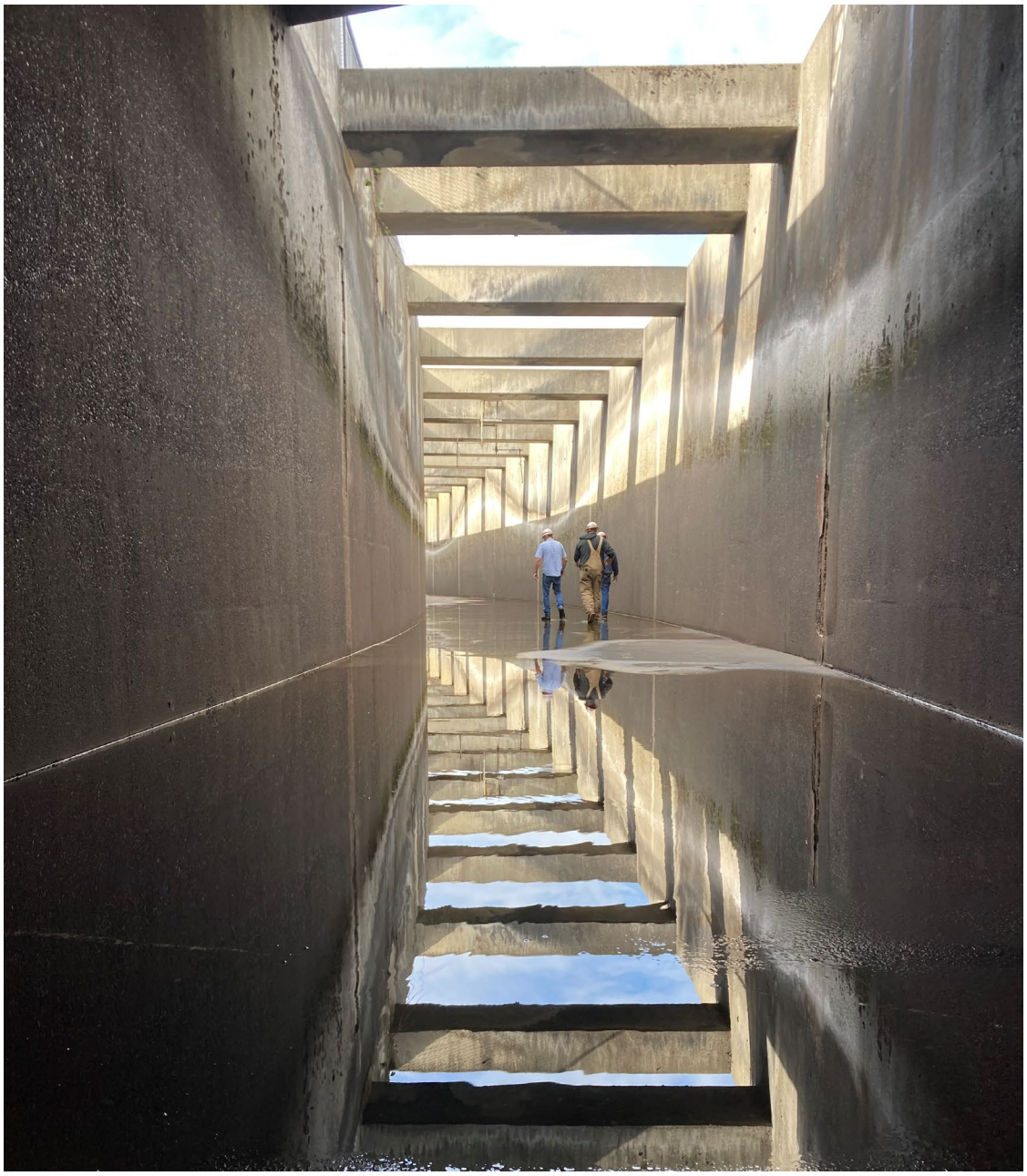
2021 Annual Fishway Status Report for Bonneville Project



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Glossary

AFF ---------- Adult Fish Facility. Research lab associated with the Washington Shore ladder.
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.
BIWW ---------- Bradford Island Wetted Wall.
BiOp ---------- Biological Opinion.
BPA ---------- Bonneville Power Association.
CI---------- Cascades Island Fishway.
CC---------- Collection Channel - Part of the adult fishway spanning the length of the downstream side of each powerhouse.
CPUE ----------Catch Per Unit Effort. Also known as catch rate.
DSM2---------- Downstream Migrant transportation channel (PH2). Transport channel for juvenile fish from gatewell orifices to the juvenile transport pipe.
FDX---------- Full-duplex Pit detection; smaller and faster tag that can receive and transmit simultaneously.
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.
FO ----------Forced Outage, not planned or coordinated with the FPP.
FU ---------- Fish Unit. Provides auxiliary water to PH2 entrance diffusers.
FV ---------- Fish Valve.
HDX ---------- Half-duplex Pit detection; larger & slower tag that transmits then receives.
ITS ---------- Ice and Trash Sluiceway.
IWW ---------- In water work period (01-December through 28-February).
JBS ---------- Juvenile Bypass System.
JMF ---------- Juvenile Monitoring Facility. Lab associated with the PH2 JBS.
LFS---------- Lamprey Flume System.
MU ---------- Main Unit. PH1 turbine units 1-10, PH2 units 11-18.
MUB ---------- Main Unit Breaker
NA ----------Not available
NDE----------North Downstream Entrance. Overflow weir adult fishway entrances at PH2.
NUE---------- North Upstream Entrance. See NDE.
NOAA ---------- National Oceanic and Atmospheric Administration.
OOS---------- Out of Service.
OWS ----------Oil Water Separator.
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.
PO ---------- Planned Outage
ROV---------- Remotely Operated Vehicle.
RS ----------Reserve Status; A unit in reserve status is available and running, but not currently generating power.
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.

1. INTRODUCTION

1.1 Introduction

This **2021** Project Fisheries Annual Report for Bonneville Project summarizes activities occurring from **01 December 2020 through 30 November 2021** and is required by the Fish Passage Plan (FPP), per **FPP section 2.5.2.3.**

The Project includes two powerhouses, a spillway, and one operating navigation lock. There are four adult fish ladders, located at each powerhouse and the north and south ends of the spillway for upstream migration. 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**).

