2023 JUVENILE SAMPLE AND BYPASS REPORT

MCNARY PROJECT JUVENILE FISH FACILITY

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U.S. Army Corps of Engineers
McNary Lock and Dam
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ESBS – Extended-length Submersible Bar Screen
FPP – Fish Passage Plan
GBT – Gas Bubble Trauma
JCC – Juvenile Collection Channel
JFF – Juvenile Fish Facility
PIT – Passive Integrated Transponder
PDS – Primary Dewatering Structure
PSMFC – Pacific States Marine Fisheries Commission
TSW – Top-over Spill Weir
USDA-WS – United States Department of Agriculture-Wildlife Services
VBS – Vertical Barrier Screen
EAS – Environmental Assessment Services
LRAD – Long-Range Acoustic Device

SUMMARY

This report summarizes the juvenile bypass and sample collection operations of McNary Project during 2023. Adult passage information is recorded in a separator report. Only adults removed from the sample tanks are recorded in this report.

FACILITY INTRODUCTION AND DESCRIPTION

McNary Dam is located at river mile 292 on the Columbia River and is the first dam downstream of the confluence of the Snake and Columbia Rivers. McNary has 14 turbine units. To bypass the turbines, the juvenile system begins with trash racks, extended length submersible bar screens (ESBS's), and vertical barrier screens (VBS's). When fish enter the turbines' intake, they are diverted into the gatewell slots. Each unit has three gatewell slots. Each gatewell slot has two orifices with one being open. The fish pass through these twelve-inch orifices to the juvenile collection channel.

The channel flow runs from north to south. The dewatering structure and associated equipment are at the southern end of the powerhouse. Here there are the two side-dewatering valves, which regulate the channel elevation. There is also a set of three floor-dewatering valves, which remove excess water. Finally, there is the 48-inch juvenile facility supply line. All flow is gravity fed.

A bar screen in the side and on the floor of the channel retains fish and allows the excess water to be removed. The screen is kept cleaned by the side, rectangular, and transition brushes. All systems are controlled by a program logic controller. In the transition area, the channel funnels down to the full flow transport flume/pipe where the fish and debris exit. The transport flume takes the fish to the facility or returns them to the river. Just upstream of the separator is the primary bypass gate. This gate is used during fish passage season to switch between primary (fish go directly back to the river) and secondary bypass (a percentage of fish are sampled fish with the remainder returned to the full flow pipe and river). The separator sorts the fish by size with the small smolts exiting down the A-flume and the large smolts going down the B-flume. Adult salmonids and other miscellaneous fish are released at the separator's return to river line.

Downstream of the separator in the A and B flumes are the passive integrated transponder (PIT) tag gates, the sample gates, and the secondary bypass gates (which tie the A and B lines back into the full flow flume/pipe). The A and B sides each have a set of sample and PIT tag systems. Inside the building is the wet lab where the sample is examined. There is also the sample recovery raceway, from which the sampled fish are returned to the river. The full flow flume/pipe, adult return line, and all facility lines have PIT tag detectors with the remainder of the PIT system inside the building.

Finally, there are top spillway weirs (TSWs) in spillbays 19 and 20.

FACILITY MODIFICATIONS/MAINTENANCE AND IMPROVEMENTS

Maintenance and improvements for the winter of 2022-2023 made to enhanced system performance over previous seasons are listed:

Collection channel/powerhouse:

1. Handrail around and access to the bushes limit switches were improved.
2. All scheduled electrical and mechanical maintenance was done on screen brushes and dewatering valves.
3. All limit switches for all screen brushes were replaced.
4. The side screen brush clutch and the lower guide were properly adjusted.
5. Water elevation meter shroud cleaned.
6. Orifice attraction lighting, orifice operators, and area lighting replaced/repaired as needed.
7. One solution to roadway drains into channel tried.
8. Wiring, motors, and gearboxes were replaced on ESBSs as needed.
9. The main air line from the powerhouse to the facility were repaired.
10. Installation and removal of the new and old intake deck cranes occurred. This added some challenges to system checks but should improve ESBS and VBS work.

Juvenile fish facility (JFF)/full flow pipe:

1. Sample and PIT tag systems rehabilitated as needed.
3. Flume gaskets and silicone were replaced as needed.
4. Airline leaks repaired as needed.
5. Sample tank crowding devices rehabilitated as needed.
6. Winterization drains on the A and B side flume water adds were repaired.
7. Miscellaneous electrical repairs were done around the facility.

One important in season event needs to be mentioned here. Station service unit 01 was rewatered in late August. The unit has been out of service since March 2017. The significance of this unit being rewatered is emergency and flush water are now available to the juvenile system along with water that can be used to refill the channel.

Other maintenance items during the year will be covered in the remaining text of this report. During all dewatering and maintenance, no invasive mussels were observed.

RIVER CONDITIONS

River Flow

Daily average total river flow, powerhouse flow, and spill were compiled from April 1 to September 30, 2023. The average included hourly values collected from 0700 hours of the previous day to 0700 hours of the current day. The 2023 maximum daily average for total river flow was 408.9 kilo cubic feet per second (kcfs) recorded on May 17. The maximum daily average for powerhouse flow and

spill was 139.4 kcfs on May 17 and 309.2 kcfs on May 23, respectively. Minimum daily average for total river flow was 62.9 kcfs on September 26, and minimum daily average for powerhouse flow during spill was 49.6 kcfs on June 10, 11, and 25. When spill occurred, minimum daily average for spill was 15.1 kcfs on September 1. Tables 1 and 2 summarize the river flow for the 2023 season.

Table 1. Average Monthly River Flows, 2023

Month	Total Flow (kcfs)	Powerhouse (kcfs)	Spill (kcfs)
April	125.4	65.4	55.8
May	324.4	77.1	242.7
June	186.8	56.7	125.4
July	148.2	59.2	84.3
August	133.8	81.9	47.2
September	79.1	73.2	1.2

Table 2. Season Start, End, Seasonal Average, Maximum, and Minimum River Flows, 2023

Date	Total Flow (kcfs)	Powerhouse (kcfs)	Spill (kcfs)
Season Start (April 1)	116.2	110.2	1.3
Season End (September 30)	72.5	66.9	0.9
Maximum (Date)	408.9 (17-May)	139.4 (17-May)	309.2 (23-May)
Minimum (Date)*	62.9 (26-Sep)	49.6 (10-Jun)	15.1 (1-Sep)

Note: *The minimum spill only considered dates when spill occurred

River Temperature

River temperature was recorded at 0700 hours daily in Sample Tank "B" at the JFF from April 4 to September 30. Maximum temperature was 72.9°F on August 17, and minimum temperature was 43.3°F on April 1. River temperatures are summarized in Tables 3 and 4.

Table 3. Average Monthly River Temperatures, 2023

Month	River Temperature (°F)
April	46.7
May	54.4
June	62.8
July	69.5
August	70.5
September	68.1

Table 4. Season Start, End, Average, Maximum, and Minimum River Temperatures, 2023

Date	River Temperature (°F)
Season Start (April 1)	43.3
Season End (September 30)	64.0
Season Average	62.0
Season Maximum (August 17)	72.9
Season Minimum (April 4)	43.3

JUVENILE BYPASS

Migration, Sampling, and Bypass of Juvenile Salmonids

Smolts navigating from the McNary forebay can pass the dam either by the spillway or the powerhouse. Smolts entering turbine intakes of the powerhouse are diverted to the juvenile fish collection channel. Subsets of the smolts are then sampled from the juvenile bypass system by a timed gated system that allows them to be collected into a sample tank. Smolts are no longer being collected for transport from McNary Dam. Bypass numbers represent an estimate of the number of smolts navigating past the dam. The number bypassed is calculated from the number of smolts sampled, the corresponding sampling rate, and by considering the fish mortality rate. Smolts are sampled every-other-day in the secondary bypass system, from April 3 until September 30. Bypass totals do not include smolts passing over the spillway and down through the powerhouse.

The JFF bypassed 562,865 smolts during the 2023 season. The estimated number of smolts bypassed during the 2023 season was lower than the 5-year average of 808,957 smolts. Total number of salmonid smolts that bypassed the dam from 2019 to 2023 along with the 5-year average are compared in Table 5. Figure 1 compares total salmonid smolts bypassed with daily average river flow.

The predominant species bypassed in 2023 was Chinook salmon (27.1% yearling Chinook salmon and 59.3% subyearling Chinook salmon). Table 6 compares the number of salmonids collected by species and clip type for the past 5 years with the 5-year average.

Juvenile salmonids exhibit a wide range of migration strategies that vary in their seasonal timing and age at migration onset. At McNary Dam, this translates into two semi-distinct peaks in the number of smolts collected—one in the spring and one in the summer, though annual variation exists. The spring migration is typically dominated by yearling Chinook salmon, steelhead, sockeye salmon, and coho salmon smolts. Subyearling Chinook salmon fry are also present. The summer migration is primarily subyearling Chinook salmon smolts. The spring collection peak of 48,901 smolts occurred on May 19 and composed of 43.1% yearling Chinook salmon, 25.8% subyearling Chinook salmon, 14.7% sockeye salmon, 11.0% coho salmon, and 5.4% steelhead. The summer collection peak of 28,300 occurred on July 8 and was composed of 100.0% subyearling Chinook salmon. Collection peaks for each species are summarized in Table 7.

Table 5. Number of Fish Bypassed by Species and Clip Type, 2023–2019 for Season and 5-Year Average

Bypassed											
	Yearling Chinook		Subyearling Chinook		Steelhead		Coho		Sockeye		
Year	Clip	Unclip	Clip	Unclip	Clip	Unclip	Clip	Unclip	Clip	Unclip	Total
2023	129,909	22,879	125,918	208,098	24,339	8,163	4,148	13,472	4,100	21,839	562,865
2022	84,013	12,458	379,912	324,216	36,611	9,084	4,754	10,507	2,500	78,050	942,105
2021	207,739	42,329	180,014	165,760	62,730	14,359	8,369	18,257	4,370	30,136	734,063
2020	210,703	50,189	247,672	355,825	36,893	10,426	13,908	16,268	5,450	94,870	1,042,204
2019	238,849	70,386	92,207	119,481	133,128	26,607	2,948	18,753	10,428	50,762	763,549
5 YR AVG	174,243	39,648	205,145	234,676	58,740	13,728	6,825	15,451	5,370	55,131	808,957

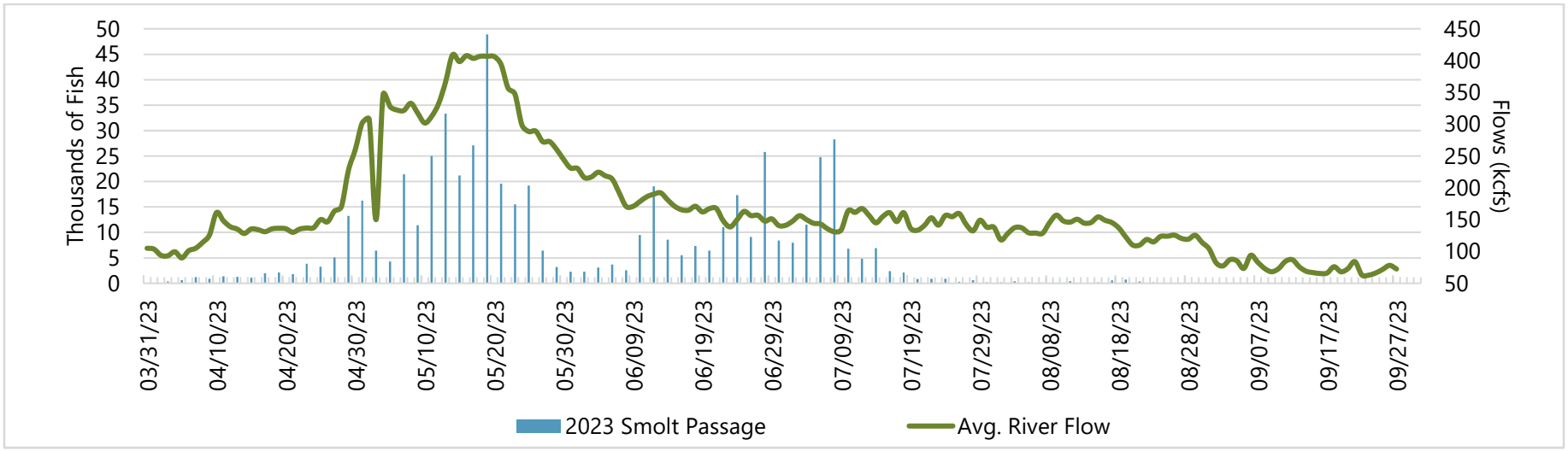

Figure 1. Daily Smolt Passage vs. Average Daily River Flow, 2023

Table 6. Number of Fish Collected by Species and Clip Type, 2023–2019 for Season and 5-Year Average

Collected											
	Yearling Chinook		Subyearling Chinook		Steelhead		Coho		Sockeye		
Year	Clip	Unclip	Clip	Unclip	Clip	Unclip	Clip	Unclip	Clip	Unclip	Total
2023	129,942	22,887	125,958	208,165	24,347	8,164	4,148	13,472	4,100	21,840	563,023
2022	84,061	12,467	379,943	324,324	36,620	9,087	4,754	10,509	2,500	78,064	942,329
2021	207,763	42,334	180,033	165,813	62,737	14,362	8,370	18,263	4,370	30,140	734,185
2020	210,728	50,195	247,702	355,967	36,900	10,430	13,910	16,271	5,450	94,878	1,042,431
2019	238,862	70,393	92,219	119,518	133,140	26,609	2,948	18,754	10,430	50,766	763,639
5 YR AVG	174,271	39,655	205,171	234,758	58,749	13,730	6,826	15,454	5,370	55,138	809,121

Table 7. Peak Collection Date and Number of Fish by Species and Clip Types, 2023–2019

Peak Collection Dates									
Year	Yearling Chinook	Subyearling Chinook	Clipped Steelhead	Unclipped Steelhead	Coho	Clipped Sockeye	Unclipped Sockeye	Total smolts	Juvenile Lamprey
2023	19-May 21,073	8-Jul 28,300	1-May 5,701	19-May 1,407	19-May 5,400	19-May 2,400	19-May 4,800	19-May 48,901	13-May 103,800
2022	11-May 9,199	18-Jun 122,300	11-May 3,251	21-May 1,862	12-Jun 2,400	25-May 800	21-May 6,200	18-Jun 123,901	8-Jun 65,000
2021	9-May 26,800	24-Jun 115,550	25-Apr 9,600	9-May 1,200	29-May 2,901	17-May 1,200	9-May 2,800	24-Jun 115,700	8-Jun 750
2020	7-May 32,601	4-Jun 80,097	7-May 3,000	11-May 1,200	27-May 2,650	21-May 1,700	17-May 9,900	4-Jun 81,702	2-Jun 26,100
2019	17-May 39,300	22-Jun 23,092	17-Apr 20,276	15-Apr 2,050	21-May 2,100	21-May 4,400	1-May 7,000	17-May 43,300	19-Apr 44,800

Sampling

Sampling for smolt migration indexing and condition evaluation was conducted every other day when the system was in secondary bypass from April 3 to September 30, 2023.

The target number is to have at least 100 fish of the predominant salmonid species. As the water temperature increased above 70°F during the latter half of the season, the sample number for salmonids decreased due to warm water sampling protocols outlined in the 2023 Fish Passage Plan. At the end of season, there were 11,826 smolts sampled, composed of 55.1% subyearling Chinook salmon, 33.5% yearling Chinook salmon, 7.7% steelhead, 1.8% coho salmon, and 2.0% sockeye salmon. The number of sampled fish is listed by species and clip type in Table 8.

In 2023, the number of salmonids sampled was lower than the 5-year average of 16,712. Sample numbers for all species were lower than the 5-year average. The largest decrease between the 5-year average and 2023 sample numbers was observed to be unclipped sockeye salmon, with 2023 sample numbers being less than one quarter of the 5-year average.

The average sample rate for the season was 11.0%. Table 9 summarizes average monthly and seasonal sample rates.

Table 8. Number of Fish Sampled by Species and Clip Type, 2023–2019 for Season, and 5-Year Average

Sampled											
	Yearling Chinook		Subyearling Chinook		Steelhead		Coho		Sockeye		
Year	Clip	Unclip	Clip	Unclip	Clip	Unclip	Clip	Unclip	Clip	Unclip	Total
2023	3,378	580	2,420	4,091	733	173	84	128	22	217	11,826
2022	3,692	610	2,595	6,719	1,840	375	191	226	39	1,980	18,267
2021	4,365	754	3,391	5,318	2,147	396	178	431	49	505	17,534
2020	4,885	1,302	2,898	7,836	1,177	413	453	318	61	1,122	20,465
2019	3,071	1,468	1,886	5,191	2,336	440	44	306	123	602	15,467
5 YR AVG	3,878	943	2,638	5,831	1,647	359	190	282	59	885	16,712

Migration, Sampling, and Bypass of Juvenile Lamprey

Lampreys belong to a group of fishes that are eel-like in form. They are an ancient form of fish that lacks jaws and paired fins, and their identification largely depends on the number, position, and structure of the teeth found within the mouth of the adult. The primary species found at McNary Dam is the Pacific lamprey (*Entosphenus tridentatus*) characterized by the presence of three large teeth and

posterior teeth on the oral disc. Pacific lampreys spawn in similar habitats to salmon. Spawning occurs between March and July, depending upon location within their range.

