CENWW-ODG ST. JOHN 12 January 2021

MEMORANDUM THRU:
Norman Bloom, Operations Project Manager, Little Goose Dam

FOR Chief, Operations Division
ATTN: Chris Peery

SUBJECT: Submission of 2019 Juvenile and Adult Fish Passage Report, Little Goose Dam.

1. Enclosed find the 2019 Juvenile and Adult Fish Passage Report for Little Goose Dam as requested.

2. If you have any questions contact Scott St. John at Little Goose Dam, (509) 399-2233 ext. 263.

Scott J. St. John
Supervisory Fisheries Biologist, Little Goose Dam

Enclosure

2019 Juvenile and Adult Fish Passage Report
Little Goose Dam

Prepared by:

Scott St. John

U.S. Army Corps of Engineers

and

Paul Burke and Elizabeth Kennedy

Anchor QEA

January 2021

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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, 2019 to December 31, 2019. The Adult fishway was in service from February 14, 2019 to January 06, 2020. Fish counting activities took place from April 01 to October 31, 2019. A total of 127 fishway inspections were conducted by U.S. Army Corps of Engineers (USACE), Anchor QEA 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 the fish ladder. This section also includes an adult fallback 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 which gravity feeds various floor diffusers in the powerhouse channel and at the bottom of the fish ladder. Additional water, gravity-fed, 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 which is not only popular for visitors but is utilized to provide adult fish count data. Fish counting by the Four Peaks Environmental, under contract with the Corps, takes place from April through November.

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) in 2019. The data represented in this report was collected from April 01 through November 01, 2019 by USACE, Anchor QEA and ODFW Smolt Monitoring Program (SMP) and transportation biologists and technicians.

The juvenile fish collection and bypass system at LGS extends from the upstream face of the dam downstream to the Juvenile Fish Facility (JFF) and 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

Above-average winter and spring precipitation resulted in flows that were 118.3% of the 5-year average. Monthly flows were above the 5-year average for all months except July (Table 1). During the 2019 fish passage season, April 01 through November 01, the average daily flow was 55.4 thousand cubic feet per second (kcfs). The maximum average daily flow of 186.2 kcfs occurred on April 11 and the minimum average daily flow of 13.1 kcfs occurred on October 20 (Figure 1).

Table 1. Comparisons of average monthly flow and spill in kcfs at Little Goose Dam JFF 2014-2019.

Month	2014	2015	2016	2017	2018	2019	2014 to 2018 Average
				Flows (kcfs)			
Mar	—	—	—	—	57.34	—	—
Apr	74.33	48.27	87.05	132.84	91.81	116.99	86.86
May	99.66	59.08	87.36	139.59	133.80	118.34	103.90
Jun	84.92	41.34	52.30	127.97	80.76	93.20	77.46
Jul	45.53	27.69	32.11	50.02	37.57	38.51	38.58
Aug	26.87	20.91	23.70	29.96	28.49	28.26	25.99
Sep	19.93	17.96	18.90	25.79	21.84	24.47	20.88
Oct	17.55	15.53	20.74	22.81	17.82	21.30	18.89
				Spill (kcfs)			
Mar	—	—	—	—	0.02	—	—
Apr	22.37	12.84	24.70	43.41	31.78	48.25	27.02
May	29.34	17.68	25.77	76.33	50.73	49.30	39.97
Jun	24.95	12.74	15.68	50.41	27.89	39.47	26.33
Jul	13.97	9.11	10.42	14.94	11.43	11.55	11.97
Aug	8.73	6.98	8.51	10.34	10.47	10.58	9.01
Sep	0.17	0.13	0.18	0.21	0.24	0.44	0.19
Oct	0.00	0.00	0.00	0.00	0.31	0.01	0.06

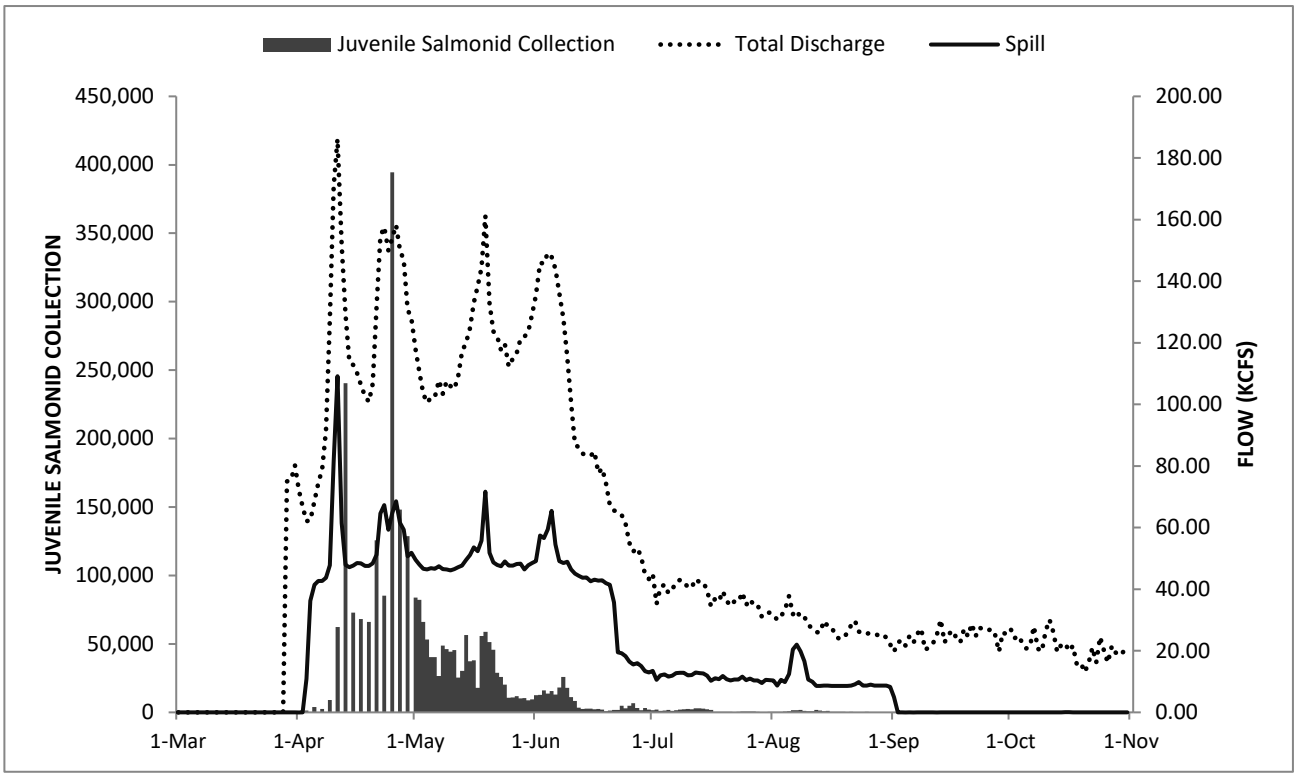

Figure 1. Total river flow, spill, and number of juvenile salmonids collected at Little Goose Dam during the fish collection and transport season, 2019.

Spill to aid juvenile fish passage occurred from April 3 through August 31, in accordance with the 2019 FOP. In previous years, the spill target was 30% of total flow from April 3 through August 31. Starting in 2018 the FOP specified that during the spring passage season, April 3 through June 20, all four projects on the lower Snake River will spill to the gas cap (120% in the tailrace). Starting in 2019, Flex Spill Operation was implemented with 16 hours of gas cap spill and up to 8 hours of performance standard (30%) spill. The division of the 8-hr performance spill operation between mornings and afternoons varied through the spring to facilitate adult passage at Little Goose. From April 3 through May 24, the morning:afternoon split of hours was 4:4 or 5:3, May 25 through May 28, 6:2, May 29 through June 5, 8:0, June 6 through June 12, 8:0 with ASW high crest partial hours and June 13 through June 20, 8:0 with ASW high crest 24 hours per day. The Adjustable Spillway Weir (ASW) was closed for the season on July 23 per the guidance outlined in the Columbia Basin Teletype. Target spill remained 30% of total flow during the summer passage season, June 21 through August 31. The target of 30% was met all but 1 day between June 21 and August 31.

To enhance fish migration and in compliance with the 2018 supplemental Federal Columbia River Power System Biological Opinion, Minimum Operating Pool (MOP) elevations were placed into effect during the spill to aid fish passage. Forebay elevations were increased from MOP elevations (633 to 634 feet MSL) to MOP +2 (634 to 636 feet MSL) after September 1, 2019, when spill to aid fish passage ended. All deviations from the FPP were coordinated through the Technical Management Team or FPOM, as necessary, to meet real-time operational requirements.

River Temperature

River temperature was recorded daily at approximately 07:00 in the JFF. The average daily river temperature during the 2019 fish passage season was 61.1°F. Average monthly water temperatures were within 1.0°F of the 5-year average for every month except September, which was 2.5°F warmer and October, which was 2.2°F colder than the 5-year average. The maximum river temperature of 70.0°F was recorded on August 14 and September 07 and was lower than the 5-year average maximum of 70.2°F. The 2019 minimum river temperature of 45.4°F was recorded April 01, only slightly below the 5-year average minimum of 46.0°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 July 04 averaging 9.9 kcfs at 43.3°F from July 04 to July 31, 9.1 kcfs at 45.4°F for the month of August and 5.0 kcfs at 48.3°F for the month of September (sourced from Columbia River Data Access in Real Time [DART]). Water temperatures recorded daily in the LGS JFF averaged 68.1°F in July, 67.6°F in July, 69.0°F in August and 68.3°F in September.

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 March 29 through September 20, and year-round in the tailwater.

The USACE Reservoir Control Center coordinates efforts to maintain TDG saturation levels in accordance with the Washington State TDG Level Variance Standard of 120.0% saturation in the project tailwater as measured throughout 12 consecutive hours.

The average daily TDG level in the LGS forebay, from April 01 through August 31, was 112.0% saturation. TDG saturation ranged from 102.1% on April 01 to 119.5% on April 25. From March 29 to June 18, there were 35 days in which TDG saturation levels exceeded 115.0% in the LGS forebay. Of those 35 days, the average TDG saturation was 116.3%.

The TDG level in the LGS tailrace ranged between 102.7% on April 01 to 127.9% on April 09, averaging 114.9% during the spill to aid fish passage season (April 3 to August 31). Tailwater TDG levels exceeded 120.0% saturation 15 days between April 08 and June 04, averaging 122.2%.

