CENWW-ODO BARNES (1130) 20 February, 2019

MEMORANDUM THRU:
Jeannette Wilson, Operations Project Manager Lower Monumental Dam

FOR: Chief, Operations Division
ATTN: Eric Hockersmith / Chris Peery

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

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

2. If you have any questions contact Chuck Barnes at Lower Monumental Dam, (509) 282-7211.

CHARLES A. BARNES JR
Supervisory Fish Biologist, Lower Monumental Dam

Enclosure

ADULT AND JUVENILE FISH FACILITY MONITORING REPORT

LOWER MONUMENTAL DAM

2018

Charles A. Barnes Jr.

Supervisory Fish Biologist

and

Raymond A. A. Addis

Assistant Biologist

Lower Monumental Dam

U.S. Army Corps of Engineers

Enclosure

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

APPENDIX

INTRODUCTION

The following report on fishway activities at Lower Monumental Dam is required under the Endangered Species Act consultation on the operation of the Federal Columbia River Power System (FCRPS) and its associated fish passage facilities. This report summarizes the operation and maintenance of adult fish passage facilities at Lower Monumental Dam, including the results of visual inspections of fishways conducted by fisheries staff during the adult fish passage period of March 1 to December 31, 2018. Inspection readings are provided in Appendix 1 (2018 Ladders LoMo.xlsx). 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 Monumental Dam can be found in the report titled "2018 Juvenile Fish Collection and Bypass Report, Lower Monumental Juvenile Fish Facility".

River Conditions

The highest daily average flow for the 2018 season was 172.4 kcfs on May 27. The lowest daily average flow for the season occurred on December 10 with a flow of 11.7 kcfs. The average flow for the season was 51.2 kcfs. Mandatory Spill occurred for 152 days from 0000 hours April 3, 2018 through midnight on August 31, 2018, with a maximum daily average spill of 84.5 kcfs on May 28, 2018. High water conditions led to involuntary spill before the 2018 season. Involuntary spill also occurred on September 11 due to turbine unit outages. The Removable Spillway Weir (RSW) was put into operation when Biological Opinion (BiOp) spill began on April 3, 2018, and was taken out of service for the season on August 8, 2018 due to a decision by the Technical Management Team (TMT).

Average river temperature for the 2018 season was 56.8°F and ranged from 39.0 °F (March 1 - 7) to 70.5 °F (August 7-8).

ADULT FISH FACILITY

Facility Description

The adult fishways at Lower Monumental are comprised of north and south shore fish ladders. The upper ladders extend from the forebay to tailwater and include: ladder exits, slotted weirs, upper diffusers, overflow weirs with orifices, and fish counting stations with picketed leads. The lower ladders contain: collection channels, channel diffusers, and ladder entrances. The north shore lower fish ladder has two north shore entrances (NSE-1 and NSE-2) and two south powerhouse entrances (SPE-1 and SPE-2). The south shore lower fish ladder has two entrances (SSE-1 and SSE-2). Auxiliary water is supplied by three turbine-driven pumps (fish pumps) located in the north side of the powerhouse. The water is pumped into a supply conduit that extends under the north and south shore lower ladders, distributing water to the lower ladder diffusers. Excess water from the juvenile fish bypass system (approximately 180-200 cfs) additionally contributes to the auxiliary water supply during the juvenile fish bypass/collection season.

Facility Modifications

No modifications were made to the adult fish passage system in 2018.

Operations and Maintenance

Fish Ladders and Collection Channels

The adult fishways were in service throughout 2018 with the exception of the winter maintenance season. Inspection and maintenance on the north and south shore fishways occurred from January 5 to January 30 and February 2 to February 26, respectively.

The upper fish ladders are dewatered annually for maintenance activities including: debris removal, diffuser grating and structural support inspections, cleaning of picketed leads, staff gauges, and fish counting windows, maintenance of count station window cleaning mechanisms, and repairing leaks in expansion joints. A minimum of twenty four hours prior to dewatering, the auxiliary water is shut off to discourage newly arriving fish from starting up the ladders. The fish exit is then bulkheaded off, any fish in the exit pool are removed and released to the forebay, and the upper ladders are partially dewatered, leaving about 4 inches running through ladder weir orifices. This flow is maintained to move any remaining fish to tailwater. Approximately 24 hours later, the flow is reduced to two inches and maintenance personnel go down the ladder through the orifices to remove debris, move remaining fish to tailwater, and inspect the full length of the channel.