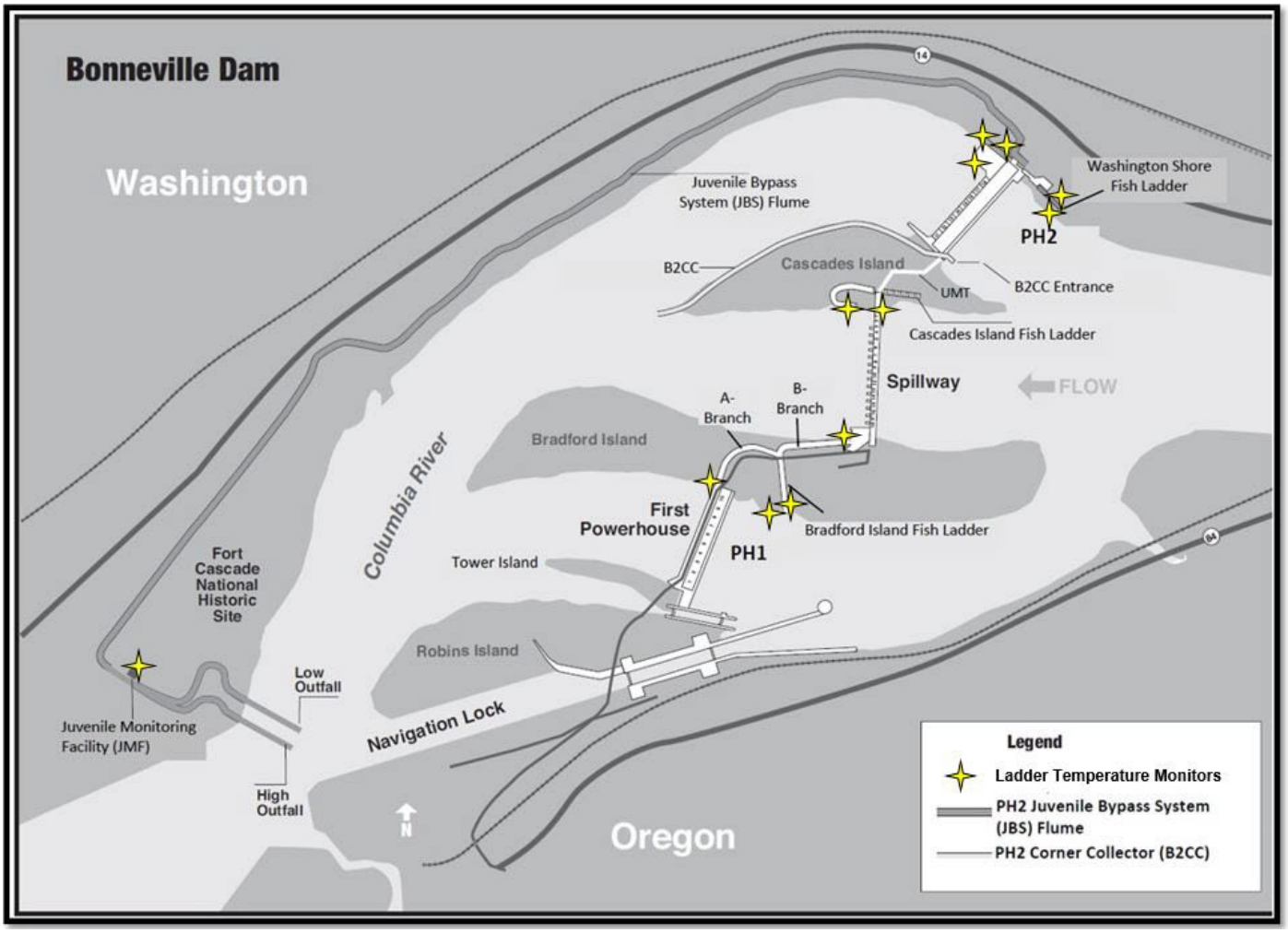

Figure 1. Bonneville Lock and Dam. Image obtained from FPP (2021).

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 2020	IN SERVICE DATE 2021	OOS DATE 2021	REASON FOR OUTAGE
BI LADDER	NA	NA	NA	NA
A-BRANCH	NA	NA	NA	NA
B-BRANCH	NA	NA	NA	NA
CI LADDER	01-Dec	25-Feb	NA	Winter Maintenance
WA SHORE LADDER	01-Dec	25-Feb	NA	Winter Maintenance
UMT	01-Dec	25-Feb	NA	Winter Maintenance
BI LPS	02-Nov	06-Apr	01-Nov	Winter Maintenance
CI LPS	02-Nov	06-Apr	01-Nov	Winter Maintenance
WA AWS LPS	02-Nov	11-May	01-Nov	Winter Maintenance
NDE LFS/LPS	14-Sept 2019	09-June	09-Sept	Low CPUE (seasonal)
AFF LAMPREY TRAP	03-Sept	09-June	09-Sept	Low CPUE (seasonal)
CI LAMPREY TRAP	16-Sept	09-June	09-Sept	Low CPUE (seasonal)
BI WETTED WALL	NA	NA	NA	NA
B2CC	1-Sept	26-Mar	1-Sept	Winter Maintenance
DSM	17-Dec	19-Feb	NA	Winter Maintenance
AFF	25-Nov	16-Apr	NA	Winter Maintenance
SMF	31-Oct	02-Mar	31-Oct	Winter Maintenance

2.2 Turbine Outages

Table 2 shows turbine outages that lasted 24 hours or longer. Note that turbine outages lasting less than 24 hours did occur but are not included for the sake of brevity.

Table 2. Turbine Outages Lasting Greater Than 24 Hours.

UNIT	OOS DATE	RTS DATE	DURATION	REASON
1	0700 on 30 Nov	1057 on 26 Jan	57 days, 3 hours, 57 mins	Station Service Work
2	0700 on 30 Nov	1116 on 26 Jan	57 days, 4 hours, 16 mins	Station Service Work
18	1250 on 30 Nov	0956 on 11 Mar	100 days, 21 hours, 65 mins	P.O., 4 Yr Overhaul
0	0900 on 04 Jan	1356 on 05 Jan	1 day, 4 hrs, 56 mins	Brush Rigging
11	0000 on 01 Feb	1832 on 04 Feb	3 days, 18 hours, 32 mins	P.O., Annual Overhaul
13	1003 on 23 Feb	1506 on 25 Mar	30 days, 5 hours, 3 mins	P.O., STS Install/ F.O. Due to Oil Leak and Spill on Start Up
15	1312 on 01 Mar	1943 on 19 Apr	49 days, 6 hours, 31 mins	P.O., FGE Work
16	0701 on 15 Mar	1427 on 06 May	52 days, 7 hours, 26 mins	P.O., 4 Yr Overhaul
10	0007 on 12 Apr	1658 on 25 June	74 days, 16 hours, 51 mins	P.O., Annual Overhaul
9	1000 on 12 Apr	1658 on 25 June	74 days, 6 hours, 58 mins	P.O., 5 Year Overhaul
8	1000 on 12 Apr	1535 on 27 May	45 days, 5 hours, 35 mins	P.O., Station Service Work
7	1000 on 12 Apr	1535 on 27 May	45 days, 5 hours, 35 mins	P.O., Station Service Work
17	0001 on 26 Apr	1758 on 29 Apr	3 days, 17 hours, 57 mins	P.O., Annual Overhaul/QTCI
14	0001 on 10 May	1744 on 13 May	3 days, 17 hours, 43 mins	P.O., Annual QTCI
13	0001 on 17 May	1648 on 18 May	1 day, 16 hours, 47 mins	P.O., QTCI/Troubleshoot Metering Issues
12	0006 on 24 May	1729 on 27 May	3 days, 17 hours, 23 mins	P.O., Annual Overhaul
5	0936 on 24 May	1613 on 25 May	1 day, 6 hours, 37 mins	F.O., BPA Disc Fail/Urgent Outage Line 2
6	0936 on 24 May	1613 on 25 May	1 day, 6 hours, 37 mins	F.O., BPA Disc Fail/Urgent Outage Line 2
14	1858 on 29 May	1000 on 02 June	3 days, 15 hours, 2 mins	F.O., STS Motor Failure
15	0016 on 05 June	1600 on 07 June	2 days, 16 hours, 28 mins	F.O., STS Motor Failure
15	2100 on 13 June	1145 on 17 June	3 days, 14 hours, 45 mins	P.O., Annual Overhaul/QTCI
5	0911 on 14 June	1432 on 12 Aug	59 days, 5 hours, 21 mins	P.O., 5 Year Overhaul/PT Install/Transformer Maint.