Turbidity

Water clarity was measured during adult fish passage facility inspections. Measurements were taken in the adult fish ladder using a Secchi disc lowered to a maximum depth of 6 feet. The fish ladder water supply is gravity fed from the forebay and is representative of river conditions. The lowest Secchi disk readings occurred during periods of high outflow from April 01 through May 31, with measurements ranging between 0.7 and 4.0 feet and averaging 2.5 feet. The highest Secchi disk readings occurred during periods of low flow, from July 01 through October 31, with measurements ranging from 3.9 feet to 6.0 feet and averaging 5.6 feet.

Adult Fish Facility

Facility Description

The adult fish facility is located on the downstream side of the dam and functions to attract and pass adult migrating fish upstream over the dam. 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 and switches back with a curve south and then east. It continues another 550 feet to the east where it passes under the dam's 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 (SSE1 and 2) have overflow weirs that are normally open. The two NPE (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 then 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 located in the channel near NPE1 and 2. It functions to prevent fish in the channel from leaving the channel 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 for which 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 dewater 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 midpoint of collection channel where flows are more representative of the entire collection channel.

Adult Fish Passage and Fishway Activities

Research and Monitoring Activities

In 2019 a total of 89,384 salmonids were visually counted passing upstream through the adult fish ladder. The species counts were: 42,665 Chinook adults; 10,564 Chinook jacks; 29,066 steelhead; 84 sockeye; 5,428 coho adults and 1,578 coho jacks. Additionally, 45 adult lamprey and 5 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 2019. These included:

- Four Peaks conducted visual fish counting activities from 0400 hours to 2000 hours April 1 – October 31[1].

- 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.

Operations and Maintenance

The Adult fishway was in service from February 14, 2019 to January 06, 2020. Adult fishway inspections were conducted three times per week by U.S. Army Corps of Engineers, Anchor QEA and Oregon Department of Fish and Wildlife biologists and technicians. The in-water maintenance period occurred from January 03 to February 19, 2019.

The fish ladder functioned adequately throughout the season. The air bubbler located at the ladder exit 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.

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

Water clarity and temperature were measured during adult fish passage facility inspections near the fish counting window area. Water clarity was measured using a Secchi disc that was lowered to a maximum depth of just over 6 feet (see River Conditions).

The packing material in expansion joints in the fishway has decomposed over the years and 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.

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 Rickly hydrologic current meter was again used in 2019 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. Subsurface velocity measurements ranged from 2.3 to 4.2 feet per second (fps) with an average of 3.1 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 0.4 to 2.7 feet per second (fps) near the SSE's, from 1.1 to 4.6 feet per second (fps) near the NPE's and 1.3 to 3.6 fps near the NSE's. Auxiliary water supply (AWS) system operated with three fish pumps for the majority of 2019.

The adult fishway was removed from service on January 03, 2019 when the ladder was dewatered. Fish ladder maintenance included repairing expansion joints, inspecting weirs, removing debris, cleaning the picketed leads, cleaning lamp lenses, cleaning viewing windows and installing an automatic fish window cleaning system. Collection channel maintenance included inspecting diffuser grating and supporting beams, removing debris and repairing the fallback 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. These gates are adjusted to position 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 2019 fish passage season were conducted by USACE, Anchor QEA and ODFW biologists and technicians. Inspections by the ODFW were done once a month from April through October, generally on designated days. Inspections by USACE and Anchor QEA 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 adult fish ladder section of the adult fishway includes differentials at the ladder exit, ladder weirs and counting station. The ladder exit and counting station met criteria throughout the entire season and the ladder weirs were found out of criteria on 4 inspections (Table 2). 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 exit area.

The collection channel continued to have mechanical and electrical problems but for the most part performed adequately throughout the season. Channel to tailwater elevation criteria (1-2 ft) was met 87.4% or better at all locations throughout the season. Weir depth criteria (6-8 ft) was met at least 85.3% of the time at NSE, 38.6% of the time at NPE and 92.1% of the time at SSE. NPE weirs were on sill for at least 52.0% of all inspections (Table 2). 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) 85.7% of the time near the SSE, 96.0% of the time near the NPE and 98.1% of the time near the NSE (Tables 2 and 3). As mentioned earlier, upwelling from diffuser 2 interferes with laminar flows near the South shore junction pool.

Average tailrace elevations in 2019 were higher than the 5-year average at all locations (Table 4). 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 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 3 tenths of a foot 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 2019 were close to the 5-year average at all entrance locations. NPE3 and NSE3 were permanently sealed with concrete in February 2011.

Average entrance weir depths at SSE and NSE were in criteria for 2019 (Table 5). The NPE entrance was on-sill or in criteria for the majority of 2019. Average entrance weir depths at all locations were higher, more water over the top of the weir, than the 5-year average. In 2016, NSE weir depths were lower than average due to electrical limits within the FSC software. Project staff were only able to lower weirs to approximately 532.7 feet for the majority of the passage season. New FSC software was placed into operation in 2016, but failed to maintain fishway criteria while operating in automatic mode and the system was returned to manual operation.

Table 2. Summary of results from adult fishway inspections at Little Goose Dam, 2019. [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 (SSE)	108	85.7	***	***	***	***	***	***	***
	***	***	***	***	***	***	***	***	***
	126								
Channel Velocities (NPE)	121	96.0	***	***	***	***	***	***	***
	***	***	***	***	***	***	***	***	***
	126								
Channel Velocities (NSE)	106	98.1	***	***	***	***	***	***	***
	***	***	***	***	***	***	***	***	***
	108								
Differentials									
Ladder Exit	125	100.0	***	***	***	***	0	0	0
	***	***	***	***	***	***	0.0	0.0	0.0
	125								
Ladder Weirs	123	96.9	***	0	2	2	0	0	0
	***	***	***	0.0	1.6	1.6	0.0	0.0	0.0
	127								
Counting Station	127	100.0	***	***	***	***	0	0	0
	***	***	***	***	***	***	0.0	0.0	0.0
	127								
South Shore	122	96.1	***	4	0	0	0	1	0
	***	***	***	3.1	0.0	0.0	0.0	0.8	0.0
	127								
North Powerhouse	127	100.0	***	0	0	0	0	0	0
	***	***	***	0.0	0.0	0.0	0.0	0.0	0.0
	127								
North Shore	111	87.4	***	10	3	2	0	0	0
	***	***	***	7.9	2.4	1.6	0.0	0.0	0.0
	127								
Weir Depths									
SSE-1	117	92.1	0	1	0	9	***	***	***
On Sill[2]	0	0.0	0.0	0.8	0.0	7.1	***	***	***
	127								
SSE-2	118	92.9	0	0	0	9	***	***	***
On Sill[2]	0	0.0	0.0	0.0	0.0	7.1	***	***	***
	127								
NPE-1	59	46.5	0	0	1	1	***	***	***
On Sill[2]	66	52.0	0.0	0.0	0.8	0.8	***	***	***
	127								
NPE-2	49	38.6	0	1	0	1	***	***	***
On Sill[2]	76	59.8	0.0	0.8	0.0	0.8	***	***	***
	127								
NSE-1	99	85.3	0	2	0	15	***	***	***
On Sill[2]	0	0.0	0.0	1.7	0.0	12.9	***	***	***
	116								
NSE-2	99	85.3	0	3	0	14	***	***	***
On Sill[2]	0	0.0	0.0	2.6	0.0	12.1	***	***	***
	116								

[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 3. LGS collection channel in-criteria rates 2015-2019.[1]

Location	Collection Channel Success Rates - Annual Comparison				
	2015	2016	2017	2018	2019
Channel Surface Water Velocities					
South Shore Entrance (SSE)	N/A	N/A	N/A	87.6%	85.7%
North Powerhouse Entrance (NPE)	99.1%	96.8%	97.4%	99.2%	96.0%
North Shore Entrance (NSE)	99.1%	95.7%	99.1%	99.2%	98.1%
Channel Head Differentials					
SSE	96.6%	93.7%	97.4%	98.5%	96.1%
NPE	94.8%	92.1%	97.4%	100.0%	100.0%
NSE	84.5%	93.7%	95.7%	92.3%	88.4%
Channel Weir Depths					
SSE1	90.5%	89.7%	96.6%	96.9%	92.1%
SSE2	87.9%	84.9%	93.1%	97.7%	92.9%
NPE1 without on-sill criteria	9.5%	38.1%	51.7%	35.4%	46.5%
NPE1 with on-sill criteria	19.0%	87.3%	100.0%	100.0%	98.4%
Location	**Collection Channel Success Rates - Annual Comparison**				
	2015	2016	2017	2018	2019
NPE2 without on-sill criteria	9.5%	33.3%	49.1%	33.8%	38.6%
NPE2 with on-sill criteria	19.8%	90.5%	100%	100.0%	98.4%
NSE1	88.8%	46.0%	92.2%	95.4%	85.3%
NSE2	88.8%	45.2%	91.4%	94.6%	85.3%

[1] Data compiled from Appendix 1, previous monitoring report appendixes and inspection forms for the years 2015-2019.

Table 4. LGS average tailrace water elevations, 2014-2019.[1]

Location	Average Tailrace Water Elevations						
	2014	2015	2016	2017	2018	2019	2014 – 2018 Average
SSE	538.46	538.34	538.43	538.83	538.50	538.71	538.51
NPE	538.42	538.26	538.34	538.65	538.40	538.59	538.41
NSE	538.48	538.36	538.44	538.76	538.46	538.61	538.50

[1] Data compiled from Appendix 1 and previous monitoring report appendixes for years 2014-2019.

Table 5. LGS adult fishway average differentials and weir depths 2014-2019.[1]

Location	Average Differential or Depth in Feet						
Channel to Tailwater Differential	2014	2015	2016	2017	2018	2019	2014 – 2018 Average
SSE	1.54	1.21	1.41	1.40	1.42	1.42	1.40
NPE	1.49	1.61	1.67	1.65	1.62	1.57	1.61
NSE	1.31	1.09	1.32	1.29	1.16	1.21	1.23
Weir Depth							
SSE-1	8.28	8.49	8.44	8.73	8.72	8.72	8.53
SSE-2	8.21	8.45	8.38	8.68	8.71	8.78	8.49
NPE-1	6.32	5.46	6.47	6.99	6.50	6.93	6.35
NPE-2	6.33	5.47	6.45	6.94	6.50	6.77	6.34
NSE-1	6.35	6.48	5.74	6.63	6.85	6.59	6.41
NSE-2	6.35	6.53	5.62	6.60	6.77	6.55	6.37

[1] Data compiled from Appendix 1 and previous monitoring report appendixes for years 2014-2019.

