CENWW-ODG Snyder August 2024

MEMORANDUM THRU:
Justin Stegall, Operations Project Manager, Little Goose Dam

FOR Chief, Operations Division
ATTN: Chris Peery

SUBJECT: Submission of 2022 Juvenile and Adult Fish Passage Report, Little Goose Dam.

1. Enclosed find the 2022 Juvenile and Adult Fish Passage Report for Little Goose Dam as requested.

2. If you have any questions contact Deborah Snyder at Little Goose Dam, (509) 404-3263

Deborah Snyder
Supervisory Fisheries Biologist, Little Goose Dam

Enclosure

2022 Juvenile and Adult Fish Passage Report
Little Goose Dam

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and

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Environmental Assessment Services

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Introduction

Little Goose Lock and Dam (LGS), located at river mile (RM) 70.3, is the third of four hydroelectric dams impounding the lower Snake River. Little Goose Dam is 2,655 feet long and impounds Lake Bryan, a 10,025-acre reservoir with normal operating elevations ranging from 633-638 feet above mean sea level (msl). Lower Monumental Dam impounds the Snake River below LGS, forming Lake Herbert G. West, creating tailwater elevations at LGS ranging from 537-544 feet msl. LGS is comprised of five major components: the powerhouse, navigation lock, earthen embankment, spillway and adult and juvenile fish passage facilities.

Adult Fish Passage

This report summarizes the operation and maintenance of the adult fish passage facility from March 01 to December 31, 2022. The adult fishway was in service from February 8, 2022 to January 9, 2023. Fish counting activities took place from March 01 to December 31, 2022. A total of 135 fishway inspections were conducted by U.S. Army Corps of Engineers (USACE), Environmental Assessment Services (EAS) and Oregon Department of Fish and Wildlife (ODFW) biologists and technicians.

The adult fishway includes a north shore entrance and a channel under the spillway that connects to the powerhouse collection system. The powerhouse collection system has a north powerhouse entrance and a channel under the tailrace deck that connects with a fish ladder. The channel also includes an adult fallout fence near the north powerhouse entrance. Ten floating orifice gates along the powerhouse channel were removed and closed off with bulkheads between 1996 and 2000. A south shore entrance also connects to the fish ladder. The ladder rises about 100’ on a 1:10 slope and exits into the forebay above the dam. Gravity provides adequate water flows for the fish ladder. For the rest of the system, however, auxiliary water is needed to attract fish into the various entrances. Auxiliary water is supplied by three turbine-driven pumps that pump water from the tailrace to the pump chamber where gravity fed water flows over various floor diffusers in the powerhouse channel and at the bottom of the fish ladder. Additional gravity-fed water is provided by diverting excess water from the primary dewaterer (a juvenile fish facility component) to the pump chamber and floor diffusers.

Additionally, the fish ladder includes a fish viewing room that is popular for visitors and is utilized to provide adult fish count data. Fish counting by Four Peaks Environmental, under contract with the Corps, took place from March through December.

Juvenile Fish Passage

This report summarizes activities and results associated with the collection, transportation and bypass of out-migrating juvenile steelhead *Oncorhynchus mykiss*; Chinook salmon *O. tschawytscha*; Sockeye salmon *O. nerka*; and Coho salmon *O. kisutch* at Little Goose Dam (LGS). Data represented in this report were collected by USACE, EAS and ODFW Smolt Monitoring Program (SMP) and transportation biologists and technicians from April 01 through November 01, 2022.

The juvenile fish collection and bypass system at LGS extends from the upstream face of the dam to the juvenile fish facility (JFF) located downstream near the tailwater area. System components include 18 extended length submersible bar screens (ESBS), 18 vertical barrier screens (VBS), 36 gatewell orifices, a collection channel, a dewatering structure, and a

corrugated flume which routes fish diverted from the forebay to the JFF. The JFF consists of a fish separator, routing flumes, fish holding raceways, a sampling and marking laboratory, truck and barge loading facilities, and a passive integrated transponder (PIT) tag detection and diversion system.

The objective of the transport program is to improve survival of out-migrating smolts, resulting in increased adult salmon and steelhead returns. Operating parameters are set forth annually in the Fish Passage Plan (FPP) and Fish Operations Plan (FOP).

River Conditions

River Flows

Below average winter precipitation, cool temperatures in early spring, and above average precipitation in late spring resulted in flows that were 89.2% of the 5-year average. Average monthly flows were below the 5-year average in April, May, September, and October, above average in June and July, and near the 5-year average in August. (Table 1). During the 2022 juvenile fish passage season (April 1 to November 1), the average daily flow was 50.8 kilo cubic feet per second (kcfs). The maximum average daily flow of 201.7 kcfs occurred on June 14, and the minimum average daily flow of 13.3 kcfs occurred on October 20 (Figure 1).

Table 1. Comparisons of average monthly flow and spill in kcfs at Little Goose Dam JFF 2017-2022**.**

Month	2017	2018	2019	2020	2021	2022	2017 to 2021 Average
Flows (kcfs)							
March	--	57.3	--	--	--	--	--
April	132.8	91.8	117.0	54.5	45.6	39.3	88.34
May	139.6	133.8	118.3	105.2	61.7	80.2	111.72
June	128.0	80.8	93.2	93.3	52.6	130.0	89.58
July	50.0	37.6	38.5	46.9	26.8	44.4	39.96
August	30.0	28.5	28.3	28.6	22.5	27.9	27.58
September	25.8	21.8	24.5	22.5	18.7	19.6	22.66
October	22.8	17.8	21.3	19.5	15.9	14.6	19.46
Spill (kcfs)							
March	--	0.0	--	--	--	--	--
April	43.4	31.8	48.3	31.3	24.0	22.3	35.76
May	76.3	50.7	49.3	64.3	39.0	48.9	55.92
June	50.4	27.9	39.5	50.0	30.5	64.9	39.66
July	14.9	11.4	11.6	14.3	8.3	13.3	12.1
August	10.3	10.5	10.6	9.0	7.2	11.8	9.52
September	0.2	0.2	0.4	0.8	1.0	0.8	0.52
October	0.0	0.3	0.0	0.5	0.6	0.5	0.28

Note:
--: not applicable

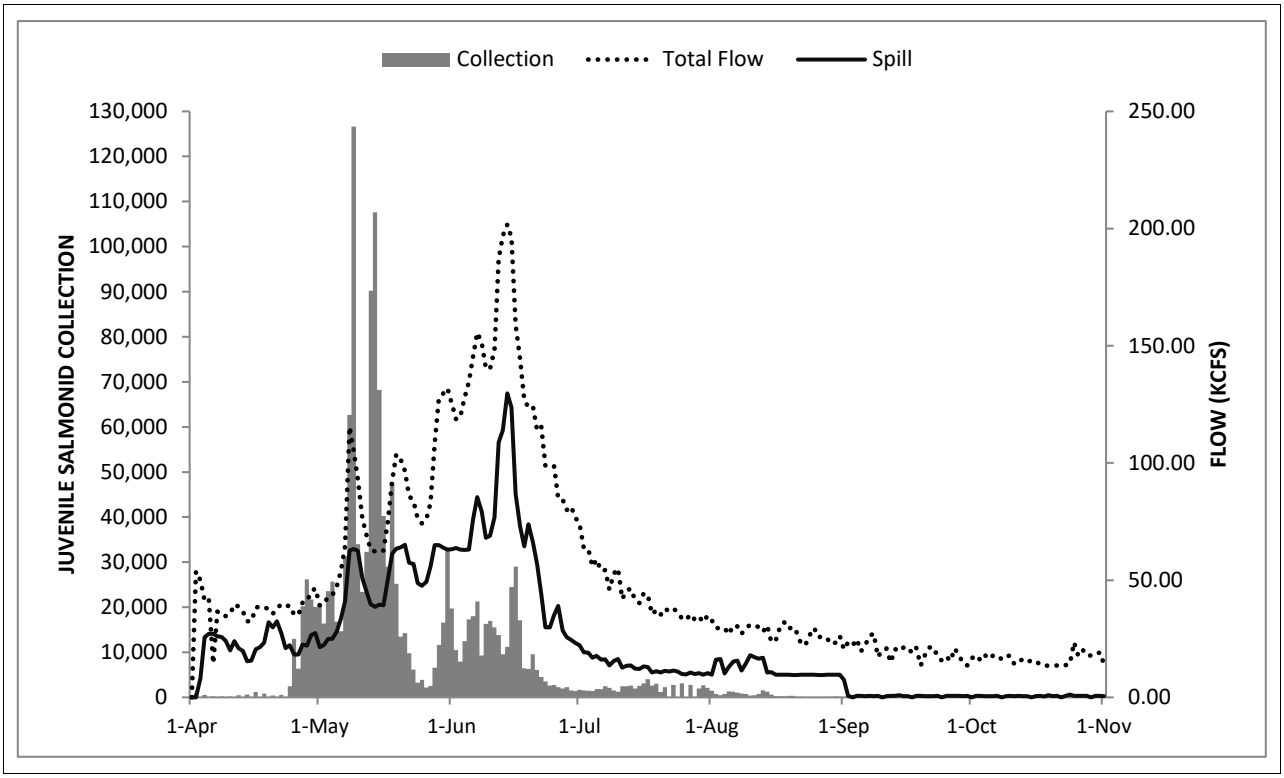

Figure 1. Total River Flow, Spill, and Number of Juvenile Salmonids Collected at Little Goose Dam During the Fish Collection and Transport Season, 2022

Spill to aid juvenile fish passage occurred from April 3 to September 1, in accordance with the 2022 FPP. Prior to 2018, the spill target was 30% of total flow from April 3 to August 31. Starting in 2018, and continuing through 2022, spill increased for the spring passage season (April 3 to June 20) at all four projects on the lower Snake River due to either court mandates or regional coordination under the Flex Spill Agreement (*NWF v. NBFS* 2018). In 2020, the spring spill Gas Cap was increased from 120% to 125% in the tailrace. The spring spill operation was 16 hours per day of Gas Cap spill and for the remaining 8 hours per day spill could be reduced to 30%. Target spill remained at 30% of total flow during the summer passage season (June 21 to August 31). In 2022, the target of 30% was not met for 21 days between June 21 and August 31. The adjustable spillway weir (ASW) was operated in Spillbay 1 on April 3 and removed on August 1 due to daily average spill falling below 35 kcfs. Spill through the ASW started up again September 1 through November 15 for adult steelhead overshoots, in compliance with the 2020 National Oceanic and Atmospheric Administration Fisheries Columbia River System Biological Opinion (NOAA 2020). Spill through the ASW occurred for 4 hours in the morning (between 5:00 a.m. and 11:00 a.m.) at least three times each week on non-consecutive days.

To enhance fish migration and comply with the 2020 Biological Opinion, the forebay elevation was at Minimum Operating Pool (633.0 to 634.0 feet MSL) from April 3 to August 31. Forebay elevation was increased to Minimum Operating Pool +2 (634 to 636 feet MSL) after September 1, 2022, when spill to aid fish passage ended. Beginning in late September, operations were under compliance with the 2020 Biological Opinion. All deviations from the FPP were coordinated through the Fish Passage Operations and Maintenance Workgroup, as necessary, to meet real-time operational requirements.

River Temperature

River temperature was recorded daily at approximately 0700 hours in the JFF. Average daily river temperature was 60.1°F during the 2022 fish passage season. Average monthly water temperatures were cooler than the 5-year average during all months (Table 2). Maximum river temperature of 70.0°F was recorded on August 29 which is 0.8°F lower than the 5-year average maximum of 70.8°F. Minimum river temperature of 45.5°F was recorded on April 17 which is 0.7°F lower than the 5-year average minimum of 46.2°F. As per the Water Management Plan, summer river temperatures were tempered by cool-water releases from Dworshak Reservoir. Supplemental flow from Dworshak Reservoir started June 23 and ended on September 23, and averaged 12.4 kcfs at 43.0°F from June 23 to June 30, 7.9 kcfs at 43.6°F for the month of July, 7.9 kcfs at 45.5°F for the month of August, and 4.7 kcfs at 47.5°F from September 1 to September 23 (Columbia Basin Research 2022). Water temperatures recorded daily in the LGS JFF averaged 66.4°F in July, 68.4°F in August, and 67.0°F in September.

Table 2: Average Monthly River Temperatures (ºF) at Little Goose Dam, 2017 to 2022**.**

Month	2017	2018	2019	2020	2021	2022	2017 to 2021 Average
Temperature (°F)							
April	48.9	49.2	48.2	49.4	50.6	46.9	49.3
May	53.4	53.7	53.3	52.5	57.1	51.7	54.0
June	58.6	61.6	61.7	59.4	60.3	55.3	60.32
July	68.4	68.1	67.6	66.8	68.7	64.4	67.92
August	68.9	69.3	69.0	69.4	69.4	68.4	69.2
September	68.1	66.2	68.3	67.8	65.8	67.0	67.2
October	61.2	60.7	59.6	63.7	61.4	56.9	61.3
Minimum	46.7	44.7	45.4	46.4	47.7	45.5	46.2
Maximum	70.3	70.9	70.0	70.7	72.0	70.0	70.8

Total Dissolved Gas

Total dissolved gas (TDG) data are automatically collected and transmitted hourly to the Columbia River Operational and Hydromet Management System to provide information for spill and gas saturation management. TDG was monitored in the forebay from April 2 to September 2, and in the tailwater year-round.