1	1528 on 27 June	0900 on 02 July	4 days, 17 hours, 32 mins	F.O., BPA Request for 115 kV Support
10	0900 on 29 June	0900 on 02 July	3 days, 0 hours	F.O., BPA Request for 115 kV Support
6	0003 on 12 July	1453 on 12 Aug	31 days, 14 hours, 50 mins	P.O., Annual Overhaul/PT Install/Transformer Maint
9	0624 on 12 July	1104 on 27 July	15 days, 4 hours, 40 mins	P.O., 115 kV Switchayard Maint
7	0653 on 12 July	1857 on 05 Aug	24 days, 12 hours, 4 mins	P.O., 115 kV Roof Disconnect Maint/Transformer Maint/Annual Overhaul
8	0653 on 12 July	1857 on 05 Aug	24 days, 12 hours, 4 mins	P.O., 115 kV Roof Disconnect Maint/Transformer Maint/Annual Overhaul
17	2202 on 27 July	1119 on 29 July	1 day, 13 hours, 17 mins	F.O., PLC Issue/Break Status
2	0012 on 09 Aug	0213 on 01 Sept	23 days, 2 hours, 1 min	P.O., Annual Overhaul
1	0630 on 09 Aug	2008 on 17 Aug	8 days, 13 hours, 38 mins	P.O., BPA Work
9	0630 on 09 Aug	1006 on 19 Aug	10 days, 3 hours, 36 mins	P.O., BPA Work
10	0630 on 09 Aug	2008 on 17 Aug	8 days, 13 hours, 38 mins	P.O., BPA Work
13	0112 on 10 Aug	1542 on 13 Aug	3 days, 14 hours, 30 mins	P.O., QTCI
3	0850 on 11 Aug	1511 on 13 Aug	2 days, 6 hours, 21 mins	P.O., ZM 234 Maint
4	0850 on 11 Aug	1511 on 13 Aug	2 days, 6 hours, 21 mins	P.O., ZM 234 Maint
3	0006 on 07 Sept	1137 on 08 Dec	92 days, 11 hours, 31 mins	P.O., Annual Overhaul/PT Install
4	0006 on 07 Sept	1154 on 08 Dec	92 days, 11 hours, 48 mins	P.O., Annual Overhaul/PT Install
8	1445 on 08 Sept	1700 on 14 Sept	6 days, 2 hours, 15 mins	F.O., Cooling Water Discharge Valve Failed
5	0755 on 27 Sept	1320 on 01 Oct	4 days, 5 hours, 25 mins	P.O., BPA Work; Line Metering CT's
6	0755 on 27 Sept	1320 on 01 Oct	4 days, 5 hours, 25 mins	P.O., BPA Work; Line Metering CT's
7	0755 on 27 Sept	1320 on 01 Oct	4 days, 5 hours, 25 mins	P.O., BPA Work; Line Metering CT's
8	0755 on 27 Sept	1320 on 01 Oct	4 days, 5 hours, 25 mins	P.O., BPA Work; Line Metering CT's
5	0839 on 04 Oct	1407 on 01 Nov	28 days, 5 hours, 28 mins	P.O., BPA Work
6	0839 on 04 Oct	1407 on 01 Nov	28 days, 5 hours, 28 mins	P.O., BPA Work
7	0839 on 04 Oct	1407 on 01 Nov	28 days, 5 hours, 28 mins	P.O., BPA Work
8	0839 on 04 Oct	1407 on 01 Nov	28 days, 5 hours, 28 mins	P.O., BPA Work

13	1428 on 04 Nov	1302 on 09 Nov	4 days, 22 hours, 34 mins	F.O., Gov Sight Glass Leak
6	1604 on 09 Nov	1507 on 01 Dec	21 days, 23 hours, 3 mins	F.O., Oil in Tail Logs; Investigation in Progress
11	1459 on 17 Nov	1531 on 18 Nov	1 day, 0 hours, 32 mins	F.O., STS Oil Leak in "A" Slot

Definitions: Planned Outage (P.O.) and Forced Outage (F.O.)

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 follow procedures outlined in the FPP and detailed in the Fish Salvage Plan to minimize impacts on fish. Adult salmonids and adult lamprey are generally released into the forebay above the new navigation lock. Juvenile salmonids, juvenile lamprey, and sturgeon are generally released below the dam at the Hamilton Island boat ramp. **Table 3** 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.

Table 3. Fish Salvages at Bonneville December 2020 – November 2021.

DATE	LOCATION	FISH SALVAGED	RELEASE SITE
12/1/2020	U18 Draft Tube	No Fish	N/A
12/2/2020	Cascades Island Fish Ladder	1 adult salmonid, 12 juvenile salmonids, 2 sculpin, 5 smallmouth bass	Above Nav Lock
12/2/2020	UMT	10 adult salmonids, 20 juvenile salmonids, mix bag of ~ 200 suckers, peamouth, and smallmouth bass	Above Nav Lock, except 1 tank of predominantly juvenile salmonids released at Hamilton Island Boat Launch
12/2/2020	CI FV 5-3/5-4 Screen Pit	1 juvenile salmonid, 20 juvenile shad	Forebay
12/3/2020	Washington Shore Fish Ladder	~100 adult salmonids (3 adult chum), 30 juvenile salmonids, mix bag of ~200 other species including peamouth, pikeminnow, sucker, sculpin, and smallmouth bass	Above Nav Lock
12/7/2020	CI Ladder Down to Tailwater	6 adult lamprey, 2 sculpin, 1 jack coho	Above Nav Lock
12/7/2020	Washington Shore Fish Ladder (Serpentine Weirs Fished for a Second Time)	1 jack salmonid, 4 juvenile salmonids, 2 smallmouth bass, ~150 other fish including suckers, pikeminnow, and peamouth	Above Nav Lock
12/8/2020	CI Diffuser Pits FG6-5,6, 7	5 juvenile salmonids, 10 adult lamprey, 8 juvenile lamprey, 10 bullhead, 5 smallmouth bass, 7 sunfish, and a mix of 25 suckers, peamouth, and stickleback	Above Nav Lock
12/10/2020	WA Shore Collection Channel	3 adult steelhead, ~20 shad, 1 smallmouth bass, 1 mountain whitefish	Above Nav Lock
12/14/2020	PH2 AWS	1 juvenile salmonid, 2 sculpin, 5 other fish	Above Nav Lock
12/15/2020	PH2 AWS	1 large adult catfish	Downstream at Hamilton Island Boat Launch

