CENWW-OD-DL HOLDREN (1130) February 2019

MEMORANDUM THRU:

Marty Mendiola, Operations Manager Lower Granite Dam

FOR Chief, Operations Division

ATTN: Eric Hockersmith / Chris Peery

SUBJECT: Submission of 2018 Adult and Juvenile Fish Facility Monitoring Report, Lower Granite Dam.

1. Enclosed find the 2018 Adult and Juvenile Fish Facility Monitoring Report Lower Granite Dam, as requested.

2. If you have any questions contact Elizabeth Holdren at Lower Granite Dam, (509) 843-2263.

ELIZABETH HOLDREN Supervisory Fisheries Biologist, Lower Granite Dam

Enclosure

**ADULT AND JUVENILE FISH FACILITY MONITORING REPORT**

**LOWER GRANITE DAM**

**2018**

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And

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Lower Granite Dam

U.S. Army Corps of Engineers

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# INTRODUCTION

The following report on fishway activities at Lower Granite Dam is required under the Endangered Species Act consultation on the operation of the Federal Columbia River Power System and its associated fish passage facilities. This report summarizes the operation and maintenance of adult fish passage facilities at Lower Granite Dam, including the results of visual inspections of the fishway conducted by fisheries biological staff during the adult fish passage period of March 1 to December 31, 2018. Inspection readings are provided in Appendix 1. Recommendations are provided for correcting problems found. This report also contains a synopsis of juvenile fish facility operations. Additional information on juvenile fish collection and transportation activities at Lower Granite Dam can be found in the, “2018 Juvenile Fish Collection and Bypass Report, Lower Granite Juvenile Fish Facility”.

River Conditions

The average daily river flow exceeded 100 kcfs on 49 days during the 2018 juvenile salmon collection season April 1-October 31. Total river flows averaged 60.8 kcfs for the season with a maximum daily average flow of 180.4 kcfs on May 27 and a minimum daily average flow of 14.8 kcfs October 20. Emergency debris spill through the RSW occurred on March 19. Spilling through the RSW began earlier than typical at 0700 hours March 25 to provide fish passage due to Phase 1a construction and commissioning that delayed juvenile fish facility (JFF) operations. Traditional spill for fish passage occurred for 152 days from April 3 through midnight on August 31. Spill is distributed according to FPP Table LWG-7 and LWG-8. The seasonal average flow through spillways was 29.7 kcfs with a maximum daily average spill of 73.4 kcfs May 27 and a minimum daily average of 11.1 kcfs August 20. The RSW was closed at 1420 hours August 8 due to total project outflow being less than 30 kcfs and forecasted flows below 30 kcfs for 3 consecutive days. River temperatures averaged 59.4o F for the season and ranged from 43.5°F March 26 to 67.1°F July18.

# ADULT FISH FACILITY

## Facility Description

Adult fish passage facilities at Lower Granite Dam consist of one south shore adult fish ladder. The upper fish ladder extends from the forebay to tailwater. The fish ladder includes forebay temperature control system with pumps to supply cooling water, one fish ladder exit, slotted weirs control section, upper diffuser, overflow weirs with orifices, and a fish counting station with picketed leads. Auxiliary water is supplied from the forebay through diffuser 14 to maintain flow over the upper ladder weirs. Lower Granite fish trap is located at the turnpool area just upstream from the fish count station. The lower ladder contains a powerhouse collection channel, three electric auxiliary water supply pumps (AWS), collection channel diffusers, a transport channel under the spillway, and ladder entrances. There are six main fish ladder entrances: two north shore entrances (NSE-1 and NSE-2), two north powerhouse entrances (NPE-1 and NPE-2), and two south shore entrances (SSE-1 and SSE-2). The powerhouse collection channel has four out of ten floating orifices operating. The three electric AWS pumps supply additional water from tailrace intakes through the lower ladder and collection channel diffusers.

## Facility Modifications

1. Permanently closed adult entrances NPE-3 and NSE-3.
2. Repaired AWS fish pump # 2.
3. Auxiliary supply line from the JFF primary dewaterer (PDW) was tied into the adult fish ladder auxiliary water supply pump (AWS) chamber.
4. Upgraded powerhouse collection channel tunnel lights observation mirror.
5. Repaired expansion joint leaks in upper fish ladder.