Table 9. Average Monthly and Seasonal Sample Rate, 2023

Month	Rate
April	14.3%
May	1.2%
June	2.9%
July	6.5%
August	19.4%
September	22.0%
Season Average	11.0%

Metamorphosis from the larvae stage (ammocoetes) to the juvenile stage (macropthalmia) occurs over a period of several months. During this time, they develop eyes, teeth, and become free swimming. They drift and swim downstream as they migrate to the ocean. It is during the macropthalmia stage when most of the lampreys end up in the sample collection at the+ JFF. Collected, sampled, and mortality data for Pacific lamprey juvenile life stages are presented in Table 10. In addition, the 5-year averages of collected, sampled, and mortality data are also presented. Mortality includes sample tank mortality only. PSMFC collected 780 fin clips for the season, for the Columbia River Inter-Tribal Fish Commission. All juvenile lamprey sampled for fin clips were released unharmed.

Table 10. Number of Pacific Lamprey Collected, Sampled, and Mortality, 2023–2019 for Season

	2023	2022	2021	2020	2019	5 YR AVG
Collected	345,374	298,028	6,203	119,750	189,639	191,799
Sampled	3,299	4,364	254	2,757	2,677	2,670
Mortality	35	84	6	86	36	49

Incidental Species Sampled (Including Adults)

Non-target fish and invertebrates incidentally sampled with target species were weighed, measured, and counted at the time of the every-other-day smolt sampling. Juvenile American shad (*Alosa sapidissima*) were the most prevalent incidental species encountered in 2023, followed by Pacific lamprey macropthalmia and smallmouth bass (*Micropterus dolomieu*). Juvenile American shad were first sampled on July 14 and due to the high quantity, their numbers were estimated by subsampling and enumerated using a weighing technique (instead of counting) from July 20 to September 30. There were 49 Siberian prawns (*Exopalaemon modestus*) that were sampled for the season. All incidental species sampled were bypassed to the tailrace excluding the Siberian prawns, which were humanely euthanized and disposed of. Table 11 summarizes incidental species sampled for the 2019 to 2023 seasons.

Table 11. Number of Incidental Species Sampled, 2023–2019.

Common Name	Species Name	2023	2022	2021	2020	2019
American Shad (Adult)	*Alosa sapidissima*	0	1	3	1	15
American Shad (Juvenile)	*A. sapidissima*	456,369	62,434	21,062	99,457	526,392
Banded Killifish	*Fundulus diaphanus*	6	9	36	10	6
Bass, Largemouth	*Micropterus salmoides*	2	0	1	1	2
Bass, Smallmouth	*M. dolomieu*	215	675	231	332	239
Bluegill/Pumpkin Seed	*Lepomis* spp.	10	4	6	26	8
Bridgelip Sucker	*Catostomus columbianus*	0	0	0	0	0
Bullhead	*Ameiurus* spp.	8	13	19	4	9
Channel Catfish	*Ictalurus punctatus*	12	9	2	5	10
Chinook Salmon (Mini-Jack)	*Oncorhynchus tshawytscha*	1	0	0	0	0
Common Carp	*Cyprinus carpio*	4	5	4	18	17
Crappie	*Pomoxis* spp.	1	7	1	3	1
Crayfish	*Pacifastacus* spp.	10	6	19	2	12
Kokanee	*O. nerka*	1	0	0	0	0
Dace, Longnose	*Rhinichthys cataractae*	1	9	1	1	7
Mountain Sucker	*C. platyrhynchus*	0	0	0	3	6
Mountain Whitefish	*Prosopium williamsoni*	21	8	0	6	6
Northern Pikeminnow	*Ptychocheilus oregonensis*	0	0	0	1	0
Pacific Lamprey (Adult)	*Entosphenus tridentatus*	9	5	1	0	6
Pacific Lamprey (Ammocoete)	*E. tridentatus*	0	7	0	5	2
Pacific Lamprey (Macropthalmia)	*E. tridentatus*	3,299	4,357	254	2,752	2,675
Peamouth	*Mylocheilus caurinus*	*0*	*0*	0	0	0
Sculpin	*Cottus* spp.	15	3	6	5	4
Siberian Prawn	*Exopalaemon modestus*	49	0	11	3	11
Speckled Dace	*R.osculus*	0	0	0	0	0
Steelhead (Clipped kelt)	*O. mykiss*	0	0	0	0	0
Steelhead (Unclipped kelt)	*O. mykiss*	0	0	0	0	0
Sturgeon	*Acipenser* spp.	0	0	0	0	0
Sucker	*Catostomus* spp.	2	0	0	1	0
Tench	*Tinca tinca*	0	0	0	1	0
Three-spine Stickleback	*Gasterosteus aculeatus*	36	86	90	81	13
Umatilla Dace	*R. umatilla*	0	0	0	0	0
Walleye	*Sander vitreus*	14	13	64	4	5
Yellow Perch	*Perca flavescens*	16	21	11	62	6
Annual Total		460,101	67,654	21,822	102,784	529,452

Adult Fallbacks

Since 2018, adult fish information is no longer included in the juvenile annual report. All adult fish data can be found in the U.S. Army Corps of Engineers Annul Fish Passage Report.

Separator Efficiency

Historically, when McNary Dam was included in the Juvenile Fish Transportation Program, separator efficiency was monitored to measure the percentage of sampled smolts segregated into the desired sample holding tank. In 2013, McNary Dam was no longer included in the transportation program

(switched to 100% bypass), but separator efficiency monitoring continued through 2018. Beginning in 2019, separator efficiency was no longer monitored.

FISH CONDITION

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 as descaled. Clipped sockeye salmon had the highest descale rate (9.1%) for the 2023 season, and clipped subyearling Chinook salmon had the lowest descaling rate (0.5%). Weekly descaling rates for all juvenile salmonids examined in 2023 are summarized and compared to the 4-year average (2019 to 2022) in Table 12. The descaling rate for all species combined was 1.1% for the season (124 descaled salmonids out of 11,270 examined for descaling; Table 13).

Other Injury and Disease

Subsamples of up to 100 smolts per species from the daily sample were examined for conditions including injuries, diseases, and predator marks. All individuals of a species were examined from the sample if 100 or fewer individuals were present. Injuries included recently acquired damage to the head, eyes, body, and fins, possibly attributable to dam operations. Diseases included fungus, *Columnaris*, bacterial kidney disease, parasites, and deformities of the spine, operculum, or other body parts. Predator marks included injury or marks consistent with scratches or bites from birds, fish, or lamprey. Conditions reported here do not include descaling because descaling was calculated separately for all sampled smolts.

Out of 7,174 smolts examined for injuries, disease, and other conditions in the subsample, 6.5% were observed with at least one condition and 1.4% had multiple conditions. Prevalence of conditions in examined fish for 2023 is summarized in Table 14. Disease was present in 2.2% of fish examined. The trematode parasite responsible for blackspot, the most common disease noted, affected 1.2% of smolts examined. Out of the 157 smolts with disease noted, 88 were marked as having the trematode parasite (56.1%). Blackspot was most predominant in subyearling Chinook salmon, with all 88 fish marked being subyearling Chinook. The number and percentage of smolts observed with disease by species is summarized in Table 15. Injuries were observed in 1.7% of smolts. Unclipped steelhead experienced the highest injury rate at 4.0%, followed by unclipped yearling Chinook salmon (2.4%), and unclipped sockeye (1.9%). The numbers and percentage of injuries by species is summarized in Table 16. Predator marks were present in 1.3% of smolts, with bird and lamprey marks being the most prevalent predator mark observed, both occurring on 0.6% of fish examined. Steelhead were observed to have the highest rate of predator marks of all species examined at roughly 3.8% combined, largely attributed to birds and lamprey. Table 17 summarizes the number and type of predator mark sustained by species in 2023.

Table 12. Weekly Descaling in Percentages & Descaled Examined Fish Count, 2023–2019.

Weekly Descaling in Percent and Actual Count of Descaling																	
2023 Week Ending Date	Current YR	Yearling Chinook		Subyearling Chinook		Clipped Steelhead		Unclipped Steelhead		Coho		Clipped Sockeye		Unclipped Sockeye		Total	
Week Number	4 YR AVG (2019-2022)	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%
6-Apr	2023	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
1	AVG	39	4.1%	0	0.0%	20	5.0%	4	6.8%	1	8.3%	0	0.0%	0	0.0%	64	4.6%
13-Apr	2023	14	1.5%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	14	1.4%
2	AVG	18	4.0%	0	0.0%	30	13.7%	4	12.2%	1	5.5%	0	0.0%	1	5.6%	53	6.5%
20-Apr	2023	9	2.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	9	1.7%
3	AVG	15	3.1%	0	0.0%	52	16.5%	8	12.2%	2	2.8%	0	0.0%	0	2.8%	78	7.9%
27-Apr	2023	7	0.9%	0	0.0%	9	5.4%	1	3.4%	1	5.9%	0	0.0%	0	0.0%	18	1.9%
4	AVG	21	3.6%	0	0.0%	45	10.7%	7	11.8%	2	3.4%	0	0.0%	1	2.6%	76	5.9%
4-May	2023	9	1.6%	0	0.0%	7	1.7%	1	1.3%	0	0.0%	0	0.0%	0	0.0%	17	1.5%
5	AVG	32	3.9%	0	0.0%	29	12.8%	4	10.0%	2	2.5%	0	0.0%	6	2.6%	72	5.5%
11-May	2023	4	0.7%	0	0.0%	1	1.5%	1	7.7%	1	6.7%	0	0.0%	0	0.0%	7	0.9%
6	AVG	18	3.6%	0	0.0%	15	17.7%	4	16.4%	1	3.6%	0	0.0%	6	2.5%	43	5.4%
18-May	2023	6	3.4%	0	0.0%	0	0.0%	0	0.0%	1	7.1%	0	0.0%	1	3.7%	8	3.3%
7	AVG	24	4.0%	0	5.0%	8	15.7%	3	13.6%	1	3.1%	3	6.7%	8	3.2%	47	4.6%
25-May	2023	7	3.4%	0	0.0%	0	0.0%	1	5.9%	1	1.8%	2	9.1%	2	3.7%	13	2.3%
8	AVG	15	5.0%	1	1.9%	8	21.5%	3	13.1%	4	6.4%	3	12.6%	6	4.1%	39	5.9%
1-Jun	2023	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
9	AVG	9	7.9%	8	1.3%	6	22.0%	3	14.6%	3	3.4%	2	29.4%	4	3.2%	34	3.7%
8-Jun	2023	0	0.0%	2	0.4%	0	0.0%	1	20.0%	0	0.0%	0	0.0%	0	0.0%	3	0.6%
10	AVG	2	2.0%	9	1.5%	1	11.6%	1	6.3%	1	0.7%	0	0.0%	2	7.6%	15	1.9%
15-Jun	2023	0	0.0%	8	0.8%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	8	0.8%

Weekly Descaling in Percent and Actual Count of Descaling																	
2023 Week Ending Date	Current YR	Yearling Chinook		Subyearling Chinook		Clipped Steelhead		Unclipped Steelhead		Coho		Clipped Sockeye		Unclipped Sockeye		Total	
Week Number	4 YR AVG (2019-2022)	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%
11	AVG	1	5.1%	13	1.6%	1	28.8%	1	16.7%	1	8.8%	0	0.0%	1	9.0%	16	2.0%
22-Jun	2023	0	0.0%	2	0.3%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	2	0.3%
12	AVG	0	8.3%	9	0.8%	1	7.1%	0	0.0%	0	12.5%	0	0.0%	0	0.0%	10	0.8%
29-Jun	2023	0	0.0%	4	0.4%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	4	0.4%
13	AVG	0	6.3%	6	1.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	6	1.0%
6-Jul	2023	0	0.0%	6	0.7%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	6	0.7%
14	AVG	0	0.0%	4	0.5%	0	25.0%	0	0.0%	0	0.0%	0	0.0%	0	12.5%	5	0.6%
13-Jul	2023	0	0.0%	1	0.3%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	1	0.3%
15	AVG	0	0.0%	5	0.9%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	5	0.9%
20-Jul	2023	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
16	AVG	0	0.0%	6	1.3%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	25.0%	7	1.4%
27-Jul	2023	0	0.0%	1	0.5%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	1	0.5%
17	AVG	0	0.0%	14	1.7%	0	25.0%	0	0.0%	0	0.0%	0	0.0%	0	12.5%	15	1.7%
3-Aug	2023	0	0.0%	1	0.3%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	1	0.3%
18	AVG	0	0.0%	8	1.2%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	8	1.2%
10-Aug	2023	0	0.0%	1	0.8%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	1	0.8%
19	AVG	0	0.0%	4	2.2%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	4	2.2%
17-Aug	2023	0	0.0%	4	1.3%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	4	1.3%
20	AVG	0	0.0%	12	2.3%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	12	2.3%
24-Aug	2023	0	0.0%	4	2.6%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	4	2.6%
21	AVG	0	0.0%	7	4.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	7	4.0%
31-Aug	2023	0	0.0%	1	3.2%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	1	3.1%
22	AVG	0	0.0%	2	5.1%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	2	4.9%

Weekly Descaling in Percent and Actual Count of Descaling																	
2023 Week Ending Date	Current YR	Yearling Chinook		Subyearling Chinook		Clipped Steelhead		Unclipped Steelhead		Coho		Clipped Sockeye		Unclipped Sockeye		Total	
Week Number	4 YR AVG (2019-2022)	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%
7-Sep	2023	0	0.0%	1	8.3%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	1	8.3%
23	AVG	0	0.0%	2	4.1%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	2	4.1%
14-Sep	2023	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
24	AVG	0	0.0%	0	0.3%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.3%
21-Sep	2023	0	0.0%	1	50.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	1	50.0%
25	AVG	0	0.0%	1	8.6%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	1	8.6%
28-Sep	2023	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
26	AVG	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
5-Oct	2023	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
27	AVG	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%

Table 13. Season Total and Percent Descaled Salmonids by Species, 2023

Species	Yearling Chinook		Subyearling Chinook		Steelhead		Coho		Sockeye		Total
Clip Type	Clip	Unclip	Clip	Unclip	Clip	Unclip	Clip	Unclip	Clip	Unclip	
Total	48	8	12	25	17	5	1	3	2	3	124
Percent	1.4%	1.4%	0.5%	0.7%	2.3%	2.9%	1.2%	2.3%	9.1%	1.4%	1.1%

Table 14. Summary of Smolt Conditions Excluding Descaling in Subsample, 2023

	Yearling Chinook				Subyearling Chinook				Steelhead				Coho				Sockeye				Annual Total	
	Clip		Unclip		Clip		Unclip		Clip		Unclip		Clip		Unclip		Clip		Unclip			
	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%
Total Conditions	71	3.6%	19	5.6%	48	4.3%	271	10.3%	37	6.7%	10	7.9%	0	0.0%	5	3.9%	0	0.0%	7	3.2%	468	6.5%
	90				319				47				5				7					
Smolts with Conditions	68	3.5%	17	5.0%	43	3.8%	183	7.0%	35	6.3%	9	7.1%	0	0.0%	4	3.1%	0	0.0%	7	3.2%	366	5.1%
	85		3.7%		226		6.0%		44		6.4%		4		1.9%		7		2.9%			
Total Fish Examined	1,952		340		1,122		2,625		559		126		84		128		22		216		7,174	
	2,292				3,747				685				212				238					

Table 15. Number and Percentage of Smolts Observed with Disease in Subsample, 2023

	Yearling Chinook				Subyearling Chinook				Steelhead				Coho				Sockeye				Total	
	Clip		Unclip		Clip		Unclip		Clip		Unclip		Clip		Unclip		Clip		Unclip			
	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%
Total	20	1.0%	6	1.8%	8	1.0%	112	1.8%	8	1.4%	1	0.8%	0	0.0%	1	0.8%	0	0.0%	1	0.5%	157	2.2%
	#		%		#		%		#		%		#		%		#		%			
	26		1.1%		120		3.2%		9		1.3%		1		0.5%		1		0.4%			

Table 16. Number and Percentage of Smolts Observed with Injury in Subsample, 2023

	Yearling Chinook				Subyearling Chinook				Steelhead				Coho				Sockeye				Total	
	Clip		Unclip		Clip		Unclip		Clip		Unclip		Clip		Unclip		Clip		Unclip			
	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%
Total	32	1.6%	8	2.4%	20	1.8%	48	1.8%	7	1.3%	5	4.0%	0	0.0%	2	1.6%	0	0.0%	4	1.9%	158	2.2%
	#		%		#		%		#		%		#		%		#		%			
	40		1.7%		68		1.8%		12		1.8%		2		0.9%		4		1.7%			

Table 17. Number and Percentage of Smolts Observed with Predator Marks in Subsample, 2023

Predator Mark	Yearling Chinook				Subyearling Chinook				Steelhead				Coho				Sockeye				Total	
	Clip		Unclip		Clip		Unclip		Clip		Unclip		Clip		Unclip		Clip		Unclip			
	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%
Bird	11	0.6%	2	0.6%	2	0.2%	1	0.0%	20	3.6%	3	2.4%	0	0.0%	1	0.8%	0	0.0%	0	0.0%	40	0.6%
Fish	8	0.4%	1	0.3%	0	0.0%	6	0.2%	0	0.0%	1	0.8%	0	0.0%	0	0.0%	0	0.0%	1	0.5%	17	0.2%
Lamprey	0	0.0%	2	0.6%	13	1.2%	24	0.9%	2	0.4%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	1	0.5%	42	0.6%
Total	#		%		#		%		#		%		#		%		#		%			
	19	1.0%	5	1.5%	15	1.3%	28	1.1%	22	4.0%	4	3.2%	0	0.0%	1	0.8%	0	0.0%	2	0.9%	96	1.3%
	24		1.0%		43		1.1%		26		3.8%		1		0.5%		2		0.8%			

Mortality

Total facility mortality is composed of mortalities found in the separator, sample tanks, and the sample recovery raceway, and is expressed as the mortality rate for the number of fish collected. Total facility mortality for all species combined was less than 0.1% (0.03%) in 2023. The highest monthly total mortality rate of 0.38% occurred in August. Monthly and annual total facility mortality for 2023 is summarized in Table 18.