12/16/2020	CI Diffuser Pit FG6-8	1 adult lamprey, 5 pikeminnow, 2 sculpin, 1 smallmouth bass	Above Nav Lock
12/17/2020	CI Diffuser Pits FG6-9,10,11	10 adult lamprey, 3 juvenile lamprey, 50 sculpin, 3 pikeminnows, 3 suckers, 5 crawdads	Above Nav Lock
12/17/2020	PH2 DSM	No Fish	N/A
1/7/2021	CI Diffuser Pit FG6-10	1 juvenile salmonid, 4 sculpin, 4 juvenile shad	Downstream at Hamilton Island Boat Launch
1/11/2021	CI Diffuser Pit FG6-11	6 adult lamprey, 6 juvenile lamprey, 35 sculpin, 5 juvenile shad, ~10 other small non-gamefish including peamouth and suckers	Above the Nav Lock
1/13/2021	CI Diffuser Pit FG6-11	6 adult lamprey, 6 juvenile lamprey, 20 sculpin, 1 sucker, 2 juvenile shad	Above the Nav Lock
1/19/2021	CI Diffuser Pits FG6-12,13,14,15	6 adult lamprey, 1 juvenile steelhead, ~70 sculpin, ~20 other non-gamefish	Above the Nav Lock
1/27/2021	CI Fishway Entrance Bay Diffuser Pits	13 adult lamprey, 3 juvenile lamprey, 40 suckers, 25 sculpin, and 3 stickleback	Downstream at Hamilton Island Boat Launch
3/1/2021	U18 Tail logs	43 sculpin, 2 smallmouth bass, 1 pike minnow	Downstream in tailrace
3/3/2021	U15 Scroll Case and Draft Tube	No Fish	N/A
3/08/2021	Nav Lock Upstream Sill	No Fish	N/A
3/16/2021	U16 Scroll Case and Draft Tube	No fish in scroll case, 5 sculpin and 6 juvenile non-salmonids	Forebay
4/13/2021	U9 Scroll Case and Draft Tube	Scroll Case: 15 JV Salmonids, 5 3-spine stickelback, 1 SMB; Draft Tube: No fish	Downstream at Hamilton Island Boat Launch
5/6/2021	U16 Tail Logs	1 sculpin	Downstream
6/14/2021	U9 Tail Logs	25 sculpin, 2 suckers, 10 crayfish	Downstream at Hamilton Island Boat Launch
6/15/2021	U5 Scroll Case and Draft Tube	No Fish	N/A
8/9/2021	U5 Tail Logs	4 Pumpkinseeds, 29 Sculpin	Downstream
8/14/2021	Lamprey Traps at AFF/LFS/CI	AFF: 12 PL, LFS: 2 PL, CI: No Fish	Upstream
11/1/2021	LPS System Shut Down for Season	No Fish	N/A
11/30/2021	U6 Scroll Case	1 dead adult unclipped salmon	N/A

2.4 Fish Unit Outages

A list identifying every closure for Fish Unit 1 and Fish Unit 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, 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 0400 to minimize impact on adult fish passage. An adjacent unit is then operated to pull trash away from the fish unit trashracks. Lamprey Operations June 1–August 31: Reduce fish unit output to operate all north (NUE, NDE) and south (SUE, SDE) entrances at 0.5' of entrance head. To ensure proper function of fish units, B2 fish unit output can be further reduced or placed on standby to float debris as necessary from 2200-0400 hours.

Table 4. List of Fish Unit Outages.

UNIT	OOS	RTS	DURATION	REASON
F1	0610 on 01 Dec	1201 on 03 Mar	92 days, 5 hrs, 51 mins	2 yr overhaul/WA Shore Fishway Outage
F2	0610 on 01 Dec	0926 on 25 Feb	86 days, 3 hrs, 16 mins	2 yr overhaul/WA Shore Fishway Outage
F2	0823 on 11 Mar	0844 on 11 Mar	21 mins	F.O., T12 Transformer Lockout Trip
F2	2232 on 31 May	0130 on 06 June	2 hours, 58 mins	R.S., Nighttime Lamprey Ops
F1	0133 on 01 June	0546 on 01 June	4 hours, 13 mins	R.S., Nighttime Lamprey Ops
F2	2231 on 01 June	0550 on 02 June	7 hours, 19 mins	R.S., Nighttime Lamprey Ops
F1	2230 on 02 June	0530 on 03 June	7 hours	R.S., Nighttime Lamprey Ops
F2	2232 on 03 June	0531 on 04 June	6 hours, 59 mins	R.S., Nighttime Lamprey Ops
F1	2238 on 04 June	0531 on 05 June	6 hours, 53 mins	R.S., Nighttime Lamprey Ops
F2	2232 on 05 June	0038 on 06 June	2 hours, 6 mins	R.S., Nighttime Lamprey Ops
F1	0040 on 06 June	0529 on 06 June	4 hours, 49 mins	R.S., Nighttime Lamprey Ops
F2	2231 on 06 June	0534 on 07 June	7 hours, 3 mins	R.S., Nighttime Lamprey Ops
F1	2232 on 07 June	0532 on 08 June	7 hours	R.S., Nighttime Lamprey Ops
F2	2231 on 08 June	0540 on 09 June	7 hours, 9 mins	R.S., Nighttime Lamprey Ops
F1	2228 on 09 June	0530 on 10 June	7 hours, 2 mins	R.S., Nighttime Lamprey Ops
F2	2230 on 10 June	0536 on 11 June	7 hours, 6 mins	R.S., Nighttime Lamprey Ops
F2	2237 on 11 June	0532 on 12 June	6 hours, 55 mins	R.S., Nighttime Lamprey Ops
F1	2229 on 12 June	0529 on 13 June	7 hours	R.S., Nighttime Lamprey Ops
F2	2241 on 13 June	0530 on 14 June	6 hours, 49 mins	R.S., Nighttime Lamprey Ops
F2	2229 on 14 June	0529 on 15 June	7 hours	R.S., Nighttime Lamprey Ops
F2	2230 on 15 June	0530 on 16 June	7 hours	R.S., Nighttime Lamprey Ops
F1	2230 on 16 June	0529 on 17 June	6 hours, 59 mins	R.S., Nighttime Lamprey Ops
F2	2233 on 17 June	0558 on 18 June	7 hours, 25 mins	R.S., Nighttime Lamprey Ops
F1	2229 on 18 June	0530 on 19 June	7 hours, 1 min	R.S., Nighttime Lamprey Ops
F2	2235 on 19 June	0533 on 20 June	6 hours, 58 mins	R.S., Nighttime Lamprey Ops
F1	2228 on 20 June	0532 on 21 June	7 hours, 4 mins	R.S., Nighttime Lamprey Ops
F2	2254 on 21 June	0532 on 22 June	6 hours, 38 mins	R.S., Nighttime Lamprey Ops
F1	2252 on 22 June	0549 on 23 June	6 hours, 57 mins	R.S., Nighttime Lamprey Ops
F2	2258 on 23 June	0531 on 24 June	6 hours, 33 mins	R.S., Nighttime Lamprey Ops
F1	2229 on 24 June	0530 on 25 June	7 hours, 1 min	R.S., Nighttime Lamprey Ops

