenile bypass route. Screens are not installed during fish passage season except from 15 September until 15 December for adult fallback. DSM1 runs south during this time.
2001-2003. Unit 8 extended submerged bar screens were deemed undesirable and replaced with standard STSs.
2001-present. The 2000 Biological Opinion (BiOp) required the removal of impediments to fish passage from the turbine environments. Removal and replacement of excess metal, with fish friendly alternatives, occurs as units go out of service for rehab.
2000-2010. Turbine rehab involves installing minimum gap runners on all PH1 main units.

POWERHOUSE ONE LAMPREY
2015/16. Modified Bradford crowder station to reduce lamprey mortality due to crowder run-over and those dying in area behind crowder. Perf plate in count slot, skirt in bottom of crowder, plating on sides of crowder.
2013/14. Lamprey passage structure pumps relocated from forebay location to within the AWS to minimize debris buildup. Fry criteria screens placed on lamprey pumps.
2012. Picket lead modifications to insure one inch spacing between leads and sill plate and prevent lead bending. Spacers installed.
2011. Lamprey count improvements including video verification network at exit flume.
2011. Picket lead spacers for lamprey passage removed on 29 June.
2011. One inch picket lead spacers installed on 24 May to allow lamprey passage under leads.
2005/06. PIT tag detection and expanded lamprey ramp installed in the Bradford Island FV3-9 AWS channel.
2003/04. Lamprey ramp installed in the Bradford Island FV3-9 AWS channel.

CASCADES ISLAND FISHWAY/ UMT
2004-present. Utilize ROVs for fishway inspections instead of divers.
2004/05. UMT fish count window crowder and window cleaner removed.
2001/02. New diffuser covers built and installed.
2000/01. More PIT tag detectors installed in four orifice weirs.
1999/00. FG6-1 through 4 filled in with concrete.
1998/99. PIT tag detectors installed in four orifice weirs.
1996-2000. The UMT drain is blind flanged and no longer used.

CASCADES ISLAND LAMPREY
2014/15. Picket lead spacing reduced and side gaps amended to block lamprey access to the AWS and ladder exit area above the lower pickets.
2012/13. Lamprey passage system extension into the forebay and conversion to volitional passage system.
2008/09. Lamprey ramp and bollards installed in CI entrance pool. Variable width entrance weir installed in May.
2005/06. Half duplex PIT tag detectors were installed along the picket leads to track lamprey.

POWERHOUSE TWO ADULT
2016/17. Flow control plates installed in 'A' and 'B' gatewells of all PH2 units, plating on upper sections of VBSs.
2013-2015. Modifications to the AFF to improve water velocity and sampling conditions.
2013. Replaced PIT antenna in WA Shore ladder serpentine section.
2013. Forebay dredging in front of the Fish Unit intakes.
2012/13. Repairs to the gates and guides on B-valves 3 and 4.
2012. Debris removal from the AWS and accompanying diffusers.
2011. SA-24 board replaced with new PH2 Collection Channel Fishway PLC.
2011. Reattached blown off diffuser grating in ladder at North Monolith and debris removal from AWS and accompanying diffusers.
2010/11. AFF sample flume modified to accommodate an auxiliary sample tank used by WDFW. CRITFC obtained and installed a new, larger sample tank complete with a PIT tag detector at the entrance to the tank.
2008/09. Picket leads installed perpendicular to existing AFF picket leads. Not used after 2009 sample season.
2007/08. Manufactured new FOG SLEDs.

2006/07. Installed new staff gauges in the monoliths.
2006/07. AFF lamprey orifice gate removed due to pulley failure resulting in salmon passage blockage and dewatering difficulties.
2005-present. SLEDs installed at fishway entrances to prevent sea lion access to the fish ladders.
2005/06. AFF count window crowder removed due to structural failure.
2004-present. Utilize ROVs for fishway inspections instead of divers.
2004/05. Repaired the AWS conduit.
2004/05. Installed new velocity meter at South Upstream Entrance (SUE).
2004/05. PIT tag detectors installed in four serpentine weirs.
2004/05. AFF brail pool modifications made. The brail pool is now the primary recovery pool.
2003/04. AFF electrical upgrades complete.
2003/04. Picket leads for the triangle section were removed.
2002/03. Removed old metal staff gauge frames from monolith entrances.
2001/02. PIT tag detectors installed in eight orifice weirs, four upstream and four downstream of the AFF.
1999/00. AFF exit ladder equipped with orifice PIT tag detectors.