The USACE Reservoir Control Center coordinates efforts to maintain TDG saturation levels in accordance with the Washington State TDG Level Variance Standard of 125.0% saturation within the project tailwater in the spring, as measured throughout 12 consecutive hours. The summer TDG criteria is at or below 120% in the immediate tailrace at Little Goose Dam and 115% in the forebay of Lower Monumental Dam.

Average daily TDG level in the LGS forebay was 112.1% saturation from April 2 to September 2. TDG saturation ranged from 98.3% on April 6 to 121.7% on June 17.

The TDG level in the LGS tailrace was 102.26% on April 2 (low) and 129.09% on June 12 (high), averaging 115.2% during the spill to aid fish passage season (April 3 to August 31). Tailwater mean total dissolved gas percent exceeded 125% a total of 5 days for the year.

Turbidity

Water clarity was measured during adult fish passage facility inspections. Measurements were taken in the adult fish ladder using a Secchi disc with a maximum depth of 6 ft. The fish ladder water supply is gravity fed from the forebay and is a representation of river conditions. The lowest Secchi disk readings occurred during periods of high outflow from June 4 to 20, with measurements ranging between 1.1 and 2.1 ft and averaging 1.7 ft. The highest Secchi disk readings occurred from July 17 to October 22, with measurements ranging from 4.1 to 6.0 ft and averaging 5.8 ft.

Adult Fish Facility

Facility Description

The adult fish facility is located downstream of the dam and functions to attract and pass adult migrating fish. The facility consists of a fish ladder and a collection channel. The collection channel acts to attract and route fish from across the tailrace to the fish ladder. Components of the collection channel system include two South Shore Entrances (SSE), two North Powerhouse Entrances (NPE), two North Shore Entrances (NSE), the collection channel itself, a fallout fence, an auxiliary water supply system, and an electronic monitoring and control system.

The pool-and-weir fish passage ladder is located on the south shore. It is approximately 1,000 feet long and rises a vertical distance of about 100 feet. The ladder begins at the junction pool near the SSE and leads upstream westward approximately 400 feet, makes a 180 degree turn and then rises another 550 feet eastward to the top of the dam where it passes under the intake deck and exits into the forebay.

The viewing room and fish counting windows are located approximately 300 feet from the start of the ladder at the junction pool. The fish counting slot is fixed at a width of no less than 18" deep by 36" high by 48" wide. Underwater vertical fences called "Picketed Leads" guide and confine fish to pass through the counting slot.

The two SSE entrances (SSE1 and 2) have overflow weirs that are normally open. The two NPE entrances (NPE1 and 2) have overflow weirs and are normally open. NPE3, a lift gate entrance, was permanently closed with a concrete bulkhead in February 2011. The two north shore entrances (NSE1 and 2) are also overflow weirs and were normally open. NSE3, a lift gate entrance, was also permanently closed with a concrete bulkhead in 2011.

Additionally, ten floating orifice gates located in front of the powerhouse have been removed and permanently sealed with bulkheads. Floating orifice gates 1, 4, 6, and 10 have been closed since the 2000 fish passage season and floating orifice gates 2, 3, 5, 7, 8, and 9 have been closed since January 1996. Research has shown that adult fish attraction into the adult fish channel improved with these gates closed.

The adult collection channel begins at the NSE, passes under the spillway, past the NPE and fallout fence, continues along the base of the powerhouse, and terminates in the junction pool near the base of the ladder. A separate short channel connects the SSE to the junction pool and ladder. The fallout fence, consisting of a steel tube framework and wire mesh panels, is in the channel near NPE1 and 2. The fence functions to prevent fish in the channel from leaving and re-entering the tailrace via NPE.

The collection channel water is supplied from three sources. First, the fish ladder coupled with a diffuser (diffuser 13) supplies approximately 75 cfs of water and flows via gravity into the channel. Second, three turbine-driven pumps (fish pumps) supply approximately 1,700-2,000 cfs of auxiliary water. The fish pumps move water from the tailrace into a head channel where gravity forces water through 21 sluice gates and up through 20 diffusers located on the floor of the collection channel in front of the powerhouse, near the junction pool and lower end of the ladder. Third, 175-230 cfs of excess water from the primary dewatering unit of the juvenile fish collection system also flows into the head channel and up through the floor diffusers.

An electronic computer interface system for operating and monitoring the adult fishway was put in service in March 1994. The Fishway System Control (FSC) includes water elevation sensors for the fishway channel and tailrace near each entrance and elevation sensors and controls for each of the 6 entrance weirs.

An electronic water velocity meter (flow meter) was added to the collection channel near the SSE in November 1997. The meter was programmed to measure subsurface water velocities near the junction pool and diffuser 2. Diffuser 2 (the largest of the water supplying diffusers) produced upwelling and non-laminar flows making measurements unreliable. The flow meter failed in spring of 2011 and was replaced with a hydrologic current meter. In 2019, subsurface water flow velocities were measured near the NPE approximately at the midpoint of the collection channel where flows are a better representation of the entire collection channel.

Adult Fish Passage and Fishway Activities

Monitoring Activities

In 2022, a total of 226,622 salmonids were visually counted passing upstream through the adult fish ladder. The species counts were: 115,782 Chinook adults; 24,320 Chinook jacks; 66,606 steelhead; 2,099 sockeye; 14,670 coho adults; 3,145 coho jacks; and 0 pink adults. Additionally, 35 adult lamprey and 8 bull trout were counted migrating upstream at the adult fish counting window.

Several monitoring activities involving the use of the adult fishway were in progress in 2022. These included:

- From 0400 hours to 2000 hours Four Peaks Environmental conducted video counting activities from March 1 – March 31, visual fish counting activities April 1 – October 31[1], and resumed video counting from November 1 – December 31.

- Water temperature within the adult ladder was recorded on an hourly basis in an ongoing trend study in support of safe fish passage.

- Invasive species were monitored with particular attention to zebra and quagga mussels. Reports were submitted weekly to District biologists.

[1] 0500 to 2100 Hours during daylight savings time. No nighttime counts are made at Little Goose Dam.

Operations and Maintenance

The Adult fishway was in service from February 8, 2022 to January 9, 2023. The in-water work maintenance period occurred from January 6 to February 7, 2022.

The fish ladder functioned adequately throughout the season. The air bubbler located at the ladder exit and used to push back debris performed well all season. Diffuser 13 functioned without incident and water level over the weirs were maintained within criteria. Picketed leads remained clear of debris and the counting window backboard was routinely cleaned throughout the season.

Water clarity and temperature were measured near the fish counting window during adult fish passage facility inspections. Water clarity was measured using a Secchi disc that was lowered to a maximum depth of visibility (see River Conditions).

The packing material in the expansion joints of the fishway has decomposed over time so when water temperatures fall below 50°F, the ladder contracts and water leaks through these joints. When temperatures drop below freezing, large icicles form overhead and large patches of ice form on the ground below. Both are hazards to safe working conditions. Incremental repairs took place in 2018 and 2019 with remaining sections planned for future winter maintenance periods.

An electronic computer interface system for operating and monitoring the adult fishway was put in service in March 1994. The original Fishway System Control (FSC) includes water elevation sensors for the fishway channel and tailrace near each entrance and elevation sensors and controls for each entrance weir (6). The FSC system that monitors and controls the fishway failed in March 2012. A new control panel and updated software were installed during the winter of 2015. The updated software was placed into service for 2016, however the system failed to maintain fishway criteria and was placed back into manual mode. The Fishway Control System panel was recommissioned on May 5, 2022.

The Rickly hydrologic current meter was used in 2022 to determine subsurface velocities in the adult collection channel. Measurements were taken monthly just downstream of the NPE before the channel enters under the spillway, approximately mid-point of the length of the channel. This position best measures laminar flows that represent the overall flow rates of the channel. Subsurface velocities were measured just below the surface, at mid-depth, and just above bottom and averaged. The subsurface velocities were measured once per month and submitted in weekly reports. Average subsurface velocity measurements ranged from 1.9 to 3.2 feet per second (fps) with an average of 2.4 fps. Collection channel surface water velocities were measured using a floating stick or bubble that was timed over a distance and calculated into feet per second. Measurements ranged from 1.5 to 3.6 feet per second (fps) near the NPE's and 1.4 to 3.6 fps near the NSE's. Auxiliary water supply (AWS) system operated with three fish pumps for the majority of 2022.

The adult fishway was removed from service on January 3, 2022, when the ladder was dewatered. Fish ladder maintenance included inspecting weirs, removing debris, cleaning the picketed leads, cleaning lamp lenses, cleaning viewing windows and removal of metal grating upstream of adult counting window. Collection channel maintenance included inspecting diffuser grating and supporting beams, removing debris and repairing the fallout fence from the powerhouse section of the adult channel. Sluice gates that function to pass auxiliary supply

water to the fish channel are in poor or non-operating condition. The positions of these gates are adjusted using a mobile electric operator. Many of the sluice gate indicator rods are bent and need replacing/repair. These gates and indicators need to be in good operational working condition to maintain correct gate position to provide the optimum water supply and flow criteria for adult fish passage.

Adult Fishway Inspections

Adult fishway inspections during the 2022 fish passage season were conducted by USACE, EAS and ODFW biologists and technicians. Inspections by the ODFW were once a month from April through October, generally on designated days. Inspections by USACE and EAS were conducted three times a week from March through December. Problems observed during an inspection were reported to the project biologist and/or the dam operator for appropriate action. Adult fishway criteria are detailed below in the results section. All inspection data were entered into a computer spreadsheet that provided an indication as to whether operating criteria were met.

Inspection Results

The fish ladder section of the adult fishway includes differentials at the ladder exit, ladder weirs and counting station. The ladder weirs met criteria 98.5% of the time (Table 3). The counting station weir met criteria throughout the entire season (Table 3). The ladder exit trash rack and picketed leads remained relatively clean throughout the season. The air bubbler at the ladder exit was in service during the season and kept debris from collecting in front of the exit area.

The collection channel continued to have mechanical and electrical problems but performed adequately throughout most of the season. Channel to tailwater elevation criteria (1-2 ft) was met at least 95.3% of the time at all locations throughout. Weir depth criteria (6-8 ft) was met at least 85.7% of the time at NSE, 31.9% of the time at NPE and 89.6% of the time at SSE. NPE weirs were on sill for at least 63.0% of all inspections (Table 3). Low tailwater elevations will cause NPE weirs to bottom-out on its sill elevation at 532 feet.

Surface water velocities met criteria (1.5 – 4.0 fps) 100.0% of the time near the NPE and 95.5% of the time near the NSE (Tables 3 and 4).

Average tailrace elevations in 2022 were lower than the 5-year average at all locations (Table 5). To enhance fish migration, reservoirs were drafted down to minimum operating pool (MOP) elevations from April through August. During MOP, Lake Herbert G. West was operated between 537.0 and 538.0 ft. elevation as measured at Lower Monumental Dam.

During inspections, tailrace water elevations were simultaneously collected at the FSC for the SSE, NPE and NSE locations. These readings usually varied from 0 to 0.3 ft in height difference. The variations are caused by the upwelling of water being released from the turbine draft tube and the number of and/or sequence of turbine units operating.

Average channel to tailwater head differentials in 2022 were slightly higher than or equal to the 5-year average at SSE, NPE and NSE locations. NPE3 and NSE3 were permanently sealed with concrete in February 2011.

Table 3. Summary of results from adult fishway inspections at Little Goose Dam, 2022.[1]

LITTLE GOOSE	No. in		Not Enough Depth				Too Much Depth		
Criteria and	Criteria/	% In	No./%	No./%	No./%	No./%	No./%	No./%	No./%
Locations	No. on Sill/	Criteria/	Weir Raised	Within	Within	>0.2	Within	Within	>0.2
	No. of	% On	Or Closed	0.01-0.1	0.11-0.2	Foot	0.01-0.1	0.11-0.2	Foot
	Inspections	Sill		Foot	Foot		Foot	Foot	
Channel Velocities (NPE)	135	100.0	***	***	***	***	***	***	***
	***	***	***	***	***	***	***	***	***
	135								
Channel Velocities (NSE)	105	95.5	***	***	***	***	***	***	***
	***	***	***	***	***	***	***	***	***
	110								
Differentials									
Ladder Exit	135	100.0	***	***	***	***	0	0	0
	***	***	***	***	***	***	0.0	0.0	0.0
	135								
Ladder Weirs	133	98.5	***	0	0	0	0	0	0
	***	***	***	0.0	0.0	0.0	0.0	0.0	0.0
	135								
Counting Station	135	100.0	***	***	***	***	0	0	0
	***	***	***	***	***	***	0.0	0.0	0.0
	135								
South Shore	132	97.8	***	0	1	0	0	0	2
	***	***	***	0.0	0.7	0.0	0.0	0.0	1.5
	135								
North Powerhouse	133	98.5	***	0	0	0	0	1	1
	***	***	***	0.0	0.0	0.0	0.0	0.7	0.7
	135								
North Shore	122	95.3	***	2	0	1	0	1	2
	***	***	***	1.6	0.0	0.8	0.0	0.8	1.6
	128								
Weir Depths									
SSE-1	121	89.6	0	2	2	10	***	***	***
On Sill[2]	0	0.0	0.0	1.5	1.5	7.4	***	***	***
	135								
SSE-2	123	91.1	0	1	1	10	***	***	***
On Sill[2]	0	0.0	0.0	0.7	0.7	7.4	***	***	***
	135								
NPE-1	47	34.8	0	0	0	3	***	***	***
On Sill[2]	85	63.0	0.0	0.0	0.0	2.2	***	***	***
	135								
NPE-2	43	31.9	0	0	0	3	***	***	***
On Sill[2]	89	65.9	0.0	0.0	0.0	2.2	***	***	***
	135								
NSE-1	108	85.7	0	2	5	11	***	***	***
On Sill[2]	0	0.0	0.0	1.6	4.0	8.7	***	***	***
	126								
NSE-2	108	85.7	0	2	7	9	***	***	***
On Sill[2]	0	0.0	0.0	1.6	5.6	7.1	***	***	***
	126								

[1] Data are from Appendix 1.