F2	2259 on 25 June	0530 on 26 June	6 hours, 31 mins	R.S., Nighttime Lamprey Ops
F1	2231 on 26 June	0529 on 27 June	6 hours, 58 mins	R.S., Nighttime Lamprey Ops
F2	2229 on 27 June	0538 on 28 June	7 hours, 9 mins	R.S., Nighttime Lamprey Ops
F1	2230 on 28 June	0531 on 29 June	7 hours, 1 min	R.S., Nighttime Lamprey Ops
F2	2229 on 29 June	0533 on 30 June	7 hours, 4 mins	R.S., Nighttime Lamprey Ops
F1	2236 on 30 June	0528 on 01 July	6 hours, 52 mins	R.S., Nighttime Lamprey Ops
F2	2259 on 01 July	0532 on 02 July	6 hours, 33 mins	R.S., Nighttime Lamprey Ops
F1	2259 on 02 July	0536 on 03 July	6 hours, 37 mins	R.S., Nighttime Lamprey Ops
F2	2301 on 03 July	0526 on 04 July	6 hours, 25 mins	R.S., Nighttime Lamprey Ops
F1	2257 on 04 July	0530 on 05 July	6 hours, 33 mins	R.S., Nighttime Lamprey Ops
F2	2256 on 05 July	0526 on 06 July	6 hours, 30 mins	R.S., Nighttime Lamprey Ops
F1	2320 on 06 July	0539 on 07 July	6 hours, 19 mins	R.S., Nighttime Lamprey Ops
F2	2301 on 07 July	0531 on 08 July	6 hours, 30 mins	R.S., Nighttime Lamprey Ops
F1	2300 on 08 July	0525 on 09 July	6 hours, 25 mins	R.S., Nighttime Lamprey Ops
F2	2259 on 09 July	0529 on 10 July	6 hours, 30 mins	R.S., Nighttime Lamprey Ops
F1	2259 on 10 July	0544 on 11 July	6 hours, 45 mins	R.S., Nighttime Lamprey Ops
F2	2259 on 11 July	0529 on 12 July	6 hours, 30 mins	R.S., Nighttime Lamprey Ops
F2	2300 on 12 July	0532 on 13 July	6 hours, 32 mins	R.S., Nighttime Lamprey Ops
F1	2300 on 13 July	0530 on 14 July	6 hours, 30 mins	R.S., Nighttime Lamprey Ops
F2	2300 on 14 July	0531 on 15 July	6 hours, 31 mins	R.S., Nighttime Lamprey Ops
F1	2302 on 15 July	0531 on 16 July	6 hours, 29 mins	R.S., Nighttime Lamprey Ops
F2	2259 on 16 July	0530 on 17 July	6 hours, 30 mins	R.S., Nighttime Lamprey Ops
F1	2257 on 17 July	0528 on 18 July	6 hours, 31 mins	R.S., Nighttime Lamprey Ops
F2	2256 on 18 July	0532 on 19 July	6 hours, 36 mins	R.S., Nighttime Lamprey Ops
F1	2257 on 19 July	0529 on 20 July	6 hours, 32 mins	R.S., Nighttime Lamprey Ops
F2	2308 on 20 July	0531 on 21 July	6 hours, 23 mins	R.S., Nighttime Lamprey Ops
F1	2302 on 21 July	0535 on 22 July	6 hours, 33 mins	R.S., Nighttime Lamprey Ops
F2	2300 on 22 July	0530 on 23 July	6 hours, 30 mins	R.S., Nighttime Lamprey Ops
F1	2300 on 23 July	0530 on 24 July	6 hours, 30 mins	R.S., Nighttime Lamprey Ops
F2	2258 on 24 July	0532 on 25 July	6 hours, 34 mins	R.S., Nighttime Lamprey Ops
F1	2259 on 25 July	0534 on 26 July	6 hours, 35 mins	R.S., Nighttime Lamprey Ops
F2	2255 on 26 July	0551 on 27 July	6 hours, 56 mins	R.S., Nighttime Lamprey Ops
F1	2259 on 27 July	0532 on 28 July	6 hours, 33 mins	R.S., Nighttime Lamprey Ops
F2	2300 on 28 July	0528 on 29 July	6 hours, 28 mins	R.S., Nighttime Lamprey Ops
F2	2300 on 29 July	0536 on 30 July	6 hours, 36 mins	R.S., Nighttime Lamprey Ops
F1	2259 on 30 July	0530 on 31 July	6 hours, 31 mins	R.S., Nighttime Lamprey Ops
F2	2259 on 31 July	0535 on 01 Aug	6 hours, 36 mins	R.S., Nighttime Lamprey Ops
F1	2244 on 01 Aug	0529 on 02 Aug	6 hours, 45 mins	R.S., Nighttime Lamprey Ops
F2	2245 on 02 Aug	0531 on 03 Aug	6 hours, 46 mins	R.S., Nighttime Lamprey Ops
F1	2243 on 03 Aug	0602 on 04 Aug	7 hours, 19 mins	R.S., Nighttime Lamprey Ops
F2	2245 on 04 Aug	0601 on 05 Aug	7 hours, 16 mins	R.S., Nighttime Lamprey Ops
F1	2246 on 05 Aug	0602 on 06 Aug	7 hours, 16 mins	R.S., Nighttime Lamprey Ops
F2	2246 on 06 Aug	0606 on 07 Aug	7 hours, 20 mins	R.S., Nighttime Lamprey Ops
F2	2244 on 07 Aug	0601 on 08 Aug	7 hours, 17 mins	R.S., Nighttime Lamprey Ops
F1	2244 on 08 Aug	0602 on 09 Aug	7 hours, 18 mins	R.S., Nighttime Lamprey Ops
F2	2245 on 09 Aug	0611 on 10 Aug	7 hours, 26 mins	R.S., Nighttime Lamprey Ops
F1	2246 on 10 Aug	0556 on 11 Aug	7 hours, 10 mins	R.S., Nighttime Lamprey Ops
F2	2244 on 11 Aug	0559 on 12 Aug	7 hours, 15 mins	R.S., Nighttime Lamprey Ops

F1	2244 on 12 Aug	0558 on 13 Aug	7 hours, 14 mins	R.S., Nighttime Lamprey Ops
F2	2244 on 13 Aug	0608 on 14 Aug	7 hours, 24 mins	R.S., Nighttime Lamprey Ops
F1	2242 on 14 Aug	0602 on 15 Aug	7 hours, 20 mins	R.S., Nighttime Lamprey Ops
F2	2242 on 15 Aug	0558 on 16 Aug	7 hours, 16 mins	R.S., Nighttime Lamprey Ops
F1	1107 on 16 Aug	1113 on 16 Aug	6 mins	R.S., Nighttime Lamprey Ops
F2	1115 on 16 Aug	1137 on 16 Aug	22 mins	P.O., DC Work
F2	2058 on 16 Aug	0603 on 17 Aug	9 hours, 5 mins	P.O., DC Work
F1	1203 on 17 Aug	1359 on 17 Aug	1 hour, 56 mins	R.S., Nighttime Lamprey Ops
F2	1203 on 17 Aug	1359 on 17 Aug	1 hour, 56 mins	P.O., R.S. for ROV Inspection
F1	2145 on 17 Aug	0601 on 18 Aug	8 hours, 16 mins	P.O., R.S. for ROV Inspection
F2	2129 on 18 Aug	0601 on 19 Aug	8 hours, 32 mins	R.S., Nighttime Lamprey Ops
F1	2130 on 19 Aug	0603 on 20 Aug	8 hours, 33 mins	R.S., Nighttime Lamprey Ops
F2	2130 on 20 Aug	0559 on 21 Aug	8 hours, 29 mins	R.S., Nighttime Lamprey Ops
F2	2129 on 21 Aug	0559 on 22 Aug	8 hours, 30 mins	R.S., Nighttime Lamprey Ops
F1	2129 on 22 Aug	0558 on 23 Aug	8 hours, 29 mins	R.S., Nighttime Lamprey Ops
F2	2130 on 23 Aug	0617 on 24 Aug	8 hours, 47 mins	R.S., Nighttime Lamprey Ops
F1	2128 on 24 Aug	0600 on 25 Aug	8 hours, 32 mins	R.S., Nighttime Lamprey Ops
F2	2129 on 25 Aug	0600 on 26 Aug	8 hours, 31 mins	R.S., Nighttime Lamprey Ops
F1	2130 on 26 Aug	0559 on 27 Aug	8 hours, 29 mins	R.S., Nighttime Lamprey Ops
F2	2130 on 27 Aug	0602 on 28 Aug	8 hours, 32 mins	R.S., Nighttime Lamprey Ops
F1	2130 on 28 Aug	0558 on 29 Aug	8 hours, 28 mins	R.S., Nighttime Lamprey Ops
F2	2129 on 29 Aug	0559 on 30 Aug	8 hours, 30 mins	R.S., Nighttime Lamprey Ops
F1	1403 on 30 Aug	1412 on 30 Aug	9 mins	R.S., DC Swap
F2	1415 on 30 Aug	1434 on 30 Aug	19 mins	R.S., DC Swap
F1	2129 on 30 Aug	0559 on 31 Aug	8 hours, 30 mins	R.S., Nighttime Lamprey Ops
F1	1456 on 31 Aug	1506 on 31 Aug	10 mins	R.S., DC Swap
F2	2139 on 31 Aug	0631 on 01 Aug	8 hours, 52 mins	R.S., Nighttime Lamprey Ops
F2	2004 on 18 Nov	2021 on 18 Nov	17 mins	R.S., Floating Trash
F1	1844 on 19 Nov	2014 on 19 Nov	1 hour, 30 mins	R.S., Floating Trash
F2	2017 on 19 Nov	2059 on 19 Nov	42 mins	R.S., Floating Trash for F1
F1	1910 on 20 Nov	2008 on 20 Nov	58 mins	R.S., Floating Trash
F1	0001 on 29 Nov	1619 on 09 Dec	10 days, 16 hours, 18 mins	P.O., Annual Overhaul