Fishway Modifications and Improvements

Fishway System Control (FSC) panel and software was 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. Therefore, the control system was operated in manual for the 2019 season.

An adult fish ladder cooling pump was installed during the 2017-2018 in water maintenance period. The adult ladder cooling pump was started on June 12 and shut off on September 23. Little Goose experienced numerous issues operating the cooling pump through 2019. The breaker that feeds power to the adult ladder cooling pump tripped, causing the pump to stop on multiple occasions. Additionally, the permanent power for the adult ladder cooling pump has not been installed and the pump was out of service during Doble testing.

Adult Fish Facility Recommendations

1. Continue to repair and/or replace ladder expansion joint seals.
2. Repair and/or replace collection channel sluice gates and indicator rods.
3. Continue to replace diffuser grating and supporting beams.
4. Replace the North Shore Rip Rap jetty that protects the NSE entrance from turbulent water forces created by the north shore clockwise eddy.
5. Repair or replace the automatic adult Fishway Control System.
6. Rotate the rebuild of fish pump gear boxes to ensure the ability to run on three fish pumps.

Juvenile Fish Facility

Facility Description

The Little Goose Juvenile Fish Facility was designed to bypass juvenile salmon and steelhead to the tailrace, or to collect for transport by truck and barge below Bonneville Dam. 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 25. Every other day collection for sampling began at 0700 on April 01. A total of 3,270,408 smolts were collected during the 2019 season (Table 6). Of those, 2,360,042 were

transported, 906,826 were bypassed, and 3,540 were facility mortalities (separator, raceway, or sample).

Table 6. Annual collection, bypass, and transport activity at Little Goose Dam JFF, 2014-2019

	Chinook Yearling		Chinook Sub-yearling		Steelhead		Coho		Sockeye		
Year	Clip	Unclip	Clip	Unclip	Clip	Unclip	Clip	Unclip	Clip	Unclip	Total
Collection											
2014	1,487,105	462,499	278,019	463,013	1,013,203	346,944	0	41,542	9,115	51,956	4,153,396
2015	643,606	163,926	169,349	478,654	590,849	158,004	8,276	33,797	11,050	2,818	2,260,329
2016	1,873,536	564,588	203,981	414,605	1,261,259	339,520	29,781	74,575	18,868	4,032	4,784,745
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
Bypass											
2014	78,418	102,125	0	294	178,448	32,046	0	600	0	5,911	397,842
2015	192,212	69,754	0	140	191,460	21,760	400	1,320	0	40	477,086
2016	1,032,728	382,708	1	2,876	766,337	163,410	3,600	10,000	6	1	2,361,667
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
Truck											
2014	0	4	400	7,520	4	6	0	0	0	34	7,968
2015	1	1	44	5,982	35	8	0	9	0	2	6,082
2016	0	0	1,345	10,576	23	3	0	0	0	0	11,947
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
Barge											
2014	1,408,338	360,039	277,207	453,966	834,621	314,847	0	40,932	9,107	45,757	3,744,814
2015	451,267	94,129	168,929	470,315	399,120	136,176	7,868	32,447	11,046	2,772	1,774,069
2016	840,410	181,791	202,183	400,476	494,818	176,078	26,140	64,542	18,645	4,024	2,409,107
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
Total Transport											
2014	1,408,338	360,043	277,607	461,486	834,625	314,853	0	40,932	9,107	45,791	3,752,782
2015	451,268	94,130	168,973	476,297	399,155	136,184	7,868	32,456	11,046	2,774	1,780,151
2016	840,410	181,791	203,528	411,052	494,841	176,081	26,140	64,542	18,645	4,024	2,421,054
2017	399,531	96,175	232,594	369,709	199,317	113,961	16726	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

Transportation

Collection for transport began at 0700 on April 23 and ended on November 01. An estimated total of 2,533,267 smolts were collected for transport during this period. Of this total, 2,337,397 smolts were barged, 22,645 were trucked, 169,854 were bypassed, and 3,371 were facility mortalities.

Juvenile salmonids collected for transport by barge or truck were held in raceways, wet-lab holding tanks, or directly loaded into barges or trucks. Maximum fish holding time prior to transport varied from 24 to 48 hours, depending on the transportation schedule. Transport time from LGS to the approved release point was approximately 2 days by barge or 6 hours by truck. Fish transported by truck were transported in a mild saline solution of 1 to 2 grams per liter to treat presumed Columnaris disease. All fish transport operations were performed without incident in 2019. Daily barging and direct loading operations occurred from April 24 to May 15, every-other-day barging occurred from May 17 to July 30, and every-other-day trucking occurred from August 01 to November 01.

A total of 2,360,042 juvenile salmonids transported from LGS in 2019; 2,337,397 of them, or 99.0%, were transported by barge (Table 6). The estimated species composition and clip type of the fish transported by barge was as follows: 32.5% clipped yearling Chinook salmon, 7.8% unclipped yearling Chinook salmon, 5.1% clipped subyearling Chinook salmon, 7.0% unclipped subyearling Chinook salmon, 32.5% clipped steelhead, 11.4% unclipped steelhead, 1.2% clipped sockeye salmon, 0.1% unclipped sockeye salmon, 0.5% clipped coho salmon, and 1.7% unclipped coho salmon.

Of the 2,360,042 juvenile salmonids transported from LGS, 22,645 of them, or 0.9% of the total, were transported by truck. The species composition of salmonids transported by truck was as follows: <0.1% clipped yearling Chinook salmon, <0.1% unclipped yearling Chinook salmon, 17.2% clipped subyearling Chinook salmon, 82.1% unclipped subyearling Chinook salmon, 0.5% clipped steelhead, <0.1% unclipped steelhead, <0.1% clipped sockeye salmon, <0.1% unclipped sockeye salmon, and <0.1% unclipped coho salmon. No clipped yearling Chinook salmon or unclipped sockeye salmon were transported by truck in 2019.

In previous years, due to high numbers of fish collected, Lower Granite Fish Facility trucked Little Goose Fish using the 3,500 gallon tanker. This “piggyback” operation delayed transport time for those fish transported from Lower Granite by approximately one hour. In 2019, Little Goose conducted 07 piggyback operations with Lower Granite. Fish transported by truck from Little Goose were transported in a mild saline solution of 1 to 2 mg/L to reduce stress and treat Columnaris disease.

The maximum daily estimated collection of 394,474 fish occurred on April 24 and accounted for 12.1% of total collection (Table 7). The composition of the collection for that date was as follows: clipped yearling Chinook salmon (14.6%), unclipped yearling Chinook salmon (3.4%), clipped steelhead (62.0%), unclipped steelhead (19.5%), unclipped coho salmon (0.6%), and unclipped sockeye salmon (<0.1%).

Table 7. Peak passage dates and totals by species group at Little Goose Dam JFF, 2014-2019.

	Yearling Chinook		Subyearling Chinook		Steelhead		Sockeye		Coho	
Year	Clip	Unclip	Clip	Unclip	Clip	Unclip	Clip	Unclip		Season
2014	6-May	22-Apr	2-Jun	3-Jun	22-Apr	8-May	10-May	20-May	10-May	6-May
	156,006	53,031	19,016	24,044	89,625	25,215	3,600	4,003	6,813	279,206
2015	28-Apr	24-Apr	29-May	13-Jul	28-Apr	09-May	19-May	12-May	17-May	28-Apr
	53,656	16,602	15,400	18,551	66,016	11,601	3,500	400	4,700	136,712
2016	30-Apr	18-Apr	11-Jun	11-Jun	24-Apr	30-Apr	21-May	12-May	9-May	28-Apr
	180,800	62,401	15,750	25,750	183,201	28,400	4,400	400	1,320	432,007
2017	28-Apr	16-Apr	6-Jun	2-Jun	28-Apr	28-Apr	20-May	26-Apr	18-May	28-Apr
	115,678	50,001	16,772	16,208	119,203	27,601	803	1,209	3,200	298,107
2018	10-May	21-Apr	29-May	29-May	9-Apr	3-May	20-May	19-May	13-May	9-Apr
	87,294	26,408	28,966	34,245	167,390	19,400	8,712	1,009	10,404	212,443
2019	24-Apr	16-Apr	7-Jun	7-Jun	24-Apr	24-Apr	19-May	19-May	18-May	24-Apr
	57,647	19,209	9,355	14,212	244,404	76,801	7,022	402	3,801	394,474

Bypass

From April 01 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 for PIT-tag detections) 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 737,141 smolts entered the facility on sampling days between April 01 and April 23. Of this total, 736,972 were bypassed and 169 were facility mortalities. There are no passage estimates for the 12 non-sample days during the month of April.

Fish bypassed during the transportation season, April 24 through November 01, included 17 Chinook salmon fry that were bypassed for continued growth, 8 unclipped Chinook salmon that were bypassed due to disease and 169,829 fish that were bypassed due to two deviations in standard operations. On April 24, due to an issue with the barge, fish could not be direct loaded and had to be routed to raceways. Raceway capacity was met before the barge was repaired, and fish had to be routed to the river via secondary bypass. Direct loading did not resume until 03:00 on April 24. A total of 222,111 fish were bypassed during this time period. Fish were also bypassed via secondary bypass on June 25 and 26 due to the Ice Harbor Lock being out of service for repairs. A total of 9,718 fish were bypassed over those 2 days. A total of 169,854 fish were bypassed during the transport season.

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 usually too large to pass between the separator bars and were released back to the river. Fallbacks were identified by species and fin clip and assessed for condition prior to being released.

A total of 1,604 adult salmon and steelhead fallbacks occurred in 2019 (Table 8). Of those, 12 small adult salmon fallbacks were collected in the sample and released back to the river.

There were 754 steelhead fallbacks in April, May and June (Table 9). 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 kelt. Table 10 lists the numbers of fish by species and condition.

Table 8. Total annual adult salmonid fallbacks at Little Goose Dam JFF, 2014-2019.

Year	Adult Chinook	Jack/mini Chinook	Clip Steelhead	Unclip Steelhead	Sockeye	Coho	Total
2014	991	558	1,518	1,425	46	186	4,724
2015	515	240	659	903	15	10	2,342
2016	643	452	1049	1272	17	9	3,442
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

Table 9. Monthly totals of fallbacks bypassed from separator at Little Goose Dam, 2019.