[2] "On sill" means the weir gate was bottomed out on its sill and within criteria at this location.

Table 4. Little Goose Dam collection channel in-criteria rates 2018-2022.[1]

Location	Collection Channel Success Rates (%) - Annual Comparison				
	2018	2019	2020	2021	2022
Channel Surface Water Velocities					
North Powerhouse Entrance (NPE)	99.2	96.0	97.1	100.0	100
North Shore Entrance (NSE)	99.2	98.1	98.5	97.4	95.5
Channel Head Differentials					
SSE	98.5	96.1	97.8	99.2	97.8
NPE	100.0	100.0	100.0	99.2	98.5
NSE	92.3	88.4	84.8	88.0	95.3
Channel Weir Depths					
SSE1	96.9	92.1	91.3	88.6	89.6
SSE2	97.7	92.9	91.3	89.4	91.1
NPE1 without on-sill criteria	35.4	46.5	57.2	24.2	34.8
NPE1 with on-sill criteria	100.0	98.4	99.3	100.0	97.8
NPE2 without on-sill criteria	49.1	33.8	55.8	23.5	31.9
NPE2 with on-sill criteria	100.0	100.0	99.3	100.0	97.8
NSE1	92.2	95.4	89.0	80.3	85.7
NSE2	91.4	94.6	82.7	81.1	85.7

[1] Data compiled from Appendix 1, previous monitoring report appendixes and inspection forms for the years 2018-2021.

Table 5. Little Goose Dam average tailrace water elevations, 2017-2022.[1]

Location	Average Tailrace Water Elevations						
	2017	2018	2019	2020	2021	2022	2017 – 2021 Average
SSE	538.83	538.50	538.71	538.83	538.45	538.45	538.66
NPE	538.65	538.40	538.59	538.73	538.37	538.36	538.55
NSE	538.76	538.46	538.61	538.75	538.32	538.37	538.58

[1] Data compiled from Appendix 1 and previous monitoring report appendixes for years 2017-2021.

Average entrance weir depths at SSE and NSE were in criteria for 2022 (Table 6). The NPE entrance was on-sill or in criteria for the majority of 2022. Average entrance weir depths at SSE and NSE locations were close to the 5-year average while the NPE average dropped below the 7 ft. over weir criteria. New FSC software was placed into operation in 2016 but continued to fail at maintaining fishway criteria when operating in automatic mode so the system was returned to manual operation. The 2022 season FSC board issues were attributed to a faulty hydro-ranger component. In addition, high tailrace conditions peaked on June 11. As a result, weir targets were lost for SSE-2 and NSE-1 and NSE-2. Impacts included total lack of FSC readings for 16 of the 135 inspections for all locations. For 7 of the 135 inspections there were no FSC readings for NSE weir, channel, and tailwater. All inspections were defaulted to manual measurement readings when accessible. Manual operations utilized physical measurements in conjunction with electronic data for maintenance, reporting, and inspection purposes.

Table 6. Little Goose Dam adult fishway average differentials and weir depths 2017-2022.[1]

Location	Average Differential or Depth in Feet						
Channel to Tailwater Differential	2017	2018	2019	2020	2021	2022	2017 – 2021 Average
SSE	1.40	1.42	1.42	1.41	1.39	1.46	1.41
NPE	1.65	1.62	1.57	1.51	1.57	1.58	1.58
NSE	1.29	1.16	1.21	1.19	1.22	1.24	1.21
Weir Depth							
SSE-1	8.73	8.72	8.72	8.60	8.65	8.51	8.68
SSE-2	8.68	8.71	8.78	8.60	8.68	8.52	8.69
NPE-1	6.99	6.50	6.93	7.02	6.47	6.63	6.78
NPE-2	6.94	6.50	6.77	6.99	6.47	6.58	6.73
NSE-1	6.63	6.85	6.59	6.61	6.43	6.51	6.62
NSE-2	6.60	6.77	6.55	6.57	6.44	6.65	6.59

[1] Data compiled from Appendix 1 and previous monitoring report appendixes for years 2017-2021.

Fishway Modifications and Improvements

Fishway System Control (FSC) panel and software were installed in 2016. The new software was installed to automatically adjust adult fish entrance weirs and ensure the adult fishway remained in criteria. Unfortunately, improper data was programmed, and the automatic controls did not function as expected. The control system was operated completely in manual from February 24 - May 4. The FSC panel was recommissioned on May 5 with NSE weir reading anomalies. Therefore, NSE weirs were operated in manual for the entirety of the season.

An adult fish ladder cooling pump was installed during the 2017-2018 winter maintenance period. The adult ladder cooling pump was started on June 27 and shut off on September 30.

Other improvements included adult channel fallback fence panel rebuilds, fish ladder metal grating removal, orifice opening of first upstream weir from the adult counting window.

Adult Fish Facility Recommendations

1. Repair and/or replace collection channel sluice gates and indicator rods.
2. Continue to replace diffuser grating and supporting beams.
3. Replace the North Shore Rip Rap jetty that protects the NSE entrance from turbulent water forces created by the north shore clockwise eddy.
4. Repair or replace the automatic adult Fishway Control System.
5. Repair and/or replace picketed leads.

Juvenile Fish Facility

Facility Description

The Little Goose Juvenile Fish Facility was designed to bypass juvenile salmon and steelhead to the tailrace or collect juvenile salmon and steelhead for transport below Bonneville Dam by truck and barge. The bypass system includes extended length submersible bar screens in the turbine intakes, vertical barrier screens, 12-inch diameter gatewell orifices, a 14-inch diameter gatewell

orifice, a collection channel running the length of the powerhouse, a dewatering structure, two emergency bypass routes, and a corrugated metal flume.

The transport system includes a fish separator, fish distribution system, raceways, a sampling and marking building, truck and barge loading areas, and a passive integrated transponder (PIT) tag detection and diversion / bypass system. Untagged fish (without PIT tags) may also be bypassed from the transport system.

Juvenile Fish Collection and Bypass

Migration and Collection

The juvenile fish bypass and collection facility was placed into primary bypass operations on March 23. Every other day collection for sampling began at 0700 on April 01. A total of 1,480,816 smolts were collected during the 2022 season (Table 7). Of those, 1,376,006 smolts were transported, 102,323 smolts were bypassed, and 2,487 smolts were facility mortalities (separator, raceway, or sample).

Table 7. Annual collection, bypass, and transport activity at Little Goose Dam JFF, 2017-2022.

Year	Yearling Chinook		Subyearling Chinook		Steelhead		Coho		Sockeye		Total
	Clip	Unclip	Clip	Unclip	Clip	Unclip	Clip	Unclip	Clip	Unclip	
Collection											
2017	957,932	380,014	236,813	386,867	812,224	252,851	17,941	25,257	7,164	6,618	3,083,681
2018	1,358,654	498,442	233,371	336,373	1,518,859	450,840	16,892	120,257	56,863	17,830	4,608,381
2019	909,931	248,210	126,440	196,296	1,335,165	367,506	12,697	43,213	27,714	3,236	3,270,408
2020	319,868	94,808	134,826	221,775	325,285	73,310	17,900	29,511	8,044	531	1,225,858
2021	80,728	18,119	61,200	160,352	97,559	23,131	2,100	6,121	1,255	3,022	453,587
2022	437,051	111,810	141,533	199,511	438,686	114,284	11,225	17,620	7,117	1,979	1,480,816
Bypass											
2017	554,485	282,676	3,282	15,172	612,738	138,805	1,200	2,001	0	3,322	1,613,681
2018	163,625	142,644	342	1,387	534,670	77,151	7	447	9	7,711	927,993
2019	147,664	65,018	3,190	13,055	574,953	99,844	10	3,052	10	30	906,826
2020	6,435	2,265	45,796	79,884	38,475	4,418	471	128	4	4	177,880
2021	1,486	665	24,725	48,070	22,128	2,954	484	88	0	124	100,724
2022	1,634	2,008	29,105	58,423	7,468	1,866	1,261	359	0	199	102,323
Truck											
2017	0	0	435	6,156	5	3	0	0	5	41	6,645
2018	0	0	370	4,163	2	6	0	2	4	13	4,560
2019	1	1	3,888	18,583	122	17	10	2	20	1	22,645
2020	1	0	2,642	30,354	3	2	1	10	1	1	33,015
2021	9	3	12,625	82,224	429	315	140	73	1	9	95,828
2022	0	4	1,719	19,053	5	2	9	7	0	1	20,800

Year	Yearling Chinook		Subyearling Chinook		Steelhead		Coho		Sockeye		Total
	Clip	Unclip	Clip	Unclip	Clip	Unclip	Clip	Unclip	Clip	Unclip	
Barge											
2017	399,531	96,175	232,159	363,553	199,312	113,958	16,726	23,230	7,099	2,930	1,454,673
2018	1,191,502	354,645	230,891	328,304	983,890	373,576	16,843	119,534	56,450	9,684	3,665,319
2019	760,457	182,729	119,157	164,092	759,935	267,573	12,644	40,086	27,537	3,187	2,337,397
2020	313,202	92,482	86,278	110,924	286,712	68,866	17,413	29,342	7,941	523	1,013,683
2021	79,094	17,431	23,749	29,497	74,904	19,850	1,451	5,939	1,245	2,866	256,026
2022	435,024	109,638	110,018	121,152	431,118	112,378	9,887	17,202	7,098	1,691	1,355,206
Total Transport											
2017	399,531	96,175	232,594	369,709	199,317	113,961	16,726	23,230	7,104	2,971	1,461,318
2018	1,191,502	354,645	231,261	332,467	983,892	373,582	16,843	119,536	56,454	9,697	3,669,879
2019	760,458	182,730	123,045	182,675	760,057	267,590	12,654	40,088	27,557	3,188	2,360,042
2020	313,203	92,482	88,920	141,278	286,715	68,868	17,414	29,352	7,942	524	1,046,698
2021	79,103	17,434	36,374	111,721	75,333	20,165	1,591	6,012	1,246	2,875	351,854
2022	435,024	109,642	111,737	140,205	431,123	112,380	9,896	17,209	7,098	1,692	1,376,006

Transportation

Year	Yearling Chinook		Subyearling Chinook		Steelhead		Sockeye		Coho	Season
	Clip	Unclip	Clip	Unclip	Clip	Unclip	Clip	Unclip		
2017	28-April	16-April	6-June	2-June	28-April	28-April	20-May	26-April	18-May	28-April
	115,678	50,001	16,772	16,208	119,203	27,601	803	1,209	3,200	298,107
2018	10-May	21-April	29-May	29-May	9-April	3-May	20-May	19-May	13-May	9-April
	87,294	26,408	28,966	34,245	167,390	19,400	8,712	1,009	10,404	212,443
2019	24-April	16-April	7-June	7-June	24-April	24-April	19-May	19-May	18-May	24-April
	57,647	19,209	9,355	14,212	244,404	76,801	7,022	402	3,801	394,474
2020	16-May	16-May	15-June	15-June	26-April	2-May	16-May	26-May	1-June	16-May
	25,103	6,802	16,544	16,993	32,901	6,801	1,803	100	3,175	44,508
2021	10-May	11-May	26-Jun	27-Jun	6-May	7-May	12-May	3-May	6-May	10-May
	8,217	1,325	6,460	8,003	6,216	1,625	200	380	645	13,881
2022	13-May	14-May	16-Jun	16-Jun	9-May	9-May	18-May	19-Jun	9-May	9-May
	48,020	8,604	13,103	11,637	75,803	16,001	1,600	400	1,805	126,661

Bypass

From April 1 to April 23, the facility was rotated between primary bypass (fish are routed directly to the river) and secondary bypass (fish are routed through the fish facility) every 24 hours for every-other-day condition sampling and gas bubble trauma (GBT) monitoring. Fish were routed to the river without being sampled on non-sample days. An estimated total of 6, 211 smolts were routed through the fish facility on sampling days between April 1 and April 23. Of this total, 6,186 smolts were bypassed and 25 smolts were mortalities. There are no passage estimates for the 12 non-sample days during the month of April.

From June 20 through August 1 no transport occurred as recommended by the Technical Management Team (TMT) and the facility operated in secondary bypass. An estimated total of 96,168 smolts were bypassed for the season. Total percent of fish by species consisted of 624 unclipped and 343 clipped yearling Chinook salmon, 58,375 unclipped and 29,105 clipped subyearling Chinook salmon, 4,545 clipped and 1,277 unclipped steelhead, 199 unclipped sockeye salmon and 1,619 coho salmon. Of the total, 96,087 were bypassed and 91 were facility mortalities.

Adult Fallbacks

Fallbacks are adult salmonids that have migrated above the dam and have "fallen back" into the downstream juvenile fish collection and bypass system. Fallbacks collected at the separator were too large to pass between the separator bars and were released back to the river. Fallbacks were identified by a species group and assessed for condition prior to being released.

A total of 2,236 adult salmon and steelhead fallbacks occurred in 2022 (Table 9). No small adult salmon fallbacks were collected in the sample and released back to the river.