Definitions: Reserve Status (R.S.) and Planned Outage (P.O.).

3. FISH PASSAGE PLAN COMPLIANCE

3.1 Fish Passage Plan Violations

Project Fisheries and the Project Operators conduct fishway inspections each day during fish passage season and at least three days per week during the winter maintenance period. Project Biologists conducted 101% (315 / 312) of the required daily fishway inspections. The number of FPP violations and the percentage of days the item was in criteria were calculated using Project Biologist's inspection data only (**Table 5**). 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 5. Fish Passage Plan Violations and Percent in Criteria.

Violation	Occurrences	In Criteria (%)
Units Running Out of Priority	50	84.1%
PH1		
Collection Channel Differential	65	79.4%
A-Branch Weir Differential	169	46.3%
B-Branch Weir Differential	9	97.1%
B-Branch South Ent. Gate	4	98.7%
B-Branch Entrance Differential	9	97.1%
FV1-1	1	99.7%
FV3-7	124	60.6%
FG3-3 (A-Branch)	12	96.2%
FG3-4 (A-Branch)	308	2.2%
FG3-5 (A-Branch)	13	95.9%
FG3-6 (A-Branch)	7	97.8%
FG3-23 (B-Branch)	6	98.1%
FG3-27 (B-Branch)	78	75.2%
Ice & Trash Sluiceway	315	0.0%
Spillway - Extra Spill	2	99.4%
PH2		
F1 Forced Outage	3	99.0%
DSM2 ERG Trip	2	99.4%
CI Entrance Differential	6	98.1%
UMT Weir Differential	22	93.0%
Weir 37 Differential	17	94.6%
Weir 38 Differential	12	96.2%
Weir 67 Differential	6	98.1%
WA Shore SUE Monolith Ent/TW Differential	14	95.6%
WA Shore SDE Monolith Ent/TW Differential	6	98.1%
WA Shore NUE Monolith Ent/TW Differential	3	99.0%
WA Shore NDE Monolith Ent/TW Differential	3	99.0%
FG6-12 (Cascades Island)	6	98.1%
FG6-18 (Cascades Island)	13	95.9%

3.1.1. Units Running Out of Priority Order: There were several occurrences when the units ran out of priority according to FPP guidance (**Table BON-1. Bonneville Dam Turbine Unit Priority Order, 2021 FPP**).

- Unit 13 was forced out of service in February and March for 30 days, causing units to run out of order.
- Units 1, 10 and 9 were run out of priority during a series of 6 days in June when BPA requested BON to provide support to the 155 kV grid during an extreme hot weather event.
- Unit 15 was forced out of service in June for 3 days, causing units to run out of order.
- Unit 17 was forced out of service in October for 1 day, causing units to run out of order.
- Unit 11 was forced out of service in November for 2 days, causing units to run out of order.
- Unit 13 was forced out of service in November for 6 days, causing units to run out of order.
- Unit 6 was forced out of service in November and Unit 9 ran in its place for 2 days.

3.1.2. Collection Channel Differentials: PH1 south (typically WG-2) and north (typically WG-64) entrances are controlled by different sources. With the aging Symax PLC system and sensors maintaining 1.0-2.0' differential is often difficult. Funding remains an issue with upgrading the PLC at PH1.

3.1.3. A-Branch Weir Differential: Leakage from the FV3-7 conduit along A-Branch is believed to be the cause for slightly above average differentials. Often the differential is +0.1' above criteria during the year.

3.1.4. FV3-7: FV3-7 (Bradford Island) was placed in manual and pinched down to reduce flow in the BI AWS to prevent blown diffuser grating and further damage to FG3-3 while FG3-4, FG3-5, and FG3-6 were unserviceable.

3.1.5. FG3-4: FG3-4 (A-Branch) was found mechanically bound and unable to move from the "almost closed" position in December of 2020.

3.1.6. FG3-27: FG3-27 was found to be mechanically bound open in August 2019. Repairs could not occur with the fishway watered up.

3.1.7. PH1 ITS: The PH1 Ice and Trash Sluiceway end gate failed on 30 December 2018. Auto-chain gates 3B, 6C, and 10B are operational; fixed-gates 1A and 1B remain closed for safety reasons.

3.1.8. Avian Lines: 5 avian lines were cut from the B2CC avian line array on 02 September 2021. Avian lines are installed prior to 10 April each year and normally remain in place as a form of avian abatement through the start of winter when they may be taken down if winter maintenance activities require. These 5 lines were damaged and hanging extremely low to the water, creating a hazard to a survey vessel entering the BON BRZ for a hydrosurvey on 03 September.

3.1.9. Temperature Monitoring: Fishway temperature monitoring is a requirement set in the FPP (**FPP Section 2.4.2.11**). During the summer of 2021, 2 of the 12 temperature probes (B-Branch Entrance and WA Shore LPS) became completely unserviceable. Of the 10 remaining serviceable temperature probes, the Cascade Island Entrance Bay temperature probe was also not accurately portraying current fishway temperatures when tailwater was below 10 feet elevation. Only 9 of 12 temperature probes across Bonneville monitored temperatures accurately through the season, causing BON to be out of FPP compliance.

3.2 STS / VBS Inspections

Submersible traveling screens (STS) and vertical barrier screens (VBS) are typically inspected once a month (**Table 6**). Each STS has a timer that automatically shows elapsed time of operation, with thirty-one days of continuous operation equaling 744 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 mid-December for juvenile fish passage and for adult fallbacks. PH1 screens have been permanently removed.

Table 6. 2021 STS / VBS Inspections.