	Chinook		Chinook Jack		Steelhead		Sockeye		Coho	
Month	Clip	Unclip	Clip	Unclip	Clip	Unclip	Clip	Unclip		Total
April	0	0	0	0	226	104	0	0	0	330
May	22	6	1	0	178	180	0	0	0	387
June	66	22	10	0	16	50	0	1	0	165
July	30	18	5	5	8	6	0	10	0	82
August	5	3	6	2	0	2	0	2	0	20
September	35	46	22	22	52	38	2	1	13	231
October	75	107	44	58	45	45	0	0	15	389
Total	233	202	88	87	525	425	2	14	28	1,604

Table 10. Condition of adult salmonids released at Little Goose Dam, 2019.

Fish	Chinook		Chinook Jack		Steelhead		Sockeye		Coho	
Condition[1]	Clip	Unclip	Clip	Unclip	Clip	Unclip	Clip	Unclip		Total
Good	214	190	81	82	350	355	2	11	22	1,307
Fair	19	10	6	5	128	56	0	3	6	233
Poor	0	2	1	0	40	14	0	0	0	57
Dead	0	0	0	0	7	0	0	0	0	7
Total	233	202	88	87	525	425	2	14	28	1,604

[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 10 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 11 gives efficiency expressed as the percentage of each group, passing through the desired side of the separator, for 2014 to 2019. Efficiency rates are based on expanded sample counts.

Separator efficiency was highest for clipped steelhead and unclipped yearling Chinook, with 84.9% of clipped steelhead entering the B-side and 72.0% of unclipped yearling Chinook salmon entering the A-side. Separator efficiency was lowest for clipped coho salmon and unclipped sockeye salmon with 21.3% of clipped coho salmon and 25.4% of unclipped sockeye salmon entering on A-side (Table 11).

Table 11. Annual juvenile salmonid separator efficiency (%) at Little Goose Dam JFF, 2014-2019.

	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
2014	81.8	78.6	58.5	56.5	75.9	54.7	—	41.3	49.5	37.6
2015	72.9	69.3	65.8	62.8	72.7	57.0	39.0	35.9	45.2	38.2
2016	65.4	64.0	57.3	56.1	88.6	68.7	36.0	32.2	23.9	27.3
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

Note: Counts do not include sample mortalities. There were no clipped coho sampled in 2014.

Sampling

The fish sampling system was operated without incident throughout the 2019 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 0.25 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 12).

Table 12. Annual percentages of juvenile salmonids collected per species and clip type that were sampled at Little Goose Dam JFF, 2014-2019[1].

	Yearling Chinook		Subyearling Chinook		Steelhead		Sockeye		Coho	
Year	Clip	Unclip	Clip	Unclip	Clip	Unclip	Clip	Unclip		Total
2014	0.8	1.0	2.8	4.7	1.0	1.1	0.9	0.9	1.0	1.8
2015	0.3	0.5	4.7	7.8	0.5	0.6	2.9	1.0	0.7	1.3
2016	0.5	0.5	3.1	5.0	0.5	0.7	1.3	1.1	1.3	1.6
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

[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 or Lyons Ferry Hatchery fall Chinook salmon. All unclipped salmon were scanned for coded wire tags. Chinook, sockeye and coho fry were defined by length, under 60 mm, and were bypassed for continued growth. None of the 2019 hatchery releases above LGS were marked with elastomer eye tags.

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

Pound counts (number of fish per pound) were taken daily during condition sampling and provided to USACE from April 02 through November 01.

A total of 57,828 fish were sampled during the 2019 season. Of these, 56,232 were examined for descaling, 38 were salmonid fry, 328 were sample mortalities, and 1,238 smolts were removed from the separator during GBT monitoring (Table 13). There were 8 fish that were both removed from the separator for GBT monitoring and counted as sample mortalities as they were first examined for GBT and later died in Raceway 10.

Fish Condition

Fish condition was monitored daily by Anchor QEA 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, 2019 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 (Table 14).

A total of 24,337 smolts from the condition subsample were examined for injuries. Of the fish examined, 12.1% or 2,947 individual smolts were observed with one or more injuries. A total of 2,991 individual injuries were observed this year. The majority of injuries involved damage to fins (89.8%) followed by operculum injury (5.5%), body injury (2.1%), head injury (1.5%), and eye injury (1.1%; Table 15). The highest rates of injury this year were observed in clipped subyearling Chinook salmon at 17.1% followed by unclipped subyearling Chinook salmon at 16.4% and unclipped yearling Chinook salmon at 13.3%.

Table 13. Weekly sample as percent of collection total and sample totals at LGS JFF, 2019.

Week Ending	Weekly % Sampled (%)	Yearling Chinook Clip	Yearling Chinook Unclip	Subyearling Chinook Clip	Subyearling Chinook Unclip	Steelhead Clip	Steelhead Unclip	Sockeye Clip	Sockeye Unclip	Coho	Totals[1]
4-Apr	7.7	40	12	0	1	288	62	1	0	0	404
11-Apr	1.6	271	104	0	0	722	67	0	3	3	1,170
18-Apr	0.4	240	128	0	20	1,168	208	0	0	3	1,767
25-Apr	0.3	554	151	0	0	1,517	369	0	0	14	2,605
2-May	0.3	1,079	252	0	5	944	279	0	0	27	2,586
9-May	0.9	1,286	313	0	0	706	254	0	1	66	2,626
16-May	0.9	1,230	233	1	11	740	332	3	4	53	2,607
23-May	1	1,109	294	133	173	503	319	239	19	148	2,937
30-May	3.8	213	97	658	911	383	203	80	13	222	2,780
6-Jun	3.2	84	94	957	1,443	343	144	8	12	190	3,275
13-Jun	2.9	9	16	914	979	63	26	0	2	42	2,051
20-Jun	12.7	3	4	912	722	24	13	0	3	8	1,689
27-Jun	8.2	4	3	1,036	1,030	24	15	0	0	19	2,131
4-Jul	10.9	0	0	624	769	13	3	0	1	9	1,419
11-Jul	14.6	0	0	858	1,288	13	4	0	0	4	2,167
18-Jul	11.7	0	5	356	916	6	0	0	1	2	1,286
25-Jul	63.7	2	2	471	1,594	41	5	2	0	7	2,124
1-Aug	71.5	0	0	346	1,380	64	11	2	0	9	1,812
8-Aug	87	0	0	1,631	5,238	58	6	2	0	4	6,939
15-Aug	88.3	0	0	983	5,292	12	0	1	0	2	6,290
22-Aug	99.8	0	1	284	1,800	3	1	2	0	1	2,092
29-Aug	99.9	0	0	143	1,000	4	0	0	0	4	1,151
5-Sep	99.7	0	0	136	1,204	5	0	1	0	0	1,346
12-Sep	99.6	0	0	93	857	1	1	4	1	0	957
19-Sep	99.5	1	0	39	510	2	1	3	0	0	556
26-Sep	98.5	0	0	14	111	1	3	0	0	0	129
3-Oct	99.3	0	0	30	243	0	1	1	0	0	275
10-Oct	99.4	0	0	36	282	0	0	4	0	0	322
17-Oct	100	0	0	8	92	0	0	5	0	0	105
31-Oct	100	0	0	18	169	4	0	2	0	0	193
1-Nov	100	0	0	2	35	0	0	0	0	0	37
Total Sampled		6,125	1,709	10,683	28,075	7,652	2,327	360	60	837	57,828
Total Collection		909,931	248,210	126,440	196,296	1,335,165	367,506	27,714	3,236	55,910	3,270,408
Percent of Sample		11	3	18.5	48.5	13.2	4	0.6	0.1	1.4	100
Percent of Collection		27.8	7.6	3.9	6	40.8	11.2	0.8	0.1	1.7	100

[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.

Table 14. Annual injury rates (%) for salmonids examined at Little Goose Dam, 2014-2019.

Year	Yearling Chinook Clip	Yearling Chinook Unclip	Subyearling Chinook Clip	Subyearling Chinook Unclip	Steelhead Clip	Steelhead Unclip	Sockeye Clip	Sockeye Unclip	Coho	Total
2014	8.4	8.4	9.0	12.3	4.3	3.4	13.3	12.9	8.6	9.8
2015	12.5	14.1	12.9	16.6	6.2	5.5	7.0	11.5	11.1	13.4
2016	10.2	12.2	19.5	23.5	0.1	6.4	5.6	13.5	14.8	17.9
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

Table 15. Percent of fish examined that were injured, had predation marks, or had signs of disease by species and clip type at Little Goose Dam, 2019.

	Yearling Chinook		Subyearling Chinook		Steelhead		Coho		Sockeye		
	Clip	Unclip	Clip	Unclip	Clip	Unclip	Clip	Unclip	Clip	Unclip	Total[1]
Injuries											
Eye	0.4	0.2	0.1	<0.1	0.1	0.1	0.9	0.2	0.3	0.0	0.1
Operculum	0.7	0.5	0.6	0.3	1.4	0.7	1.2	1.0	2.8	0.0	0.7
Head	0.1	0.0	0.3	0.1	0.2	0.3	0.0	0.4	0.6	0.0	0.2
Body	0.2	0.5	0.1	0.1	0.6	0.6	0.0	0.6	0.3	1.7	0.3
Fin	7.8	12.4	16.4	15.9	1.7	2.3	4.3	6.6	6.0	6.8	11.0
Total Injury	**9.0**	**13.3**	**17.1**	**16.4**	**3.9**	**3.9**	**6.2**	**8.4**	**9.9**	**8.5**	**12.1**
Disease											
Fungus	0.1	0.4	0.1	<0.1	0.3	0.4	0.9	0.2	1.1	0.0	0.2
Columnaris	0.0	0.0	1.9	4.2	0.3	0.3	0.6	0.2	4.5	1.7	2.1
BKD	0.7	0.1	0.1	0.0	<0.1	0.0	0.0	0.0	0.0	0.0	0.1
Parasites	0.4	1.0	0.5	0.3	0.9	4.3	0.0	0.2	0.0	0.0	0.7
Deformity	0.3	0.2	0.2	0.2	0.2	0.3	0.9	0.2	0.3	0.0	0.2
Disease Other	0.6	0.1	1.3	2.9	0.3	0.2	0.3	0.4	28.7	3.4	1.9
Total Disease	**2.1**	**1.7**	**3.8**	**7.2**	**1.9**	**5.5**	**2.8**	**1.2**	**33.5**	**3.4**	**5.0**
Predation											
Bird	0.8	0.5	0.2	0.3	2.1	1.6	1.6	0.2	0.3	0.0	0.8
Fish	0.7	0.6	1.0	1.1	0.6	0.5	2.2	1.6	1.1	0.0	0.9
Lamprey	0.0	0.0	0.4	0.7	<0.1	0.1	0.6	0.0	0.0	0.0	0.3
Other	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Predation	**1.5**	**1.1**	**1.6**	**2.1**	**2.7**	**2.2**	**4.4**	**1.8**	**1.4**	**0.0**	**2.0**
Misc. Conditions											
Pop Eye	0.2	0.2	<0.1	<0.1	<0.1	0.0	0.0	0.0	1.1	0.0	0.1
Fin Hemorrhage	4.5	8.9	14.3	16.5	1.6	1.5	2.5	2.2	6.0	5.1	10.1
Pink Fin	13.5	20.7	34.2	34.5	2.9	3.5	4.3	4.2	6.5	0.0	22.4
Fin Discoloration	1.2	1.0	1.2	1.9	0.1	0.0	0.3	0.2	0.9	0.0	1.2
Eye Hemorrhage	0.6	1.0	0.1	0.1	0.3	0.3	0.6	0.6	2.0	1.7	0.3
Total Misc. Conditions	**18.8**	**28.1**	**41.2**	**43.1**	**4.6**	**5.1**	**7.1**	**6.8**	**14.2**	**6.8**	**28.4**
Total sample size	3,400	1,047	3,716	9,467	3,768	1,703	322	503	352	59	24,337

[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 more than 20% of the scales were missing from either side of the fish. Only descaling that appeared fresh enough to have occurred at LGS was recorded. Prior to 2009, all descaling, old or new, was recorded.