There were 372 steelhead fallbacks in April, May and June (Table 10). In previous years, USACE classified out-migrating kelts due to their post spawned condition; kelts collected during this period accounted for the majority of fish in fair, poor, and dead condition. In April of 2018, FPOM asked that steelhead fallbacks be classified as adult steelhead rather than steelhead kelts. Table 11 lists the numbers of fish by species group and condition.

Table 9. Total annual adult salmonid fallbacks at Little Goose Dam JFF, 2017-2022.

Year	Adult Chinook	Jack/mini Chinook	Clip Steelhead	Unclip Steelhead	Sockeye	Coho	Total
2017	1,345	455	583	528	4	47	2,962
2018	374	210	923	667	3	0	2,177
2019	435	175	525	425	16	28	1,604
2020	485	913	324	338	87	31	2,178
2021	358	425	126	149	31	130	1,219
2022	659	314	570	486	32	175	2,236

Table 10. Monthly totals of fallbacks bypassed from separator at Little Goose Dam, 2022.

	Chinook		Chinook Jack		Steelhead		Sockeye			
	Clip	Unclip	Clip	Unclip	Clip	Unclip	Clip	Unclip	Coho	Total
April	0	0	0	0	12	6	0	0	0	18
May	27	5	1	0	85	82	0	0	0	200
June	62	46	7	6	40	147	0	0	0	308
July	32	27	13	3	15	13	23	3	0	129
August	15	10	4	6	25	29	2	2	1	94
September	106	90	59	34	148	54	1	0	23	515
October[1]	116	123	107	74	245	155	0	1	151	972
Total	358	301	191	123	570	486	26	6	175	2,236

[1]Includes fallbacks on the last sample day, November 1.

Table 11. Condition of adult salmonids released at Little Goose Dam, 2022.

Fish	Chinook		Chinook Jack		Steelhead		Sockeye			
Condition[1]	Clip	Unclip	Clip	Unclip	Clip	Unclip	Clip	Unclip	Coho	Total
Good	317	282	177	118	497	380	26	6	164	1,967
Fair	34	15	14	4	47	76	0	0	10	200
Poor	7	3	0	0	20	24	0	0	1	55
Dead	0	1	0	1	6	6	0	0	0	14
Total	358	301	191	123	570	486	26	6	175	2,236

[1] Condition ratings for live fish were determined subjectively based on the presence/absence and severity of fungus, headburn, fin wear, and other injuries.
Note: Table 11 does not separate post spawned "kelt" steelhead from pre-spawned healthier steelhead.

Separator Efficiency

Separator efficiency is a measure of how fish entering the facility are separated by size. Smaller fish, primarily salmon smolts, are expected to enter through the narrower bars on the upstream end of the separator (A-side). Larger fish, primarily steelhead, are expected to enter through the wider bars on the downstream end of the separator (B-side). Table 12 gives efficiency expressed as the percentage of each group, passing through the desired side of the separator, from 2017 to 2022. Efficiency rates are based on expanded sample counts.

Separator efficiency was highest for clipped steelhead and clipped yearling Chinook, with 70.7% of clipped steelhead entering on B-side and 66.2% of clipped yearling Chinook entering on A-side. Separator efficiency was lowest for clipped coho salmon, with 19.4% entering on A-side (Table 12).

Table 12. Annual juvenile salmonid separator efficiency (%) at Little Goose Dam JFF, 2017-2022.

	Yearling Chinook		Subyearling Chinook		Steelhead		Coho		Sockeye	
	Clip	Unclip	Clip	Unclip	Clip	Unclip	Clip	Unclip	Clip	Unclip
Year	A-side	A-side	A-side	A-side	B-side	B-side	A-side	A-side	A-side	A-side
2017	62.0%	56.5%	45.6%	46.9%	85.8%	69.6%	24.9%	22.0%	11.2%	34.8%
2018	69.7%	71.5%	55.8%	52.0%	81.1%	62.6%	31.8%	33.2%	24.0%	13.7%
2019	69.1%	72.0%	61.5%	60.6%	84.9%	55.7%	21.3%	31.2%	34.3%	25.4%
2020	52.0%	54.9%	43.1%	43.2%	88.3%	78.4%	15.0%	21.3%	11.2%	10.2%
2021	50.5%	46.8%	39.5%	37.3%	81.2%	70.9%	19.5%	42.9%	19.7%	17.3%
2022	66.2%	57.0%	43.1%	44.7%	70.7%	60.1%	19.4%	32.2%	43.6%	44.3%

Note: Counts do not include sample mortalities.

Sampling

The fish sampling system was operated without incident throughout the 2022 season. Sampling procedures followed the smolt monitoring guidelines developed by the Fish Passage Center and USACE. The resulting data were used for management of facility and fish transport operations. Collection and fish condition data were also transmitted daily by ODFW personnel to the Fish Passage Center electronic database in support of the Smolt Monitoring Program (SMP).

Sample rates were set by USACE project biologists. To obtain the target sample of 300 to 500 smolts, sample rates were varied between 0.05% and 100.0% as fish migration numbers fluctuated. The percentage of each species sampled was dependent on their migration timing and the overall sample rate in effect at that time (Table 13).

Table 13. Annual sample rate percentages of juvenile salmonids collected per species and clip type that were sampled at Little Goose Dam JFF, 2017-2022[1].

	Yearling Chinook		Subyearling Chinook		Steelhead		Sockeye		Coho	
Year	Clip	Unclip	Clip	Unclip	Clip	Unclip	Clip	Unclip	All	Total
2017	0.5%	0.5%	3.3%	6.4%	0.5%	0.7%	1.3%	1.9%	1.2%	1.5%
2018	0.5%	0.7%	3.1%	5.8%	0.7%	0.7%	0.8%	1.9%	0.7%	1.1%
2019	0.7%	0.7%	8.4%	14.3%	0.6%	0.6%	1.3%	1.9%	1.5%	1.8%
2020	1.2%	1.3%	6.8%	16.3%	1.9%	1.6%	0.7%	1.7%	1.3%	4.8%
2021	5.9%	6.7%	11.1%	11.6%	7.2%	7.6%	6.9%	7.6%	8.0%	9.1%
2022	1.1%	1.8%	4.5%	9.1%	1.6%	1.5%	1.1%	3.0%	2.1%	2.7%

[1]All research fish and sample mortality are included in percentages.

All fish in the sample were examined to determine species, clip type, and prevalence of descaling. In addition, Chinook salmon age class was determined as subyearling or yearling. All yearling Chinook salmon in the sample were examined for characteristics typical of holdover Lyons Ferry Hatchery fall Chinook salmon. All unclipped salmon were scanned for coded wire tags. Chinook, sockeye, and coho salmon fry were defined by length (less than 60 millimeters) and were bypassed for continued growth. Fry are not examined for fish condition or descaling. None of the 2022 hatchery releases above LGS were marked with elastomer eye tags.

Fish condition data were collected from a random subsample of 100 fish of each species present in the daily sample when possible. Data collected included weight, length, descaling, injury, disease, predation, and other monitored conditions, including pink fin, fin hemorrhage, fin discoloration, popeye (exophthalmos), and eye hemorrhage. Injury and descaling data were used by managers to assess passage conditions at the dam.

Number of fish per pound was calculated from the weights taken during fish condition sampling, and the species composition from the entire sample, and was provided to USACE from April 2 to November 1.

A total of 40,624 fish were sampled during the 2022 season. Of these, 38,396 were examined for descaling, 260 were salmonid fry, 214 were sample mortalities, and 1,754 were removed from the separator during GBT monitoring (Table 14).

Table 14. Weekly sample as percent of collection total and sample totals at Little Goose Dam JFF, 2022.

Week Ending	Weekly Sampled (percent)	Yearling Chinook		Subyearling Chinook		Steelhead		Sockeye		Coho	Totals[1]
		Clip	Unclip	Clip	Unclip	Clip	Unclip	Clip	Unclip	All	
7-Apr	4.0%	11	30	0	0	24	2	0	0	0	67
14-Apr	24.0%	82	55	0	0	160	56	0	0	0	353
21-Apr	14.7%	72	42	0	0	211	40	0	0	0	365
28-Apr	4.2%	557	235	0	0	2010	104	0	0	1	2907
5-May	1.3%	451	126	0	0	1236	115	0	3	5	1936
12-May	0.7%	955	178	0	0	910	179	0	1	44	2267
19-May	0.6%	1221	212	10	41	508	212	32	3	26	2265
26-May	2.6%	515	181	21	48	331	213	38	5	50	1402
2-Jun	3.1%	738	614	301	420	558	352	3	6	130	3122
9-Jun	2.4%	128	173	741	939	235	167	1	3	99	2486
16-Jun	2.0%	47	70	1067	849	176	85	1	1	61	2357
23-Jun	3.6%	16	25	567	938	228	71	0	22	70	1937
30-Jun	11.7%	19	34	429	883	233	42	0	11	67	1718
7-Jul	13.2%	7	12	587	900	63	16	0	3	34	1622
14-Jul	15.9%	0	4	919	1349	16	4	0	1	6	2299
21-Jul	11.3%	0	0	732	1392	1	1	0	0	2	2128
28-Jul	10.9%	0	0	226	713	0	0	0	0	0	939
4-Aug	9.6%	0	1	156	827	0	0	0	0	0	984
11-Aug	20.4%	0	0	156	1100	0	0	0	0	1	1257
18-Aug	19.2%	0	0	64	877	0	0	0	0	1	942
25-Aug	63.5%	0	0	46	678	1	0	0	0	2	727
1-Sep	100.0%	0	0	44	718	0	0	0	0	0	762
8-Sep	78.7%	0	0	41	868	1	1	0	0	0	911
15-Sep	99.8%	0	0	59	788	1	0	0	0	0	848
22-Sep	99.5%	0	0	25	592	0	0	0	0	0	617
29-Sep	99.6%	0	0	10	211	0	1	0	0	0	222
6-Oct	99.5%	0	0	15	166	0	0	0	0	0	181
13-Oct	100.0%	0	0	5	153	0	0	0	0	1	159
20-Oct	99.6%	0	0	8	252	1	0	0	0	0	261
27-Oct	100.0%	0	1	50	1620	1	1	0	0	0	1673
3-Nov	100.0%	0	0	21	887	0	0	0	1	1	910
Total Sampled		4,819	1,993	6,300	18,209	6,905	1,662	75	60	601	40,624
Total Sample Collection[2]		5,033	2,074	6,642	18,559	6,947	1,671	89	86	608	41,709
Percent of Sample		11.9%	4.9%	15.5%	44.8%	17.0%	4.1%	0.2%	0.1%	1.5%	100.0%
Percent of Collection		0.3%	0.1%	0.4%	1.3%	0.5%	0.1%	0.0%	0.0%	0.0%	2.8%

[1]All research fish, GBT fish and sample mortality included in species group and clip type numbers.
[2]Separator mortalities are included in collection totals but are not sampled.

Fish Condition

Fish condition was monitored daily by EAS and ODFW biologists. "The primary role of the condition monitoring is to identify the proportion of each species of migrant juvenile salmonid and larval and juvenile lamprey (where applicable) that are descaled (salmonids only) or have significant injuries indicative of problems in fish passage at dams such as debris in fish bypass apparatus. Secondarily, the data collected on disease, predation, and other injuries will provide a relative indication of the health of fish passing at the dams." (Condition Sampling Protocol, 2022 Smolt Monitoring Season).

Injuries

Prior to 2009, recorded injuries were based solely on the presence of an injury, with no attempt made to determine the age or origin of the injury. From 2009 to date, only fresh injuries presumed to have occurred during passage through Little Goose Dam, have been recorded.

The highest rates of injury this year were observed in clipped sockeye salmon (35.7%), followed by unclipped subyearling Chinook salmon (10.7%), and unclipped yearling Chinook salmon (8.9%) (Table 15).

Table 15. Annual injury rates (%) for salmonids examined at Little Goose Dam, 2017-2022.

	Yearling Chinook		Subyearling Chinook		Steelhead		Sockeye		Coho	
Years	Clipped	Unclip	Clipped	Unclip	Clipped	Unclip	Clipped	Unclip	All	Total
2017	9.9%	10.6%	12.3%	16.6%	5.4%	4.9%	11.8%	7.8%	7.1%	13.0%
2018	10.0%	13.3%	14.0%	14.1%	3.3%	4.7%	10.1%	15.1%	7.3%	10.7%
2019	9.0%	13.3%	17.1%	16.4%	3.9%	3.9%	9.9%	8.5%	7.5%	12.1%
2020	9.3%	10.8%	10.3%	11.5%	2.8%	4.1%	9.1%	11.1%	7.4%	9.4%
2021	7.8%	6.7%	8.6%	10.6%	2.2%	2.4%	16.9%	10.7%	4.9%	7.6%
2022	6.8%	8.9%	8.4%	10.7%	3.1%	3.0%	35.7%	7.8%	5.3%	8.1%

A total of 22,709 smolts from the condition subsample were examined for injuries. Of the fish examined, 1,832 (8.1%) individual smolts were observed with one or more injuries. A total of 1,883 individual injuries were observed this year. Most injuries involved fin damage (80.0%), followed by body injury (8.8%), operculum injury (8.5%), eye injury (1.0%), and head injury (1.5%). A detailed list of individual injury types and injury rates by species and clip type is provided in Table 16.

Table 16. Percent of fish examined that were injured, had predation marks, or had signs of disease by species and clip type at Little Goose Dam, 2022.