Unit	Install Dates & Run Hours Upon Installation	FEB/MAR	APR/MAY	JUN	JUL	AUG	SEPT	OCT	NOV	DEC	Removal Dates & Run Hours at Removal
11	24-Feb-21	977	667.5	978	531	663	648	1025	481	814	13-Dec-21
	56546										63330
12	24-Feb-21	984	234.1	851	508	233	418	1018	468	903	17-Dec-21
	43169										48786
13	24-Feb-21	285	234.1	580	421	52	192	884	482	768	17-Dec-21
	4117										7950
14	16-May-40	1008	131.8	357	266	27	110	552	365	888	17-Dec-21
	14747										18451
15	24-Feb-21	0	10.4	334	156	19	64	241	228	1062	16-Dec-21
	24383										26497
16	24-Feb-21	466	0.4	313	103	10	50	77	55	1051	15-Dec-21
	36731										38856
17	24-Feb-21	1033	174.2	828	476	170	384	1018	469	1043	15-Dec-21
	3227										8822
18	24-Feb-21	628	669.2	978	530	667	647	1030	478	1055	15-Dec-21
	3051										9733

3.3 Avian Counts and Abatement Measures

Bonneville Project Fisheries recorded daily bird counts between 01 April through 31 October 2021 (**Figure 2)**. These counts consist of the total numbers of gulls, cormorants, pelicans, grebes, and Caspian terns that were observed in the tailraces of Powerhouse 1, Powerhouse 2, Spillway tailrace, B2 Corner Collector outfall, and the Juvenile Bypass outfalls.

USDA Wildlife Service's avian hazing occurred from 01 April through 31 July 2021. This hazing was focused on locations included but not limited to the tailrace side of the powerhouses, the spillway, and the shoreline.

The passive hazing abatements at Bonneville Lock & Dam are the avian wires and hydro-cannons. Avian wires are installed prior to April 10 of each year, in the tailraces of Powerhouse 1, Powerhouse 2, and the spillway. Hydro-cannons operate continuously on top of the outfall flumes of the Smolt Monitoring Facility from 01 March through 01 November 2021.

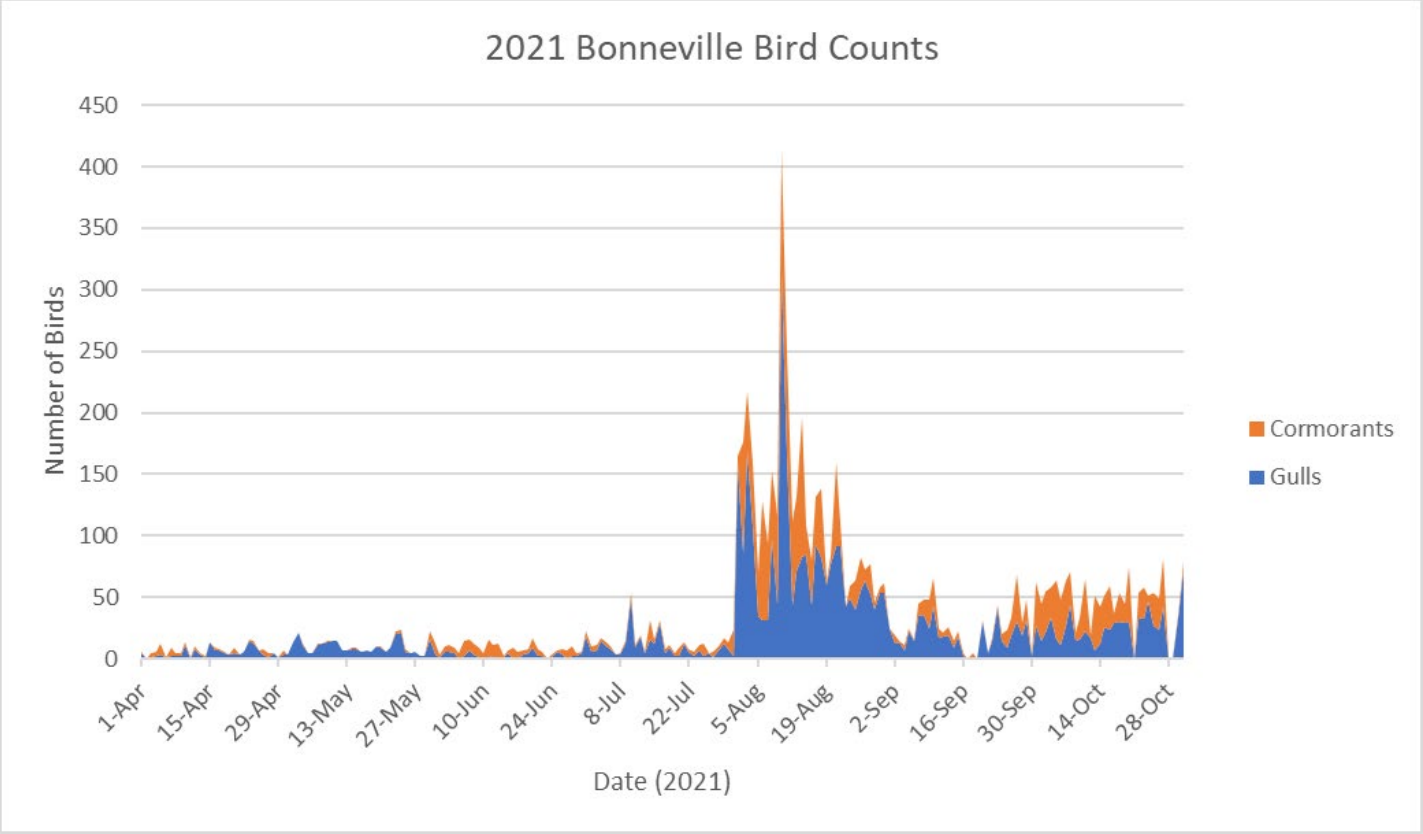

Figure 2. 2021 Bonneville Avian Counts.
Please note that pelicans, grebes, and terns are not included in this figure due to the extremely low observations (<5 for total monitoring period). However, data can be provided upon request.

3.4 Fish Counts

The Corps of Engineers contracted with Four Peaks Environmental for fish counting during the 2021 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 the Fish Passage Center (http://www.fpc.org/).

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. The Project stays involved in regional preparation for zebra/quagga mussel arrival by sending project personnel to trainings 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 24 February through 09 October (**Figure 3**). Temperature probes are installed at the following locations: A-Branch Entrance, B-Branch Entrance, Bradford Island Exit, Washington Shore Entrance (NDE), Washington Shore Exit (near FV6-9), AFF, SMF, BI LPS, CI LPS, WA LPS, and the LFS. Additionally, the Technical Management Team (TMT) tracks BON forebay temperature on their website. The TMT temperature is publicly accessible in real-time, and is the standard utilized per the FPP to determine when high-temperature fish sampling restrictions are operative in BON facilities. In 2021, these temperatures were available from 28 February through 22 September. Detailed daily temperatures can be found in the weekly reports and are available upon request.