POWERHOUSE TWO JUVENILE
2014. Testing of a flow control plate in Unit 15 A slot.
2013. Gantry 7 rehabilitation.
2013. Turbulence Reduction Device (TRD) testing in Unit 14 A slot.
2013. Alarm installed on the 2-way rotating gate at the SMF.
2012. B2CC bulkhead converted to permanent hoist with automatic control.
2012. B2CC joint repair to fix spalling and decrease channel roughness.
2008/09. Release pipe attached to JMF outfall pipe for juveniles trucked from Walla Walla District.
2007/08. Behavioral Guidance Structure (BGS) installed in PH2 forebay. Removed in December 2010.
2007/08. PH2 Downstream Migrant transportation channel (DSM2) LED lights returned to halogen lights due to the unknown effects of LEDs.
2007/08. Units 14 and 18 are modified for new VBSs and improved FGE.
2006/07. New LED lights replace the halogen lights. The LED lights are cooler and will last years longer than the halogens. These lights were salvaged from DSM1.
2006/07. Units 11, 15, 16 are modified for new VBSs and improved FGE.
2005/06. B2CC PIT tag antenna installed.
2005/06. SMF full flow PIT tag antenna installed.
2005/06. Units 12 and 13 modified for new VBSs and improved Fish Guidance Efficiency (FGE).
2004/05. VBS modifications for Unit 17 result in screen failure. The design for the new VBSs is re-examined and redrawn.
2004/05. SMF Outfall hydrocannon piping is replaced.
2004/05. B2CC complete and online.
2003/04. Unit 17 VBSs and gatewells are modified to improve FGE. Modifications include gap closure devices on the STSs and modified VBSs.
2002/03. NOAA Fisheries fyke net frame is removed from the tailrace.
2002/03. Unit 15 gatewells are partially modified to improve FGE. Modifications include gap closure devices on the STSs.
2002/03. Biologists noticed places of ovality while inspecting the two mile pipe. The pipe has been monitored regularly to document potential changes.
2002-present. The 2000 BiOp required the removal of impediments to fish passage from the turbine environments. Removal and replacement of excess metal, with fish friendly alternatives, occurs as units come out of service for maintenance.
2001/02. Raised the DSM2 walkway grating to prevent fish from impacting it.
2001/02. Modified the DSM2 add-in screen to vertical bars to allow juveniles to move out of the add-in water and into the channel. The bars didn't reach the walkway so a perforated plate was added later in the season to prevent adults from jumping into the add-in section.
2001/02. Flume covers were added over the switch gates. This was to encourage fish to stay in the main channel and not seek shade by swimming under the switch gates.
2000/01. Saltwater rearing moved into the SMF.
2000/01. Modifications were made to the primary dewatering structure drain pipe to divert more water into the

wetlands. This reduced the flow fluctuations and air bubbles under the perforated plate in the primary dewatering structure.
1998-2000. SMF construction completed. The facility goes online.

POWERHOUSE TWO LAMPREY
2016/17. Removed lamprey plating in N entrance area, replaced with orifice plates. AWS LPS extensions and new pump system. Orifice slots drilled in lower serpentine weir walls; trial rest boxes installed.
2016. LFS repairs. Divers replaced missing hatch, hydraulic air entrainment 'dampener' installed.
2013. Lamprey refuge boxes installed in the WA Shore ladder, near the UMT confluence.
2012/13. Construction of Lamprey Flume System and associated LPS at NDE on the north monolith.
2012/13. Picket lead modifications to insure 1 ½ inch spacing between leads and sill plate and prevent lead bending. Spacers installed.
2011. Picket lead spacers for lamprey passage removed on 29 June.
2010/11. NOAA installed a picket lead sill ramp to ease the transition from the ladder into the AWS. NOAA also installed ¾ inch crowder picket leads at the count station.
2010. One inch picket lead spacers installed on 25 May for lamprey passage under leads.
2007/08. Lamprey ramp installed in the Washington Shore FV6-9 AWS channel.
2004/05. Lamprey ramp installed at North Downstream Entrance (NDE).
2000/01. Lamprey plates are installed over the Washington Shore diffuser grates.

BASS LAKE
2006. The leaking drain is repaired. The lake holds water and Coho are seen spawning in the outlet (Moffett Creek) of Bass Lake. The salvaged logs create log jams over the sink hole.
2004. Salvaged logs are placed in Bass Lake to provide habitat.

GLOSSARY

AFF---------- Adult Fish Facility. Lab associated with the Washington Shore ladder. Adult fish are trapped for research purposes.
AWS---------- Auxiliary Water Supply.
B2CC---------- Powerhouse Two Corner Collector. A surface bypass system located in the southern corner of the Bonneville Second Powerhouse forebay.
BI---------- Bradford Island Fishway.
BiOp---------- Biological Opinion.
BPA---------- Bonneville Power Association.
CI-- ---------- Cascades Island Fishway.
Collection Channel(CC) Part of the adult fishway spanning the length of the downstream side of each powerhouse.
DSM2 ---------- Downstream Migrant transportation channel (PH2). Transport channel for juvenile fish from gatewell orifices to the juvenile transport pipe.
FG ---------- Fish diffusion gate.
FGE---------- Fish Guidance Efficiency.
FOG ---------- Floating Orifice Gate.
Forebay---------- That area of a reservoir immediately upstream of a dam.
FPOM---------- Fish Passage Operations and Maintenance Coordination Team
FPP---------- Fish Passage Plan.
FV---------- Fish Valve.
ITS---------- Ice and Trash Sluiceway.
JBS---------- Juvenile Bypass System.
JMF---------- Juvenile Monitoring Facility. Lab associated with the PH2 JBS.
LFS---------- Lamprey Flume System.
NDE----- ---------- North Downstream Entrance. Refers to one of the four large overflow weir adult fishway entrances at PH2.
NUE ---------- North Upstream Entrance. See NDE.
NOAA ---------- National Oceanic and Atmospheric Administration.
OOS---------- Out of Service.
PH1---------- Bonneville Powerhouse One.
PH2---------- Bonneville Powerhouse Two.
PIT ------ ---------- Passive Integrated Transponder. A tag inserted into juvenile and adult fish. Detectors are installed at all fish passage systems.
Project ---------- Bonneville Lock & Dam.
ROV---------- Remotely Operated Vehicle.
SDE ---------- South Downstream Entrance. See NDE.
SLED---------- Sea Lion Exclusion Device
SUE ---------- South Upstream Entrance. See NDE.
STS---------- Submersible Traveling Screen.
Tailrace---------- The portion of a river immediately downstream of a dam or powerhouse.
TDG---------- Total dissolved gas.
UMT----- ---------- Upstream Migrant Transportation channel. This channel connects Cascades Island ladder to Washington Shore ladder through PH2.
VBS ---------- Vertical Barrier Screen.
WDFW---------- Washington Department of Fish & Wildlife.

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