	Yearling Chinook		Subyearling Chinook		Steelhead		Coho		Sockeye		Total[1]
	Clip	Unclip	Clip	Unclip	Clip	Unclip	Clip	Unclip	Clip	Unclip	
Injuries											
Eye	0.2%	0.2%	<0.1%	<0.1%	0.1%	<0.1%	0.3%	0.0%	1.4%	3.9%	<0.1%
Operculum	0.6%	1.0%	0.5%	0.4%	1.6%	0.7%	0.7%	0.4%	2.9%	0.0%	0.7%
Head	0.0%	0.2%	<0.1%	0.1%	0.2%	0.1%	0.3%	0.0%	0.0%	0.0%	0.1%
Body	0.3%	0.2%	0.7%	1.2%	0.3%	0.4%	0.0%	0.4%	1.4%	0.0%	0.7%
Fin	5.8%	7.5%	7.3%	9.3%	1.1%	1.8%	4.1%	4.5%	32.9%	3.9	6.6%
Total Injury	**6.8%**	**8.9%**	**8.4%**	**10.7%**	**3.1%**	**3.0%**	**5.4%**	**5.3%**	**35.7%**	**7.8%**	**8.1%**
Disease											
Fungus	0.3%	0.4%	0.3%	0.2%	0.9%	0.8%	1.7%	0.8%	4.3%	23.5%	0.5%
Columnaris	0.0%	<0.1%	1.0%	3.1%	<0.1%	<0.1%	0.0%	0.0%	0.0%	2.0%	1.5%
BKD	0.4%	1.7%	<0.1%	<0.1%	0.0%	0.0%	0.0%	0.4%	0.0%	0.0%	0.2%
Parasites	0.1%	0.4%	0.5%	0.2%	0.2%	2.6%	0.0%	2.0%	0.0%	0.0%	0.4%
Deformity	0.2%	0.6%	2.1%	0.8%	0.5%	0.4%	1.4%	2.8%	5.7%	0.0%	0.8%
Disease Other	<0.1%	0.3%	0.2%	0.4%	<0.1%	0.0%	0.3%	0.0%	0.0%	0.0%	0.2%
Total	**1.0%**	**3.3%**	**4.1%**	**4.7%**	**1.6%**	**3.8%**	**3.0%**	**6.0%**	**10.0%**	**25.5%**	**3.6%**
Predation											
Bird	0.3%	1.0%	0.2%	0.2%	2.9%	1.7%	1.7%	0.0%	2.9%	3.9%	0.8%
Fish	0.5%	0.6%	2.0%	6.7%	0.3%	0.7%	0.3%	0.0%	0.0%	0.0%	3.4%
Lamprey	<0.1%	0.0%	0.0%	<0.1%	<0.1%	0.0%	0.3%	0.0%	0.0%	0.0%	<0.1%
Other	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Total	**0.9%**	**1.5%**	**2.2%**	**7.0%**	**3.3%**	**2.4%**	**2.4%**	**0.0%**	**2.9%**	**3.9%**	**4.3%**
Miscellaneous Conditions											
Popeye	0.1%	0.2%	0.1%	<0.1%	0.0%	0.0%	0.0%	0.0%	1.4%	0.0%	<0.1%
Fin Hemorrhage	2.3%	4.7%	9.7%	11.5%	1.2%	0.6%	1.4%	2.0%	7.1%	0.0%	7.1%
Pink Fin	2.9%	7.0%	18.6%	21.4%	2.3%	2.6%	0.0%	0.8%	0.0%	2.0%	13.1%
Fin Discoloration	0.9%	1.0%	1.2%	1.6%	<0.1%	0.0%	0.7%	0.0%	0.0%	0.0%	1.0%
Eye Hemorrhage	0.5%	0.8%	0.2%	<0.1%	<0.1%	<0.1%	0.0%	0.4%	0.0%	0.0%	0.2%
Total Misc. Conditions	**6.4%**	**12.2%**	**25.5%**	**29.2%**	**3.5%**	**3.3%**	**2.0%**	**3.2%**	**8.6%**	**2.0%**	**18.4%**
Total Sample Size	**2,793**	**1,263**	**2,886**	**9,982**	**3,733**	**1,388**	**296**	**247**	**70**	**51**	**22,709**

[1] Overall disease and injury rates are less than the sum of the individual categories because some individual fish had more than one injury or disease. BKD = bacterial kidney disease

Descaling

All live smolts in the sample were examined for descaling. A smolt was considered descaled if 20% or more of the scales were missing from either side of the fish. Only descaling that appeared fresh enough to have occurred at LGS was recorded.

A total of 38,396 smolts were examined for descaling in 2022. Smolts examined for descaling include live smolts in the sample and do not include smolts examined for GBT, sample mortalities, or fry. The overall rate of descaling was 1.7% (638 fish), which is slightly higher than the 5-year average of 1.3% (Table 17). Of the 38,396 smolts examined for descaling, 22,709 smolts (59.1%) were examined as part of condition subsampling. During condition subsampling, fish with descaling >20.0% were differentiated into two categories: 1) descaling associated with dam passage, and 2) descaling on fish with bite marks indicative of predation attempts by birds, fish, or lamprey. The rate of descaling observed in the condition subsample was 2.0% (460 smolts). Of the 460 descaled smolts observed, total percent of descaling associated with dam passage was 61.5%, while total percent of descaling associated with predation marks was 38.5%. The rate of descaling observed in the non-condition sample was 1.1% (178 smolts) from a sample size of 15,687 salmon. Descaling recorded from the non-condition sample does not differentiate between descaling as a result of passage and descaling as a result of predators.

Table 17. Annual descaling rates for salmonids examined at Little Goose Dam JFF, 2017-2022.

	Yearling Chinook		Subyearling Chinook		Steelhead		Sockeye		Coho	
Year	Clip	Unclip	Clip	Unclip	Clip	Unclip	Clip	Unclip	All	Totals
2017	2.2%	1.5%	1.2%	1.4%	1.5%	0.8%	3.1%	6.5%	1.7%	1.5%
2018	1.7%	0.8%	1.2%	1.0%	1.3%	1.9%	1.1%	4.6%	1.9%	1.2%
2019	2.3%	1.7%	1.5%	1.2%	2.0%	1.7%	2.3%	3.4%	3.1%	1.5%
2020	1.5%	2.0%	0.6%	0.9%	1.0%	1.9%	3.6%	0.0%	1.5%	1.0%
2021	1.5%	1. 7%	0.5%	0.9%	1.9%	2.1%	1.2%	1.8%	2.2%	1.2%
2022	1.7%	1.5%	1.0%	1.7%	2.0%	2.2%	0.0%	0.7%	2.4%	1.7%

Note: GBT sample numbers not included in descaling rate calculations.

Partial descaling of 3% to 19% above background levels was also recorded for fish in the condition subsample. The rate of partial descaling was 4.1% of the 22,709 smolts examined for condition in 2022, or 928 partially descaled fish.

Weekly descaling rates per species and clip types are listed in Table 18. The average weekly descaling rate ranged from 0.0% to 4.3%.

Table 18. Weekly descaling rates for salmonids examined at Little Goose Dam JFF, 2022.

Week Ending	Yearling Chinook		Subyearling Chinook		Steelhead		Sockeye		Coho	Total
	Clip	Unclip	Clip	Unclip	Clip	Unclip	Clip	Unclip	All	
7-Apr	9.09%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	1.54%
14-Apr	0.00%	0.00%	--	--	0.00%	0.00%	--	--	--	0.00%
21-Apr	2.78%	0.00%	--	--	0.60%	0.00%	--	--	--	0.97%
28-Apr	1.36%	0.93%	--	--	0.81%	2.88%	--	--	0.00%	1.00%
5-May	0.97%	2.46%	--	--	0.93%	5.56%	--	0.00%	0.00%	1.31%
12-May	1.14%	0.58%	--	--	1.57%	2.89%	--	0.00%	0.00%	1.39%
19-May	1.14%	0.98%	0.00%	0.00%	4.22%	2.86%	0.00%	0.00%	0.00%	1.96%
26-May	2.69%	1.82%	0.00%	6.67%	3.81%	2.04%	0.00%	0.00%	2.22%	2.72%
2-Jun	2.80%	1.65%	0.69%	1.00%	7.07%	1.81%	0.00%	0.00%	1.54%	2.70%
9-Jun	1.69%	2.99%	1.53%	0.57%	4.19%	1.23%	0.00%	0.00%	1.03%	1.48%
16-Jun	2.13%	2.90%	0.99%	1.50%	3.61%	0.00%	0.00%	--	1.72%	1.43%
23-Jun	6.67%	4.00%	1.29%	1.53%	1.59%	0.00%	--	5.00%	8.96%	1.81%
30-Jun	5.26%	0.00%	1.49%	0.84%	0.95%	4.88%	--	10.00%	3.08%	1.34%
7-Jul	0.00%	0.00%	0.37%	0.74%	0.00%	0.00%	--	0.00%	0.00%	0.54%
14-Jul	--	0.00%	0.46%	0.78%	0.00%	0.00%	--	--	20.00%	0.69%
21-Jul	--	--	0.57%	0.84%	0.00%	0.00%	--	--	0.00%	0.75%
28-Jul	--	--	0.51%	0.91%	--	--	--	--	--	0.82%
4-Aug	--	0.00%	2.21%	1.05%	--	--	--	--	--	1.22%
11-Aug	--	--	3.38%	1.30%	--	--	--	--	0.00%	1.57%
18-Aug	--	--	0.00%	0.12%	--	--	--	--	--	0.11%
25-Aug	--	--	2.17%	1.50%	--	--	--	--	0.00%	1.54%
1-Sep	--	--	0.00%	1.81%	--	--	--	--	--	1.71%
8-Sep	--	--	2.44%	1.96%	0.00%	0.00%	--	--	--	1.98%
15-Sep	--	--	3.45%	3.12%	0.00%	--	--	--	--	3.14%
22-Sep	--	--	0.00%	2.62%	--	--	--	--	--	2.51%
29-Sep	--	--	0.00%	2.90%	--	0.00%	--	--	--	2.76%
6-Oct	--	--	0.00%	4.85%	--	--	--	--	--	4.44%
13-Oct	--	--	0.00%	0.66%	--	--	--	--	0.00%	0.63%
20-Oct	--	--	12.50%	5.16%	0.00%	--	--	--	--	5.36%
27-Oct	--	0.00%	2.00%	3.71%	0.00%	0.00%	--	--	--	3.65%
3-Nov	--	--	0.00%	3.04%	--	--	--	0.00%	0.00%	2.97%
Total Exam.	**4479**	**1903**	**5981**	**17231**	**6533**	**1561**	**73**	**53**	**582**	**38396**
Percent Desc.	**1.67%**	**1.52%**	**1.02%**	**1.69%**	**2.02%**	**2.18%**	**0.00%**	**3.77%**	**2.41%**	**1.66%**

[1] Descaling figures do not include sample mortalities or fish examined for GBT.
[2] "-----" means species group not present in sample during this week.

Disease

Data on the presence of disease symptoms were collected from fish in the condition subsample to provide relative information about fish health. Disease classifications included fungus, Columnaris, bacterial kidney disease (BKD), body parasites, deformity, and other diseases such as cysts or tumors. The year 2014 was the first season parasites were identified and documented to genus, which included fish louse (*Argulus*), gill lice (*Salmincola*), and leech (*Piscicola*). Types of deformity were also documented, including spinal curvatures (such as scoliosis and lordosis), dwarfism, or truncated body.

A total of 817 smolts (3.6%) of the total condition subsample were observed with one or more symptoms of disease (Table 16). Columnaris was the most prevalent at 41.8% of the total, followed by deformity (23.0%), fungus (13.1%), parasite (11.0%), other (6.2%), and presumed BKD (5.0%). Almost all other symptoms of disease observed this season consisted of smolts with rotted caudal fins or smolts with symptoms of abdominal distention similar to BKD. In 2015, several subyearling fall Chinook salmon smolt mortalities were observed with these symptoms, which prompted ODFW personnel to collect a specimen for the ODFW Fish Health Laboratory in La Grande, Oregon. Results were positive for the intestinal protozoan parasite (*Ceratomyxa shasta*). Fish exhibiting symptoms of abdominal distention previously were reported as "disease other," rather than BKD, since 2015.

Predation Marks

Bite marks were recorded on fish from the condition subsample, which were indicative of predation attempts by bird, fish, lamprey, and mammalian predators such as mink and otter. A total of 968 smolts were observed with one or more predatory wounds with an overall rate of 4.3% of the total condition subsample. Most marks observed were indicative of predation by fish at 80.2% of the total bite marks recorded, followed by bird (19.2%) and lamprey bites (0.6%). No mammalian bite marks were observed this year. The highest rate of predatory attempts were observed on unclipped subyearling Chinook (7.0%), unclipped sockeye (3.9%), and clipped steelhead (3.3%) (Table 16).

Overall rate of bird bite marks was 0.8, which is slightly lower than the 5-year average of 0.9% (Table 19). The highest prevalence of bird bite marks was observed on unclipped sockeye (2 out of 51) and unclipped steelhead (107 out of 3,733).