Sample mortality is composed of the mortalities found in the sample tank. The mortality rate of the sample population for all species combined was 0.8% in 2023. Subyearling Chinook salmon had the highest number of sample mortalities at 59 fish for the season. The highest monthly sample mortality rate was in September at 1.9%. Monthly and annual sample mortality for 2023 is summarized in Table 19. A weekly comparison of 2023 and the average mortalities for the last 4 years is presented in Table 20. The first week of sampling for 2023 ended on April 6, and the final week for the season ended on October 5, with the final sample being conducted on September 30.

Table 18. Monthly and Total Facility Mortality, 2023

Month	Yearling Chinook				Subyearling Chinook						Steelhead				Coho				Sockeye				Total	
	Clip		Unclip		Clip		Unclip		Fry		Clip		Unclip		Clip		Unclip		Clip		Unclip			
	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%
April	10	<0.1%	4	0.1%							4	<0.1%	1	0.1%									19	<0.1%
May	22	<0.1%	2	<0.1%	1	<0.1%			3	<0.1%	4	<0.1%									1	<0.1%	33	<0.1%
June	1	0.2%	2	0.9%	13	<0.1%	10	<0.1%															26	<0.1%
July					26	0.1%	38	0.1%															64	0.1%
August							15	0.4%															15	0.4%
September							1	0.4%															1	0.4%
Total	33	<0.1%	8	<0.1%	40	<0.1%	64	<0.1%	3	<0.1%	8	<0.1%	1	<0.1%							1	<0.1%	158	<0.1%
	41		<0.1%		107		<0.1%				9		<0.1%						1		<0.1%			

Note: Blanks indicate no facility mortalities.

Table 19. Monthly and Total Sample Mortality for 2023 Season

Month	Yearling Chinook				Subyearling Chinook						Steelhead				Coho				Sockeye				Total	
	Clip		Unclip		Clip		Unclip		Fry		Clip		Unclip		Clip		Unclip		Clip		Unclip			
	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%
April	6	0.3%	4	1.1%							3	0.6%	1	0.9%									14	0.4%
May	15	1.5%	2	1.0%					3	0.7%	2	0.8%									1	0.5%	23	0.9%
June	1	5.6%	2	25.0%	11	0.6%	7	0.6%															21	0.7%
July					16	3.9%	17	1.2%															33	1.8%
August							4	0.5%															4	0.5%
September							1	1.9%															1	1.9%
Total	22	0.7%	8	1.4%	27	1.1%	29	0.8%	3	0.6%	5	0.7%	1	0.6%							1	0.5%	96	0.8%
	30		0.8%		59		0.9%				6		0.7%		0		0.0%		1		0.5%			

Note: Blanks indicate no sample mortalities.

Table 20. Weekly Mortality in Percentages and Sample Tank Mortality Count, 2023–2019

Weekly Mortality in Percent and Actual Count of Sample Tank Mortality																	
2023 Week Ending Date	Current YR	Yearling Chinook		Subyearling Chinook		Clipped Steelhead		Unclipped Steelhead		Coho		Clipped Sockeye		Unclipped Sockeye		Total	
Week Number	4 YR AVG (2019-2022)	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%
6-Apr	2023	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
1	AVG	6	0.7%	0	0.0%	1	0.1%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	7	0.5%
13-Apr	2023	3	0.3%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	3	0.3%
2	AVG	2	0.2%	0	1.1%	1	0.4%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	3	0.2%
20-Apr	2023	1	0.2%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	1	0.2%
3	AVG	2	0.2%	0	1.2%	0	0.1%	1	1.2%	1	1.4%	0	0.0%	0	0.0%	4	0.3%
27-Apr	2023	4	0.5%	0	0.0%	3	1.8%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	7	0.7%
4	AVG	2	0.3%	0	0.0%	2	0.6%	0	0.0%	0	0.0%	0	0.0%	0	0.5%	4	0.4%
4-May	2023	4	0.7%	0	0.0%	2	0.5%	1	1.3%	0	0.0%	0	0.0%	0	0.0%	7	0.6%
5	AVG	2	0.2%	2	11.1%	1	0.5%	0	0.0%	1	1.3%	0	0.0%	2	0.8%	7	0.4%
11-May	2023	10	1.8%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	1	1.0%	12	1.4%
6	AVG	2	0.4%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	1	0.2%	3	0.2%
18-May	2023	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	1	0.2%
7	AVG	1	0.1%	2	1.3%	0	0.5%	0	0.0%	0	0.0%	0	0.0%	1	0.1%	5	0.2%
25-May	2023	4	1.9%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	4	0.6%
8	AVG	1	1.0%	3	0.2%	0	0.0%	0	0.0%	0	0.4%	0	12.5%	0	0.0%	5	0.3%
1-Jun	2023	1	14.3%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	2	1.4%
9	AVG	2	1.3%	2	0.3%	0	0.0%	0	0.0%	1	0.8%	0	0.0%	1	0.3%	5	0.4%
8-Jun	2023	3	16.7%	3	0.6%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	6	1.1%
10	AVG	1	2.6%	4	0.8%	0	7.7%	0	0.0%	1	10.3%	0	0.0%	0	0.0%	6	1.1%
15-Jun	2023	0	0.0%	2	0.2%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	2	0.2%
11	AVG	0	0.0%	4	0.5%	0	0.0%	0	5.9%	0	0.0%	0	0.0%	0	0.0%	4	0.5%
22-Jun	2023	0	0.0%	6	1.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	6	1.0%
12	AVG	0	3.0%	3	0.3%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	3	0.3%
29-Jun	2023	0	0.0%	7	0.7%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	7	0.7%
13	AVG	0	0.0%	4	0.4%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	4	0.4%
6-Jul	2023	0	0.0%	18	2.1%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	18	2.0%

Weekly Mortality in Percent and Actual Count of Sample Tank Mortality																	
2023 Week Ending Date	Current YR	Yearling Chinook		Subyearling Chinook		Clipped Steelhead		Unclipped Steelhead		Coho		Clipped Sockeye		Unclipped Sockeye		Total	
Week Number	4 YR AVG (2019-2022)	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%
14	AVG	0	0.0%	6	1.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	6	1.0%
13-Jul	2023	0	0.0%	7	1.8%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	7	1.8%
15	AVG	0	0.0%	10	1.2%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	100.0 %	11	1.2%
20-Jul	2023	0	0.0%	5	2.1%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	5	2.0%
16	AVG	0	0.0%	6	0.9%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	6	0.9%
27-Jul	2023	0	0.0%	1	0.5%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	1	0.5%
17	AVG	0	0.0%	3	0.4%	0	50.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	3	0.4%
3-Aug	2023	0	0.0%	2	0.6%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	2	0.6%
18	AVG	0	0.0%	8	1.3%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	8	1.3%
10-Aug	2023	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
19	AVG	0	0.0%	5	1.2%	0	0.0%	0	0.0%	0	100.0 %	0	0.0%	0	0.0%	5	1.2%
17-Aug	2023	0	0.0%	3	0.9%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	3	0.9%
20	AVG	0	0.0%	9	3.6%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	9	3.6%
24-Aug	2023	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
21	AVG	0	0.0%	7	4.2%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	7	4.2%
31-Aug	2023	0	0.0%	1	3.1%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	1	3.0%
22	AVG	0	0.0%	1	0.4%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	1	0.5%
7-Sep	2023	0	0.0%	1	7.7%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	1	7.7%
23	AVG	0	0.0%	1	0.6%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	1	0.6%
14-Sep	2023	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
24	AVG	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
21-Sep	2023	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
25	AVG	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
28-Sep	2023	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
26	AVG	0	0.0%	1	11.1%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	1	7.7%
5-Oct	2023	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
27	AVG	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%

JUVENILE RESEARCH

Gas Bubble Trauma Monitoring

PSMFC conducted gas bubble trauma (GBT) examinations as part of the Smolt Monitoring Program from April 11 to August 1. Examinations were done twice per week up to July 18 and once per week for the remaining 3 weeks. A combination of up to 100 juvenile Chinook salmon and steelhead were collected from the separator and inspected for GBT.

In 2023, 2,832 smolts were examined for GBT. Signs of GBT were seen in 11 smolts: 1 clipped yearling Chinook salmon and 4 clipped and 6 unclipped subyearling Chinook salmon. Gas bubble trauma monitoring for the year is summarized in Table 21.

Table 21 Gas Bubble Trauma Monitoring, 2023

ANNUAL	Yearling Chinook		Subyearling Chinook		Steelhead		Clip Type Totals		Annual Total
	Clip	Unclip	Clip	Unclip	Clip	Unclip	Clip	Unclip	
Collected	923	116	704	827	216	46	1,843	989	2,832
GBT Signs	1	0	4	6	0	0	5	6	11

FACILITY OPERATIONS AND MAINTENANCE

Bypass Operations

To start the year, the system remained in emergency bypass due to severe winter weather. Orifices were closed on January 5. The facility was already dewatered.

After winter maintenance, primary bypass began on March 27. All systems were watered up, tested, and cleaned. The channel systems were fully functional. The facility systems remained out of service until April 2 at 0700 hours, at which time secondary bypass for sample collection began. The season consisted of 24-hour alternating days of primary and secondary bypass. During secondary bypass, samples were collected. For the season, the sample gates were only on during sample collection.

Listed below are deviations outside the alternating schedule:

The system was in primary bypass for less than one minute on May 10 to examine the transport flume behind the separator for a future PNNL juvenile lamprey study. No sampling was missed. After, the separator adult release flush line had to be reset.

The system was switched into secondary bypass for 10 minutes with the sample gates off on May 17 for a WDFW tour.

The system was switched to primary bypass mode for the fall bypass season on September 30, at 0700 hours. During the fall primary season, partial winterization occurred along with light maintenance and preparations for the winter outage. To enhance maintenance, the facility was dewatered by closing the facility water supply lines and adjusting the juvenile channel system on October 15, which will be discussed below in that section.

The juvenile system was switched from primary to emergency bypass mode on December 13, just after ESBS removal began. Channel maintenance began.

With the last set of ESBSs being raised, the channel orifices were closed for the season and the channel was winterized on December 19.

Turbine Operations

The one percent hard criteria for unit operation ran from April 10 to August 31, inclusive. We have no records of units running outside the constraint for long periods of time. We saw only short test runs of units returning to service along with slight variances which occurred during the season.

The project ran units outside the constraint at the BPA's request during the soft one percent criterion from September 1 to April 9.

Unit priority was in effect from March 1 to November 30.

After testing, the wicket gates were inadvertently left open with headgates down in units 11 and 12 from May 19 to 22. During this period, sturgeon and/or channel catfish could have possibly swum from the draft tube to the lower scroll case. After discussion, it was determined the best way to evacuate any possible fish in the scroll case was when the units were briefly spun for testing in speed no load on May 24. During the testing, the tailwater was observed and no problems were noted. We will ensure the wicket gates remain closed during any future control system upgrades in other units.

Unit 11 run testing occurred on May 30 to 31. Per FPP Appendix A, the testing occurred with no ESBS's installed. Other units were moved into and out of standby during the testing and other work.

Unit 12 run testing occurred on June 6 to 7. Per FPP Appendix A, the testing occurred with no ESBS's installed. Other units were moved into and out of standby during the testing.

Units 13 and 14 were briefly run tested on November 9 to 10. Per Appendix A, the testing occurred with no ESBS's installed. Other units were moved into and out of standby during the testing.

Unit 12 was in standby on November 16, from 0632 to 1644 hours.

To reduce heat stress, the saw tooth pattern (an alternating pattern of units on/off) was in effect from July 2 to September 26, inclusive. Possible heat stress mortality will be discussed later in this report.

Water Temperature Monitoring

Temperature probes were deployed on June 12 to 14. Temperature monitoring by the smolt monitoring contractor occurred from June 15 to August 31. The smolt monitoring staff published separate daily, weekly, and annual reports. Any issues with the temperature monitoring system were published in these reports.

Spill Operations

Before the spring spill season, spill recorded in March was for adult fallback passage over the top spillway weir (TSW) in bay 20. The spring spill program, recorded in the 2023 Fish Passage Plan (FPP) and related memorandums, was from April 10 to June 15. The summer spill program, with 57 percent of flow being spilled, was from June 16 to August 14 and 20 kcfs being spilled from August 15 to 31. However, higher, or lower spill volumes can occur due to flow volumes, generation requirements, and spill adjustment conducted at midnight. Also, during the spill seasons, spill adjustments for navigation were made as required. After the spill season, the TSW in bay 20 was operated for the adult fallback season. During the fall, spillway hoist and crane maintenance was performed. However, some maintenance occurred throughout the year. Slight spill may have occurred during hoist or crane testing.

A fire in the debris along the spillway was reported on June 17, at 1458 hours. Due to strong winds, the fire department was unable to extinguish the fire. An emergency spill was performed by opening bay 7 fully (had been at 2 stops) from 1532 to 1632 hours. This allowed the debris to pass downstream into the tailrace and extinguished the fire. No cause to the fire was determined.

Due to the unit 11 outage, flow exceeded powerhouse capacity, so spill was increased to approximately 33 kcfs on August 17, from approximately 1300 to 1700 hours. Alterations in the spill schedule due to crane and hoist issues along with debris spill will be discussed in the next two sections below.

Spillway Cranes 6 and 7

Repairs to cranes 6 and 7 were completed. Crane 6 received a new motor. However, due to their age and the importance of these cranes, they were only used to adjust spillgates without a hoist as outlined in the 2023 Fish Passage Plan and related memorandums.

Cranes 6 and 7 were attached to bays 6 and 2, respectively, and were used to open both bays on April 10. Due to safety concerns, the cranes can only be used to open and close the gates once per year (perform two overloaded engineered lifts per spillway crane without violating applicable codes) per the January 26th, 2023, Walla Walla District Design Section memorandum. Also, we were unable to adjust spillway gates 2 and 6 for flow this season. Bays 2 and 6 were set at 4 and 6 feet, respectively. Later in April, we discovered cranes 6 and 7 had each used their second lifts for the year on April 12 and 18, respectively. At that point, we could not perform an overloaded lift again until April 2024. However, in late July, District personnel informed project staff that cranes 6 and 7 could be used to perform a third critical lift to close bays 2 and 6. This closure occurred when the spill flow was reduce from 57 percent to 20 kcfs.

The spill was reduced to 20 kcfs on August 15 at 0100 hours with bays 2, 4 and 6 left open. Crane operators began work in bays 2 and 6 on August 15 at 0800 hours. First, bay 6 was set to split leaf to spill the remaining debris along the spillway. Then bays 2 and 6 were closed with the cranes (the control room operator closed bay 4) as bays 14, 15, 18, 19, and 20 were opened per FPP Table MCN-9 for 20 kcfs. The full closure and opening of bays were done by approximately 0900 hours.

Maintenance and rehabilitation began on crane 7 in November and will carry through the winter along with crane 6 maintenance.

Spillway Hoist, Gates & Dogging Assemblies

All hoist maintenance was completed fall of 2022, through the winter, and into the fall of 2023. One hoist with a broken coupler was repaired. The hoist that was in bay 6 remained out of service for repairs to start the season. Crane 6 was used in bay 6. Spill pattern adjustments were made for issues outlined below. The required spill volume was evenly distributed through the remaining open bays during the work. The auto/manual spill pattern per FPP was used in 2023.

Over the winter, weld cracks were found in the gate's downstream dogging assembly in bay 16. To start the season, bay 16 remained closed since the gate could not be raised. After inspections and repairs were completed, it was discovered on May 2 that the anchor points for each mechanism was highly eroded and would require repair before the mechanisms could be reinstalled. To repair the anchor points, the two adjacent bays (15 and 17) were closed from May 2 at 0745 hours to May 3 at 0836 hours as part of the safety protocol. The bays were supposed to be reopened on May 2 at 1700 hours. However, the bays were left closed overnight due to miscommunication. The bays were again closed on May 4 from 0731 hours to 1646 hours. Bays 15 and 17 were closed from 0711 to 1411 hours on May 8, from 0644 to 1700 hours on May 9, and from 0638 to 1557 hours on May 10. Since bay 17 was an auto bay for the May spill

pattern, bay 18 was switched to automatic mode when bay 17 was closed. After the anchor repairs were done and the dogging assembly installed, bay 16 remained closed until the hoist mentioned above could return to service.

The hoist mentioned above was installed in bay 16 on June 15. However, more work on the hoist was required. Bays 15 and 17 were closed for work in bay 16 from 0945 to 1620 hours on May 10 and from May 11 at 0704 hours to May 13 at 1425 hours. Due to low flow, the bays were inadvertently left closed overnight instead of being open during non-work hours. With bay 16 still being closed, bays 15 and 17 were closed from 0751 to 1550 hours on July 17. Bays 15 and 17 were closed from 1245 to 1410 hours on July 18. The hoist and bay 16 returned to service and opened that day at 1410 hours.

Another hoist failure occurred on July 13. During an operational check of spillway bay 20, it was observed that the hoist was not holding the gate and the gate was drifting down after the hoist stopped. After the gate slipped down and automatically raised twice, the hoist dropped the load about 1/2 feet down to seal at 1645 hours, where the gate remained. A brake failure was the most likely explanation. The gate and hoist were removed from service with the bay closed while the cause for the dropped gate was investigated. While bay 20 was closed, bay 21 was selected as an auto bay replacement.

With bay 20 closed, hoist inspection and brake replacement began on July 17. Bays 19 and 21 were closed that day from 1448 to 1544 hours. Bays 19 and 21 were closed from 1007 to 1617 hours on July 18. The hoist and bay 20 returned to service and opened at 0818 hours on July 19. All hoists were now functional.

Bays 14 and 15 were closed, and bay 10 was open from approximately 1000 to 1600 hours on August 15 for spillgate work in bay 15. Again, for spillgate work, bays 14 and 15 were closed with bays 11 and 12 opened at approximately 0700 hours on August 16. Due to miscommunication, the bays were not swapped back until approximately 1330 hours on August 20.