**Operations and Maintenance**

## Fish Ladder and Collection Channel

### The adult fish ladder was in service throughout 2018 with the exception of the winter maintenance season from January 2-February 28 and for ladder leak repair related to Phase 1a construction from February 28-March 5. During the winter annual outage the upper fish ladder is dewatered for maintenance activities including: debris removal, diffuser grate and structural support inspections, picketed lead, staff gauge, and fish counting window cleaning, maintenance of count station window cleaning mechanisms, and packing of leaks in expansion joints. A minimum of 24 hours prior to dewatering, the auxiliary water is shut off to discourage newly arriving fish from starting up the ladder. A bulkhead is then placed in the fish ladder exit, any exit pool fish are removed and released to the forebay, and the upper ladder is partially dewatered. Diffuser 14 is gradually closed to allow fish to move through the orifices to the tailrace. The drain for diffuser 14 is closed to maintain a minimal amount of water in the ladder while remaining fish are flushed down the ladder. Biologists and maintenance personnel descend the ladder through orifices to remove debris, inspect the ladder, and move remaining fish to the tailrace. Fish recovered in the upper section of the ladder and released to the tailrace or forebay January 2 included 1 unclipped juvenile steelhead and 2 adult lamprey. All diffuser grating passed inspection.

The lower ladder is typically dewatered to a depth of one foot providing a holding pool for fish. Once the target depth is obtained, maintenance personnel and biologists inspect entrance weirs, diffuser grates, fallback fence, and exposed diffuser gate operating equipment. Staff gauges are then cleaned and debris is removed. Water is lowered 4/10th of a foot for visual inspection of grating and fish recovery. When dewatering for repair is necessary; fish are crowded to the entrance pools, netted, and placed in fish only transport containers. Fish in the containers are raised from the collection channel with the crane and transported to the tailrace or forebay for release. Fish recovered from the powerhouse collection channel January 4 included 7 unclipped juvenile steelhead, 1 unclipped and 6 clipped juvenile Chinook, 1 peamouth, 2 juvenile white crappie, 2 bass, 2 clipped adult steelhead, 1 sculpin, 1 sandroller, 1 long-nosed dace, 1 white fish, and 1 northern pikeminnow. Mortalities included 2 decomposed adult shad. No problems were observed during the inspection of the north powerhouse channel. Fish recovered from the spillway section of the collection channel February 3 included 1 carp, 1 peamouth, and 2 unclipped juvenile steelhead. Mortalities included 1 peamouth. Diffuser 13 powerhouse collection channel transverse bulkhead was installed to separate NPE3 and NSE3 permanent closure work from Phase 1a commissioning.

## Auxiliary Water Supply

AWS fish pumps were out of service (OOS) from January 1 to February 28 for annual maintenance. Annual maintenance consists of general mechanical and electrical inspection and repairs. AWS pump 3 was removed from service and AWS pump 2 was returned to service June 20 after completion of lower guide bearing repairs. Fish pumps 1 and 2 remained in service for the remainder of the season with pump 3 in standby mode. Significant pump outages are summarized in Table 1.

**Table 1.** Fish pump outages at Lower Granite Dam, 2018 \*

|  |  |  |
| --- | --- | --- |
| Affected Pump(s) | Dates | Reason for Outage/Comments |
| 2 | Jan 1 – Jun 20 | Annual maintenance/ Repairs |
| 1, 3 | Jan 1 – Feb 28 | Annual maintenance |

\*Only outages involving two or more calendar days are included.

## Adult Fish Trap Operations

Lower Granite adult fish trap was operated March 07 through November 18 by NOAA Fisheries. Sample rates were adjusted with adult passage to meet collection and research needs. The adult ladder temperature control system sustained adult trap temperatures below 70°F, and trapping operations were not postponed due to water temperatures. The maximum adult trap water temperature during 2018 was 67.9 °F July 24 and Aug 1,9,10, and 28. The adult trap total collection for the season was 27,692 fish, including 72 sockeye, 829 Coho, 11,643 steelhead, 7,023 spring Chinook, 1,440 summer Chinook, and 6,684 fall Chinook. One bull trout was incidentally trapped April 27, PIT tagged, genetic sampled, and released.

Idaho Department of Fish and Game (IDFG) assisted NOAA in sampling throughout the trapping season. Sampling included scale collection, genetic sample, sex determination, fork length, adipose fin clipped/unclipped, and evaluating non-adipose clipped hatchery fish run proportion. Natural origin adult steelhead and spring/summer Chinook salmon were PIT tagged to estimate headwater tributary escapement. Known source natural origin PIT tagged fish were recaptured and radio tagged to evaluate final location, homing, spawning success and other factors. One steelhead and 6 spring/summer Chinook were radio tagged as part of this effort.

Steelhead collection totaled 11,643 (9,043 clipped, 2,600 unclipped) with 2,850 having genetic samples only taken, 2,470 PIT tagged with both genetic and scale samples taken, 130 recaptured PIT tagged fish having genetic and scale samples taken. Of the recaptured PIT tagged steelhead, one was radio tagged.