Table 19. Annual bird bite rates for salmonids examined at Little Goose Dam, 2017-2022

	Yearling Chinook		Subyearling Chinook		Steelhead		Sockeye		Coho	
Year	Clipped	Unclip	Clipped	Unclip	Clipped	Unclip	Clipped	Unclip	All	Total
2017	1.0%	0.3%	0.3%	0.5%	2.7%	2.2%	2.2%	1.9%	0.2%	0.9%
2018	0.8%	0.5%	0.2%	0.3%	1.8%	2.0%	0.6%	0.6%	0.6%	0.8%
2019	0.8%	0.5%	0.2%	0.3%	2.1%	1.6%	0.3%	0.0%	0.7%	0.8%
2020	0.8%	0.5%	<0.1%	0.3%	2.8%	2.8%	3.6%	0.0%	1.0%	0.8%
2021	1.3%	1.4%	0.3%	0.4%	2.9%	2.7%	1.2%	0.4%	0.8	1.1%
2022	1.0%	0.3%	0.2%	0.2%	2.9%	1.7%	2.9%	3.9%	0.9%	0.8%

Other Miscellaneous Conditions

Other miscellaneous conditions included popeye (exophthalmos), hemorrhaged fin, pink fin, discolored fin, and hemorrhaged eye. A total of 4,870 individuals were observed for miscellaneous conditions. There were 4,181 smolts with one or more miscellaneous conditions with a rate of 18.4% of the total condition subsample (Table 16). Many smolts examined had multiple conditions. Pink fin and hemorrhaged fins often occurred on the same individual fish, but in different fins. Pink fin constituted most of the observations at 61.0% of total individuals with miscellaneous conditions, followed by hemorrhaged fins (33.2%), fin discoloration (4.8%), eye hemorrhage (0.8%), and popeye (exophthalmos) (0.2%). Subyearling fall Chinook salmon had the highest rates in this condition category at 29.1% for unclipped and 25.5% for clipped.

Mortality

Mortality at the JFF included fish that entered the system dead and those that died at the facility. Mortality was recorded by location within the facility and was divided into facility mortality (raceways and separator) and sample mortality. Total facility mortality is the sum of facility mortality (raceway and separator) and sample mortality.

Total facility mortality rate in 2022 was the same as the 5-year average rate (0.2%) with 2,487 mortalities out of 1,480,816 fish collected (Table 20). Average weekly total facility mortality rate ranged from 0.0% to 4.0% (Table 21). Minimum weekly rates of 0.1% and less than 0.1% occurred prior to May 20 when mortalities represented a small proportion of total collection. Mortality rates increased later in the collection season when total collection numbers decreased and disease and injury rates increased, presumably due to warmer river temperatures. Average rate of monthly total facility mortality was highest in September at 2.0% with 60 total facility mortalities from a collection of 2,928 smolts.

Maximum weekly total facility mortality rate of 4.0% occurred the week ending September 29, with a weekly collection of 223 fish and 9 mortalities. The median weekly total facility mortality rate for all smolts was 0.2%. The highest number of facility mortalities occurred the week ending June 16 when 1,002 mortalities were recorded.

Sample mortality for smolts was 0.5% of 40,624 smolts sampled (Table 22). Increased sample mortality in late summer was observed when river temperatures and outbreaks of disease, such as Columnaris, were higher than in spring and fall. On average, monthly sample mortality was lowest in June (0.2%) and October (0.2%), from a sample size of 4,215 and 3,163 smolts respectively. The highest sample mortality was in September (1.7%) from a sample number of 2,674 smolts.

Total sample mortality rate of Pacific lamprey ammocoete was 7.4% in 2022; 23 of 309 total ammocoete sampled. Total sample mortality of Pacific lamprey macropthalmia was 3.1%; 19 from a collection of 615 (Table 22). Sample mortality rates for ammocoetes were higher than the 5-year average and macropthalmia were lower than the 5-year average.

Table 20. Annual total facility mortality as a percentage of total collection at Little Goose Dam JFF 2017-2022.

Year	Yearling Chinook		Subyearling Chinook		Steelhead		Sockeye		Coho	Total[1]	Pacific lamprey	
	Clip	Unclip	Clip	Unclip	Clip	Unclip	Clip	Unclip			Ammocoete	Macropthalmia
2017	0.4%	0.3%	0.4%	0.5%	<0.1%	<0.1%	0.8%	4.9%	0.1%	0.3%	0.3%	0.3%
2018	0.3%	0.2%	0.8%	0.7%	<0.1%	<0.1%	0.7%	2.4%	0.2%	0.2%	0.1%	0.1%
2019	0.2%	0.2%	0.2%	0.3%	<0.1%	<0.1%	0.5%	0.6%	0.2%	0.1%	0.5%	0.2%
2020	0.1%	0.1%	0.1%	0.3%	<0.1%	<0.1%	1.2%	0.6%	0.1%	0.1%	0.1%	0.1%
2021	0.2%	0.1%	0.2%	0.3%	0.1%	<0.1%	0.7%	0.8%	0.6%	0.2%	0.5%	0.8%
2022	0.1%	0.1%	0.5%	0.4%	<0.1%	<0.1%	0.3%	4.4%	0.4%	0.2%	0.4%	0.1%

Note: Mortality rate for collected fish includes sample, raceway, and separator mortalities. Lamprey numbers are not included in "Totals" column.

Incidental Species

Total incidental fish collection was determined by using the sample rate to expand the number of incidental fish in the sample and adding the number of incidental fish removed from the separator to the expanded sample count. Incidental species were counted individually, except when handling large numbers of Siberian prawn (*Exopalaemon modestus*) and juvenile American shad (*Alosa sapidissima*). When the number of Siberian prawn and juvenile American shad was too large to practically count individuals, a fish-per-pound calculation was obtained for these species. The result was then multiplied by the total daily weight of the sampled species to obtain an estimated count for the day. All sampled incidental fish were returned to the river, except for Siberian prawns, which were humanely euthanized per the directive issued by Washington Department of Fish and Wildlife on July 24, 2007. In past years, all Siberian prawns from the sample were frozen and returned to the river, but starting in 2017 prawns have been frozen and put in a landfill.

When the sample rate was <100%, incidental species were inadvertently collected and transported along with smolts. When the sample rate was 100%, all incidental species were removed from collection and returned to the river, except for of Siberian prawns.

Total incidentals collected was 150,752 fish. This included an expanded sample count of 64,778 fish and 63,458 Siberian prawn, plus 22,516 fish from the separator, 16,828 of which were juvenile American shad (Table 23). Two unclipped and three clipped Chinook minijack salmon are excluded in Table 23.

Collection numbers of Siberian prawns, Walleye (*Sander vitreus*), Pacific Lamprey ammocoete (*Entosphenus tridentatus*), Pacific Lamprey macropthalmia (*E. tridentatus*), Rainbow trout (*Oncorhynchus mykiss*), Yellow perch (*Perca flavescens*), and Kokanee (*O. nerka*) were much higher than the 2017 to 2021 average. Chiselmouth (*Acrocheilus glutaceus*), Crappie (*Pomoxis* sp.), Mountain whitefish (*Prosopium williamsoni*), Peamouth (*Mylocheilus caurinus*), Sculpin (*Cottus* sp.), and Sucker (*Catostomus* sp.) numbers were much lower than the 2017 to 2021 average while numbers of most other species were similar to the 2017 to 2021 average. (Tables 23 & 24).

Table 21. Weekly total facility mortality in percent at Little Goose Dam JFF, 2022.

Week Ending	Yearling Chinook		Subyearling Chinook		Steelhead		Sockeye		Coho	Total
	Clip	Unclip	Clip	Unclip	Clip	Unclip	Clip	Unclip	All	
7-Apr	0.4%	1.2%	--	--	0.0%	2.0%	--	--	--	0.7%
14-Apr	0.3%	1.1%	--	--	0.0%	0.0%	--	--	--	0.3%
21-Apr	0.3%	2.2%	--	--	0.0%	0.0%	--	--	--	0.4%
28-Apr	0.1%	0.2%	--	--	0.0%	0.0%	--	0.0%	0.0%	0.0%
5-May	0.1%	0.3%	--	--	0.0%	0.0%	--	0.0%	0.0%	0.1%
12-May	0.1%	0.2%	--	--	0.0%	0.0%	--	0.1%	0.1%	0.1%
19-May	0.1%	0.0%	0.0%	0.2%	0.0%	0.0%	0.1%	0.3%	0.2%	0.1%
26-May	0.2%	0.2%	0.4%	0.4%	0.0%	0.1%	0.5%	0.5%	0.5%	0.1%
2-Jun	0.2%	0.1%	0.1%	0.0%	0.0%	0.0%	1.4%	0.0%	0.1%	0.1%
9-Jun	0.1%	0.1%	0.2%	0.2%	0.1%	0.1%	0.0%	0.2%	0.5%	0.2%
16-Jun	0.3%	0.2%	0.9%	1.1%	0.1%	0.2%	0.0%	1.8%	1.4%	0.8%
23-Jun	0.4%	0.1%	0.6%	0.5%	0.1%	0.1%	100.0%	1.0%	0.6%	0.5%
30-Jun	0.0%	0.0%	0.1%	0.1%	0.1%	0.3%	--	1.2%	0.7%	0.1%
7-Jul	0.0%	0.0%	0.0%	0.1%	0.0%	0.0%	--	0.0%	0.0%	0.1%
14-Jul	--	0.0%	0.1%	0.1%	0.0%	4.2%	--	0.0%	2.6%	0.1%
21-Jul	--	--	0.1%	0.1%	0.0%	0.0%	--	0.0%	3.6%	0.1%
28-Jul	--	--	0.1%	0.1%	--	--	--	--	--	0.1%
4-Aug	--	25.0%	0.2%	0.2%	--	--	--	--	--	0.2%
11-Aug	--	--	1.5%	1.0%	--	--	--	20.0%	20.0%	1.0%
18-Aug	--	--	0.9%	0.7%	--	--	--	--	10.0%	0.7%
25-Aug	--	--	1.4%	0.7%	0.0%	--	--	50.0%	50.0%	0.8%
1-Sep	--	--	2.3%	0.0%	--	--	--	--	--	0.1%
8-Sep	--	--	0.0%	0.2%	0.0%	0.0%	--	--	--	0.2%
15-Sep	--	--	1.7%	2.9%	0.0%	--	--	--	--	2.8%
22-Sep	--	--	0.0%	4.0%	--	--	--	--	--	3.9%
29-Sep	--	--	18.2%	3.3%	--	0.0%	--	--	--	4.0%
6-Oct	--	--	0.0%	1.8%	--	--	--	--	--	1.6%
13-Oct	--	--	0.0%	0.7%	--	--	--	0.0%	0.0%	0.6%
20-Oct	100.0%	--	0.0%	0.0%	0.0%	--	--	--	--	0.4%
27-Oct	--	0.0%	0.0%	0.2%	0.0%	0.0%	--	--	--	0.2%
3-Nov	--	--	0.0%	0.0%	--	--	--	0.0%	0.0%	0.0%
Total Exam.	**437,051**	**111,810**	**141,533**	**199,511**	**438,686**	**114,284**	**7,117**	**1,979**	**28,845**	**1,480,816**
Percent Mort.	**0.09%**	**0.14%**	**0.49%**	**0.44%**	**0.02%**	**0.03%**	**0.27%**	**4.45%**	**0.42%**	**0.22%**
Median	**0.16%**	**0.16%**	**0.11%**	**0.22%**	**0.00%**	**0.02%**	**0.34%**	**0.12%**	**0.49%**	**0.20%**

[1]Total facility mortality includes facility, sample and raceway mortality.
Note: "-----" indicates that the species group was not present in the sample

Table 22. Annual sample mortality as percent of total sample at Little Goose JFF, 2017-2022.

	Yearling Chinook		Subyearling Chinook		Steelhead		Sockeye				Pacific Lamprey	
Year	Clip	Unclip	Clip	Unclip	Clip	Unclip	Clip	Unclip	Coho	Total	Ammocoetes	Macropthalmia
2017	0.5%	0.4%	0.4%	0.7%	0.2%	0.1%	0.0%	12.1%	0.2%	0.5%	4.6%	2.3%
2018	0.3%	0.6%	0.7%	0.9%	0.1%	<0.1%	0.8%	3.0%	0.4%	0.6%	2.6%	4.3%
2019	0.5%	0.6%	0.4%	0.8%	0.1%	0.2%	1.9%	1.7%	1.2%	0.6%	3.6%	5.8%
2020	0.4%	0.2%	0.7%	1.0%	0.1%	0.1%	3.5%	<0.1%	1.0%	0.8%	2.3%	2.1%
2021	0.7%	0.3%	0.1%	0.5%	0.5%	0.1%	4.6%	2.2%	1.4%	0.5%	3.2%	4.3%
2022	0.5%	0.6%	0.4%	0.6%	0.0%	0.5%	2.7%	11.7%	4.0%	1.8%	7.4%	3.1%

Note: Mortality rate in sampled fish excludes research, raceway, and separator mortalities. Includes GBT sample fish. Pacific lamprey mortalities are not included in the total mortalities to facilitate across year comparisons.

Adult Pacific lamprey collections totaled 98 in 2022; 52 counts from the separator and raceways and 46 counts from the sample. The first adult Pacific lamprey of the season was collected on June 20 and the last on October 20. Upriver adult migrants were most frequently observed falling back into the collection system from August to September. For the eighth consecutive year, USACE transported all adult Pacific lamprey captured at the facility approximately one mile above the dam, releasing them at Little Goose Landing. In addition, to avoid exposure to sampling anesthesia, any adult Pacific lamprey found in the sample tanks were removed by USACE, ODFW, and EAS personnel prior to SMP sampling.

Research

ODFW and USACE personnel provide various types of research assistance during the fish passage season. Typically, ODFW provides research specimens that are collected on site via the sample. The summaries below describe each research or monitoring project that occurred at LGS in 2022.