In late July, funding came in for repairing the spillgate dogging assemblies. The removal of the dogging assemblies from the bays is described below. All assemblies were downstream except bay 21, which was upstream.

Bays 1, 3, and 4 were closed at 0655 hours on July 27. The gate in bay 6 was set to split leaf at 0741 hours and the gate in bay 1 was set to split leaf at 0830 hours to spill debris. Debris was spilled from bays 1 and 6 from 0830 to 1010 hours then bays 3, 4, and 6 were returned to normal service at 1029 hours. Bay 1 was on seal and removed from service at 1029 and 1206 hours to prepare it for dogging assembly removal. Bay 4 replaced bay 1 in the spill pattern. To facilitate more preparations and to move stored spillgate sections, bays 15, 16, and 17 were on seal from 1207 to 1307 hours, bays 19, 20, and 21 were on seal from 1307 to 1438 hours, and bays 3 and 4 were on seal from 1537 to 1602 hours. With bay 1 out of service, the dogging assembly was removed on July 29. The assembly for bay 1 was reinstalled on September 20, returning the bay to service.

Bays 3 and 4 were closed at 0721 hours on July 28. Bay 4 was reopened, and bay 3 was removed from service at 1050 hours. Flow from bay 3 was made up by the auto hoist bays. Bay 4 was closed from 1305 to 1548 hours on July 31 to remove gate sections from bay 3. Bay 4 was closed from 0839 to 1344 hours on August 1 for dogging mechanisms removal in bay 3. When bay 4 was closed, spill was moved to bay 5

and the automatic bays, on July 31 and August 1, respectively. Bay 3's dogging assembly was reinstalled on September 23, returning the bay to service.

As part of the spillgate dogging mechanism rehabilitation, bay 20 was closed and bay 12 was opened from approximately 0730 to 1630 hours on August 23 to remove the upstream dogging devices in bay 21. The operation was repeated from approximately 0730 to 1000 hours on August 24. Since this was the upstream dogging assembly, bay 21 remained available for service. The north and south side upstream dogging assemblies were reinstalled in bay 21 on October 3 and October 20, respectively.

With spill season over, the dogging assemblies in bay 2 and bay 9 were removed on September 29 and October 2, respectively. The dogging assemblies were reinstalled in bays 2 and 9 on October 20 and November 3, respectively. The downstream dogging assemblies were removed from bays 4 and 5 on October 26 and November 2, respectively. The assemblies were reinstalled in bays 4 and 5 on December 1.

New hoist power supply plugs were installed in November. The gate in bay 9 was repaired along with other gate maintenance and spillgate linkages during the winter outage. Other dogging assemblies will be rehabilitated as the winter workload allows. The plan is to rotate through the bays and repair one set of dogging mechanisms at a time.

Due to their overload issues, the hoists were put under the same operational restrictions as the cranes in early October. There are 20 spillway hoists, and all are overloaded. In the full gate (double leaf) configuration, 13 of the gates are loaded more than 125 percent of rated capacity, which prohibits their use per EM 385-1-1. The remaining seven hoists are overloaded between 100 and 125 percent of rated capacity. Only two Engineered Lifts are allowed for each of these hoists in a consecutive 12-month period. As a result, the 13 overloaded spillway hoists are limited to split-leaf operations and the seven hoists within the 100 to 125 percent of capacity are to be left closed in reserve in case their two engineered lifts are needed to accommodate spill for flood events.

As part of the effort to find alternatives to the current spill pattern until hoist issues are resolved, a test was conducted with split leaf configurations on October 19. First, the TSW was opened from 1005 to 1101 hours. The flow over the TSW will be used as a baseline. Next, bay 8 was opened split leaf with the spill gates in the downstream slot, from 1147 to 1242 hours. Lastly, bay 9 was opened in split leaf with the spill gates in the upstream slot, from 1318 to 1422 hours. The TSW and bay 8 were opened with hoists. Bay 9 was opened with a crane. Bays 8 and 9 were opened to nine feet. Water quality monitoring, drone footage, and staff observations occurred during the testing. The fisheries staff watched the gull activity during this time and saw no difference in the bird behavior during the three phases of the test. Due to the testing, the average spill was 1.3 kcfs on October 19. Results from the testing appeared promising for the use of the split-leaf gates in the upstream slots. Split-leaf operation in the upstream bay slot was tested in bay 9 from 1025 to 1032 hours on November 6. Options for future spill were considered. However, project staff began taking steps to operate the spill with split leaf gates in the upstream slots for at least 13 bays, which will include hoists and the two cranes.

No smolt mortalities were observed in spillways 1 and 22 this year.

TSW's

The TSW in bay 20 was installed by February 23, and was used for spring adult fallback spill starting March 1. The TSW for bay 19 was installed from March 28 to 30. Limits were set on April 4. Both TSW's were attached to hoists. The spring fallback spill operation concluded on April 9. Both TSW's were opened for the spring spill season at 0001 hours on April 10.

Due to regional discussion, TSW closure and removal scheduled for June 8 was delayed. No problems occurred with the TSWs during the spill season. All Fish Passage Plan spill patterns were followed before, during, and after the TSW removal.

The TSWs in bays 19 and 20 were closed at 0825 hours on June 20. Work began in bay 19 and was completed on June 22 with a standard gate in place. Limits on the hoist were set on June 27. However, the spillway control program would not communicate with the hoist. After two days of no success with the program, the bay was opened manually at 1509 hours on June 29.

Bays 19 and 20 remained closed during the TSW removal and install of standard gates (bay 16 was currently closed). Bays 5 and 7 were closed from 0825 to 1349 hours on June 20 to retrieve gate parts from bay 6, which was dogged open. Bays 14, 15, 17, and 18 were closed at 1100 hours for work in bay 19. Due to miscommunication, these bays were left closed overnight and were not reopened until work was completed at 1545 hours on June 21. To retrieve gate parts from bay 13, bays 12 to 14 were closed from 0705 to 0805 hours on June 22. Bays 15, 17, and 18 were closed for work in bay 19 from 0705 to 1041 hours. In preparations to work in bay 20, bay 21 was closed at about 1100 hours. Bay 19 through 21 remained closed through the weekend. The TSW work mentioned above did reduce the debris alongside the spillway from heavy to light.

TSW removal and standard gate installation along with the hoist's limits being set in bay 20 occurred on June 26 and 27. The bay was opened at 1620 hours on June 27 per the current spill pattern.

After the TSW/standard gate work in bay 19, bays 19 through 21 remained closed through the weekend from June 22 to 26. Bays 19 and 20 remained closed during the TSW removal and install of a standard gate in bay 20 (bay 16 was closed). Bays 5 and 7 were closed from 0930 to 1545 hours on June 26 for work in bay 20 to retrieve gate parts from bay 6, which was dogged open. Bays 15, 17, and 18 were closed from 0730 to 1545 hours. Bay 21 was also opened at 1545 hours. Again, bays 5 and 7 were closed from 0645 to 0850 hours on June 27 to retrieve gate parts from bay 6, which was dogged open. Bays 18 and 21 were closed at 0654 hours. These gates and bay 20 were opened at 1620 hours.

For TSW preparations in bay 20, bays 19 and 20 were closed and bays 10 and 12 were opened on August 22, from approximately 1030 to 1500 hours. For the fall adult fallback season, the TSW for bay 20 was installed on August 30 and 31. Per RCC schedule, the TSW began to be used on September 1. When installing the TSW in bay 20, the spill of 20 kcfs had to be moved to northern bays. Bays 19 and 20 were closed with bays 16 and 17 opened on August 30 at 0700 hours. Bay 18 was closed and bay 14 was opened at 1100 hours. Bays 15, 16, and 17 were closed and bays 11, 12, and 13 were opened at 1400 hours. Bays 11, 12, and 13 were closed and bays 15, 16, 17, and 18 were opened after TSW testing on August 31 from 1500 to 1700 hours. The open bays were closed at the end of the spill season.

Due to a Washington Department of Transportation dive on the highway bridge piers, the TSW opening scheduled for Sunday, September 24 was moved to Monday, September 25.

The fall season concluded on November 15. The TSW in bay 20 will remain in place until the spring season, 2024.

Forebay Debris

During the winter, the powerhouse debris load was light to heavy. Incoming debris volume was minimal to light. Wind direction changes moved the debris from the powerhouse to the Oregon shoreline and back repeatedly.

For the season, wind directional changes continued to move tumbleweeds, woody material, and aquatic vegetation across the forebay from the spillway to the Oregon shoreline and back. Tumbleweeds occurred mostly in the spring. Woody material was throughout the season. Aquatic vegetation debris began in the summer and ran through late fall.

The forebay debris volume and location was affected by TSW use, the spill program, spillway maintenance, trash rack cleaning, and powerhouse operations. Over time, the debris was passed, removed, or dissipated.

Along the shorelines, the debris loads varied between minimal to heavy.

Powerhouse and spillway debris loads for the season are recorded in Table 22.

Table 22. Forebay Debris Loads

Month	Powerhouse	New Debris	Spillway	New Debris
Mar	Moderate-heavy	Minimal	Minimal	Minimal
Apr	Minimal-heavy	Minimal-very light	Minimal-very light	Minimal-very light
May	Minimal-moderate	Minimal-light	Minimal-heavy	Minimal-light
Jun	Minimal-light	Minimal-very light	Light-heavy	Minimal-very light
Jul	Minimal-light	Minimal-very light	Light-moderate	Minimal-very light
Aug	Minimal-light	Minimal-very light	Minimal-light	Minimal-very light
Sep	Minimal-moderate	Minimal	Minimal	Minimal
Oct	Minimal-moderate	Minimal	Minimal	Minimal
Nov	Minimal-moderate	Minimal	Minimal	Minimal
Dec	Minimal-moderate	Minimal	Minimal	Minimal

Forebay Debris Removal

Along the Washington shoreline, much of the debris was flush down the navigation lock as needed during the spring and summer months.

Some forebay debris would pass downstream or be removed when TSWs were in use, trash racks were cleaned, wind direction would change, and/or project operations were altered,.

Debris removal occurred during spillway adjustments as described in the Spillway Operations to TSW's sections above. June 17, June 20 to 22, July 27, and August 15 are the main dates debris was spilled.

Trash Racks

During the winter, trash rack differentials were checked at least weekly. No problems were observed. Seven slots were test cleaned and 15 yards of debris removed on January 12. No fish mortalities were noted.

Just before the ESBSs were installed, all trash racks were cleaned from March 27 to 29. There were 173 yards of debris removed. Again, no fish were observed in the debris.

For the season, we generally monitored the trash differentials daily. Trash racks were cleaned in units 1, 10, 13, and 14 on April 17 and 17.5 square yards of debris were removed. Next, trash racks were cleaned in units 1, 8, 9, 10, 13, and 14 on May 30 and 31. There were 20 square yards of debris removed. Finally, the trash racks in units 1, 7, 8, and 9 were cleaned on June 27. There were 2.0 square yards of debris removed. No fish were observed in the debris, and the debris was mostly brush, woody and man-made material. Due to the high spill volume, very few units were operational during the trash rack cleanings.

Trash racks in station service unit 1 were cleaned on August 24. No debris or fish were observed. The racks in 1A slot were cleaned on September 13 to test the new intake deck crane. Minimal debris was recovered, and no fish were observed. Again, to test the new crane, the racks in 6B and 6C slots were cleaned on September 26. Three square yards of debris were removed, and no fish were noted.

No other cleaning occurred.

New trash racks will be delivered during the upcoming winter.

Gatewells

During the winter outage, no issues were observed in the gatewell slots, which were checked at least weekly.

During the season, gatewell slots were checked daily. Small amounts of woody material were removed as required and is listed below in Table 23 along with other issues. No large accumulations of woody material were noted. No oil was observed.

Units 12 to 14 gatewells slots were covered on June 15 for the new intake crane assembly but only unit 12 was online during the crane assembly. The gatewell in 7C slot was covered on June 22 for the transformer gasket contractor's trailer to be moved. Openings around the covers allowed for monitoring VBS differentials in unit 12 and 7C slot. Covers in unit 12 were removed from July 24 to 25 for VBS cleaning and ESBS camera inspections. The gatewell in 7C slot was uncovered on August 7 and briefly recovered on August 8 so a contractor trailer could be moved. The cover at 12A slot was removed on September 7. The covers in 12B and 12C slots were removed on September 11. The cover in 13A slot was removed on September 12. 13B and 13C slots were uncovered on October 4. The gatewell slots at unit 14 were uncovered on October 26.

Table 23. Gatewell Slot Observations

Date(s)	Issue Type	Location	Amount	Source/Solution
Apr 9, 13 & 19	Wood	Various Slots	Minimal	River/Removed
Apr 21 to 23	Wood	Various Slots	Minimal	River/Removed
Apr 28 & May 1	Wood	Various Slots	Minimal	River/Removed
May 9	Wood	Various Slots	Minimal	River/Removed
Jun 21 to 27	Algae bloom	Units 5 & 6/OOS	Surface	River/Dissipated
Jul 5 to Aug 3	Algae bloom	10A slot/OOS	Surface	River/Dissipated
Aug 6 to 16	Vegetation	Unit 10/OOS	Surface	River/Dissipated
Aug 6 to 15	Algae bloom	2B & 2C/OOS	Surface	River/Dissipated
Sep 21	Wood/Plastic	Various Slots	Minimal/Sheet	River/Removed
Sep 29	Wood	Various Slots	Minimal	River/Removed

In preparations to disassemble the old intake deck crane, the gatewell slots in unit 1 were covered on October 30. Again, there were gaps between the covers, which allowed for continued VBS differential monitoring. Disassembly of the old intake deck crane was completed on November 21. The gatewell slots in unit 1 were uncovered on November 22.

The new intake crane was used to test installation and removal of an emergency bulkhead in 5A slot from September 26 to 27. Again, the new intake deck crane was tested with an emergency bulkhead in unit 14 on October 20. Both units had been out of service for an extended period.

The assembly of the new crane and disassembly of the old crane made many tasks more difficult to complete during the season.

Extended-Length Submersible Bar Screens (ESBS)

During the winter maintenance season, electrical cables, gearboxes, and motors were replaced as required. ESBS control programming was also verified.

ESBS's were installed by unit priority, in units 2 through 8 and 14 from April 3 to 6. Unit 14's screens were installed early due to miscommunication about the order of install per the FPP. ESBS's were installed in units 1, 9, 10, and 13 from April 10 to 11. The screens in units 11 and 12 were installed before those units returned to service on June 2 and 8, respectively. The brush cycle time for all ESBS's was set at 60 minutes.

The ESBS's in units 9, 10, and 11 were out of service and raised on December 4 and 5. All other screens were raised for winter maintenance December 11 to 14.

From May 9 to December 5, the fisheries staff performed underwater camera inspections, starting about one month after ESBS installation. A new camera which was ordered last year was used all season. Camera inspection results are recorded in Table 24 below.

Table 24. ESBS Camera Inspection Results.

Date	Location	Issues
May 9	Units 13 & 14	None/Two smolt mortalities noted in unit 13
May 16	Units 8 & 9	None/One smolt mortality noted in unit 9
May 23	No inspections	Very few operational units
May 30	Units 1, 7 & 10	None
Jun 6	No inspections	Very few operational units
Jun 13	Units 13 & 14	None
Jun 20	Unit 8	None
Jun 27	No inspections	Deck traffic high
Jul 4	No inspections	Holiday
Jul 11	Units 7 & 9	None/ESBS in 7C not examined as slot covered
Jul 18	Units 4, 5 & 11	None
Jul 25	Units 1, 3 & 12	None
Aug 1	Unit 8	None
Aug 8	Units 7 & 9	None
Aug 15	Unit 5	Deck traffic high
Aug 29	Units 3 & 6	None
Sep 5	Units 1, 7 & 9	None
Sep 12	Units 10, 11 & 12	None
Sep 19	Units 2, 5 & 8	None
Sep 26	Units 1, 3 & 4	None
Oct 3	Units 7 & 9	None
Oct 10	Units 10, 11 & 12	None
Oct 17	Unit 1 & 8	None
Oct 24	Units 6, 7 & 9	None
Oct 31	Units 10 & 12	None
Nov 7	No inspections	Most ESBS's recently examined
Nov 14	Units 6, 7, 8, 10 & 12	None
Nov 21	Units 4, 5 & 9	None
Nov 28	Units 1, 2 & 3	None
Dec 5	Units 13 and 14	None

After the ESBS's were raised, an inspection revealed all ESBS's to be clean. During the year-end inspection, only juvenile shad were noted on top of each brush.

During the season, ESBS problems were mostly programming and electrical issues. Human error may have been involved. Gearbox, motor, brush drive, or coupler issues were minimal. Three ESBS's were replaced this season. No fish mortalities were noted during ESBS issues, which are recorded in Table 25 below.

The new ESBS control program will be tested during the winter maintenance season in unit 4.

Table 25. ESBS Issues.

Slot(s)	Date(s)	Issue
9B	Apr 10	Brush cycle failed/ESBS replaced next day
Unit 13	Apr 11	Found in manual mode/switched to automatic
Unit 6	Apr 15 to 17	No communication from control program to ESBS's/unit in standby/operator could run manually
Unit 1	May 16	Program adjustments/no problems
Unit 12	Jun 15	ESBS's briefly unplugged so slots could be covered
7C	Jun 22	ESBS briefly unplugged so slots could be covered
Unit 10	Aug 17	Manual mode for 16 hours/switched to automatic
10A & 10C	Aug 17	Brush cycles tripped and were reset
13A	Sep 13 to 15	Test new intake deck crane by raising ESBS/unit OOS
5A	Sep 26 to 27	Test new crane/remove ESBS/install bulkhead/unit OOS
Unit 1	Oct 30	ESBS's briefly unplugged so slots could be covered
Unit 1	Oct to Dec	Test new ESBS control program
Unit 13	Nov 1 to 15	ESBS's raised/brief testing after control system upgrades
Unit 14	Nov 2 to 15	ESBS's raised/brief testing after control system upgrades
13A	Nov 1	Brush cycle tripped alarm and was reset
14A	Nov 16	Brush bar issue/ESBS replaced
Unit 13	Nov 17	Brush cycle switched from manual to automatic/24 hours
13A	Nov 19 to 20	Brush cycle failed/ESBS replaced 11B ESBS/unit 11 OOS
14A	Nov 28	Brush cycle tripped multiple alarms/electrical staff reset

Vertical Barrier Screens (VBS)

No VBSs were replaced this season. All spare screens were available if needed.