Spring Chinook collection totaled 7,023 (5,417 clipped, 1,606 unclipped) with 1,803 having genetic samples only taken, 1,494 PIT tagged with both genetic and scale samples taken, 112 recaptured PIT tagged fish having genetic and scale samples taken. Of the recaptured PIT tagged spring Chinook five were radio tagged.

Summer Chinook collection totaled 1,440 (775 clipped, 665 unclipped) with 259 having genetic samples only taken, 607 PIT tagged with both genetic and scale samples taken, 58 recaptured PIT tagged fish having genetic and scale samples taken. Of the recaptured PIT tagged summer Chinook, one was radio tagged.

Genetic samples were taken from 69 of the 72 adult sockeye collected in the trap.

Fall Chinook collection for broodstock transport began 18 August. Of the 6,684 fall Chinook handled at the adult trap, 3,175 were transported and 3,509 were released. Washington Depatment of Fish and Wildlife (WDFW) transport to Lyons Ferry Hatchery began August 21 and ended October 15 when hatchery needs were met. WDFW transported 2,295 (1,784 adults and 511 jacks) fall Chinook. Nez Perce Tribe collection for transport to Cherry Lane/Dworshak hatcheries occurred August 18 through October 30 when broodstock needs were met. Nez Perce Tribe transported 880 (866 adults and 15 jacks) fall Chinook. The turnpool gate remained in trapping position during the fall Chinook collection season.

Broodstock collection of Coho for the Nez Perce Tribe occurred from September 17 to November 18. Coho ≥ 45 cm in length were collected. Of the 829 Coho collected at the adult trap, 478 were transported and 351 were returned to the fish ladder.

There was no emergency trapping operation of sockeye for IDFG transport. However, IDFG handled and released 13 adult sockeye outfitted with “I-button” temperature recording devices, PIT tagged, and genetic sampled to determine thermal units experienced by returning adult sockeye from Lower Granite to natal locations. Please contact Eric Johnson (IDFG) for more specific information.

There were 16 adult lamprey incidentally trapped this year.

For additional information on Lower Granite adult trap operations contact Darren Ogden (NOAA; darren.ogden@noaa.gov) or Tiffani Marsh (NOAA; tiffani.marsh@noaa.gov).

Special Operations for Adult Ladder Water Temperature

Electronic temperature probes were used to monitor fish ladder watertemperatures at the ladder exit, diffuser 14, turn pool, and the junction pool throughout the fish passage season. Real-time fish ladder temperature data along with that for four additional Project temperature monitoring stations can be found online at: <http://www.nwd-wc.usace.army.mil/dd/nww/fl_temps/www> /index.html. The permanent fish ladder temperature control system has been operational since 2016. Forebay fish ladder auxiliary water supply pumps 1 and 2 were modified to intake cooler water from an elevation of 667.0 feet (66.0 feet below MOP) and supply the spray bar in front of the fish ladder exit. Gravity flow then distributes the cooler water from the forebay down the ladder. The system also includes a chimney structure that drafts cold water from an elevation of 667.0 feet into diffuser 14 intake. Water from diffuser 14 cools the ladder as it flows down the overflow sections of the ladder and is the main supply for the adult fish trap. Ladder temperature control system operation occurred June 21 through September 18.

## Adult Fishway Inspections

## Methods

The automated fishway control system consists of a computer in the control room that interfaces with process level controllers that receive information from remote terminal units. The terminal units are fed by sensors detecting entrance weir gate positions, collection channel and tailwater elevations, and upper diffuser pool levels. Lower Granite automated fishway control system programing continues to be adjusted as needed to maintain fish ladder operational compliance. The system’s digital touch screen displays are located in the control room and the third floor of the powerhouse with gates remotely operated from the control room. The control system “biologist snapshot” of fish ladder operation is printed concurrent with ladder inspections to compare physical readings and identify calibration issues. Collection channel temperatures and velocities are measured with sensors in the south powerhouse and the north shore channels as part of the automatic system. Powerhouse electricians manually calibrate fish ladder gates to ensure the control system program operates in criteria parameters following winter maintenance. During the 2018 fish passage season, the fish ladder control system was unable to consistently maintain both depth over the weir and channel/tailwater head differential at the north shore during spill operations at MOP elevation. NSE depth over the weir criteria was sacrificed to achieve channel/tailwater head differentials.

Operating criteria involve normal and special operating conditions. Under normal operating condition: NSE-1 and NSE-2 are operated to meet criteria of at least 7 feet (depth criteria) or be on sill if less than 7 feet (sill criteria). NPE-1, NPE-2, SSE-1 and SSE2 weir gates are operated to meet criteria of at least 8 feet or be on sill if less than 8 feet (sill criteria). Four floating orifice gates (1, 4, 7, and 10) are operated in the powerhouse collection channel. Normal operating criteria for the rest of the ladder include maximums of 0.5-foot heads at the exit, maximums 0.3 feet head at the picketed leads, 1.0-1.3 feet of water over the ladder weirs, 1.5-4.0 feet per second collection channel velocity, and 1.0-2.0-foot head differentials at all fishway entrances. Special operating conditions are used if normal operating criteria cannot be met.