Kelt Reconditioning and Reproductive Success Evaluation Research

The purpose of the study was to evaluate steelhead kelt physiology and endocrinology for rehabilitating post-spawned steelhead. USACE staff collected 120 steelhead kelts from the Little Goose juvenile separator from May 3 to June 17 for University of Idaho, Columbia Intertribal Fish Commission (CRITFC) and the Nez Perce Tribe (NPT). Of the kelts collected, 46 steelhead were transported to Dworshak National Fish Hatchery for acclimation and feeding studies. No steelhead died before handling or after handling.

Gas Bubble Trauma Monitoring

GBT monitoring was performed by ODFW biologists from Little Goose Dam. When juvenile salmonid numbers permitted, a maximum of 102 fish were examined. Sampling occurred weekly from April 8 to August 24. GBT monitoring ended for the season the week of August 24 due to small numbers of fish. Sampling was designed to determine the relative proportion of migrating juvenile salmonids passing the dam that exhibited symptoms of GBT in the unpaired fins and eyes.

Table 23. Collection of incidental species at Little Goose Dam, 2022.

Common Name	Scientific Name	Expanded Sample	Separator	Total Collection[1]
American shad	*Alosa sapidissima*	17,928	16,930	34,858
Banded killifish	*Fundus diaphanus*	0	0	0
Bass, smallmouth	*Micropterus dolomieu*	4,989	109	5,098
Bass, largemouth	*M. salmoides*	10	0	10
Bullhead	*Ameiurus* sp.	402	7	409
Bull trout	*Salvelinus confluentus*	0	3	3
Channel catfish	*Ictalurus punctatus*	101	38	139
Chiselmouth	*Acrocheilus alutaceus*	0	1	1
Common carp	*Cyprinus carpio*	60	83	143
Crappie	*Pomoxis* sp.	1,013	1,008	2,021
Dace	*Rhinichthys* sp.	2	0	2
Goldfish	*Carassius auratus*	0	0	0
Kokanee	*Oncorhynchus nerka*	1,095	18	1,113
Lamprey adult, Pacific[2]	*Entosphenus tridentatus*	46	52	98
Lamprey ammocoete, Pacific	*E. tridentatus*	5,794	0	5,794
Lamprey macropthalmia, Pacific	*E. tridentatus*	30,076	6	30,082
Mountain whitefish	*Prosopium williamsoni*	368	12	380
Northern pikeminnow	*Ptychocheilus oregonensis*	2	7	9
Peamouth	*Mylocheilus caurinus*	103	69	172
Rainbow trout[3]	*O. mykiss*	12	3,244	3,256
Redside shiner	*Richardsonius balteatus*	0	0	0
Sand roller	*Percopsis transmontana*	231	43	274
Sculpin	*Cottus* sp.	630	0	630
Siberian prawn	*Exopalaemon modestus*	63,458	206	63,664
Sucker	*Catostomus* sp.	338	46	384
Sunfish[4]	*Lepomis* sp.	160	22	182
Tadpole madtom	*Noturus gyrinus*	0	0	0
Walleye	*Stizostedion vitreum*	343	291	634
White sturgeon	*Acipenser transmontanus*	0	15	15
Yellow perch	*Perca flavescens*	1,070	306	1,376
Other[5]		0	0	0
Total		**128,231**	**22,516**	**150,747**

Notes:

1. Collection totals are estimated by expanding the sample counts, then adding the separator counts. Numbers include live and dead incidental fish.
2. Number includes adult lamprey removed from separator and from raceways.
3. Includes all juvenile *O. mykiss* too large to fit through the separator bars.
4. Sunfish collection total includes 182 bluegill/pumpkinseed.
5. "Other" fish include expanded counts of live unidentified non-salmonid and unidentifiable/decomposed non-salmonid.

Table 24. Numbers of incidental species collected at Little Goose Dam JFF, 2017-2022.

Common Name	Scientific Name	2017	2018[1]	2019	2020	2021	2022	2017 to 2021 Average
American shad	*Alosa sapidissima*	157,259	136,814	91,725	81,366	56,253	34,858	104,683
Banded killifish	*Fundus diaphanous*	0	1	0	0	0	0	0
Bass, smallmouth	*Micropterus dolomieu*	2,992	8,977	2,939	4,896	5,933	5,098	5,147
Bass, largemouth	*M. salmoides*	13	5	28	2	4	10	10
Bullhead	*Ameiurus* sp.	166	1,263	574	403	202	409	522
Bull trout	*Salvelinus confluentus*	10	1	0	1	0	3	2
Channel catfish	*Ictalurus punctatus*	80	91	99	118	73	139	92
Chiselmouth	*Acrocheilus alutaceus*	19	3	57	71	10	1	32
Common carp	*Cyprinus carpio*	49	296	103	61	12	143	104
Crappie	*Pomoxis* sp.	3,135	38,778	3,807	1,043	3,015	2,021	9,956
Dace	*Rhinichthys* sp.	0	6	3	4	0	2	3
Goldfish	*Carassius auratus*	0	0	0	0	0	0	0
Kokanee	*Oncorhynchus nerka*	101	4	0	0	2,027	1,113	426
Lamprey adult, Pacific	*Entosphenus tridentatus*	117	232	137	66	54	98	121
Lamprey ammocoete, Pacific	*E. tridentatus*	1,592	5,157	4,794	2,674	184	5,794	2,880
Lamprey macropthalmia, Pacific	*E. tridentatus*	33,631	2,431	31,332	22,010	4,992	30,082	18,879
Mountain whitefish	*Prosopium williamsoni*	81	973	3,189	1,744	172	380	1,232
Northern pikeminnow	*Ptychocheilus oregonensis*	29	106	0	9	25	9	34
Peamouth	*Mylocheilus caurinus*	512	4,687	707	624	776	172	1,461
Rainbow trout[2]	*O. mykiss*	2	25	336	1,483	272	3,256	424
Redside shiner	*Richardsonius balteatus*	0	0	0	0	0	0	0
Sand roller	*Percopsis transmontana*	294	559	138	71	86	274	230
Sculpin	*Cottus* sp.	633	199	2,908	5,786	389	630	1,983
Siberian prawn	*Exopalaemon modestus*	51,518	31,668	11,159	36,217	131,109	63,664	52,334
Sucker	*Catostomus* sp.	504	1,225	797	1,345	676	384	909
Sunfish[3]	*Lepomis* sp.	501	1,182	736	123	79	182	524
Tadpole madtom	*Noturus gyrinus*	3	1	1	0	0	0	1
Walleye	*Stizostedion vitreum*	65	110	170	101	743	634	238
White sturgeon	*Acipenser transmontanus*	15	4	20	45	48	15	26
Yellow perch	*Perca flavescens*	78	77	120	92	98	1,376	93
Other[4]		2	0	11	21	0	0	7
Total		**253,401**	**234,875**	**155,891**	**160,376**	**207,232**	**150,747**	**202,355**

Notes:
Numbers include expanded sample counts and separator releases.
[1] No data on incidentals exist for 19 days between September 16 and October 13 in 2018 due to the system being in primary bypass.
[2] Starting in 2018, includes all juvenile O. mykiss too large to fit through the separator bars.
[3] Sunfish include bluegill/pumpkinseed and warmouth.
[4] "Other" fish include expanded counts of live non-salmonid and unidentifiable/decomposed non-salmonid.

A total of 1,784 fish were handled for GBT monitoring in 2022. Of the 30 fish handled and enumerated but not examined for GBT, 16 were coho salmon, 2 were yearling Chinook salmon, 5 were subyearling Chinook salmon, 6 were steelhead, and 1 was a clipped sockeye salmon. A total of 1,754 fish were examined for GBT. Of those, 51.1% were subyearling Chinook salmon, 26.6% were steelhead smolts, and 22.3% were yearling Chinook salmon. Signs of GBT were exhibited for 13 fish (0.7% of total examined). There was 1 unclipped subyearling Chinook mortality causing a mortality rate of 0.06%.

Sample System/PIT Tag System

The PIT tag detection and diversion systems at the lower Snake and Columbia River dams are maintained and operated by the Pacific States Marine Fisheries Commission. PIT tagged salmonids have been monitored for movement and behavior in the Columbia and Snake rivers since 1987. At Little Goose Dam, there are 11 PIT tag monitors located throughout the JFF. Further discussion of the PIT Tag System, including the Divert During Sample (DDS) system, can be found in the Facility Operations & Maintenance portion of this report.

Miscellaneous Monitoring

Juvenile Lamprey Monitoring

Beginning in 2011, all SMP sites were directed to report juvenile lamprey collections in more detail. Lamprey numbers are not included in the overall salmonid mortality data in this report but have been added to the mortality tables for future comparisons (Tables 20 and 21). The lamprey ammocoete total mortality rate in 2022 was 0.4%, from a total collection count of 5,794 lamprey ammocoetes. The total mortality rate for Pacific lamprey macropthalmia this year was 0.1%, from a collection total number of 30,082 Pacific lamprey macropthalmia. No notable peak in total facility mortality for either life stage of juvenile lamprey was observed.

Mussel Monitoring

USACE personnel at the Little Goose JFF monitored the facility for both zebra mussel *Dreissena polymorpha* and quagga mussel *Dreissena rostriformis bugensis* infestations. The mussel monitor is a piece of substrate suspended in the adult fish ladder near the ladder exit. There were no zebra or quagga mussels observed during the 2022 season.

Turbine Strainers

USACE monitored turbine unit strainers for the fifth consecutive year. Strainers are in the piping associated with the cooling water intake valve for each of the six turbine units. Strainers were rotated and flushed weekly by USACE from mid-December until mid-June. Strainers are inspected for any fish entrapment, particularly juvenile lamprey. If 10 or more lampreys are collected during the last sample date an additional month of inspections is made. Results were reported throughout the season in the USACE and EAS weekly report.

Avian Predation and Behavior

Avian activity was monitored and reported by USACE and EAS. New bird protocols documenting bird behavior were established and implemented in 2012 and revised in 2014 by the

USACE Fisheries Field Unit. One of the main goals of the avian data collection process is to standardize bird survey methodologies amongst the eight Federal Columbia River Power System hydro-projects. Collecting behavioral data will augment existing historical bird data and aid in bird hazing activities during the smolt out-migration.

EAS personnel conducted avian surveys daily from April 1 to November 1, 2022. Surveys were typically conducted between 1100 hours and 1400 hours during the juvenile collection system inspection. Only two specific bird behaviors were recorded this year—foraging and nonforaging—compared to the loafing/resting (on land or water), flyby, scavenging, and predation behaviors previously recorded. Piscivorous birds present in 2022 included seagulls, double crested cormorants, American white pelicans, western grebe, great blue heron, and osprey. Piscivorous birds numbers remained relatively low between April and mid-July, ranging from 0 to 26 birds per day. Numbers increased late in the season when the number of juvenile American shad entering the facility increased. Maximum number of birds counted was 111 on October 27: 110 gulls and 1 cormorant.

Juvenile Facility Operations & Maintenance

The juvenile fish bypass system was inspected a minimum of three times daily during the fish passage season. The juvenile bypass system and the collection facility were not significantly impacted by debris during the 2022 fish passage season.

Forebay Debris/Trashracks

The surface area covered by debris and its location in the forebay was estimated daily by EAS personnel during juvenile collection system and adult fishway inspections. All forebay debris was recorded as outside trash sheer boom, inside trash sheer boom, in front of the spillway, and in front of the adjustable spillway weir (ASW). All debris passed through the project via spill, turbine intakes, or the juvenile collection system. High accumulations of woody debris averaging 7,863 square feet, ranging from 1,290 to 20,300 square feet, were present in the forebay from April 1 to April 7. Orifice blockages were most frequent and numerous from April to June, and the highest amount of forebay debris was observed during April. Increased orifice rotations were necessary to decrease debris accumulations within the juvenile collection system this year. Forebay debris decreased to minimal to moderate amounts after April 7, averaging 337 square feet per day from April 7 to November 1, with a spike from June 16 to June 22, averaging 2.945 square feet per day.

Spillway Weir

The ASW was placed into operation on March 2 in the high crest (622 ft. msl) position. Spring spill operations began as scheduled on April 3 with the ASW in high crest. The ASW was positioned in low crest on May 28. Summer spill operations began as scheduled on June 21, and the ASW was repositioned into high crest on June 28. The ASW closed for the spill season on August 1. Summer spill concluded for the season on August 31. Surface spill to facilitate downstream passage of pre-spawn adult steelhead as natal stream overshoots commenced on September 1. The ASW was positioned at an elevation of 639 ft. with final ASW steelhead natal stream overshoot spill ending on November 15.

The ASW operated in high crest (622 ft.) for four hours in the morning, three days a week in spring and fall to provide passage for adult steelhead overshoots. This operation occurred March 1 through March 31 and September 1 through November 15.

Turbine Operation

Efforts were made to operate all turbine units within 1% limitation of best efficiency from April 1 to October 31. There were numerous scheduled and unscheduled turbine unit outages during the fish passage season. Unit out of service (OOS) and return to service (RTS) dates, times and descriptions are listed in Table 25.