Daily VBS head differential monitoring began with ESBS installation and continued until ESBS removal. The first VBS was cleaned on May 16, and the last screen was cleaned on November 28. Freshwater sponge was removed from the back side of VBSs as needed. Mesh retaining clips were reinstalled as required. VBS's cleaned by month and fish mortalities are recorded in Table 26. VBSs were cleaned as a preventative measure. One high differential was recorded in 7A slot at 72 MW on November 16. Reduced load demands along with units 13 and 14 returning to service resulted in a reduction in the differential, which restored it to criterion. The screen was cleaned on November 17. For the VBS in 1A slot, a three-foot section of mesh edge was reinstalled under the retaining stripe on August 24. There was no issue for fish as the problem was caught in time. The screen in 1A slot was raised but not cleaned for the new intake deck crane testing on September 13. No fish were observed. Unit 1's VBSs were cleaned before the gatewell slots were covered on October 30.

VBS inspections and cleanings are recorded in Table 27. Every VBS had been examined for cleaning and inspection this season.

Table 26. VBS Cleaning by Month (Debris & Freshwater Sponge Removal).

Month	Days	VBS's Cleaned	Measured 1.5 Feet or More	Lamprey Mortality	Live Lamprey	Smolt Mortality
Mar	None	None	None	None	None	None
Apr	None	None	None	None	None	None
May	3	10	None	111	None	8
Jun	2	8	None	1	None	None
Jul	3	6	None	None	None	3
Aug	4	7	None	None	None	None
Sep	2	3	None	None	None	None
Oct	4	15	None	None	None	None
Nov	5	16	1	None	None	None
Dec	None	None	None	None	None	None
Total	23	65	1	112	0	11

Table 27. VBS Inspections by Month.

Month	Days	VBSs Inspected	Lamprey Mortality	Live Lamprey	Smolt Mortality
Jul	2	9	None	None	None
Aug	4	15	None	None	None
Nov	1	3	None	None	None
Total	7	27	0	0	0

No serious problems were found during the VBS inspections with only mesh retaining clips being replaced and sponge being washed off the back side. No fish mortalities were observed. The VBS in 5B slot would have been cleaned if the inspection had not been scheduled on August 10. When reinstalling the VBS in 5C slot, the screen would not completely seat. The unit was removed from service for approximately one hour and a camera was used to inspect the screen guides, but no issue was found. After the inspection, the screen seated properly. The VBS in 7B slot would have been cleaned if the inspection had not been scheduled on August 15.

JCC Orifices and Collection Channel

The season began with 42 orifices opened on March 27, as primary bypass began. The orifice count remained consistent most of the year. The orifices in unit 11 were out of service and closed on October 15, so the facility supply line could be closed, and the facility could be dewatered for maintenance. This reduced the orifice count to 39 until December 12.

An attempt to switch from primary to emergency bypass occurred on December 12 from 1000 to 1538 hours. However, due to mechanical and electrical issues with the hoist that installs the emergency bypass stoplogs, completion of the switch was delayed. The system was left in a hybrid primary/emergency bypass with 57 orifices open (north orifices in units 1 to 5 along with the normal 42 south orifices) and the three floor dewatering valves closed. Water flowed out the primary full flow flume and the emergency bypass slots with the channel elevation controlled by the two side dewatering valves. The only issue was the screen cleaning brushes cycle sequence had to self-reset, which happened later.

After hoist repairs were completed from 0835 to 0958 hours on December 13, the switch to emergency bypass was fully completed with stoplogs installed. There were 42 orifices in use. The release valve at the end of the lower emergency bypass channel was lubricated on December 11. With station service unit 1 back in service, the full flow flume flush line was used during the two days of switching. Maintenance began in the channel control section on December 14. Emergency bypass concluded with orifice closure on December 19 and the start of winter maintenance.

Orifices were cycled once or twice a shift when in primary bypass or on day shift. Orifice issues are described in Table 28. Brief orifice exchanges occurred for trash rack cleaning, VBS cleaning and inspection, or ESBS camera inspections. No water was noted in the orifice operators' air supply line this year as the airline system desiccant drier worked well. Orifice attraction lights, area lighting, operator air, and oil leaks were repaired or replaced as required. No oil entered the water when working with oil reservoirs. Airline packing nuts were tightened. An electrical outlet was replaced on September 21. The fisheries staff monitored the JCC when the JFF was in primary bypass or on day shift when in secondary bypass, when cleaning VBSs, during VBS inspections, and when cleaning trash racks. At times, orifice adjustments and cycling resulted in brief high/low water alarms, which quickly reset. After each incident, we reviewed orifice cycling protocols. After all issues with the JCC system listed below, the fisheries staff would monitor the system. Three orifice blockages occurred this year.

Table 28. Orifice Issues.

Date	Issue	Result	Comment
Jun 11	7B slot orifice partially closed	Reduce orifice flow/blockage	Fortunately, unit in standby
Jun 23	7A slot orifice partial blockage	Reduced orifice flow/blockage	Immediately cleared
Jul 5 to 11	7A slot orifice partial blockage/2nd time	Immediately cleared	South orifice closed; north orifice opened
Jul 11	7A south orifice	Camera inspection	No obstruction found/south orifice reopened/north closed
Jul 23 to 27	8A south attraction light out	Switched to north orifice	Light repaired/ south orifice reopened/north closed
Jul 25	High water alarm	Improper orifice cycling	Protocol reviewed
Sep 13	1A orifice	Crane testing	Orifice adjusted as required
Sep 25 to 28	Units 5 & 6 orifices closed/units OOS	Crane testing	Makeup orifices open in units 4 & 7 for duration
Sep 28	Unit 4/one orifice	Found closed	Inadvertently left closed briefly/low water alarm
Oct 30	Flush floor dewatering valves	Adjusted orifices open and closed	45 minutes/did to help with water elevation fluctuations
Nov 9 to Dec 19	12B south light fixture failed/removed Nov 16	South orifice closed /north opened	North orifice open Nov 12 to 14 and Nov 19 to Dec 19/orifices inadvertently swapped
Nov 17	Orifices left open during VBS cleaning	Dewatering screens clogged	Brushes and air burst operated to clear screens

JCC Mortalities

One adult nonclipped steelhead morality was recovered in late March from the upper emergency bypass chamber. No other mortalities were observed. The jump barrier netting was reinforced and partially replaced in early March.

JCC Power Outages

Bus switchings resulted in brief power outages throughout the juvenile system with no ill effect on March 13 and 14. No other power outages were recorded for the JCC this season.

JCC Hoist & Tuggers

There were mechanical and electrical issues with the stoplog hoist from December 12 to 13, which delayed the switch to emergency bypass. Scheduled maintenance occurred on the hoist during the season and no other issues occurred. The two air tuggers, which are used to remove and install the emergency bypass covers, received scheduled maintenance on August 28.

JCC Primary Dewatering Structure (PDS)-Program and Alarms

The channel control program and systems were operational in automatic mode from March 27 to December 13. The control system continued to be monitored closely because of concerns over the program functionality. Programing, along with brush and water alarm issues, are reflected in this report in JCC sections above and below. When alarming, the three screen cleaning brushes will not operate. The channel's water elevation meter had no problems this year. Scheduled maintenance was performed on all JCC systems described below.

A typical number of water elevation alarms came in this season and are recorded in Table 29.

Table 29. Water Elevation Alarms.

Date	Alarm Type	Comment
Sep 3	1 High water	Cleared immediately/initially thought due to unit load change
Sep 15	None	Unusual fluctuations in water elevation noted
Sep 23	1 High water	No reason determined/fluctuations continue
Oct 7	1 Low water	Cleared immediately/maybe due to slow side dewatering valve response/ fluctuations continue
Oct 13	1 High water	Cleared quickly or side dewatering valves appeared to chase elevation Oct 13 to 19
Oct 14	2 High & 1 low	Elevation set point is 327.60 ft/fluctuations ran from 327.3 to 327.9 ft Oct 13 to 19
Oct 15	8 Mix high & low	High/low alarms come in at 0.2 ft plus/minus
Oct 16	13 Mix high & low	Fortunately, no sample collection was occurring in Oct
Oct 17	49 Mix high & low	Electrical staff examined the two side dewatering valves and the control program Oct 17 to 19

Table 29 continued.

Oct 18	5 Mix high & low	They adjusted the north valve to match the south valve's percentage open, this did help
Oct 19	4 Mix high & low	The north valve appeared to be binding at times especially when closing
Oct 20	6 Mix high & low	Like the comments above
Oct 21	1 High water	Electrical staff examined the two side dewatering valves and the control program Oct 23
Oct 22	55 Mix high & low	It appeared the brass gear that connects the drive motor to the north dewatering valve shaft needed replaced
Oct 23	30 Mix high & low	North valve removed from service Oct 24 0657 to 1045 hours/gear replaced & valve tested
Oct 24	16 Mix high & low	Alarms before gear was replaced
Oct 24	1 High water	After gear was replaced
Oct 25	5 Mix high & low	Alarms still more frequent than normal
Oct 26	11 Mix high & low	More examination of the system required
Oct 27	4 Mix high & low	Alarms cleared quickly
Oct 29	2 High & 1 low	Alarms less frequent but troublesome
Oct 30	None	East floor dewatering valve vibrations noted on Oct 26/all three floor dewatering valves flushed this date
Nov 5	3 High water	Still water alarms more frequent than normal after above work in comments
Nov 7	7 Mix high & low	Alarms are clearing quickly
Nov 8	1 High & 1 low	Mechanics and electricians examined the system
Nov 11	1 High & 1 low	Alarms continued to come in/clear quickly/less frequent
Nov 12	2 Low water	Still an issue that needs resolved
Nov 15	1 Low water	Alarms continued to come in/clear quickly/less frequent
Nov 17	1 Low water	Still an issue that needs resolved
Nov 20	1 Low water	Alarms continued to come in/clear quickly/less frequent
Nov 21	3 Low water	Still an issue that needs resolved
Nov 22	3 High water	Alarms continued to come in/clear quickly/less frequent
Nov 24	7 Mix high & low	Still an issue that needs resolved
Nov 28	Multiple alarms	Appears PLC lost power for 2 hours/no adverse effect on channel/recorded only in control room
Nov 29	2 High water	Alarms continued to come in/clear quickly/less frequent
Nov 30	4 High and 1 low	Still an issue that needs resolved
Dec 1	2 High water	Alarms continued to come in/clear quickly/less frequent
Dec 2	1 High water	Still an issue that needs resolved
Dec 11	1 High water	System will be examined this winter

JCC PDS-Rectangular/Transition Screens Air Burst System

The air burst system had no issues this year. Reduced powerhouse air supply for one hour on August 3 had no adverse effects. The air supply was briefly reduced so a second compressor could return to service on August 7 with no adverse effects. The air burst system has five functional zones with zone 6 still included in the cycle timing. The brushes were programmed to run in sequence (first side screen, next rectangular screen, and last transition screen) after a selected number of air burst cycles were completed. To start the season, the brushes cycled approximately every four hours. The brush cycle sequence was set to every six hours on April 2, where it remained for the remainder of the season. The air burst system was instrumental in keeping the screens clean during rectangular and transition screen cleaning brush issues.

JCC PDS-Rectangular Dewatering Screen Cleaning Brush

Before the season, the rectangular screen cleaning brush and limit switches were adjusted as required. The brush cycles for the rectangular and transition screens overlap, thus, both report sections can refer to each brush. The program is not supposed to allow them to run at the same time. Issues with the rectangular screen cleaning device are recorded in Table 30.

Table 30. Rectangular Screen Cleaning Mechanism Issues.

Date(s)	Problem	Resolution
Apr 27	Brush appears to be cycling longer/Possibly delaying start of transition brush	Brush cycle time and overall brushes cycle increased
May 23	Brush appears to be cycling longer/Possibly still delaying start of transition brush	Overall brushes cycle time increased
Jun 2	Brush appears to be cycling longer/Possibly still delaying start of transition brush	Retracting springs need tension adjustment
Jun 12	Brush appears to be cycling longer/Possibly still delaying start of transition brush	Spring tension adjusted/brush cycle time reduced
Jul 2	Brush tripped alarm/roving operator reset	No issues found
Jul 2	Brush stalled/tripped alarm/lowered but not moving downstream	Brush reset/OOS for about 3 hours
Jul 3	Brush examined by mechanics and electricians	Limit switches adjusted/may have caused earlier alarms
Nov 2	Brush tripped timing alarm	Brush finished cycle/possibly debris delayed
Nov 3	Due to previous alarm	Limit switches adjusted
Nov 17	Brush tripped timing alarm	Side brush delay/possibly debris/delayed all brushes
Dec 12	Attempt to switch to emergency bypass	Brush cycle sequence reset

JCC PDS-Side Dewatering Screen Cleaning Brush

The side screen cleaning brush received scheduled maintenance on June 20. The brush was out of service for three hours.

The side, rectangular, and transition screen brushes tripped the brush cycle timing alarms on November 17. It was assumed the side brush was delayed by debris, which tripped all three timing alarms. It appeared the side brush parked itself successfully, the alarms cleared, and the brush cycle sequence reset. The side brush limit switches were checked on November 19. The mechanics checked the side screen brush on November 21, and no issues were found. The sequential alarming and delays remain a concern.

JCC PDS-Transition Dewatering Screen Cleaning Brush

Before the season, the limit switches were adjusted. Issues with the transition screen cleaning device are recorded in Table 31. The air burst system kept the screen relatively clean when the brush was out of service, except for Zone 6.

Table 31. Transition Cleaning Mechanism Issues.

Date	Problem	Resolution
Mar 27	Failed latch pin sensor/new sensor ordered	Does not affect brush cycle sequence
Apr 17	Timing alarm/no issue found/could be cause by another brush	Latch pin alarm masked this alarm
Apr 20	Latch pin alarm	Disabled
Apr 23	Timing alarm/only recorded in channel/not control room	The next day no issue found/could have been cause by rectangular brush delay
May 5	Timing alarm/did alarm to control room	No issue found
May 22	Timing alarm/no issue found	Maybe related to rectangular brush delay
May 23	Previous timing alarms/failure to start	Brush cycle sequence adjusted
Jun 2	Timing alarm/no issue found/rectangular brush delay will time out transition brush	Related to rectangular brush delay
Jun 11	Timing alarm/failure to start/no issue found/brushes cycle later	Believed related to rectangular brush
Jun 12	Previous timing alarms/failure to start	Rectangular brush springs and brush cycle timing adjusted
Jul 2	One timing alarm (rectangular brush had alarm too)	Roving operator reset alarms
Jul 3	Previous timing alarms/failure to start/ second rectangular alarm reset by biologist	Rectangular brush limit switch adjusted/resolved transition brush timing issue also
Nov 2	Timing alarm/brush stalled on B beam/Rectangular alarmed too	Reset both brushes/electricians assumed rectangular brush delay stalled transition brush
Nov 3	Timing alarm/upstream raised on B beam/ brush reset	Mechanic cleaned limit switches on Nov 6
Nov 17	Timing alarm (all three brushes)/brush cycle sequence self-reset	Side brush delay caused delay in other two brushes
Dec 12	Attempt to switch to emergency bypass	Brush cycle sequence self-reset

JCC PDS-Side Screen Dewatering Valves (2)

During winter maintenance, no new problems were found. The dewatering valves are tied into the JCC programming and control the JCC water elevation. The valves normally operate with very similar percentage openings. Scheduled maintenance occurred on September 25. During that time, the isolation valve for the north side dewatering valve was found partially closed and was reopened. For the season, the two side dewatering valves were functional in automatic mode and operated well, except as outlined below.

When dropping from 42 to 39 orifices on October 15, the floor valves were adjusted to ensure the side dewatering valves remained the same percentage open. The side dewatering valves were examined during the water elevation alarms mentioned above starting on October 17 to 19. The north valves percentage open was adjusted, and the north valve appeared to be binding at times. The valves were again examined on October 23. The brass gear that connects the drive motor to the north valve's shaft appeared to be worn. The gear was binding on the shaft and not allowing the valve to adjust as quickly as normal.

The north side dewatering valve was removed from service on October 24 at 0657 hours. The gear was replaced, and the valve was returned to service at 0953 hours. The electrical staff completed testing the valve at 1045 hours, and all alarms were cleared. This did not fix all the problems with the water elevation alarms, but a quicker responding dewatering valve did help.

The two side dewatering valves were put in manual mode on October 30 from 1030 to 1115 hours To flush the three floor valves.

When having the primary/emergency bypass hybrid mode overnight from December 12 to 13, both side dewatering valves were in automatic to regulate the channel elevation. The valves were removed from service on December 13 with the start of emergency bypass.

JCC PDS-Floor Screen Dewatering Valves (3)

All three floor valves functioned properly at the start of the season. During the season, these valves were partially opened, and the actuators turned off as the valves only function as drains.

Orifices in unit 11 were closed on October 12 at 1015 hrs, to dewater the facility so the supply lines could be closed. This reduced the orifice count to 39. Unit 11 was out of service at the time. The system was returned to 40 operating orifices at 1126 hours. The system was still in primary bypass.

While looking for causes for the channel water elevation fluctuations, it was noted the east floor dewatering valve was vibrating, possibly due to a debris obstruction on October 26.

The two side dewatering valves were put in manual mode and all three floor valves were rotated fully opened to flush debris on October 30 from 1030 to 1115 hours. Extra orifices were opened and close to maintain channel elevation.