Adult fishway inspections consist of observing facility operating conditions and recording visual readings from staff gauges, weir gate selsyns, and electronic meters. Inspections by fisheries staff are normally conducted three or more times per reporting week with day and times randomized. An average of 3.9 inspections per week were performed (171 inspections /44 weeks) in 2018. Depths and head differentials that were out of criteria, as well as other problems, were reported to maintenance staff and/or powerhouse shift operators for correction. Anchor (SMP contractor) biologists performed a minimum of two ladder inspections each week while on Project. Lower Granite biologist staff typically performed 2 to 3 inspections per week. Inspections were also conducted by Oregon Department of Fish and Wildlife personnel once a month.

## Inspection Results

Visual readings of staff gauges and weir gate depths were recorded and compared with automated control system readings to check for calibration problems. High variability between wave crests and troughs created by spill reduced the accuracy of biologists’ staff gauge readings in the tailrace. The automatic fish ladder control system was upgraded to the Automation Direct PLC and HMI Configuration Software (C-More Programming Software) in 2016. The control system program is unable to consistently maintain both depth over the weir and channel/tailwater head differential at the north shore during spill operations. Automatic control system adjustments were made throughout the passage season. Entrance gates found out of criteria during ladder inspections due to fish ladder control system problems were manually adjusted to depth or sill criteria and left in manual mode until electricians completed diagnostics and made adjustments. Electricians continue to troubleshoot control system internal functioning errors in the program. Data from fishway inspections were entered into an Excel spreadsheet (Appendix 1). The average compliance of all criteria points in 2018 was 92.5% compared to 95% in 2017. The majority of out-of-criteria readings were due to fish ladder control system issues. A summary of fish ladder performance and variability is provided in Table 2.

Ladder exits

Ladder exit head differentials were in criteria on 100% of the inspections.

Ladder weirs

The depths over the fish ladder weirs were within criteria on 96.5% of the inspections. Out of criteria readings included 6 at 0.1 feet above criteria.

Counting stations

The head differential across the counting station picketed leads was in criteria on 100% of inspections.

Entrance head differentials

SSE-1 & 2 head differential was in criteria on 96.5% of inspections.

Out of criteria readings included 6 at 0.1 feet below criteria that were likely related to control system calibrations issues.

NPE-1 & 2 head was in criteria on 100% of inspections.

NSE-1 head differential was in criteria on 90.1% of inspections compared to 47.7% in 2015 and 35.4% in 2014. Operation with NSE2 closed during 2017 likely contributed to improved north shore channel/tailrace head differential compliance. Historically AWS pump operation was unable to maintain both head differentials and weir depths when tailrace was at minimum operating pool (MOP). Weir depths were sacrificed to maintain a minimum of 1.0 foot of head differential during MOP operation. NSE2 has been suspended with a chain fall hoist since the gate operator failed in 2011. Head differential readings were out of criteria (criteria 1.0-2.0 feet) on 17 inspections in 2018. Out of criteria readings included 2 at 0.1 feet below criteria, 8 at 0.2 feet below criteria, and 4 greater than 0.2 feet below criteria.

There were 3 readings greater than 0.2 feet above criteria. NSE channel/tailwater head differentials were likely out of criteria due to the fish ladder control system being unable to consistently maintain both depth over the weir and channel/tailwater head differential at the north shore during spill operations and at MOP.

Entrance Gate Depths

SSE-1 weir gate was in depth or sill criteria on 81.9% of inspections (81.9% depth, 0.0 % sill). Out of criteria readings included 6 at 7.9 feet, 2 at 7.8 feet, and 23 at 7.7 feet. SSE-1 and SSE-2 physical reading at the gate were consistently higher than the electronic reading on the control system. A depth Radar Unit identified the control system reading was about 0.4 feet higher than the physical reading. Adjustments were made to the gates and program May 29 and the issue seems to be resolved. There were 21 out of criteria reading related to control system calibration repaired May 29.

SSE-2 weir gate was in criteria on 78.9% of inspections (78.9% depth, 0.0 % sill). Out of criteria readings included 8 at 7.9 feet, 2 at 7.8 feet, and 26 at 7.7 feet. SSE-1 and SSE-2 reading at the gate were consistently reading higher than control system readings resulting in the gates being out of criteria. Electricians used a Radar Unit to evaluate the issue and found the readings to be about 0.4 feet off. They made adjustments to the gates and program May 29 and the gates remained in criteria.