Table 25. Little Goose Dam turbine unit outages, 2022**.**

Turbine Unit	Date OOS	Time	Date RTS	Time	Description
Unit 1	4/4/22	5:00	4/11/22	13:51	Frequency excursion / ground fault
	4/12/22	5:10	4/12/22	8:17	Unit gland water leak
	4/18/22	5:56	4/21/22	14:29	Bus linkage prep for roof repair
	7/7/22	12:05	7/7/22	16:05	Camera Inspections
	8/17/22	13:03	8/18/22	11:40	Oil spill into headgate slot 1C
	10/17/22	15:30	1/20/23	17:00	Oil leak investigation, nose cone fix
Unit 2	4/4/22	5:00	4/11/22	13:51	Frequency excursion / ground fault
	4/18/22	5:56	4/21/22	14:29	Bus linkage prep for roof repair
	5/13/22	12:10	5/19/22	9:20	oil in cooling water discharge
	7/7/22	9:00	7/7/22	11:50	Camera Inspections
Unit 3	3/24/22	6:11	3/25/22	17:26	Forced - packing gland water line leak
	4/4/22	5:00	4/11/22	13:51	Frequency excursion / ground fault
	4/18/22	5:56	4/21/22	14:29	bus linkage prep for roof repair
	6/28/22	15:52	6/28/22	16:52	Broken Packing Gland water line repair
	7/6/22	13:05	7/6/22	16:30	Camera Inpsections
	8/8/22	8:45	9/1/22	16:00	Unit Annual
Unit 4	1/26/22	6:06	1/26/22	7:28	Regulator Trip
	4/4/22	5:00	4/11/22	13:51	Frequency excursion / ground fault
	4/18/22	5:56	4/21/22	14:29	bus linkage prep for roof repair
	7/11/22	10:34	7/28/22	16:15	Unit Annual
Unit 5	4/14/17	14:11	2/1/24	1700	Spider arm and upper guide bearing replacement
	7/6/22		7/6/22		Camera inspections
Unit 6	2/7/22	11:00	2/9/2022	15:54	Headcover pump failure
	4/4/22	5:00	4/11/22	13:51	Frequency excursion / ground fault
	4/18/22	5:56	4/21/22	14:29	bus linkage, station service only
	4/18/22	5:10	2/22/23	ERTS	Roof top repair / BUS work / 6 yr overhaul
	7/6/22	7:44	7/6/22	16:30	Camera Inspections

Extended-Length Submersible Bar Screens (ESBS)

All ESBS were installed the week of March 21 and performed satisfactorily for the entire season. ESBS winter maintenance removal occurred on December 12 and December 13 for units 1, 5, and 6. ESBS removal for units 2 and 3 took place on December 19, and unit 4 on December 20. Drawdown inspections across trashracks and ESBS/VBS were performed according to the FPP. All inspections measured within criteria throughout the season. Video inspections and manual operation inspections showed all screens in good operating condition.

Vertical Barrier Screens (VBS)

Inspections of all VBS were performed by underwater video camera per FPP requirements. Underwater camera inspections occurred on July 6 and 7 for all Units except Unit 4. Camera inspections in conjunction with Unit annual occurred on July 21 for Unit 4.

In conjunction with ESBS/VBS underwater video camera inspections, orifice liners were also inspected. During camera inspections in 2022, minor orifice liner bolt issues were noted to be addressed during the winter maintenance period.

Gatewells

Gatewells were checked for debris and oil contamination daily. As needed, debris was removed using a dip basket or grappling hook. In 2022, the occasional oil films were observed on the water surface in several gatewells similar to previous years. Some oil films appeared to be petroleum based and may have been produced, in part, from rain-washed oil/grease residue associated with mechanical equipment and vehicles. Fish salvages occurred during the Unit 3 annual maintenance period on August 9 and August 15 in gatewells 3A and 3B. No salmonids were recovered. A fish salvage occurred on August 29 in gatewell 6B during Unit 6 annual maintenance. No salmonids were recovered.

Orifices and Collection Channel

The collection channel was operated throughout the season with 17 to 20 open orifices depending on forebay elevations. Orifices were inspected and/or back-flushed two to three times per day. All orifice operations were manually performed throughout the year.

The collection channel was dewatered and removed from service on December 21. Fish salvage operations during the dewatering included releasing approximately 152 adult steelhead, 37 adult Chinook salmon, 23 adult lamprey, and 1 dead sculpin. All fish were released to the tailrace via the emergency release pipe except for the adult lamprey, which were transported upstream to Little Goose Landing. Inspection underneath the Johnson bar screen led to the recovery of 29 living juvenile lamprey, 19 dead juvenile lamprey, and 2 dead sculpin.

Primary Dewaterer/Primary Bypass Pipe

The 36” emergency adult release pipe located underneath the primary dewatering structure will need to be repaired. A pinhole leak was discovered in the piping at the end of the collection season. The pipe is used annually during the dewatering process of the juvenile bypass system to release fish from the flume to the tailrace. Otherwise, the primary dewatering structure and components functioned adequately throughout the season. Weirs were adjusted manually when

needed. Inspection of the primary dewaterer and manual operation of the cleaning brushes was performed twice daily. As in past years, the excess water was diverted to the adult fish channel pump chamber throughout the season to improve adult fish attraction and migration.

Bypass Flume/Pipe

The primary bypass flume functioned satisfactorily in 2022. During winter maintenance 2010, the flume outfall was relocated from near shore to mid channel, which extended the release site approximately 400 feet north into the river mid-channel. This new section of outfall is made of 36" corrugated metal pipe. The new point of release returns bypassed fish farther from the shoreline and in an area of higher velocity to reduce exposure to piscivorous predation. The flume was inspected during the winter maintenance period and observed in overall good condition and found free of obstructions and rough edges.

Separator

The separator was operated similar to previous years. The water level was kept about one to two inches above the downstream end of the B-side separator bars. During the winter maintenance period, the interior and exterior surfaces of the separator were cleaned and refurbished as needed.

Sample System/PIT Tag System

The PIT tag detection and diversion systems at the lower Snake and Columbia River dams are maintained and operated by the Pacific States Marine Fisheries Commission. PIT tagged salmonids have been monitored for migration in the Columbia and Snake rivers since 1987. At Little Goose Dam, there are 11 PIT tag monitors located throughout the JFF.

In previous years, the state of the Divert During Sample (DDS) system was manually changed by USACE project biologists and technicians based upon fish passage and sample rates. However, in 2012, the DDS system was upgraded during the winter maintenance period to allow for automatic changes of operational mode per entry of the sample rate. However, the system still retains the ability to override the automation and change the system manually.

At low sample rates ($\leq$20%), when large numbers of fish are passing through the system, the DDS setting is deactivated. When the DDS is deactivated, the PIT tag slide gate will not open when the sampling system is engaged. This setting helps avoid potential sample bias caused by diverting large numbers of untagged fish, along with the targeted PIT tagged fish, away from the sample during a sampling event. At sample rates greater than or equal to 20%, (low numbers of fish passing through system), the potential for sample bias is lower and the DDS system is set to "On" or activated.

DDS settings for the A and B side sample tanks followed recommendations for most of the season. Minute deviations (hundredths of a second) typically occur daily at approximately 0700 as a result of equipment operation as the facility prepares for a new 24- hour sampling period. In addition, deviations from the recommended settings occur when debris removal is conducted at the separator. During a separator clean out, large volumes of fish and debris are flushed from the separator and thus it becomes essential to turn the DDS off. Four separator cleanouts occurred in 2022 on October 20, 22, 30 and November 1. These cleanouts were conducted in the last 2 weeks of the collection season to encourage fish to exit the separator before the last sample of the year There were no problems with the DDS system in 2022.

Pit Tag Detections

The PIT-tag detection system records data on PIT-tagged salmonids as they pass through the juvenile collection system. The PIT Tag Information System database categorized all PIT-tag detections based on species, race, and clip/rearing type. An additional "orphan" category was used for detections of PIT tags for which the database contained no record of tagging and release. Fish dispositions were categorized as follows based upon exit monitor detections: 1) to the river; 2) to transport holding areas; 3) to the smolt monitoring sample; and 4) unknown. This last category included final detections of PIT-tagged fish at locations that did not constitute an exit from the facility.

From March 24 to November 1, a total of 37,737 PIT-tagged fish were detected within the juvenile collection/bypass system: 22,974 Chinook salmon, 13,974 steelhead, 458 sockeye salmon, 277 coho salmon, 2 white sturgeon (*Acipenser transmontanus*), and 52 orphans of unknown species/rearing type. Of the total number of detections, 20,859 (55.2%) were routed to the river and 16,878 (44.8%) were routed to transport areas. PIT-tagged fish in the sample were treated as the other fish in the sample and were either released to the river—if the facility was operating in secondary bypass mode—or transported—when the facility was operating in collection mode. Approximately 147 PIT-tagged fish (0.4%) at LGS were detected in the sample, and of these, 26 fish (47.5%) were transported and 121 fish (82.3%) were returned to the river during pre-transport operations or while operating in secondary bypass mode. All PIT-tagged fish were bypassed to the river before transportation season and between June 21 and August 1. Approximately 2,243 PIT-tagged fish (5.9%) were detected before collection for transportation or between June 21 and August 1 when no transport was taking place.

Avian Predation Deterrence

USDA Animal and Plant Health Inspection Service (APHIS) began bird hazing activities in 1999. In 2021, APHIS bird hazing activities at Little Goose took place from March 29 through June 19. The hazing schedule included 8 hours per day for 7 days per week of land-based hazing and 8 hours per day for 3 days a week of boat-based hazing from March 30 through June 19. Additionally, a second 8 hour per day shift was conducted from April 11 through May 22. Bird hazing took place in the areas of the juvenile bypass outfall, spillway and powerhouse discharge areas, and areas where birds congregate or feed, ranging from about 2,000 feet upstream of the dam to as much as 1 mile downstream of the dam.

USACE Biologists and personnel from EAS conducted bird counts extending from the immediate tailrace and forebay to approximately a half mile upstream and a half mile downstream of Little Goose Dam and were broken into two zones: tailrace (T1) and forebay (FB1).

Counts were conducted using binoculars 2 to 3 times daily from April 01 through October 31, 2022. Bird counts also monitored foraging and non-foraging activities of gulls, cormorants and terns. Maximum daily bird counts were utilized to tabulate weekly and annual reports.

Avian counts did not reach the maximum threshold allowed per the Fish Passage Plan from April 01 to August 31. Gull counts exceeded the 100-bird threshold 1 time in October. Cormorant counts did not exceed the 50-bird threshold. Lethal take was implemented with 157 gulls sacrificed during the 2022 season. There were no cormorants lethally taken in 2022. Additional

hazing by project personnel utilized bird scare products including propane scare cannons, bird bangers and bird screamers deployed intermittently throughout the remainder of the fish passage season. The water cannon located at the bypass outfall was used continuously throughout the season. Little Goose continued to use passive bird deterrent devices to include needle strips, bird wires and visual scare devices.

Gull Counts

The maximum daily count of 110 gulls occurred on October 27. The average daily total count was 13 gulls. The maximum daily count in the forebay was 56 gulls and occurred on October 29. The daily average count in the forebay was 6.1 gulls. The maximum daily count in the tailrace was 98 gulls and occurred on July 18, with a daily average of 7 gulls.

Double Crested Cormorant Counts

The maximum daily count of 40 cormorants occurred on October 28. Average daily count was 3 cormorants. The maximum daily count in the forebay was 25 cormorants and occurred on October 28. The maximum daily count in the tailrace was 35 cormorants and occurred on October 29.

Caspian Tern Counts

The maximum daily count of 3 Caspian Terns occurred on April 27. The maximum daily count in the forebay was 3 terns and occurred on April 27. The maximum daily count in the tailrace was 1 tern and occurred on July 29.

Other Piscivorous Bird Counts

1 Grebe was observed on August 12. Average daily total count was <1 grebes. The maximum daily number of 14 pelicans occurred on May 10. Average daily total count was 1 pelicans.

Avian Foraging Behavior

Foraging behavior was monitored and recorded for gulls, cormorants and Caspian terns. Gulls had the highest overall percent of observed foraging behavior (61.07%) followed by cormorants (31.08%). Gulls had the highest percent of feeding behavior in the tailrace (91.43%) followed by cormorants (85.96%). Gulls had the highest percent of feeding behavior in the forebay (28.04%) followed by cormorants (10.38%). Caspian terns numbers were too small to be statistically meaningful in 2022. Most of bird foraging occurred in the tailrace, while resting, loafing and perching occurred in the forebay.

Facility Modifications

Several modifications and repairs were made prior to, during and after the 2022 season.

1. Repaired and replaced PIT tag gate components per FPP requirements.
2. All scaling and rough edges removed in sample tanks and holding tanks
3. Repaired separator and resurfaced and painted various sections.
4. Repaired/replaced multiple ESBS screen cleaning motors.
5. Repaired juvenile bypass system orifice cylinders.

6. Nez Perce Tribe (NPT) personnel installed a permanent tank and piping system for their ongoing steelhead kelt reconditioning program.

Juvenile Facility Recommendations

1. Continue to write revisions and updates to the operations maintenance manual pertaining to new equipment and facility collection and transport procedures
2. Continue to rebuild orifice valve cylinders.
3. Repair or replace corroded outer steel orifice pipe with stainless steel.
4. Review protocols yearly to ensure effective communication between all parties during truck/barge loading, dewatering events, separator cleanouts, etc. This will ensure that fish are properly routed, flush water is available for fish transfer, and that there is sufficient water in holding tanks
5. Continue to remove scale and rough edges in the facility flumes, tanks, and transition areas.
6. Repair pinhole leaks in emergency release pipe located underneath the primary dewatering structure.
7. Modify the cooling chimney in the forebay near the adult ladder to prevent fish from entering and becoming stranded inside.
8. Add a flush line immediately after the swing gate before separator to flush out fish that get stranded during switching from primary bypass to collection during every other day collection operations. At present, the only way to handle these fish is for someone to manually net them out.
9. Repair pre-anesthetic tanks, as some of them have faulty seals and leak.
10. Consider repainting/retreating the wet lab floor as the traction seems to be declining with time.

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