An attempt to switch from primary to emergency bypass occurred on December 12 from 1000 to 1538 hours. However, due to mechanical and electrical issues with the hoist, completion of the switch was

delayed. The system was left in a hybrid primary/emergency bypass with 57 orifices open and the three floor dewatering valves closed. Water flowed out the primary full flow flume and the emergency bypass slots with the channel elevation controlled by the two side dewatering valves. After hoist repairs were completed, the switch to emergency bypass was fully completed on December 13 from 0835 to 0958 hours.

A new harness anchor system was installed above the drain valve pit where the floor valves are on September 19. Harness attachment points were added to the two access ladder ways going down to the floor dewatering valves on November 21.

Full Flow Bypass Flume and Pipe & Flume Adult Flush Line

A camera inspection of the bypass pipe occurred on March 15 and 16. It was determined further inspection was required. The section from the channel to the facility will be manually inspected on March 22. There was some erosion found, which was monitored.

The access walkway section is still missing along with the outfall hazing sprinkler system. A LRAD and laser(s) are currently in use.

The full flow flume adult flush line supply valve, which is triggered to open and close with the primary bypass gate (open during secondary bypass to improve the passage of adult fish released from the separator), had no issues this season.

JFF Mortalities

Mortality rates were typical except for what is listed below.

Five juvenile lamprey mortalities were removed from the dewatering perforated plate upstream of the separator on May 4. Flume barrier installation was reviewed with the fisheries staff. Two juvenile lamprey mortalities were removed from the area of the primary/secondary bypass gate on May 29. Before switching to secondary bypass, the technician on duty found 21 juvenile lamprey mortalities on the perforated plate on June 15. Main flume barrier installation and inspection was reviewed with the staff.

The mortality rate of the sample tanks was 3.04% on July 6. To reduce fish handling, the sample rate was decreased from 2% to 1% for the next sample collection day on July 7. The mortality rate of the sample tanks was 4.41% on July 10. Sample collection and mortality were monitored. Eight subyearling Chinook mortalities were removed from the sample recovery raceway on July 14. The mortality rate of the sample tanks was 4.17% on July 16. Sample collection and mortality continued to be adjusted and monitored. Two sub-yearling Chinook (one clipped) mortalities were removed from the perforated plate while in primary bypass on August 9 (data day was August 10). The separator upwell level was immediately reduced.

JFF Power Outages

Bus switching resulted in brief power outages throughout the juvenile system on March 13 and 14 with no adverse effects. In order to tie in the new project sewer system with the electrical controls at the juvenile

fish facility, the facility was without power during primary bypass on July 24 from 1218 to 1330 hours. No issues occurred. A power outage for the new sewage system from 1334 to 1555 hours on December 11 had no ill effect at the facility. A septic outage on December 14 for one hour also had no adverse effect.

Juvenile Fish Facility (JFF) Issues

After water up on March 27, residual debris in the system's water lines had to be flushed and two jammed flush valves had to be repaired.

The project biologist and the assistant biologist cleaned the sample holding tanks upwell screens and replaced facility light bulbs on April 11.

Three walleye adults were removed from the separator in early April, which is an unusual occurrence.

The access hatch gasket on the secondary bypass line wye was found loose and was replaced on May 16.

Area lighting was repaired as needed from May 22 to 25, June 5 to 8, and June 19 to 22.

Both sample tank crowding devices were lubricated on June 20.

The wet lab was inadvertently flooded when one of the sample tank release gates was found to be partially open on June 24. The wet lab and area below were completely dry by June 26. To prevent this problem in the future, the release gates were marked on June 26. No fish were lost.

The smolt monitoring staff lost access to the internet for most of the first three weeks of July. With access being intermittent, they investigated relocating their dish or using a new provider.

The A side sample tank release valves and the primary/secondary bypass gate oil reservoirs both developed air leaks on July 2. Both reservoirs were repaired early on July 3.

The first juvenile shad was observed on July 8. Juvenile shad became the predominate species in the collected samples by July 12.

After the system was switched into primary bypass, two pieces of woody material were removed from the A-side transport flume, one upstream and one downstream of the sample gate on August 17. No fish injuries were noted in the A-side sample.

No smolts were observed in the sample on September 20, 24, 28 and 30.

Light fixture in the dry lab was repaired on October 9.

The facility was dewatered for inspection and maintenance on October 15. Winterization was completed soon after.

Flume gaskets were replaced the last two weeks of December.

For the season, flow into the separator is depended on collection channel changes and debris blockage on the perforated plate just upstream of the separator. High flows were generally due to debris on the perforated plate, which technicians cleaned. During the spill program, project operations, juvenile channel adjustments, and other issues described in this report, the separator experienced severe fluctuations at times. Regularly tapping and back flushing of the separator upwell screens improved flow. The end of the spill program had no significant effect on separator debris loads. Flow adjustments were made as required.

Debris issues as describe elsewhere in this report affected the separator and facility when operational. During the year, the facility was cleaned as needed.

JFF Sample System (A & B)

The sampling season consisted of alternating days of primary and secondary bypass with the switch occurring every morning at 0700 hours. Sample gates were turned on for the first day of secondary bypass on April 2. The sample gates were activated only during secondary bypass. We shut down the sample system for the year on September 30 at 0700 hours. Turning the sample gates on and off during other events is recorded in the Bypass Operations and JCC sections of this report.

The sampling system operated well during the season with very few issues to report. The mortality rate of the sample tanks was 3.04% on July 6. To reduce fish handling, the sample rate was decreased from 2% percent to 1% for the next sample collection day on July 7. Eight subyearling Chinook mortalities were removed from the sample recovery raceway on July 14. Mortality rate of the sample tanks was 4.41% on July 10 and 4.17% on July 16. It was assumed the mortality was due to heat stress. Sample collection and mortality were adjusted and monitored during this time frame.

The person on day shift duty (0730 to 1600 hours) on July 20, August 3, and 13 did not count juvenile shad sample tank mortalities. The employee also worked partial duty on day shift on July 12, 18, and August 9. Generally, day shift does not see high shad sample tank mortality. However, on the days listed, overall juvenile shad bypass estimates maybe low. The issue was resolved with the employee.

JFF PIT Tag System Primary (A & B) & Secondary (C & D)

The PIT tag system will remain out of service as there are no studies requiring its use. During the bypass season, the primary PIT tag gates were not used. All PIT-tagged fish were detected in the full flow flume during primary bypass and at the facility, including the return to river lines, during secondary bypass. The primary PIT system received scheduled inspection.

The secondary bypass slide gates, which also can serve as a PIT tag diversion system (C gate is on the A side and D gate is on the B side) have not been used in a PIT tag study for several years. These gates received no preseason or in-season adjustments.

JFF Secondary Bypass Lines (A & B)

There were no problems to report with the secondary bypass lines. Inspections and blind ice block checks continued.

JFF Operations Related to Gas Bubble Trauma (GBT) Examinations/Research

Monitors/researchers publish their results in separate reports.

GBT examinations mostly occurred twice a week (report week/Friday through Thursday) from April 10 to July 31 with data reported the next day. The examination scheduled for May 8 was moved to May 12. A piece of electrical tape that was across the inside of the GBT transport pipe, which runs from the separator to the wet lab, was removed on May 22. No injuries were noted. There were 11 smolts that showed signs of trauma starting in mid-June, into July. In early July, five GBT smolt mortalities were recorded during the report week. Six sub-yearling Chinook mortalities were removed from the recovery raceway on July 17. GBT-examined smolts were allowed to recover in the sample recovery raceway before being released by the project biologists. Due to possible heat stress, examinations were reduced to once a week starting on July 17. With reduced fish numbers and heat stress, the last examinations occurred on July 31.

As their fallback study had concluded, ODFW personnel removed their equipment from the area around the TSW in bay 20 on March 30.

USGS personnel installed their equipment for a juvenile survival study along the upstream edge of the powerhouse and spillway on March 20 and 21. Unfortunately, the cable connection to the receiver in spillbay 17 was lost during TSW work on June 20. The receiver in bay 1 was lost during spillway work on July 27. USGS personnel removed their equipment for a juvenile passage study from along the upstream edge of the powerhouse on September 5. The staff members removed the spillway equipment on November 19.

Tissue samples were collected from 780 juvenile lamprey during the sample collection season for a CRITFC study. All fish were returned to the river unharmed except one lamprey morality, not due to tissue sampling.

PNNL did a sight visit for next year's juvenile lamprey passage study on December 4.

OTHER

Juvenile Fish Salvage

Only juvenile fish salvage at various locations will appear in this report. Adult fish rescue will be covered in the McNary Adult Report. Fish were not examined for clips as their survival was a higher priority.

No juvenile salmon were observed during the January 2023 closure of the JCC orifices. Several juvenile shad were noted with one mortality. Twelve small walleye and one juvenile carp were observed. This estimate includes the December 2022 switch to emergency bypass.

During the Oregon ladder outage in January, two Chinook and two steelhead smolts were rescued. There were 211 live (one mortality) juvenile walleye, eight live (five mortalities) juvenile suckers, six live (one mortality) juvenile yellow perch, and 36 live (four mortalities) juvenile smallmouth bass. Most of the non-salmonids were from the isolated auxiliary channel. Most of the fish looked to be one to two years old.

Only one juvenile lamprey mortality was recovered during the navigation lock fish rescue in March.

No juvenile fish were observed during the unit 10 dewatering in June and the unit 11 dewatering in October.

Three juvenile steelhead were rescued from the JCC in December 2023. This estimate includes the switch to emergency bypass and the orifice closure, which took two days. Several juvenile shad, four juvenile walleye, and five juvenile smallmouth bass were observed. Most of the non-salmonids were observed before the switch to emergency bypass was completed.

Cooling Water Strainers

Results of this year's main unit cooling water strainer examinations for juvenile lamprey and smolts are in Table 32.

Table 32. Cooling Water Strainer Results.

Month	Lamprey Mortality	Live Lamprey	Smolt Mortality	Live Smolts
Jan	10	0	0	0
Feb	37	0	0	0
Mar	28	7	0	0
Apr	17	1	2	0
May	85	14	0	0
Jun	146	315	0	0
Jul	40	79	2	0
Aug	2	1	0	0
Dec	0	0	0	0
Dec	0	0	0	0

The mortalities noted were approximately 1,360 juvenile shad, one juvenile channel catfish, and 1 juvenile yellow perch in January. Five juvenile shad mortalities were noted in February. The smolt mortalities were one clipped steelhead and one unclipped yearling Chinook in April. Approximately 300 or more of the live lamprey juveniles came from unit 1 in June. The smolt mortalities in July were one clipped and one ubclipped sub-yearling Chinook. The examination in December revealed approximately 1,600 juvenile shad mortalities. An emergency cleaning of the cooling water strainers occurred after unit 5 was noted overheating on December 20. The mechanics reported seeing only large numbers of juvenile shad mortalities.

Lamprey juveniles were mostly found in units that were in standby for long periods or unit 1. Live fish were returned to river unharmed.

Invasive Species

During winter maintenance, no issues were found for other dewatering activities and monthly mussel station examinations.

One Siberian prawn was noted in the separator on July 12. Another prawn was removed from the perforated plate just upstream of the separator in early August. Five prawns were removed from the perforated plate upstream of the separator on October 3.

The first prawn in the sample was noted in early August. There were 49 total Siberian prawns removed from the samples and euthanized this season. Most of the prawns were collected in August and September.

Avian Predation-General

From January to February, about seventy-five cormorants were seen roosting in the outfall pipe and the Washington fish ladder walls. There were between four and thirty pelicans seen between the tailwater area and the forebay zone. There were a few gulls and bald eagles seen around the project as well.

Daily bird counts occurred from April 1 to September 28. There are four zones: bypass outfall, spill, powerhouse (these three zones make up the tailwater area), and forebay. Generally, all zones are counted once a day in the morning. There are five species of interest: gulls, pelicans, terns, cormorants (primarily in the tailwater area) and grebes (primarily in the forebay zone). Bird numbers fluctuated with smolt, juvenile lamprey, and shad outmigration peaks. Pelicans appear to arrive with the adult shad migration. Avian numbers also appeared to be affected by the migration patterns of the birds.

For the tailwater area, the technicians or biologists performed the counts from the separator building using binoculars. Gulls and terns are difficult to distinguish with binoculars. Cormorants are difficult to observe unless they are roosting. For the forebay zone, bird counts were performed with the unaided eye while doing gatewell observations. All daily counts were reported in the Endangered Species Act (ESA) weekly reports.

The avian hazing program was based on the ten-year smolt passage average. The hazing season this year was from April 23 to July 29. The avian graphs below will be for species during the hazing season in zones where the birds were abundant. These graphs cover the bird counting season from April 1 through July 31. Counts are not included for August and September due to the lack of smolts and high juvenile shad numbers, thus the graphs just cover the hazing season.

Avian Predation-Tailwater Area

In the bypass outfall zone, cormorants and gulls were noted roosting on the juvenile bypass pipe in March. A few of each were noted feeding. Cormorants remain overwinter, while gulls arrived in early April. Cormorants were observed feeding in late April. High water flow reduced the bird numbers in May. Pelicans were observed visiting the outfall in June. Feeding pelicans became more prevalent in July. Overall numbers decreased into August. Roosting and feeding gulls and cormorants were noted into September. For the outfall, pelican, gull, tern, and cormorant numbers during the hazing season are in Figures 2-5.

In the spillway zone, a few fly-by gulls were noted in early March. There were no birds noted feeding in the TSW flow in March. More gulls were flying, roosting, and feeding in April. Feeding gulls and an occasional pelican were observed in May. Osprey were noted in early May. Terns began to be observed in

June. Pelican and tern numbers increased in June. Gull and cormorant numbers were low in June. An occasional roosting osprey was noted. Pelican and tern numbers decreased in late June. Gull numbers increased July and August. Juvenile gulls were noted in August. Gulls feed in the TSW flow in September. Pelican, gull, tern, and cormorant numbers in the spillway during the hazing season are in Figures 6-9.

In the powerhouse zone, gulls were noted roosting next to the spillway in late April. Gulls feed in an eddy between spillway and powerhouse in mid-May. Pelicans feeding just outside floating orifice gates of the Oregon ladder began in June. This persisted throughout the season. One pelican was observed inside the Oregon ladder on June 11 and 14. One pelican was observed inside the Washington ladder on June 15. Two pelicans were observed inside Oregon ladder on June 18. One of the security guards indicated that they saw five pelicans within the Oregon ladder in June. One pelican was observed inside the Washington ladder on June 18. As many as fifty pelicans were seen near the floating orifice gates during the week of June 23 to 29. One pelican was observed inside the Washington ladder on June 28. Seven pelicans were observed just outside the Washington ladder entrance on July 5. One pelican was inside the Oregon ladder on July 11. One pelican was observed on the Washington ladder wall on July 12 and July 23. There was one pelican just outside the Washington ladder entrance on July 23 and 26. Two pelicans were roosting on Washington ladder wall on August 7. Pelican and gull numbers near the powerhouse during the hazing season are in Figures 10 and 11. Gulls were seen early. Pelican numbers were due to them feeding at the Oregon ladder floating orifice gates.

Birds moved from spillway zone to powerhouse zone with decreased spill on August 15. Gulls moved freely between three zones.

Daily observation and counts concluded on September 28. Casual observations began and went to the end of the year. The month of October had an increase in gull and cormorant numbers. There were 100 to 300 gulls and 50 to 100 cormorants each day. The birds were seen roosting or feeding most days with activity on or near the outfall, in the TSW flow, and in the powerhouse flow. Bird numbers appeared to fluctuate with the juvenile shad outmigration.

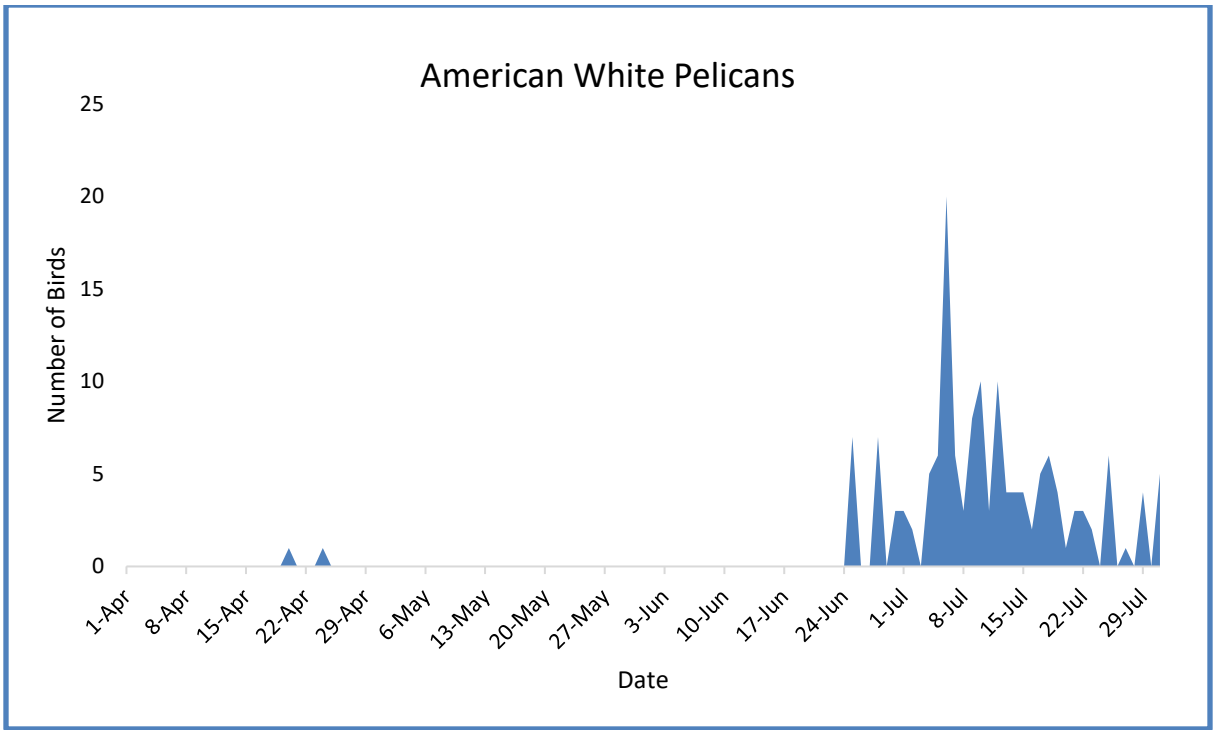

Figure 2. Pelicans at Outfall, Hazing Season, 2023.