NPE-1 weir gate was in depth or sill criteria on 97.1% of inspections (27.5% depth, 69.6% sill). Out of criteria readings included 1 at 7.8 feet and 4 at 7.7 feet. Electricians identified a hidden fault in the control system that was responsible for 4 of the out of criteria readings.

NPE-2 weir gate was in depth criteria or sill on 96.5% of inspections (26.9% depth, 69.6% sill). Out of criteria readings included 1 at 7.9, 1 at 7.8, and 4 at 7.7 feet. The hidden fault discovered by electricians was responsible for 4 of these out of criteria readings.

NSE-1 weir gate was in depth or sill criteria on 85.8% of inspections (85.8% depth, 0.0 % sill). Out of criteria readings included 10 at 7.9 feet, 5 at 7.8 feet, and 9 at 7.7 feet. The fish ladder control system was unable to consistently maintain both depth over the weir and channel/tailwater head differential at the north shore during spill operations. NSE depth over the weir criteria is being sacrificed to achieve channel/tailwater head differentials.

NSE-2 weir gate was in the closed position for the 2018 season. NSE-2 has been out of service and suspended with a chain fall hoist since the 2011 season. The fish ladder control system was unable to consistently maintain both depth over the weir and channel/tailwater head differential at the north shore during spill operations at MOP elevation. NSE depth over the weir criteria is being sacrificed to achieve channel/tailwater head differentials.

Collection channel velocity

Velocities were in criteria on 87.1% of inspections (criteria: 1.5-4.0 ft/s). The collection channel velocity meter was upgraded to a Teladyne Signature Flowmeter as part of the fish ladder control system. The sensor also provides water temperature and is located in the powerhouse collection channel between the transition pool and unit 1. A Signature Laser Sensor was also installed above the north shore collection channel that measures channel elevation and also surface velocity.

## Recommendations

1. Replace NSE-2 failed gate and operating system.
2. Replace all entrance weir gates and operating systems.
3. Continue to operate the north shore with one NSE closed to improve channel/tailwater head differential.
4. Try different ladder operations including closing FOG’s to determine if North Powerhouse and North Shore entrance depth and head differentials can be improved.
5. Resolve adult fish ladder automatic control system programing issues.
6. Replace/relocate staff gauges that are difficult to read.
7. Label adult fish trap valves (identifying their function) and develop updated O&M manual.

**Table 2.** Summary of adult fishway inspections at Lower Granite Dam, 2018 1

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **LOWER GRANITE** | | | Not Enough Depth | | | Too Much Depth | | |
| Criteria & Locations | No. In Criteria  /  No. On Sill  /  No. of Inspections | % In Criteria  /  % On Sill | No.  /  % Within 0.01-0.1 Foot | No.  /  % Within 0.11-0.2 Foot | No.  /  % >0.2  Foot | No.  /  % Within 0.01-0.1 Foot | No.  /  % Within  0.11-0.2  Foot | No.  /  % >0.2  Foot |
|  | | | | | | | | |
| **Channel Velocities** | 149  \*\*\*  171 | 87.1  \*\*\* | \*\*\*  \*\*\* | \*\*\*  \*\*\* | \*\*\*  \*\*\* | \*\*\*  \*\*\* | \*\*\*  \*\*\* | \*\*\*  \*\*\* |
| **Differentials** | | | | | | | | |
| Ladder Exit | 171  \*\*\*  171 | 100.0  \*\*\* | \*\*\*  \*\*\* | \*\*\*  \*\*\* | \*\*\*  \*\*\* | 0  0.0 | 0  0.0 | 0  0.0 |
| Ladder Weirs | 165  \*\*\*  171 | 96.5  \*\*\* | 0  0.0 | 0  0.0 | 0  0.0 | 6  3.5 | 0  0.0 | 0  0.0 |
| Counting Station | 171  \*\*\*  171 | 100  \*\*\* | \*\*\*  \*\*\* | \*\*\*  \*\*\* | \*\*\*  \*\*\* | 0  0.0 | 0  0.0 | 0  0.0 |
| South Shore | 165  \*\*\*  171 | 96.5  \*\*\* | 6  3.5 | 0  0.0 | 0  0.0 | 0  0.0 | 0  0.0 | 0  0.0 |
| North Powerhouse | 171  \*\*\*  171 | 100  \*\*\* | 0  0.0 | 0  0.0 | 0  0.0 | 0  0.0 | 0  0.0 | 0  0.0 |
| North Shore | 154  \*\*\*  171 | 90.1  \*\*\* | 2  1.2 | 8  4.7 | 4  2.3 | 0  0.0 | 0  0.0 | 3  1.8 |
| **Weir Depths** | | | | | | | | |
| SSE-1 | 140  0  171 | 81.9  0.0 | 6  3.5 | 2  1.2 | 23  13.5 | \*\*\*  \*\*\* | \*\*\*  \*\*\* | \*\*\*  \*\*\* |
| SSE-2 | 135  0  171 | 78.9  0.0 | 8  4.7 | 2  1.2 | 26  15.2 | \*\*\*  \*\*\* | \*\*\*  \*\*\* | \*\*\*  \*\*\* |
| NPE-1 | 47  119  171 | 27.5  69.6 | 0  0.0 | 1  0.6 | 4  2.3 | \*\*\*  \*\*\* | \*\*\*  \*\*\* | \*\*\*  \*\*\* |
| NPE-2 | 46  119  171 | 26.9  69.6 | 1  0.6 | 1  0.6 | 4  2.3 | \*\*\*  \*\*\* | \*\*\*  \*\*\* | \*\*\*  \*\*\* |
| NSE-1 | 145  0  169 | 85.8  0.0 | 10  5.9 | 5  3.0 | 9  5.3 | \*\*\*  \*\*\* | \*\*\*  \*\*\* | \*\*\*  \*\*\* |