The lower ladders are 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 and exposed diffuser gate operating equipment. Staff gauges are then cleaned and debris is removed. The north shore water is lowered to a depth of 0.40 ft for visual inspection of grating. When dewatering for repair is necessary, fish are crowded to the entrance pools, netted, and placed in a 600 gallon container (or 32 gallon containers if fish numbers are very low). The large container is manipulated with the crane to release fish to tailwater and refill the tank if needed. The need for replacement of the diffuser grates and clasps has been an issue for years and is scheduled to begin during the 2020 winter maintenance period. No other problems were observed during the inspection of the lower north shore channel and the lower south shore ladder.

Auxiliary Water Supply

Fish pumps 2 and 3 were out of service (OOS) from January 2 until March 1 for annual maintenance. Annual maintenance consists of changing oil in pedestals, adjusting or replacing packing and shaft seals, inspecting and cleaning heat exchangers, inspecting and replacing broken shear pins on the wicket gates, adjusting brakes, removing trash and debris from the fish pump turbine, and general mechanical and electrical inspection. Fish pump 1 was out of service the entire year due to seized wicket gate bushings, although it is functional at a fixed speed in emergency situations. The more significant pump outages are summarized in Table 1.

Table 1. Fish pump outages at Lower Monumental Dam, 2018

Affected Pump(s)	Dates	Reason for Outage/Comments
1	Jan 1 – Dec 31	Damaged Wicket Gate Bushings
2, 3	Jan 2 – March 1	Annual maintenance
2	Aug 22 – Aug 27	Vibration and bearing overheating

Adult Fishway Inspections

Methods

The automated fishway control system consists of a computer in the control room that interfaces with process level controllers and receives information from remote terminal units. The terminal units are fed by sensors detecting entrance weir gate positions, collection channel water and tailwater elevations, and upper diffuser pool levels within the fishways. The automated fishway control system is based on a GE Fanuc Series 90 control program. The computer is used to change the control parameters of the terminal units and provide datum acquisition and storage. The remote terminal units control the fishway entrance weir gates according to set points that either regulate the gate depths below tailwater or channel-to-tailwater entrance head differentials. The computer printout contains the following information: dates; times (hour, minute, and second); channel temperatures; channel and tailwater elevations (feet above mean sea level) for the north shore, south powerhouse, and south shore; gate elevations; gate depths; entrance heads; and set points for the gate depths and entrance heads. The automated control system was operating throughout the 2018 operating season.

Operating criteria involve normal and special operating conditions. Under normal operating conditions, NSE-1, NSE-2, SPE-1, SPE-2, and SSE-1 weir gates are operated to meet criteria of at least 8 foot depths (depth criteria) or be on sill if less than 8 foot depths occur (sill criteria). SSE-2 weir gate is operated with a 6-foot opening. Normal operating criteria for the rest of the ladder includes maximums of 0.5 foot heads at the exits, maximums of 0.4 foot and 0.3 foot heads at the north and south shore picketed leads, respectively, 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. When only two fish pumps are operational, SSE-2 and SPE-2 may be closed and SPE-1 raised to provide 1.0-2.0 feet of entrance head differentials. Special emergency operations were required to maintain depth criteria this season from August 22 to August 27 during which time only one fish pump was in service. These emergency operations followed established protocols found in the Fish Passage Plan.

Adult fishway inspections consist of observing facility operating conditions and recording visual readings from staff gauges, weir gate selsyns, and electronic meters. Wave action and impact from large debris have consistently resulted in loss of the south ladder tailwater staff gauge. Readings of the lower south ladder and tailwater are therefore taken from an electronic panel in the service gallery.

Inspections by fisheries staff and QC personnel are normally conducted three or more times per reporting week with times randomized. An average of 3.86 inspections per week were

performed (170 inspections /44 weeks) in 2018. Depths and head differentials that were out of criteria, as well as other problems, were reported to powerhouse shift operators and/or maintenance staff for correction. Powerhouse operators conduct shift inspections in addition to the inspections performed by fisheries staff.

Inspection Results

Visual readings are normally recorded and compared with automated control system readings to check for calibration problems. Data from fishway inspections were entered into an Excel spreadsheet (Appendix 1). The average compliance of all criteria points in 2018 was 97.9%. A summary of fish ladder performance and variability is provided in Table 2.

Ladder exits: North shore ladder exit head differentials were in criteria during all inspections. South shore ladder exit head differentials were in criteria during all inspections. North and south shore exits were operated without debris booms again this season. Changing designs of debris booms which will be able to withstand high winds and wave action have delayed debris boom replacement.

Ladder weirs: The depths over the weirs of the north shore ladder were within criteria during all inspections.