A total of 56,232 smolts were examined for descaling in 2019. 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 1.5% (855 descaled), which is comparable

to rates observed in previous years (Table 16). Of the 56,232 smolts examined for descaling, 43.3% (24,337) were examined as part of condition subsampling. During condition subsampling, fish with descaling greater than or equal to 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 1.8% (442 descaled smolts). Of the 442 descaled smolts observed in the condition subsample, descaling associated with dam passage was 70.8% of the condition descale total, and the rate of descaling on fish with predation marks present was 29.2% of the condition descale total. The rate of descaling observed in the non-condition sample was 1.3% (413 descaled smolts) from a sample size of 31,895 salmon. Note that all 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 16. Annual descaling rates (%) for salmonids examined at Little Goose Dam JFF, 2014-2019.

	Yearling Chinook		Subyearling Chinook		Steelhead		Sockeye		Coho	
Year	Clip	Unclip	Clip	Unclip	Clip	Unclip	Clip	Unclip		Totals
2014	1.2	0.5	1.0	0.9	1.0	1.2	0.0	3.4	1.9	1.0
2015	1.3	1.1	0.7	0.7	1.9	1.9	0.0	3.8	1.4	1.0
2016	1.1	0.7	1.0	1.5	1.2	1.2	1.3	2.4	1.8	1.3
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

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

For fish in the condition subsample, in addition to descaling of 20% or greater, partial descaling was also recorded. Partial descaling was considered scale loss above background levels of approximately 5% scale loss but below the 20% threshold for descaling. The rate of partial descaling was 3.8% of the 24,337 smolts examined for condition in 2019.

Overall weekly descaling rates per species and clip types are listed in Table 17. The average weekly descaling rate ranged from 0.5% to 3.1%.

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, BKD, body parasites, deformity, and other disease such as cysts or tumors. 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 including spinal curvatures such as scoliosis and lordosis, and also dwarfism or truncated body were also documented.

A total number of 1,211 smolts (5.0%) of the total condition subsample were observed with one or more symptoms of disease (See Table 15 above). Of the 1,269 individual signs of disease observed this year, Columnaris was the most prevalent at 39.4% of the total, followed by other disease (37.1%), parasite (14.1%), deformity (4.2%), fungus (3.0%) and presumed bacterial kidney disease (2.2%). Almost all the other diseases this season consisted of observations of smolts with rotted caudal fins or smolts with symptoms of abdominal distention similar to BKD.

Table 17. Weekly descaling rates (%) for salmonids examined at Little Goose Dam JFF, 2019.

Week Ending	Yearling Chinook		Subyearling Chinook		Steelhead		Sockeye		Coho	Total[1]
	Clip	Unclip	Clip	Unclip	Clip	Unclip	Clip	Unclip		
4-Apr	2.50	8.33	—	—	0.00	0.00	0.00	—	—	0.50
11-Apr	0.45	2.20	—	—	1.03	0.00	—	0.00	0.00	0.94
18-Apr	1.36	0.84	—	—	0.72	0.00	—	—	0.00	0.73
25-Apr	1.97	1.44	—	—	2.17	1.38	—	—	0.00	1.96
2-May	2.54	2.04	—	0.00	2.43	0.74	—	—	11.11	2.34
9-May	3.46	1.68	—	—	3.13	3.29	—	0.00	1.52	3.10
16-May	2.05	3.21	0.00	0.00	1.82	2.19	0.00	0.00	3.77	2.13
23-May	1.71	1.06	1.50	1.76	3.16	2.91	1.27	5.26	3.42	2.09
30-May	1.92	0.00	0.49	1.15	2.95	1.50	3.75	0.00	2.26	1.46
6-Jun	2.50	0.00	1.84	1.36	1.79	2.17	12.50	0.00	3.70	1.74
13-Jun	0.00	0.00	1.96	2.61	4.92	3.85	—	50.00	0.00	2.37
20-Jun	0.00	25.00	1.46	0.71	0.00	0.00	—	0.00	0.00	1.16
27-Jun	0.00	0.00	1.33	1.32	0.00	6.67	—	—	0.00	1.33
4-Jul	—	—	1.50	1.21	0.00	0.00	—	0.00	22.22	1.46
11-Jul	—	—	1.79	1.11	7.69	0.00	—	—	0.00	1.42
18-Jul	—	0.00	0.85	1.01	0.00	—	—	0.00	50.00	1.04
25-Jul	0.00	0.00	0.85	1.07	7.32	0.00	0.00	—	0.00	1.13
1-Aug	—	—	1.16	0.36	3.13	0.00	0.00	—	0.00	0.61
8-Aug	—	—	2.09	1.45	3.45	0.00	0.00	—	0.00	1.62
15-Aug	—	—	1.43	1.10	0.00	—	0.00	—	0.00	1.15
22-Aug	—	0.00	1.44	0.96	0.00	0.00	0.00	—	0.00	1.02
29-Aug	—	—	1.43	1.01	0.00	—	—	—	0.00	1.05
5-Sep	—	—	0.74	1.18	0.00	—	0.00	—	—	1.13
12-Sep	—	—	0.00	0.36	0.00	0.00	0.00	0.00	—	0.32
19-Sep	0.00	—	0.00	0.63	0.00	0.00	0.00	—	—	0.59
26-Sep	—	—	0.00	0.00	0.00	0.00	—	—	—	0.00
3-Oct	—	—	0.00	0.42	—	0.00	0.00	—	—	0.37
10-Oct	—	—	2.78	0.72	—	—	0.00	—	—	0.94
17-Oct	—	—	0.00	2.20	—	—	20.00	—	—	2.88
24-Oct	—	—	0.00	6.00	0.00	—	—	—	—	5.08
31-Oct	—	—	0.00	1.68	0.00	—	0.00	—	—	1.49
1-Nov	—	—	0.00	0.00	—	—	—	—	—	0.00
Total Exam.	**5,787**	**1,611**	**10,402**	**27,579**	**7,360**	**2,254**	**353**	**59**	**827**	**56,232**
Percent Desc.	**2.3**	**1.7**	**1.5**	**1.2**	**2.0**	**1.7**	**2.3**	**3.4**	**3.1**	**1.5**
Median	**1.7**	**1.0**	**1.4**	**1.1**	**0.4**	**0.0**	**0.0**	**0.0**	**0.0**	**1.2**

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

In 2015, several subyearling fall Chinook salmon smolt mortalities were observed with these symptoms which prompted ODFW to collect a specimen for the ODFW Fish Health Laboratory in La Grande, Oregon. Preliminary results were positive for the intestinal protozoan parasite (*Ceratomyxa shasta*). As a result, nearly all fish exhibiting symptoms of abdominal distention have been 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 484 smolts were observed with one or more predatory wounds, for an overall rate of 2.0% of the total condition subsample. The majority of marks observed in the subsample were indicative of attempted predation by fish at 45.1% of the 486 total individual bite marks recorded, followed by bird bites (38.1%), and lamprey bites (16.9%). No mammalian bite marks were observed this year. Steelhead and clipped coho salmon sustained the highest rate of predatory attempts, which were predominately a result of predation attempts by birds (See Table 15 above).

The overall rate of bird bite marks was the same as in 2018 and was slightly lower than the 5-year average of 1.0 (Table 18). The highest prevalence of bird bite marks was observed on clipped steelhead.

Table 18. Annual bird bite rates (%) for salmonids examined at Little Goose Dam, 2014-2019.

	Yearling Chinook		Subyearling Chinook		Steelhead		Sockeye		Coho	
Year	Clipped	Unclip	Clipped	Unclip	Clipped	Unclip	Clipped	Unclip		Total
2014	0.5	0.5	0.3	0.3	2.7	2.5	0.0	0.7	0.9	0.7
2015	0.8	0.9	0.2	0.3	4.4	3.3	0.0	3.9	<0.1	1.1
2016	0.8	0.2	0.5	1.6	2.3	2.7	1.7	0.0	1.0	1.4
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

Other Miscellaneous Conditions

The other miscellaneous conditions category included popeye (exopthalmos), hemorrhaged fin, pink fin, discolored fin, and hemorrhaged eye. There were 6,911 smolts with one or more miscellaneous conditions, for an overall miscellaneous condition rate of 22.4% of the total condition subsample (See Table 15 above). A total of 8,281 individual observations of miscellaneous conditions were found. Many smolts that were examined had multiple conditions. For example, pink fin and hemorrhaged fins often occurred on the same individual fish, though in different fins. Pink fins constituted most of the observations in this category at 65.7% of the individual miscellaneous conditions total followed by hemorrhaged fin(s) (29.8%), fin discoloration (3.4%), eye hemorrhage (0.9%), and popeye (exopthalmos) (0.2%). Subyearling fall Chinook salmon had the highest rates in this condition category at 43.1% for unclipped and 41.2% for clipped due to the high incidence of pink and hemorrhaged fin(s).

Mortality

Mortality at the JFF included fish that entered the JFF system dead as well as 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 this year was lower than that of the 5-year average at 0.1% from a total collection of 3,270,408 smolts (Table 19) and was lower than in 2017 and 2018.