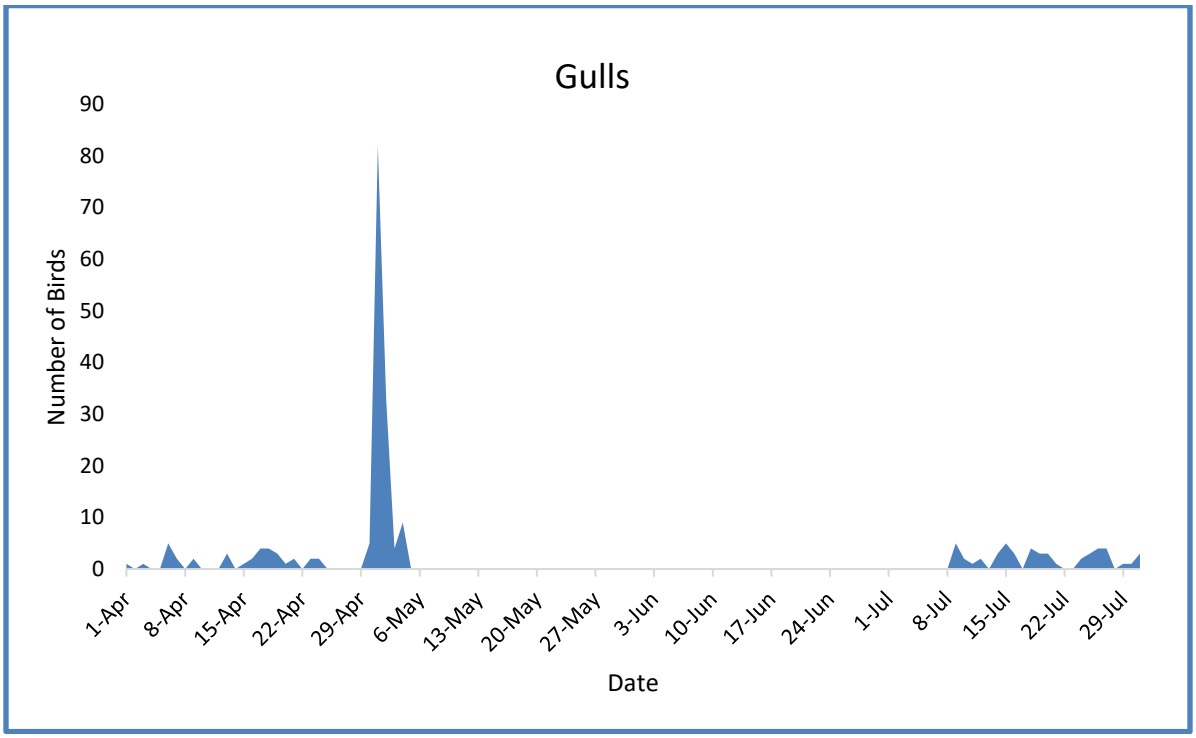

Figure 3. Gulls at Outfall, Hazing Season, 2023.

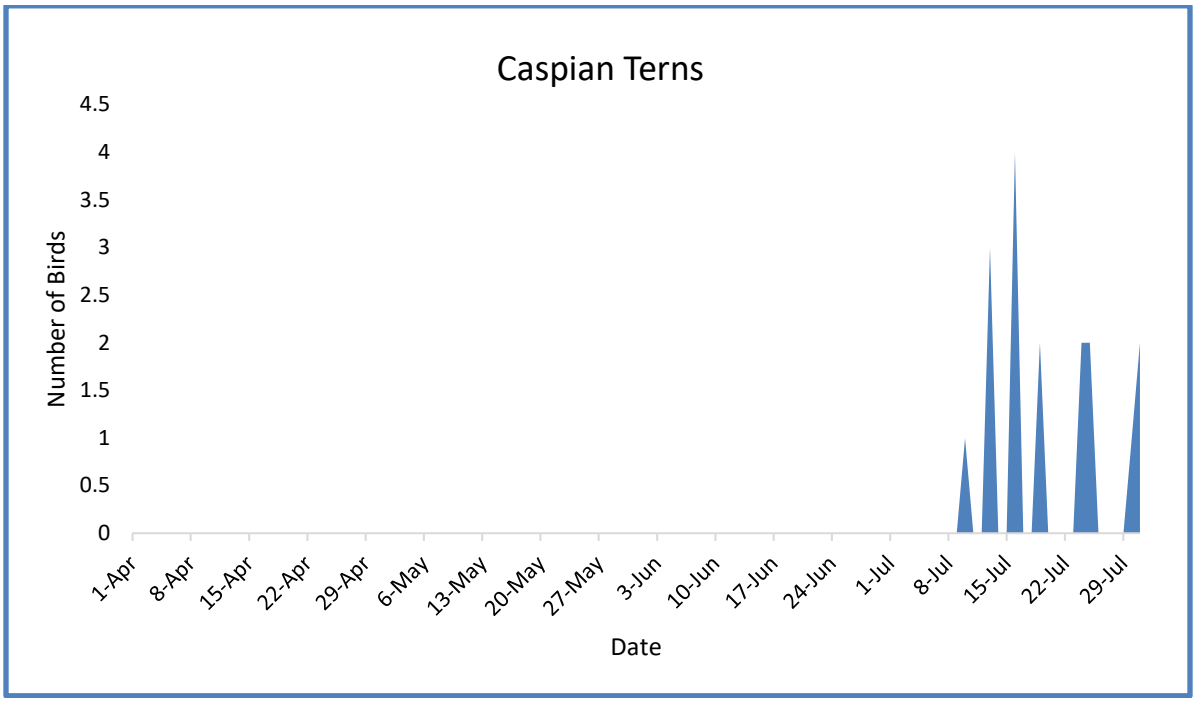

Figure 4. Terns at Outfall, Hazing Season, 2023.

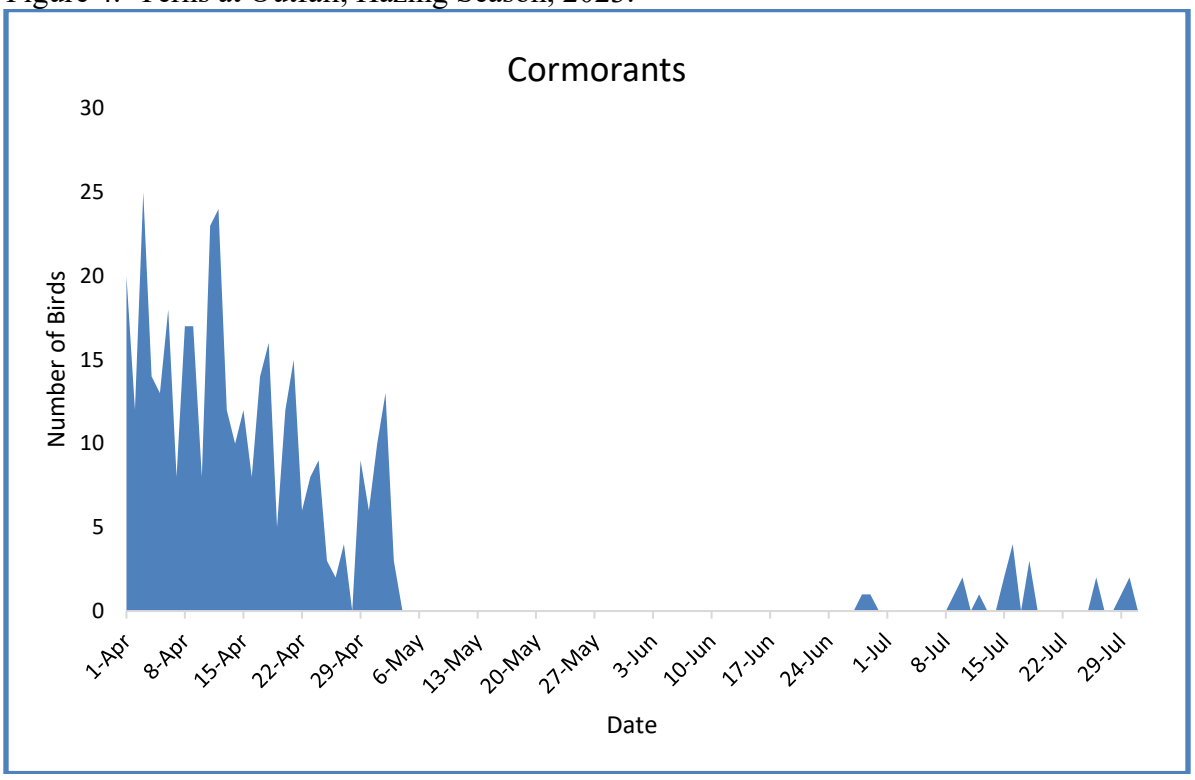

Figure 5. Cormorants at Outfall, Hazing Season, 2023.

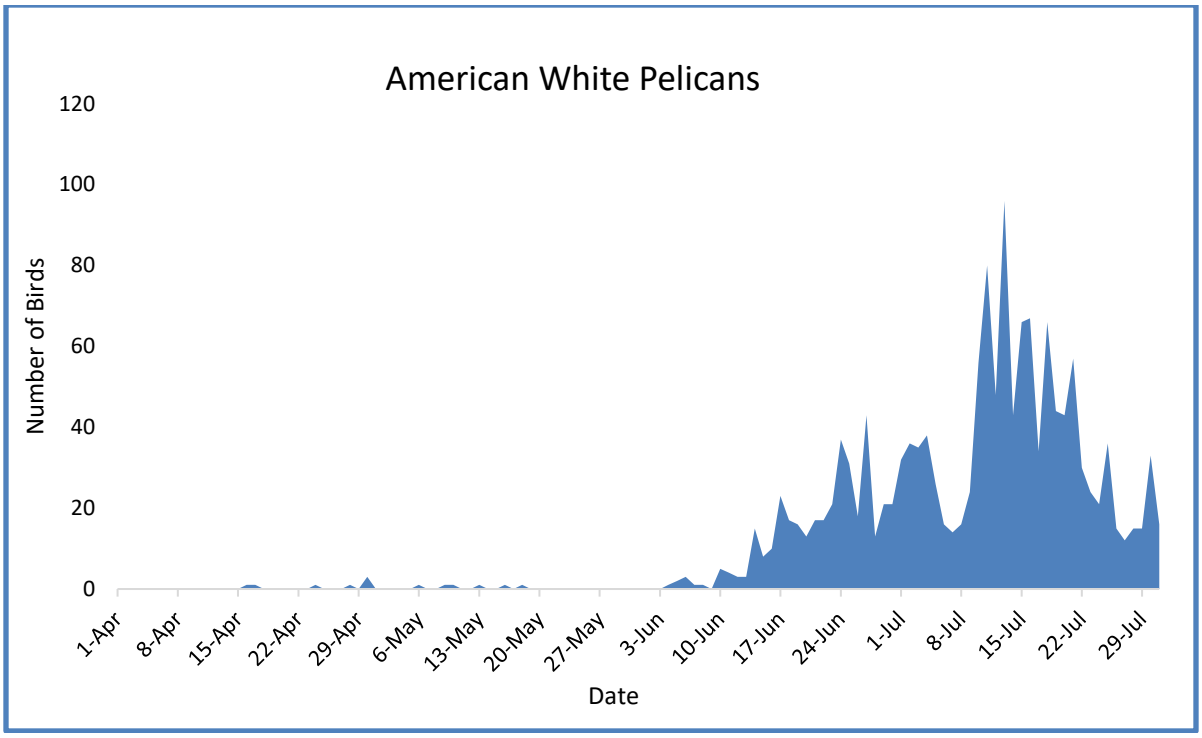

Figure 6. Pelicans in the Spillway, Hazing Season, 2023.

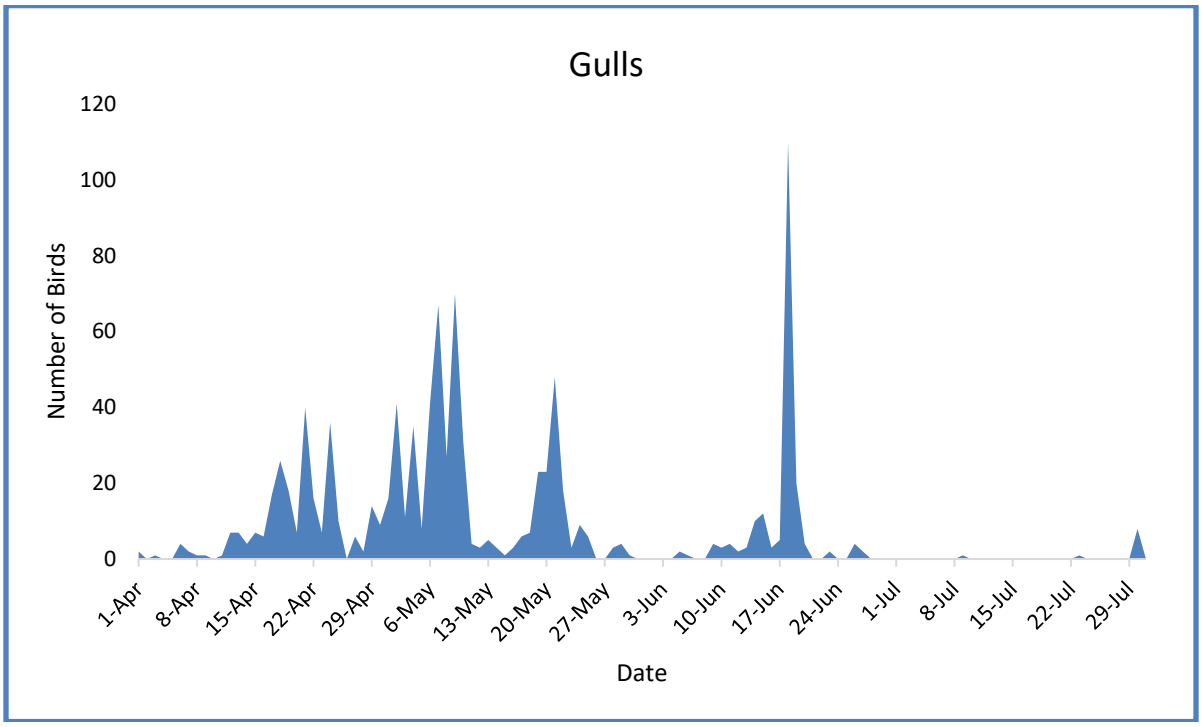

Figure 7. Gulls in the Spillway, Hazing Season, 2023.

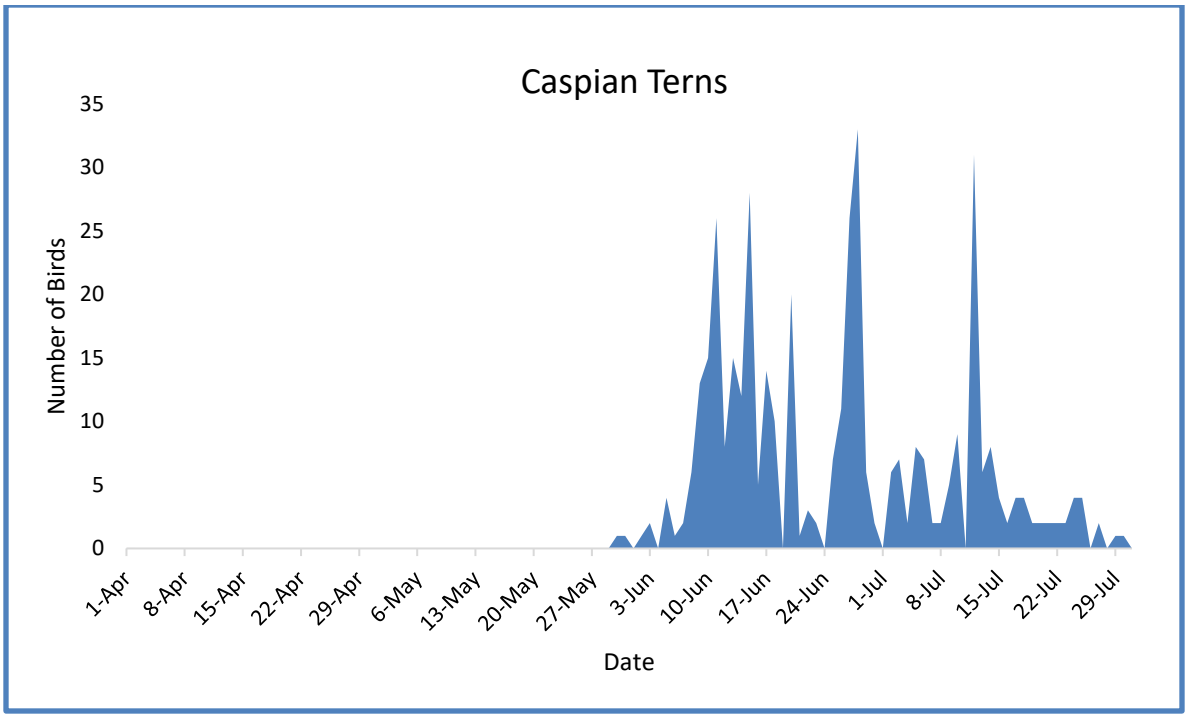

Figure 8. Terns in the Spillway, Hazing Season, 2023.