1 Data from Appendix 1.

2 “On sill” means the weir gate is resting on its sill and meets “on sill” criteria at this location.

**SYNOPSIS OF JUVENILE FISH FACILITY OPERATION**

**Facility Description**

Juvenile fish facilities at Lower Granite Dam consist of: extended-length submersible bar screens (ESBSs), vertical barrier screens, ten and fourteen inch orifices, a collection channel, a primary dewaterer, emergency and primary bypass, fish separator, fish distribution system that includes PIT tag bypass and sort by code, sampling system with lab, holding facilities distribution, and barge and truck loading.

ESBS’s guide fish in the forebay away from the turbine units into one of the 18 gatewell slots that contain two orifices for diverting fish into the collection channel. South orifices are 14 inches and north orifices are 10 inches in diameter. The collection channel typically operates with the 14 inch orifices open in each gatewell slot of operating units. Lights are directed at each open orifice to enhance fish passage into the collection channel. Fish in the collection channel are transported into an above ground flume and are either bypassed to the river via the outfall pipe or directed to the collection facility juvenile separator. Once in the separator, adult and larger non-target fish are released to the river and juvenile fish pass below separator bars and enter the distribution system. Collected fish are then routed directly to a barge, bypassed back to the river, held in a raceway for later transport, utilized for research, or become part of the sample.

Facility Modifications

1. Juvenile bypass upgrade Phase 1a tie in to the existing facility was completed. Phase 1a construction/cleanup is ongoing.
2. Refurbished the sample diversion slide gates per PSMFC guidelines.
3. Sea chest and flapper seals replaced/installed on fish transport barge 8108.
4. Continued replacing aerators biological balls on fish transport barges.
5. Replaced facility supply manifold and lines.
6. Continued replacing old mesh on raceway supply headbox screens to prevent fry and juvenile lamprey passage.
7. Raised upstream raceway loading platform to uniform height for improved loading safety.
8. Installed handles and securing pins to upstream raceway tailscreens eliminating the need for full removal.
9. Fabricated and installed fueling platforms on barges 8105 and 8106.
10. Raised fueling platforms on barges 8107 and 8108 series barges.
11. Replaced/rebuilt all 48 fish hold water supply aerator valves on 8000 series barges.

**Operation and Maintenance**

## Turbine Operations

Efforts were made to operate all turbine units within one percent of the peak efficiency from April 1 to October 31. Deviations were infrequent and brief or required by BPA (table 18).

Table 18. Lower Granite turbine unit outages, 2018.