The average weekly total facility mortality rate ranged from less than 0.0% to 10.9% (Table 20). The minimum weekly rates of 0.1% and less than 0.1% occurred frequently during the month of April when mortalities that occurred represented a small proportion of the total collection. Increased mortality rates later in the collection season occurred when total collection numbers decreased and descaling, disease, predation, and injury rates increased. The average monthly total facility mortality rate was highest in September at a rate of 4.8% from a collection total of 2,859 smolts.

The maximum weekly total facility mortality rate of 10.9% occurred during the week ending September 19, with a total weekly collection of 559 fish and 59 mortalities. The relatively high mortality rate was presumed to be the result of the high prevalence of Columnaris. The median weekly total facility mortality rate for all smolts was 0.2%. The highest number of facility mortalities occurred during the week ending May 02 when a total of 890 mortalities were recorded.

Sample mortality for smolts was 0.6% of 57,828 smolts sampled (Table 21). As in previous years, increased sample mortality in late summer was observed when river temperatures and outbreaks of disease, such as Columnaris, were higher than in the spring and fall. On average, monthly sample mortality rates were lowest in June at 0.2% from a sample total number of 9,322 smolts. The highest sample mortality rate was in September at 3.4% from a sample total number of 2,845 smolts.

The total sample mortality rate for Pacific lamprey ammocoetes was 3.6%, which was 14 of 391 total ammocoete sampled. The sample mortality rate for Pacific lamprey macropthalmia was 5.8%, which was 41 from a total of 707 sampled (Table 21). No notable peak in sample mortality for either life stage of juvenile Pacific lamprey was observed.

Table 19. Annual total facility mortality as a percentage of total collection at LGS JFF 2014-2019.

	Yearling Chinook		Subyearling Chinook		Steelhead		Sockeye		Coho		Pacific lamprey	
Year	Clip	Unclip	Clip	Unclip	Clip	Unclip	Clip	Unclip		Total	Ammocoete	Macropthalmia
2014	<0.1	0.1	0.2	0.3	<0.1	<0.1	0.1	0.5	<0.1	0.1	0.4	0.2
2015	<0.1	0.1	0.2	0.5	<0.1	<0.1	<0.1	0.1	0.1	0.1	<0.1	<0.1
2016	<0.1	<0.1	0.2	0.2	<0.1	<0.1	1.2	0.2	<0.01	<0.1	0.2	<0.1
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

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

Table 20. Weekly total facility mortality in percent at Little Goose Dam JFF, 2019.

Week Ending	Yearling Chinook Clip	Yearling Chinook Unclip	Subyearling Chinook Clip	Subyearling Chinook Unclip	Steelhead Clip	Steelhead Unclip	Sockeye Clip	Sockeye Unclip	Coho	Total[1]
4-Apr	0	1.4	—	0	0	0.1	0	—	—	0.1
11-Apr	0.3	0.4	—	—	0	0.1	—	3.2	0	0.1
18-Apr	0	0	—	0.1	0	0	—		0.1	0
25-Apr	0.2	0.4	—	100	0	0	—	100	0.1	0.1
2-May	0.2	0.2	—	0	0	0	100	—	0.1	0.1
9-May	0.2	0.1	—	100	0	0	—	2	0.1	0.1
16-May	0.2	0.2	3	0.7	0	0	0	0	0.1	0.1
23-May	0.2	0.2	0.1	0.1	0.1	0	0.5	0.5	0.2	0.2
30-May	0.2	0	0	0.1	0.1	0	0.6	0.7	0.2	0.1
6-Jun	0.1	0.1	0.1	0.1	0	0.1	1.2	0	0.2	0.1
13-Jun	0	0.2	0.1	0.2	0	0	—	0	0.3	0.1
20-Jun	0	0	0.1	0.2	0	0	—	3.3	2.9	0.2
27-Jun	0	0	0.1	0.1	0	0	—	—	1.6	0.1
4-Jul	—	—	0.2	0.2	0.8	0	—	0	2.2	0.2
11-Jul	—	—	0.2	0.3	0	0	—	—	4.3	0.2
18-Jul	—	2.2	0.4	0.7	0	—	—	0	26.7	0.6
25-Jul	0	0	0	0.6	0	0	50	—	15.4	0.5
1-Aug	—	—	0.6	0.4	0	0	0	—	50	0.6
8-Aug	—	—	0.4	0.4	0	0	0	—	0	0.4
15-Aug	—	—	0.7	0.8	0	—	0	—	75	0.8
22-Aug	—	0	4.6	2.6	0	0	0	—	0	2.8
29-Aug	—	—	2.8	2.4	0	—	—	—	25	2.5
5-Sep	—	—	2.2	2.9	0	—	50	—	—	2.9
12-Sep	—	—	6.3	2.9	0	0	75	0	—	3.5
19-Sep	0	—	23.1	9.2	0	0	75	—	—	10.6
26-Sep	—	—	0	3.6	0	0	100	—	—	3.8
3-Oct	—	—	6.5	2.5	—	0	0	—	—	2.9
10-Oct	—	—	0	2.8	—	—	40	—	—	3.1
17-Oct	—	—	0	2.2	—	—	0	—	—	1.9
31-Oct	—	—	0	0	0	—	0	—	—	0
1-Nov	—	—	0	0	—	—	—	—	—	0
Median Weekly Rate	0.1	0.2	0.2	0.5	<0.1	<0.1	0.5	0.3	0.2	0.2

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

Table 21. Annual sample mortality as percent of total sample at Little Goose Dam JFF, 2014-2019.

	Yearling Chinook Clip	Yearling Chinook Unclip	Subyearling Chinook Clip	Subyearling Chinook Unclip	Steelhead Clip	Steelhead Unclip	Sockeye Clip	Sockeye Unclip	Coho	Total	Pacific Lamprey Ammocoetes	Pacific Lamprey Macropthalmia
2014	0.3	0.3	0.3	0.8	0.2	0.1	1.7	4.7	0.4	0.6	20.4	5.6
2015	0.2	0.5	0.3	0.9	0.2	0.2	2.0	0.0	0.0	0.6	20.0	4.1
2016	0.3	0.2	0.4	0.4	0.2	0.1	4.0	0.0	0.1	0.4	8.6	3.8
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

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. In 2014, the sample mortality rate for Pacific lamprey ammocoete includes 2 unknown ammocoetes.

Incidental Species

The 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 shad was too large to practically count each individual, a weekly fish per pound calculation was obtained for these species. The result was then multiplied by the 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 prawn. Siberian prawns that occurred in the sample were euthanized per the directive issued by Washington Department of Fish and Wildlife on July 24, 2007. All Siberian prawns from the sample were frozen and disposed into a landfill.

When the sample rate was less than 100%, incidental species were inadvertently collected and transported along with the smolts. Therefore, when the sample rate was below 100%, incidental fish species were weighed, and the average weight was applied to the expanded sample count to determine their contribution to transport loading densities. When the sample rate was at 100%, all incidental species, except Siberian prawns, were collected and returned to the river.

Incidental collections totaled 160,376. This included an expanded sample count of 95,500 fish and 36,217 Siberian prawn, plus 28,659 fish from the separator (Table 22).

American shad collection totals were the lowest since 2015. Numbers of Pacific lamprey macropthalmia, mountain whitefish (*Prosopium williamsoni*), rainbow trout (*Oncorhynchus mykiss)*, and sculpin (*Cottus* sp.) were much higher than the 2014–2018 average (Table 23), while collection numbers for crappie (*Pomoxis sp*.), kokanee (*O. nerka*), northern pikeminnow (*Ptychocheilus oregonensis),* peamouth *(Mylocheilus caurinus),* sand roller *(Percopsis transmontana),* and Siberian prawn were much lower. Collection totals for most other groups that contribute substantial numbers to the incidental collection were similar to those in 2018.

This year saw a high number of juvenile *O. mykiss* too large to fit through the separator bars. Because it could not be determined in some cases if these fish were rainbow trout or residualized steelhead, they were all reported simply as "*O. mykiss*" and are included in the totals for rainbow trout in Tables 22 and 23.

Adult Pacific lamprey collections totaled 66 in 2019, 50 from the separator and raceways and 16 from the sample. The first adult Pacific lamprey of the season was collected May 15 and the last on September 13. Upriver adult migrants were most frequently observed falling back into the collection system from July through August. USACE transported all adult Pacific lamprey captured at the facility approximately 1 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/or Anchor QEA personnel prior to SMP sampling.

Table 22. Collection of incidental species at Little Goose Dam, 2019.

Common Name	Scientific Name	Expanded Sample	Separator	Total Collection [1]
American shad	*Alosa sapidissima*	55,762	25,604	81,366
Banded killifish	*Fundus diaphanus*	0	0	0
Bass, smallmouth	*Micropterus dolomieu*	4,808	88	4,896
Bass, largemouth	*M. salmoides*	2	0	2
Bullhead	*Ameiurus* sp.	403	0	403
Bull trout	*Salvelinus confluentus*	0	1	1
Channel catfish	*Ictalurus punctatus*	69	49	118
Chiselmouth	*Acrocheilus alutaceus*	69	2	71
Common carp	*Cyprinus carpio*	23	38	61
Crappie	*Pomoxis* sp.	246	797	1,043
Dace	*Rhinichthys* sp.	4	0	4
Goldfish	*Carassius auratus*	0	0	0
Kokanee	*Oncorhynchus nerka*	0	0	0
Lamprey adult, Pacific[2]	*Entosphenus tridentatus*	16	50	66
Lamprey ammocoete, Pacific	*E. tridentatus*	2,674	0	2,674
Lamprey macropthalmia, Pacific	*E. tridentatus*	22,010	0	22,010
Mountain whitefish	*Prosopium williamsoni*	1,722	22	1,744
Northern pikeminnow	*Ptychocheilus oregonensis*	1	8	9
Peamouth	*Mylocheilus caurinus*	512	112	624
Rainbow trout[3]	*O. mykiss*	0	1,483	1,483
Redside shiner	*Richardsonius balteatus*	0	0	0
Sand roller	*Percopsis transmontana*	53	18	71
Sculpin	*Cottus* sp.	5,786	0	5,786
Siberian prawn	*Exopalaemon modestus*	36,217	0	36,217
Sucker	*Catostomus* sp.	1,156	189	1,345
Sunfish[4]	*Lepomis* sp.	102	21	122
Tadpole madtom	*Noturus gyrinus*	0	0	0
Walleye	*Stizostedion vitreum*	36	65	101
White sturgeon	*Acipenser transmontanus*	0	45	45
Yellow perch	*Perca flavescens*	26	66	92
Other[5]	—	20	1	22
Total		**131,717**	**28,659**	**160,376**

[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 the separator and from raceways.