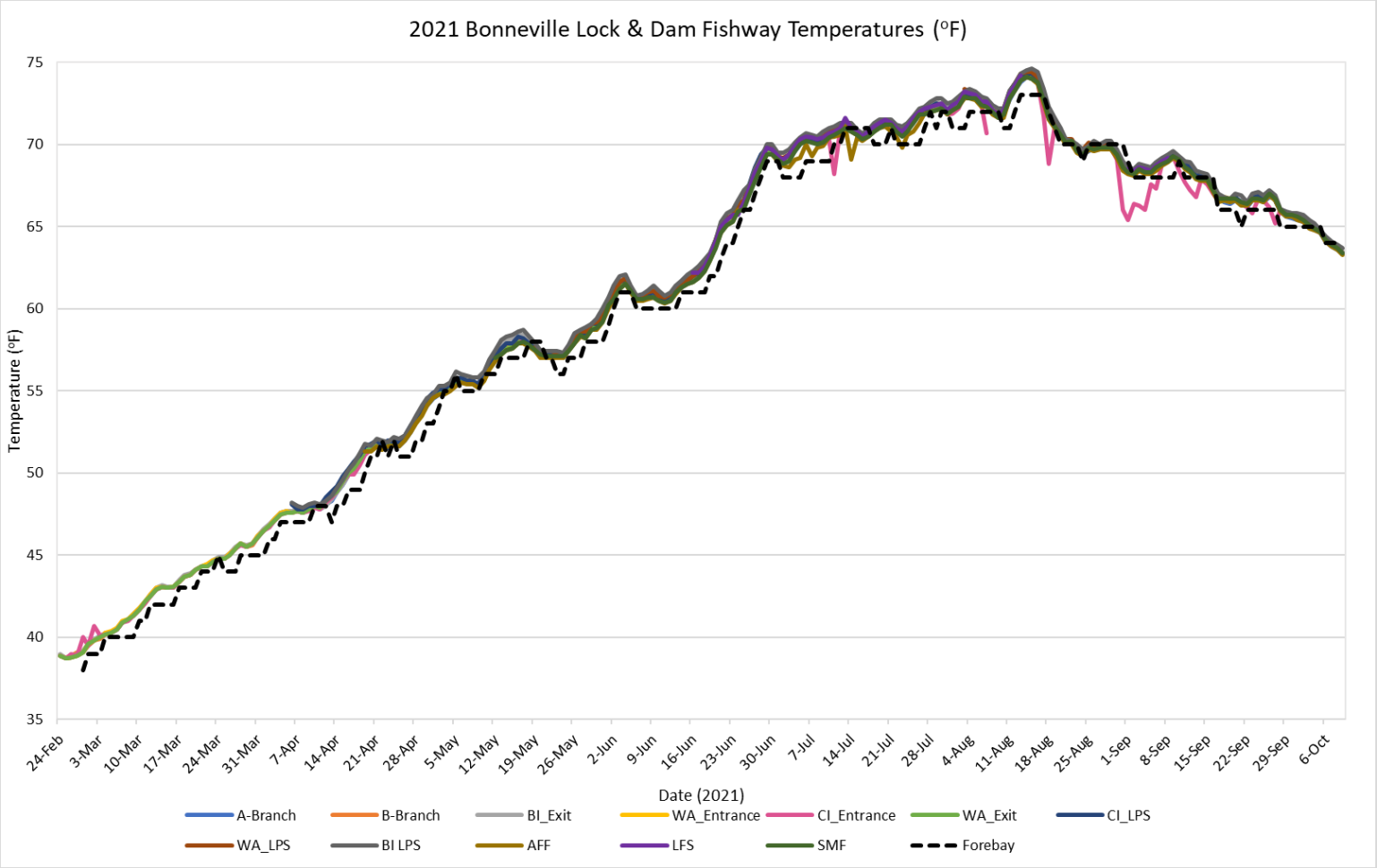

Figure 3. 2021 Temperatures at Bonneville.
Please note the following temperature probe issues: WA_LPS temperature probe failed to log temperatures after 28 August 2021. B-Branch temperature probe broke off inside the stilling well pipe and failed to log temperatures after 21 August 2021. CI_Entrance temperature probe failed to log consistent temperatures at tailwater levels below 10 feet.

5. FISHWAY MODIFICATIONS (1996 - present)

POWERHOUSE ONE ADULT

2018. Installed HOBO temperature monitors.
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

2021. ITS end gate slot inspected by USACE engineers to facilitate the future gate repair.
2019. Broken ITS end gate removed.
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

2020. Lamprey refuge boxes were moved to their permanent locations in the BI flow control section.
2019. Bradford Island LPS exit ramp had grooves deepened and lid installed to dissuade algae growth and avian predation.
2018/19. Tested reduced nighttime entrance velocities at PH1 and B-branch entrances.
2018/19. Field tested the Bradford Is. Wetted Wall (BIWW).
2018. Installed HOBO temperature monitors.
2017/18. Modified the Bradford Is. LPS exit. Objective was to allow for adjustable slope and to release lamprey further from the adult ladder exit thus reducing fallback.
2017/18. Orifice slots drilled in lower serpentine weir walls (weirs 1, 3, and 5); trial rest boxes installed.
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

2021. PSMFC installed new PIT antennas at UMT Entrance and count station window, pending start up.
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

2020. Cascade Island lamprey trap was constructed and placed into service 3 June 2020.
2017/18. FDX PIT systems installed.
2016. Gaps in picket leads fixed with addition of new pickets to reduce lamprey incursion into AWS.
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. HDX PIT tag detectors were installed along the picket leads to track lamprey.

POWERHOUSE TWO ADULT

2021. PSMFC installed four new PIT antennas in WA flow control section.
2017. Removal of Collection Channel velocity meter.
2017. Permanent SLEDs (Sea Lion Exclusion Devices) were fabricated and installed on top of FOGs to prevent Sea Lions from entering the fishway.
2017. Four floating orifice gates (FOGs) were removed and replaced with bulkheads to minimize locations for potential sea lion entry. This reduced the number of FOGs from 12 to 8.
2017. An opening in the wall separating the crowder area of the main ladder from the AWS was covered with screen to prevent possible Sockeye incursion into the AWS.
2017. Installed ID plates at bases of "C" diffusers in the collection channel for ROV inspections.
2017. The base of the AWS picket leads was modified to reduce possible Sockeye incursion into the AWS.
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

2021. A concrete corbel was added behind the VBSs of Unit 15 gatewells A and B to improve FGE flow criteria. Pending tests in Spring 2022 to determine hydraulic environment after modifications.
2018. Removal of FGE flow control plates from all units.
2018. Installed HOBO temperature monitors.
2018. Major electrical upgrades to the SMF PLC.
2016/17. LED lighting improvements to DSM.
2016/17. Flow control plates installed in 'A' & 'B' gatewells of all PH2 units, plating on upper sections of VBSs.
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 hydro-cannon 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

2021. Four new pumps for the lamprey passage structures installed at WA shore.
2021. Lamprey refuge boxes were moved to their permanent locations in the WA flow control section.
2020. Repair of the blown LFS inspection hatch by District Dive Safety.
2019. Orifice slots in weir 1 closed permanently. Six additional slots drilled in odd numbered weirs to exit (7, 9, 11, 13, 15, &17).
2019. Lamprey weir caps installed on NDE and NUE.
2018. Replaced the two winch deployed AFF lamprey traps for a permanently installed single ramp trap.
2018. Installed HOBO temperature monitors.
2018. WA AWS LPS exit "plunge box" installed.
2017. Blackout blinds were installed over visitor center viewing windows in order to reduce in-ladder nighttime light pollution.
2017. The count station crowder was modified with perf plating and a rubber "skirt" to reduce incidences of lamprey being run over. Grating was installed on the downstream side of the crowder to reduce fish incursion into the area behind the crowder.
2016/17. Lamprey weir caps installed on SDE and SUE.
2016/17. Orifice slots drilled in lower serpentine weir walls (weirs 1, 3, and 5); trial rest boxes installed.
2016/17. LFS velocity barrier plate installed to reduce areas of high velocity.
2016/17. Removed lamprey plating in N entrance area, replaced with orifice plates. AWS LPS extensions and new pump system.
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 spacers were installed on the AWS picket leads 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.

REFERENCES

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