|  |  |  |
| --- | --- | --- |
| Unit | Date OOS | Reason out of service |
| Units 1 – 6 | February 27 – March 2 | Trash rack raking |
| Units 1 – 6 |  | ESBS installation |
| Units 1, 3 – 6 | March 1 - 3 | RAS Testing |
| Units 1 - 5 | August 13 - 16 | Doble Testing |
| Units 2 - 6 | November 13 - 15 | ESBS Removal |
|  |  |  |
|  |  |  |
| Unit 1 | January 1 - 12 | Blade Runner Repair |
|  | January 13 - 29 | Unit 1 Commissioning Testing |
|  | February 12 - 16 | Distribution Valve Removal |
|  | March 5 - 29 | Servo Oil Supply Repair |
|  | March 19 | ESBS Installation |
|  | April 5 | Gate Lock Oil Leak |
|  | April 30 | Governor Oil Pump |
|  | November 13 - 26 | Thrust Bearing Electrical Isolation |
|  | December 27 - | Digital Governor Upgrade/Annual Maintenance |
|  |  |  |
| Unit 2 | March 29 – April 3 | ESBS Installation (Forced Outage Delay in Installation) |
|  | August 27 - September 5 | EAL Grease Replacement |
|  |  |  |
|  |  |  |
| Unit 3 | March 29 | ESBS Installation |
|  | June 18 - 27 | Governor Oil Leak Repair |
|  | July 7 | 3C Headgate Position Verification |
|  | July 14 - 16 | Oil Leak 3C Intake Gatewell Slot |
|  | October 1 – November 8 | Digital Governor Upgrade/Annual Maintenance |
|  | November 12 - 13 | Loss of Communication for AGC Control. |
|  |  |  |
|  |  |  |
| Unit 4 | March 29 – April 2 | ESBS Installation (Forced Outage Delay in Installation) |
|  | September 20 | Stilling Basin Survey |
|  | November 7 – December 20 | Digital Governor Upgrade/Annual Maintenance |
|  |  |  |
|  |  |  |
| Unit 5 | January 22 - 25 | TO2 PM |
|  | March 29 | ESBS Installation |
|  | August 20 – September 28 | Digital Governor Upgrade/Annual Maintenance |
|  |  |  |
|  |  |  |
| Unit 6 | February 5 | Governor Prep Measurement |
|  | March 29 – April 2 | ESBS Installation (Forced Outage Delay in Installation) |
|  | July 9 – August 24 | Digital Governor Upgrade/Annual Maintenance |
|  | September 10 - 21 | OPTP, PLC Module Upgrade |

Debris/Trash Racks

Trashracks were raked February 27 through March 2. Trashrack raking was not required during the fish passage season.

Extended-length Submersible Bar Screens (ESBSs)

ESBSs were inspected and tested prior to installation. Screens were installed in unit 1 prior to returning the unit to service. ESBSs were installed in units 3 and 5 March 29. The remaining ESBSs were installed in units 2, 4, and 6 on April 2 and 3. Delays in installing ESBSs were due to commissioning and tie in of Phase 1a. ESBSs were removed November 13-15 due to juvenile bypass upgrade programming and constructions repairs. Brush cleaning cycle was set to operate every two hours this season.

Vertical Barrier Screens (VBSs)

VBSs were video inspected in conjunction with ESBSs during the 2018 fish passage season. Detailed inspections were performed during the June ESBS inspection. VBS screen panel mesh has the potential to deteriorate and become brittle over time. VBS panels for screens that pass underwater camera inspection but showed potential for deterioration continue to be replaced/repaired during unit annual outages or during winter maintenance as time permits.

Gatewells

Gatewells were normally less than 1% covered with debris and did not exceed the 50% debris surface coverage criterion. Turbulence in gatewells with ESBSs causes debris to tumble around and exit through the orifices rather than accumulate on the gatewell surfaces. Surface debris was removed from individual gatewells with a hand dipping basket during initial water-up in late March and continued throughout the season. Occasional oil sheens were dealt with by floating oil absorbent pads in the affected gatewells.

Orifices/Collection Channel

During the 2018 season, the number of open orifices typically remained consistent with all 18 of the 14 inch orifices open. Orifices were inspected every three hours and cycled and back-flushed with air to remove debris as needed March 29-August 15. Irregular 14” orifice flow was observed in slots 2A and 4A May 4. Both 14” orifices were closed and three 10” orifices were opened. Mortar splatter from construction in the collection channel was removed from the 14” orifices and operation was returned to all 14” orifices that day. Depending on forebay elevation, 10” orifices are operated in place of 14” orifices to maintain optimal collection channel flow. Orifice operation programming continues as part of Phase 1a. The facility was operated by two biological technician to monitor the orifice gallery and the operation of the newly completed PDW during the 2018 season. Orifice lights were checked daily.

Primary Dewaterer

Lower Granite’s historic incline screen dewatering structure was replaced with a more standard Primary Dewaterer (PDW) as part of Phase 1a Juvenile Bypass system (JBS) upgrade. The PDW has floor screen and side screen cleaning brushes and a pneumatic screen cleaning system. Brush screen cleaners were operated in manual mode by powerhouse operators due to mechanical and programing issues with the new system. The pneumatic system was operated by hand at the beginning of the season and then changed to automatic mode. All overflow weirs required manual operation until May 9 when weirs in groups A. B, and C were returned to auto and group D continues to be in manual for optimal PDW flow to the transport flume. Programming, mechanical, and structural issues with the PDW will be addressed during the ongoing Phase 1a construction.

Wet Separator/Distribution and Sampling Systems

Water levels in the separator and flumes varied with the forebay elevation and PDW operations requiring adjustment in porosity control valves and separator exit gates. Adjustments in flume flow were made to reduce fish holding in the transport flume and under the separator. Porosity control valves were adjusted to prevent water from drying out on the east side of the porosity plate. This operation resulted in increased volume of water exiting the separator. Modifications to the porosity control unit to balance water across the plate and enable adequate dewatering will be made as time permits during the winter maintenance season.