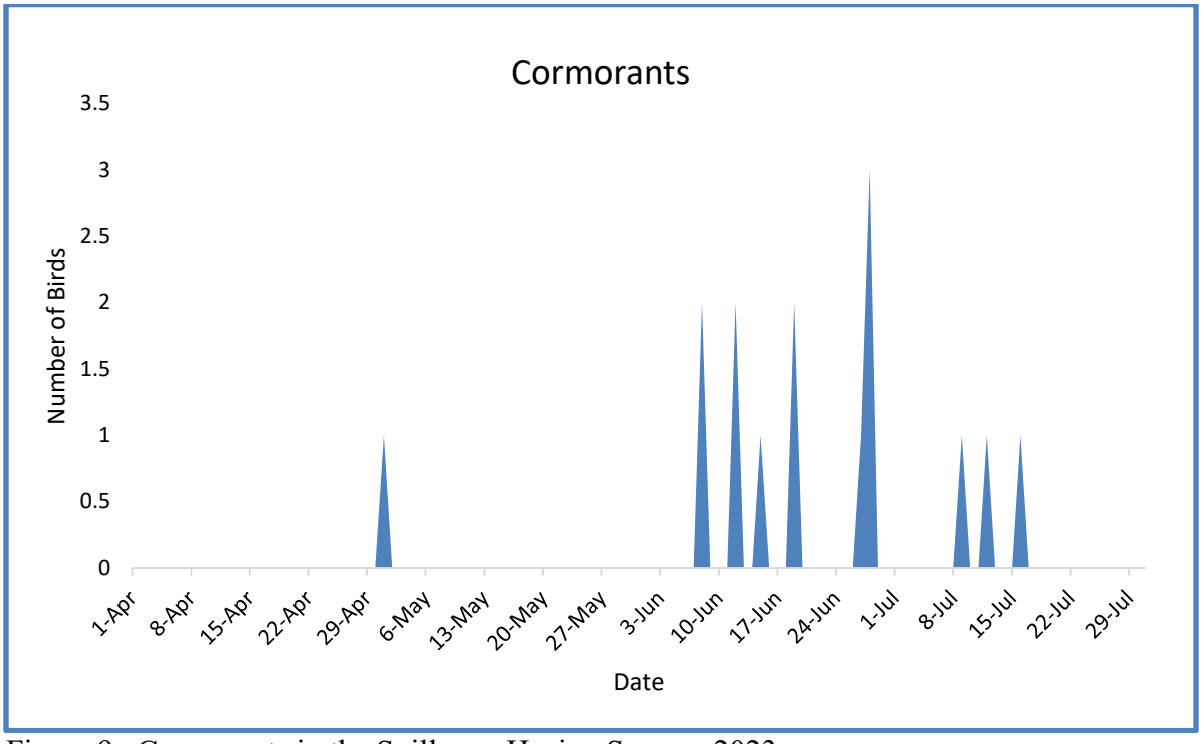

Figure 9. Cormorants in the Spillway, Hazing Season, 2023.

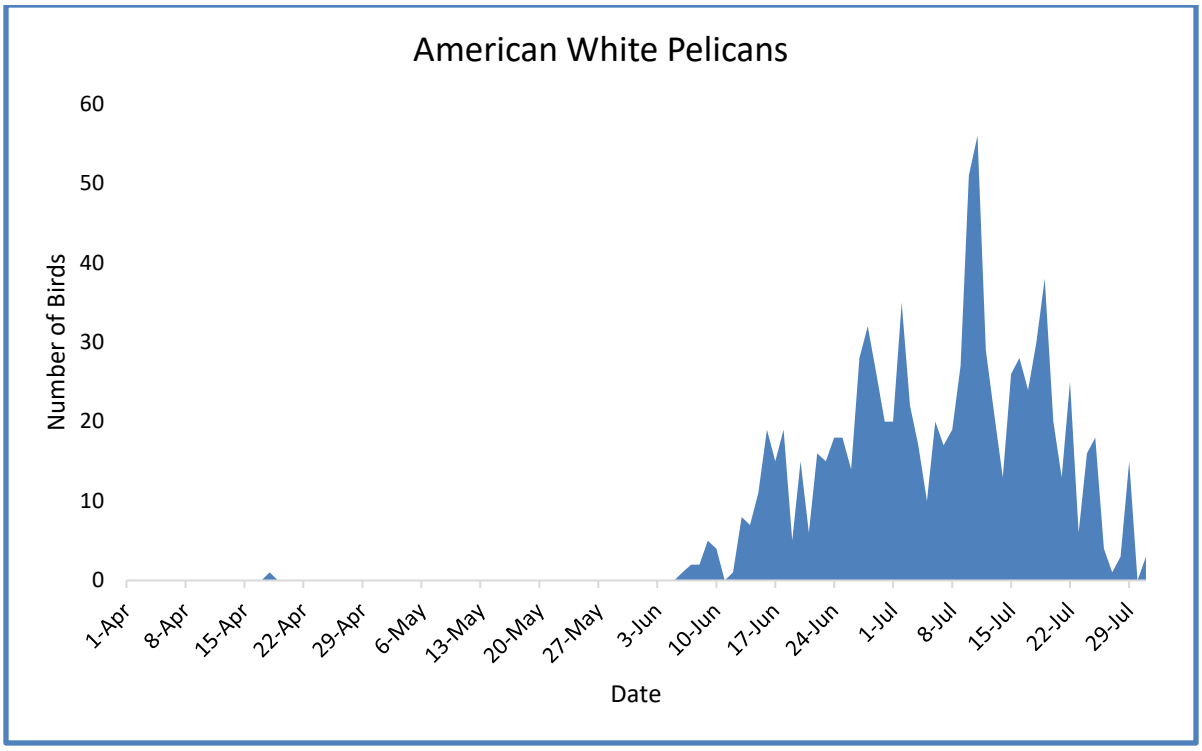

Figure 10. Pelicans at Powerhouse, Hazing Season, 2023.

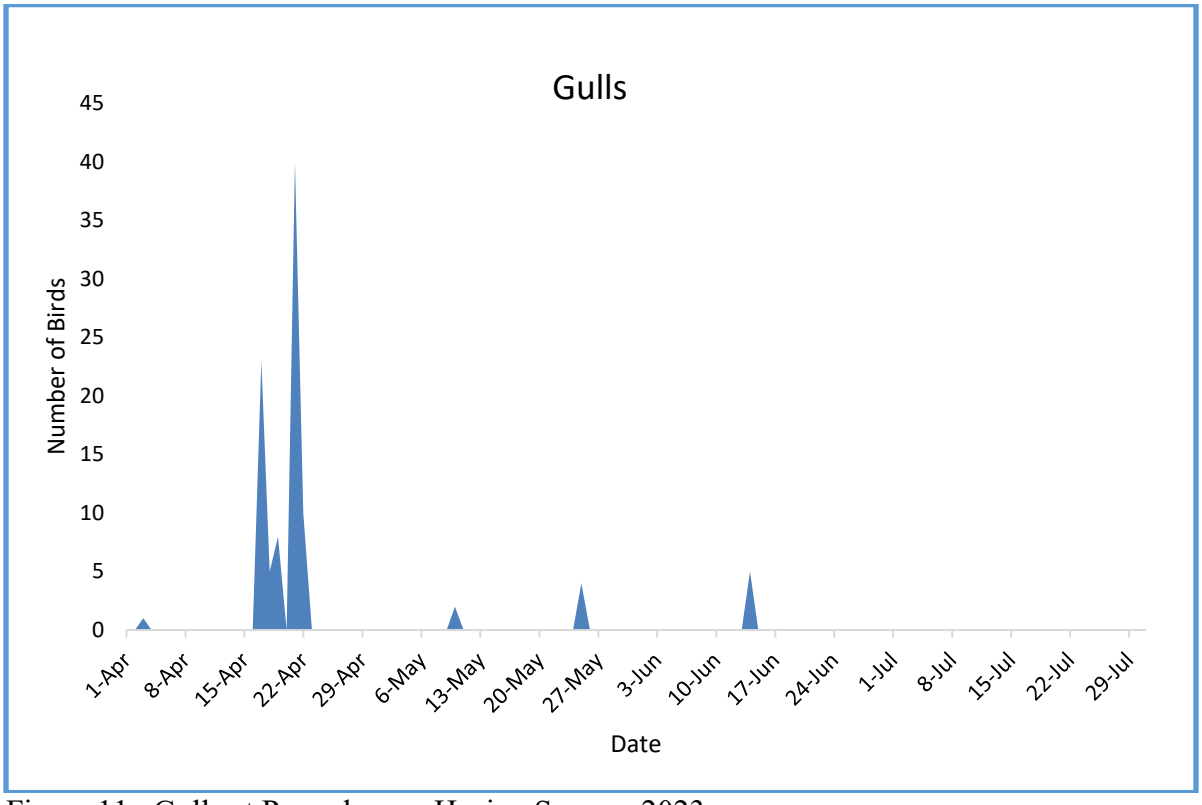

Figure 11. Gulls at Powerhouse, Hazing Season, 2023.

Avian Predation-Forebay Zone

There were a couple grebes and up to three loons seen within the forebay zone in April. The number of grebes observed increased in May. There were feeding and fly-by gulls observed as well in May. One great blue heron was observed during the counts in June. There were also some fly-by cormorants and pelicans observed in June. The number of grebes began to decrease in June and July, then remained consistent through September. The number of grebes observed increased in October with up to 200 counted. Pelicans and juvenile gulls were observed in the forebay zone in increasing numbers in July. They were observed as fly-by or roosting on the water. Grebes were the only species seen consistently in the Forebay zone. Grebe numbers during the hazing season are in Figure 12.

The birds observed outside the forebay zone showed similar trends. Pelicans were observed staging near the Washington shore in May. This number varied between twenty-five and seventy-five pelicans. There were also gulls, grebes, osprey, loons, great blue herons, and a bald eagle observed during the season. The overall number of gulls and pelicans observed decreased into August. Some additional cormorants were observed in September. There were no pelicans observed in the Oregon ladder exit. The deterrent screen is still working.

Daily observation and counts concluded on September 28. Casual observation began and ran into the end of the year. Many of the same species in fluctuating numbers were noted.

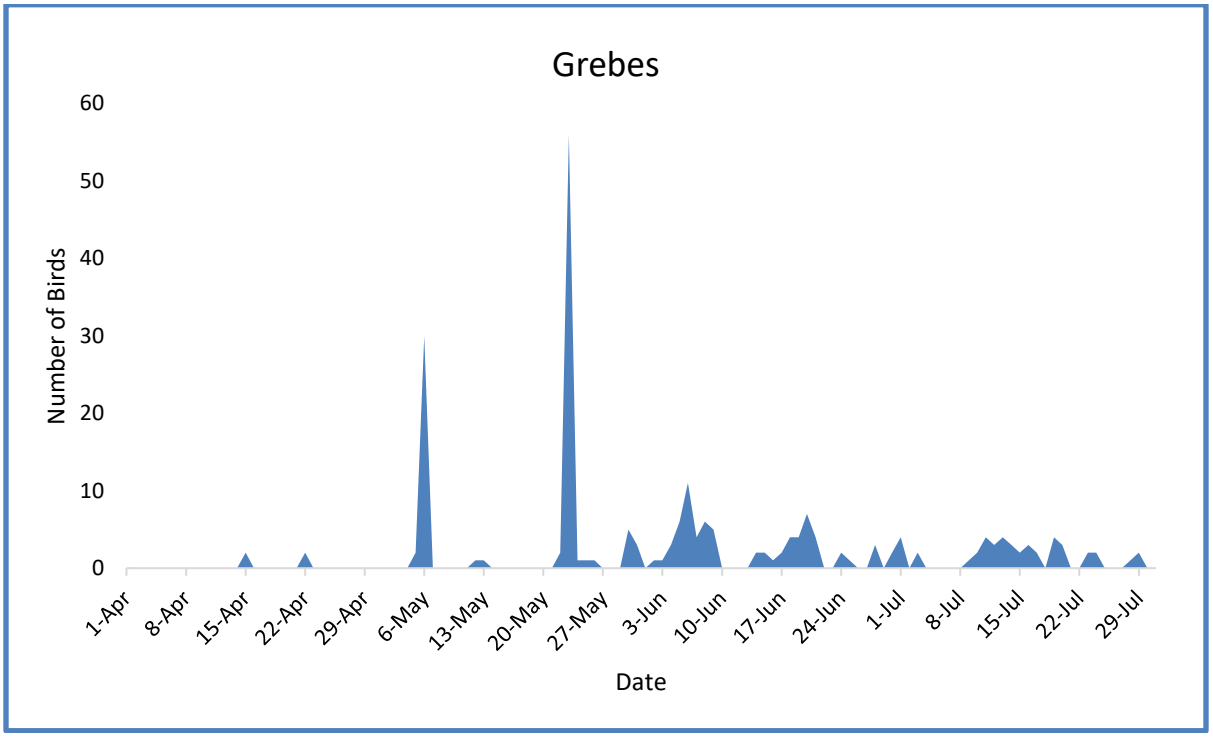

Figure 12. Grebes in the Forebay, Hazing Season, 2023.

Avian Predation-Grebes in Gatewell Slots

No grebes were seen or removed from gatewell slots this season.

Avian Predation-Pelican Observations

This year, Pacific States Marine Fisheries Commission (PSMFC) smolt monitoring personnel did not observe pelican activity at the bypass outfall. Pelican activity was observed by USACE personnel throughout the project.

Avian Predation-Gut Contents

Gut contents of cormorants and gulls taken lethally were examined by PSMFC and Corps staff members. The results were sent to the operations district biologist.

Avian Hazing-Bypass Outfall Sprinklers

Replacement of or alternative to the outfall walkway, sprinkler system, bird wire, bird spikes, and other items are still under consideration.

Avian Hazing-Bypass Outfall Laser

Green light laser was deployed on the outfall pipe on March 13. The laser was programmed and activated on March 30. To accommodate USDA-WS hazing, the laser was turned off on May 1 and 2. The laser was turned back on May 2. The laser was determined to have failed due to water damage on May 27. The damaged laser was removed from the pipe on June 8. The laser from the wingwall was relocated to the outfall pipe on July 14. This laser was removed for the winter on October 18. There are no plans to buy a new laser. A laser on the outfall was only partially effective at times.

Avian Hazing-Navigation Lock Wingwall Laser

Green light laser was deployed on the wingwall on March 13. The laser was programmed and activated on March 30. After appearing to be ineffective, the laser was turned off on April 25. The laser returned to service on May 13. The laser was removed from service to relocate to bypass outfall pipe on June 29.

Avian Hazing-Distress Calls

The two large distress call stations include three species of gulls and the double-breasted cormorant. The calls were deployed along the navigation lock wing wall where birds in the past roosted in large numbers on March 14. The calls were effective until the juvenile shad outmigration. The speakers and controls were removed for the winter on October 19.

Avian Hazing-LRAD

The LRAD was deployed on the outfall pipe on March 13 and activated on March 23. The frequency of operation was in question. The LRAD was removed for reprogramming from April 7 to 13 and returned to service on April 13. Again, the LRAD was removed for reprogramming on May 3 and returned to service on May 13. The LRAD was turned off on June 8 and returned to service on June 10. We found the LRAD off on June 25 and returned it to service on June 27. We again removed the LRAD from service on June 29 for reprogramming. After testing the LRAD near the Oregon ladder south entrance, it

was reinstalled on the outfall on July 14. The LRAD was restarted for better timing on July 20. The LRAD was removed for the winter on October 18. The LRAD was partially effective.

Avian Hazing-Bird Wires/Spikes

Bird wires remain across the powerhouse tailrace, around the barge dock, and on the outfall bypass pipe. Wires are also on the handrails of the outfall, navigation lock wing wall, powerhouse, and ice/trash sluiceway walkways. Avian spikes are used on the outfall bypass pipe, outfall walkway, barge dock, and the light fixtures along the navigation lock wing wall.

Avian Hazing-United States Department of Agriculture-Wildlife Services (UDSA-WS)

The USDA-WS hazing program is outlined in Table 33. Early in the season, the boat remained below the bypass outfall due to high flows. Later in the season, the boat was able to move slightly upstream of the outfall pipe. Boat hazing was very effective at the outfall. When weather conditions did not allow the boat crew to go out, they would haze from the shoreline. Boat and shore hazing were planned to conclude on July 8 and July 22, respectively. However, due to staffing issues, funds were available for additional time. Boat hazing was able to resume on July 14 and concluded on July 28. Shore hazing concluded on July 29. The additional hazing was for pelicans at the outfall and entering the Oregon shore ladder south entrance. This marked the second season pelicans could be hazed in the ladders and the first season they could be hazed at the outfall. From the boat, USDA-WS personnel lethally took 45 cormorants and 103 gulls.

Hazing grebes from the forebay deck was very effective if USDA-WS personnel were persistent.

Table 33. Avian Hazing Program.

Personnel	Days	Dates	Shift
Deck hazer	Mon-Sat = 12 hours/Sun = 8 hours	Apr 23-Jul 29	Day
Boat captain & hazer	3 days a week except Sun = 10 hours	Apr 30-Jul 8 & Jul 14-28	Day

RECOMMENDATIONS

1. Address inside erosion in old section of full flow flume above separator.
2. Paint inside (joints) and outside (erosion) of new section of full flow bypass pipe.
3. Install new plugs in experimental orifices in JCC.
4. Reprogram JCC control PLC.
5. Deal with those road drains over the JCC control section.
6. The transition brush does not seem to be cleaning well. Establish air burst zone 6.
7. Repaint sections of JFF.
8. Mothball or remove JFF transport systems.
9. Improve fish crowding devices in both JFF sample holding tanks.
10. Remove old section of adult release line that was not removed in 2012.
11. Other issues mentioned throughout this report.

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