[3] Includes all juvenile *O. mykiss* too large to fit through the separator bars.

[4] "Sunfish collection total includes bluegill/pumpkinseed and warmouth.

[5] "Other" fish include expanded counts of live non-salmonid and unidentifiable/decomposed non-salmonid.

Table 23. Numbers of incidental species collected at Little Goose Dam JFF, 2014-2019.

Common Name	Scientific Name	2014	2015	2016	2017	2018[1]	2019	2014 to 2018 Average
American shad	*Alosa sapidissima*	1,799	5,634	157,259	136,814	91,725	81,366	78,646
Banded killifish	*Fundus diaphanous*	111	53	0	1	0	0	33
Bass, smallmouth	*Micropterus dolomieu*	3,528	2,102	2,992	8,977	2,939	4,896	4,108
Bass, largemouth	*M. salmoides*	3	1	13	5	28	2	10
Bullhead	*Ameiurus* sp.	235	284	166	1,263	574	403	504
Bull trout	*Salvelinus confluentus*	4	0	10	1	0	1	3
Channel catfish	*Ictalurus punctatus*	204	440	80	91	99	118	183
Chiselmouth	*Acrocheilus alutaceus*	10	7	19	3	57	71	19
Common carp	*Cyprinus carpio*	102	44	49	296	103	61	119
Crappie	*Pomoxis* sp.	887	9,407	3,135	38,778	3,807	1,043	11,203
Dace	*Rhinichthys* sp.	19	3	0	6	3	4	6
Goldfish	*Carassius auratus*	0	0	0	0	0	0	0
Kokanee	*Oncorhynchus nerka*	14	1	101	4	0	0	24
Lamprey adult, Pacific	*Entosphenus tridentatus*	77	163	117	232	137	66	145
Lamprey ammocoete, Pacific	*E. tridentatus*	2,495	89	1,592	5,157	4,794	2,674	2,825
Lamprey macropthalmia, Pacific	*E. tridentatus*	18,673	8,155	33,631	2,431	31,332	22,010	18,844
Mountain whitefish	*Prosopium williamsoni*	163	271	81	973	3,189	1,744	935
Northern pikeminnow	*Ptychocheilus oregonensis*	43	32	29	106	0	9	42
Peamouth	*Mylocheilus caurinus*	864	1,230	512	4,687	707	624	1,600
Rainbow trout[2]	*O. mykiss*	8	27	2	25	336	1,483	80
Redside shiner	*Richardsonius balteatus*	0	0	0	0	0	0	0
Sand roller	*Percopsis transmontana*	3,681	1,603	294	559	138	71	1,255
Sculpin	*Cottus* sp.	391	1,836	633	199	2,908	5,786	1,193
Siberian prawn	*Exopalaemon modestus*	81,310	464,586	51,518	31,668	11,159	36,217	128,048
Sucker	*Catostomus* sp.	1,062	1,631	504	1,225	797	1,345	1,044
Sunfish[3]	*Lepomis* sp.	791	263	501	1,182	736	123	695
Tadpole madtom	*Noturus gyrinus*	3	4	3	1	1	0	2
Walleye	*Stizostedion vitreum*	14	27	65	110	170	101	77
White sturgeon	*Acipenser transmontanus*	27	11	15	4	20	45	15
Yellow perch	*Perca flavescens*	14	63	78	77	120	92	70
Other[4]	—	52	52	2	0	11	21	23
Total		**116,584**	**498,019**	**253,401**	**234,875**	**155,891**	**160,376**	**251,754**

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.

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 2019.

Gas Bubble Trauma Monitoring

GBT monitoring was performed by Pacific States Marine Fisheries Commission biological technicians from LMN. When juvenile salmonid numbers permitted, a maximum of 100 fish were examined. Sampling occurred weekly from April 07 through July 15, when GBT monitoring was discontinued due to small sample sizes. 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.

A total of 1,316 smolts were handled by Pacific States Marine Fisheries Commission GBT personnel in 2019. There were 41 fish which had been previously PIT-tagged and were enumerated and released without examination. A total number of 1,238 smolts were examined for GBT. Of those, 39.4% were subyearling Chinook salmon, 32.0% were yearling Chinook salmon, and 28.6% were steelhead smolts. Of those examined, 2.3% (29) showed signs of GBT. The total GBT mortality rate was 0.0% of the 1,316 smolts handled.

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 years' comparisons (Tables 19 and 21). The lamprey ammocoete total mortality rate in 2019 was 0.5%, from a total collection count of 2,674 lamprey ammocoetes. The total mortality rate for Pacific lamprey macropthalmia this year was 0.2%, from a collection total number of 22,010 Pacific 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 quaggu 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 quaggu mussels observed during the 2019 season.

Turbine Strainers

USACE continued to monitor turbine unit strainers this year at LGS. Strainers are located 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 staff. Inspections took place at least once per month from January through July and again in December, in accordance with the Fish Passage Plan. USACE staff inspected for any fish entrapment, particularly juvenile lamprey, and results were reported monthly to District biologists.

Avian Predation and Behavior

Avian activity was monitored and recorded at LGS by USACE and Anchor QEA. 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 outmigration.

Anchor QEA personnel conducted avian surveys daily from April 01 through November 2, 2019. Surveys were typically conducted between 1100 and 1400 during the juvenile fishway inspection. Piscivorous birds present in 2019 included seagulls, double crested cormorants, American white pelicans, bald eagles, osprey and red-tailed hawks. Only two specific bird behaviors were recorded this year—foraging and non-foraging—compared to the loafing/resting (on land or water), flyby, scavenging, and predating behaviors previously recorded.

The number of piscivorous birds sighted remained low between April and June averaging less than 4 birds per day. Numbers increased late in the season when the number of juvenile American shad entering the facility increased. The maximum number of birds counted during an Anchor QEA inspection was 148 individuals on October 30; 123 gulls and 25 cormorants.

As in previous years, copies of the juvenile inspection form were forwarded to project USACE biologists. Survey results, along with the USACE survey results, were entered into a USACE database by USACE fishery personnel and included in weekly reporting.

Juvenile Facility Operations & Maintenance

The juvenile fish bypass system was inspected a minimum three times daily during the fish passage season. The juvenile bypass system and the collection facility were moderately impacted by debris during the 2019 fish passage season.

Forebay Debris/Trashracks

The surface area covered by debris and its location in the forebay was estimated daily by Anchor QEA personnel during juvenile bypass system and adult fishway inspections. In 2014, the trash sheer boom cable separated rendering the equipment ineffective. It was repaired in 2018 prior to the start of the season. Consequently, this year all forebay debris was recorded as outside trash sheer boom, inside trash sheer boom, or in front of the spillway. All debris passed

through the project via spill, turbine intakes, or the juvenile collection system. Minimal to moderate accumulations of woody debris averaging 9,244 square feet and ranging from 3000 to 23,000 square feet were present in the forebay from April 01 through June 15. Orifice blockages were most frequent from April through June. Increased orifice rotations were necessary to decrease debris accumulations within the juvenile collection system this year. Forebay debris decreased to minimal amounts after June 15 averaging 309 square feet from June 15 through August 31 and 1,840 square feet September 01 through November 01.

Spillway Weir

The ASW was placed into operation on April 03 in the high crest (622 ft. msl) position. The ASW was placed into low crest position (618 ft. msl) on April 09. ASW was closed to facilitate calibration during the morning hours on June 06. The ASW was operated in both high and low crest during peak adult Chinook salmon passage to facilitate upstream passage. The spillway weir was removed from service for the 2019 season on July 23.

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 24.

Table 24. Little Goose turbine unit outages, 2019.

Turbine Unit	Date OOS	Date RTS	Description
Unit 1	22-Nov 06:46	16-Jan 10:45	U1 tripped 15 KV ground
	19-Mar 07:30	19-Mar 16:05	Trash raking
	25-Mar 07:26	25-Mar 12:30	ESBS install
	10-Apr 08:00	10-Apr 16:55	Flush trash through spillway
	09-May 00:06	09-May 15:50	Water intrusion to turbine guide bearing oil system
	13-May 07:40	13-May 13:40	Trash raking & VBS Inspections
	17-Jun 15:20	01-Jul 15:45	Sheared 1” air vent on U1 spiral scroll case drain
	08-Jul 08:10	08-Jul 09:30	ESBS/VBS inspections
	05-Aug 08:27	08-Aug 16:52	Isophase bus inspections
	06-Oct 03:20	07-Oct 12:45	Control system fault
	10-Oct 05:43	10-Oct 10:51	Control system fault
	15-Oct 13:45	15-Oct 16:14	T1 outage for XJ measurements
	29-Oct 09:20	29-Oct 14:50	Dive for installation of unwatering pipes
	05-Nov 09:05	05-Nov 11:00	Trash raking
	12-Nov 09:00	12-Nov 17:00	Divers in tailrace for unwatering pump work
	25-Nov 15:30	20-Dec 11:25	Unit annual
Unit 2	18-Dec 06:30	16-Jan 10:45	Tripped on protective relay
	19-Mar 07:30	19-Mar 16:05	Trash raking
	25-Mar 12:54	25-Mar 16:35	ESBS install
	01-Apr 01:55	01-Apr 10:59	Component in governor HMI failed- tripped unit
	10-Apr 08:00	10-Apr 16:55	Flush trash
	13-May 10:45	13-May 16:00	Trash raking
	15-May 10:25	15-May 16:10	Brake maintenance
	23-May 18:31	23-May 18:42	Thyristen bridge temp external trip active
	04-Jun 07:15	04-Jun 17:25	Trip-Exciter overtemp
	08-Jul 09:45	08-Jul 10:50	ESBS/VBS inspections