Biological technicians adjusted porosity dewatering valves and exit gate positions in response to separator water elevation changes related to PDW weir operation. Separator exit gates were adjusted due to increased volume from the separator exits to improve PIT tag detection efficiencies per PSMFC request.

Barge Loading Operations

Barge loading operations occurred April 24 through August 14. Direct loading did not occur.

Truck Loading Operations

Truck transport operations occurred from August 16 through October 31.

**Avian Predation**

Injuries associated with wounds inflicted by birds, other fish, and lamprey were observed on 0.9% of smolts examined. Predator injuries caused by piscivorous birds comprised 53.7% of smolts examined with injuries followed by 40.6% caused by fish and 5.7% caused by lamprey. Predator marks were highest on clipped steelhead at 1.4% (65 of 4,724 fish examined), followed by unclipped steelhead at 1.3% (25 of 1,936 fish examined), and clipped yearling Chinook at 1.2% (43 of 3,545 fish examined).

## Control Measures

Areas of avian monitoring included: the forebay, turbine and spillway discharge, and the JFF bypass outfall. Deterrent measures included: bird wires across the tailrace of the powerhouse and hazing (April 2 through June 30) under the animal control contract (APHIS). Two shift hazing coverage (daylight to dusk) occurred from April 23 through June 1. This appeared to be effective at reducing the number of gulls returning to feed. Hazing efforts included the use of 15 mm pyrotechnics and long-range rockets. Due to safety concerns, propane canons were not utilized at Lower Granite. Lethal take was implemented this season with one gull removed. Lower Granite biologist binocular monitoring of piscivorous bird presence and foraging behavior occurred from April 1 through October 31.

Gull Counts

Lower Granite biologists made binocular gull counts in the tailrace extending from immediately below the dam to about ½ mile downstream and in the forebay to about ½ mile upstream of the dam. Daily biologist count observations were made after sunrise and just before sunset from April 1 through October 31. During the counting period 1,548 gulls were counted with an average daily count of 7.4 and a maximum of 105 counted April 9.

Double Crested Cormorants

Daily count observations were made after sunrise and just before sunset from April 1 through October 31. During the April 1 to October 31 counting period 2,294 cormorants were counted with an average daily count of 11.0 and a maximum of 43 counted September 26.

American White Pelicans

White Pelicans were observed foraging in Lower Granite tailrace from May 2 through July 24 with a maximum of 38 counted in the tailrace June 8. Additional pelicans were commonly observed resting on the island adjacent to Boyer Park Marina during this time period. Hazing of pelicans did not occur at Lower Granite.

Avian Foraging Behavior

Foraging behavior was recorded for gulls, cormorants, and Caspian terns. Gulls had the highest percent of foraging behavior observed (55.3%) followed by cormorants (8.3%) and Caspian terns (0.0%).

## Cooling Water Strainer Counts

Turbine unit cooling water strainers were examined for biologic content once per month throughout operating year 2018. Timing of the lamprey entry into the strainers represents migration timing coupled with susceptibly of being drawn into the cooling water system. Annual unit run time totaled 21,573.3 hours and 765 lamprey were recovered from cooling water strainers this year. Juvenile lamprey were most abundant in February (352) and January (293).

Invasive Species:

No zebra/Quagga muscles were observed in the trap substrate this season.

Recommendations

1. Complete Phase 1a modifications and programming.
2. Operate the PDW flume outflow between 35-40 cfs to reduce delays in system.
3. Modify porosity control system operating valves.
4. Replace porosity control system round perforated plate with narrower oval perforation plate.
5. Replace mesh tailscreens with porosity plates to allow lamprey passage.
6. Improve sample recovery truck loading pipe slope to eliminate fish stranding in pipe.
7. Continue rebuilding motors on the 2000 series barges.
8. Replace barge bumper cable and tire system with actual bumpers.
9. Paint hulls on 8000 series barges.
10. Install ballast material in barges 4394 and 4382 voids to eliminate use of river water.
11. Upgrade trucks and tanks and purchase a trap and transport service truck.
12. Install electronic operators for raceway supply knife gate valves.
13. Improve juvenile collection facility pneumatic system air compressors and air lines.
14. Replace sample holding tank fish exit release manual valves with pneumatic valves.
15. Improve/modify anesthetic chamber door operation.
16. Permanently close the collection channel 5A research weir that is becoming a safety concern.
17. Modify the JFF sample anesthetic system and procedure to minimize volume of MS-222 waste and develop filter and disposal systems for LWG JFF MS-222.
18. Ensure all researcher working at LGW are accountable for anesthetic waste disposal in compliance with the EPA Clean Water Act.

**APPENDIX**