	05-Aug 08:27	08-Aug 16:52	Isophase bus inspection
	15-Oct 05:56	25-Nov 14:45	Unit Annual
	05-Dec 06:35	05-Dec 15:05	Bus link work
	16-Dec 07:15	16-Dec 11:50	ESBS removal
Unit 3	13-Jan 07:35	16-Jan 10:45	T1 line down for troubleshooting/testing
	18-Mar 10:40	18-Mar 15:20	Trash raking
	25-Mar 16:21	25-Mar 16:56	Exciter overtemp
	26-Mar 10:15	26-Mar 11:40	ESBS install
	13-Apr 22:40	14-Apr 10:38	Fish screen trouble
	13-May 13:50	13-May 16:00	Trash raking
	05-Jun 16:16	05-Jun 17:03	Thyristor high temp
	08-Jul 11:45	08-Jul 16:00	ESBS/VBS inspections
	05-Aug 08:27	08-Aug 16:52	Isophase bus inspections
	09-Sep 07:29	03-Oct 15:15	Unit annual
	15-Oct 05:56	15-Oct 13:45	T1 outage for XJ measurements
	29-Oct 09:20	29-Oct 14:50	Dive for install of unwatering pumps
	04-Nov 13:40	04-Nov 15:40	Trash raking
	05-Nov 08:15	05-Nov 08:50	Trash raking
	12-Nov 09:00	12-Nov 17:00	Divers in tailrace for unwatering pump work
	05-Dec 06:35	05-Dec 15:05	T1 outage for XJ upgrade measurements
	16-Dec 11:20	16-Dec 15:36	ESBS Removal
Unit 4	13-Jan 07:35	16-Jan 10:45	T1 OOS for troubleshooting/testing
	04-Mar 06:11	04-Mar 15:50	86GX on S/U
	18-Mar 10:40	18-Mar 15:20	Trash raking
	26-Mar 10:15	26-Mar 14:20	ESBS screens
	28-Mar 08:25	28-Mar14:10	Fish screen swap
	29-Mar 17:10	01-Apr 07:23	Fish screen OOS
	09-Jul 07:55	09-Jul 10:15	ESBS/VBS inspections
	05-Aug 08:27	08-Aug 16:52	Isophase bus inspections
	14-Aug 12:51	05-Sep 14:58	Unit annual
	15-Oct 05:56	15-Oct 13:45	T1 outage for XJ measurements
	04-Nov 12:50	04-Nov 15:40	Trash raking
	05-Dec 06:35	05-Dec 15:05	T1 outage for XJ upgrade measurements
	17-Dec 07:30	17-Dec 13:55	ESBS removal
Unit 5	14-Apr-2017		Spider and upper guide bearing repair
Unit 6	13-Jan 07:35	13-Jan 16:21	Line down for T1 troubleshooting/testing
	14-Jan 06:48	14-Jan 16:29	T2 disconnects to open troubleshooting T1 ground
	15-Jan 06:10	15-Jan 16:56	T2 disconnects to open troubleshooting T1 ground
	25-Feb 08:00	26-Feb 13:00	Trash raking
	27-Feb 10:35	27-Feb 11:45	Governor oil pump failure
	27-Mar 07:20	27-Mar 13:00	ESBS install
	18-Jun 07:35	18-Jun 16:07	Switching station power caused Unit to trip
	08-Jul 08:40	01-Aug 10:22	Unit annual
	05-Aug 08:27	05-Aug 16:58	Isophase bus inspection
	06-Aug 05:45	06-Aug 17:01	Isophase bus inspection
	07-Aug 05:40	07-Aug 17:20	Isophase bus inspection
	08-Aug 05:45	08-Aug 16:52	Isophase bus inspection
	04-Nov 09:33	04-Nov 12:50	Trash raking
	17-Dec 14:05	17-Dec 16:50	ESBS removal

Extended-Length Submersible Bar Screens (ESBS)

All ESBS performed satisfactorily for the majority of the season. Fish screen 4B failed on March 27 due to a faulty cleaning brush motor and was replaced with an unused ESBS from Unit 5. All screens were removed for the end of fish passage season during the week of December 16. 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 May 13 for Units 1, 2 and 3. Camera inspections occurred on Units 1, 2, 3, 4 and 6 on July 8 and 9. Camera inspections in conjunction with Unit annuals occurred on August 28 for Unit 4, October 10 for Unit 2 and December 3 for Unit 1. Unit 5 ESBS screens are stored in a position that does not allow underwater inspections. Worn screens were repaired or replaced. Screens will continue to be replaced with new during Unit annual maintenance.

Gatewells

Gatewells were checked for debris and oil contamination daily. As needed, debris was removed using a dip basket or grappling hook. In 2019, 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 in gatewells 3A, 2A and 2B for VBS repairs other annual maintenance needs during 2019.

Orifices and Collection Channel

The collection channel was operated throughout the season with 18 to 22 open orifices depending on forebay elevations. Orifices were inspected and/or back-flushed two to five times per day. All orifice operations were manually performed throughout the year.

The collection channel was dewatered and removed from service on December 19. Fish salvage operations during the dewatering included releasing approximately 75 adult steelhead to the tailrace via the emergency release pipe.

Primary Dewaterer/Primary Bypass Pipe

The primary dewatering structure and components functioned adequately throughout the season. 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 2019. During winter maintenance 2010, the flume outfall was relocated from near shore to mid channel. The relocation extended the release site approximately 400 feet north into the river mid-channel. This new section of

outfall is made of 36 inch 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.

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 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. There were no separator cleanouts was conducted this year. There were no problems with the DDS system in 2019.

Pit Tag Detections

The Passive Integrated Transponder (PIT) tag detection system records data on PIT tagged salmonids as they pass through the juvenile collection system. The PTAGIS database categorized all PIT tag detections based upon 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 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 27 through November 01, a total of 101,820 PIT-tagged fish were detected within the juvenile collection/bypass system: 46,824 Chinook salmon, 51,950 steelhead, 2,094 sockeye salmon, 737 coho salmon, 5 Pacific lamprey (*E. tridentatus),*1 cutthroat trout (*O. clarkia)* and 209 orphans of unknown species/rearing. Of the total number of detections, 64.5%, or 65,645 fish, were routed to the river, and 35.5%, or 36,175 fish, were routed to transport areas. PIT-tagged fish in the subsample were treated as the other fish in the sample and were either routed back to the river, if the facility was operating in secondary bypass mode, or routed to a transport holding area when the facility was operating in collection mode. Approximately 0.5% of the PIT-tagged fish detected at LGS, or 490 PIT-tagged smolts, were last detected in the sample; 84.7% (415) were transported and 15.0% (75) were returned to the river during pre-transport operations or while operating in secondary bypass mode. Prior to the start of the transportation season, all PIT-tagged fish were bypassed to the river. Approximately 30.0%, or 30,589, of the total PIT-tagged fish detected were detected prior to the start of collection for transportation.

Avian Predation Deterrence

USDA Animal and Plant Health Inspection Service (APHIS) began bird hazing activities in 1999. In 2019, APHIS bird hazing activities at Little Goose took place from April 01 through June 22. The hazing schedule included 8 hours per day, 7 days per week of land based hazing and 8 hours per day, 3 days a week of boat based hazing from April 01 through June 22. Additionally, a second 8 hour per day shift was conducted from April 14 through May 25. 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 Anchor QEA conducted bird counts extending from the immediate tailrace and forebay to approximately one half mile upstream and downstream of Little Goose Dam and were broken into two zones; tailrace (T1) and forebay (FB1). Additional zones were monitored to include the newly installed trash shear boom, floating forebay debris, boat barrier and modified boat barrier. The modified boat barrier had buoy weights and bird spikes removed to allow debris to pass more easily.

Counts were conducted using binoculars 2 to 3 times daily from April 01 through October 31, 2019. 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 reporting.

Avian counts did not reach the maximum thresholds allowed per the Fish Passage Plan from April 01 to August 31. However, gull counts exceeded the 100 bird threshold 1 time throughout the bird counting season, April through October. Of these occurrences, gulls counts never exceeded the threshold while APHIS personnel were actively hazing and only 1 time outside of the active hazing activities. Cormorant counts exceeded the 50 bird threshold 3 times throughout the bird counting season, however all occurrences took place in October. Lethal take was implemented with 69 gulls and 4 cormorants sacrificed during the 2019 season. 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 total daily number of 123 gulls counted occurred on October 30. The average daily total count was 13.1 gulls. The maximum daily count in the forebay was 119 gulls and occurred on October 30 with a daily average of 7.4 gulls. The maximum daily count in the tailrace was 71 gulls and occurred on October 12 with a daily average of 5.6 gulls.

Double Crested Cormorant Counts

The maximum total daily number of 68 cormorants occurred on October 12. The average daily total count was 5.5 cormorants. The maximum daily count in the forebay was 45 cormorants and occurred on October 24 with a daily average of 5.5 cormorants. The maximum daily count in the tailrace was 50 cormorants and occurred on October 25 with a daily average of 1.4 cormorants.

Caspian Tern Counts

There were no terns observed during the 2019 season.

Other Piscivorous Bird Counts

The maximum total daily number of 3 grebes occurred on October 23. The average daily total count was 0.0 grebes. The maximum total daily number of 5 pelicans occurred on June 18. The average daily total count was 0.1 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 (28.6%) followed by cormorants (23.9%). Cormorants had the highest percent of feeding behavior in the tailrace (85.1%) followed by gulls (57.0%). Cormorants had the highest percent of feeding behavior in the forebay (8.1%) followed by gulls (7.0%). Caspian terns were not observed at Little Goose in 2019. The majority of all avian foraging occurs in the tailrace with resting, loafing and perching occurring in the forebay.

Facility Modifications

Several modifications and repairs were made prior to, during and after the 2019 season.

1. Repaired porosity control floor section in separator.
2. Repaired and replaced PIT tag gate components per FPP requirements.
3. Replaced barge loading hose.
4. Repaired separator and resurfaced and painted various sections.
5. Repaired/replaced multiple ESBS screen cleaning motors.
6. Repaired juvenile bypass system orifice cylinders.

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. Repair the trash/shear boom.
3. Continue to rebuild orifice valve cylinders.
4. Repair or replace corroded outer steel orifice pipe with stainless steel.
5. 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
6. Continue to remove scale and rough edges in the facility flumes, tanks, and transition areas.

Acknowledgements

The Little Goose Dam JFF was managed, operated, and maintained during 2019 by the following people:

Scott St. John, Project Lead Fishery Biologists, COE
Richard Weis, Assistant Fisheries Biologist, COE

Ron Ashley, Maintenance Work Leader, COE
Kreg Buryta, Maintenance Worker, COE
Matthew Hutchens, Maintenance Worker, COE

Deborah Snyder, Lead Biological Technician, COE
Ashley Smith, Biological Technician, COE
Maria Gerard, Biological Technician, COE
Bryan Nelson, Biological Technician, COE

Paul Burke, Anchor QEA
Delaney Anderson, Anchor QEA

Pat Keniry, Fishery Biologist, Smolt Monitoring Project Leader, ODFW
Anne Dowdy, Natural Resource Specialist, ODFW
Ruth Shearer, Natural Resource Specialist, ODFW

Pacific States Marine Fisheries Commission Personnel: Don Warf, Darren Chase, Alan Brower, Roger Clark, Scott Livingston and Mark Leonard.