Depths over the weirs of the south shore ladder were within criteria during 97.6% of inspections. The four readings out of criteria, all reading 0.9 feet, occurred on June 20, July 7, August 25 and November 19. The first three were due to woody debris accumulation on the lower picketed lead. The November 19 reading was due to a fault in the automatized system for the diffuser valve which was quickly corrected by project personnel.

Counting stations: The head differential across the north shore counting station picketed leads was in criteria on 97.6% of inspections. The out of criteria readings were on June 5, June 27, August 5 and October 1 with readings of 0.6, 0.5, 0.6 and 0.6 feet, respectively. These were all due to debris, adult shad mortalities or algae accumulation on the picketed leads. The south shore counting station met criteria on all inspections.

Entrance heads: North shore entrance head differential was in criteria during 98.2% of the inspections. Readings out of criteria were caused by failure of the automated control system due to the high level of the tailwater during elevated river flows.

South powerhouse entrance head was in criteria during 96.5% of the inspections. Criteria breaches were also caused by failure of the automated control system due to the high level of the tailwater during elevated river flows.

South shore entrance head differential was in criteria during 95.3% of the inspections. Criteria breaches were again caused by failure of the automated control system due to the high level of the tailwater during elevated river flows.

North shore entrance (NSE-1 & 2) depths: NSE-1 weir gate was in depth criteria or sill criteria during 97.6% of the inspections (97.6% depth, 0.0% sill). Readings out of criteria were due to calibration issues within the automated control system or due to Fish Pump 2 outage from August 22 through August 27.

NSE-2 weir gate was in depth or sill criteria during 97.6% of the inspections (97.6% depth, 0.0% sill). Readings out of criteria were due to calibration issues within the automated control system or due to Fish Pump 2 outage from August 22 through August 27.

South powerhouse entrance (SPE-1 & 2) depths: SPE-1 weir gate was in depth or sill criteria during 95.8% of the inspections (22.9% depth, 72.9% sill). Readings out of criteria were due to calibration issues within the automated control system or due to Fish Pump 2 outage from August 22 through August 27.

SPE-2 weir gate was in depth or sill criteria during 97.0% of the inspections (23.5% depth, 73.5% sill). Readings out of criteria were due to calibration issues within the automated control system or due to Fish Pump 2 outage from August 22 through August 27.

South shore entrances (SSE-1 & 2): SSE-1 weir gate was in depth or sill criteria during 98.3% of the inspections (41.2% depth, 57.1% sill). Readings out of criteria were due to calibration issues within the automated control system or due to Fish Pump 2 outage from August 22 through August 27.

SSE-2 weir gate was in criteria during 97.6% of the inspections. Readings out of criteria were due to Fish Pump 2 outage from August 22 through August 27.

North shore collection channel velocity: The velocity unit is located in the north shore collection channel in the transition area between main units 1 and 2. The sending unit is positioned in the channel to avoid non-characteristic high or low readings that are not representative of overall velocity conditions. Accurate velocity readings require the inspector to wait for the digital display to warm up and achieve a duplication of its peak reading.

Velocities were in criteria during 97.6% of the inspections (criteria: 1.5-4.0 ft/s). Velocities were out of criteria due to Fish Pump 2 outage from August 22 through August 27.

Recommendations

1. Design and reinstall ladder exit debris booms capable of withstanding turbulent waters.
2. Remove sand and debris from the supply conduits and replace all original ladder diffuser grates, support structures, and mud valves.
3. Finish rebuilding the fish pumps so three reliable fish pumps are available to meet criteria.
4. Repair north and south shore fish ladder joint leakage.

Table 2. Summary of adult fishway inspections at Lower Monumental Dam, 2018 [1]

			------Not Enough Depth------			-------Too Much Depth-------		
Criteria and Locations	**No. in Depth Criteria/ No. in Sill Criteria/ No. of Inspections**	**% In Depth Criteria/ % In Sill Criteria**	**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**
North Channel Water Velocities	166 *** 170	97.6 ***	*** ***	*** ***	*** ***	*** ***	*** ***	*** ***
Differentials								
North Ladder								
Ladder Exit	170 *** 170	100.0 ***	*** ***	*** ***	*** ***	0 0.0	0 0.0	0 0.0
Ladder Weirs	170 *** 170	100.0 ***	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0
Counting Station	166 *** 170	97.6 ***	*** ***	*** ***	*** ***	2 1.2	2 1.2	0 0.0
South Ladder								
Ladder Exit	170 *** 170	100.0 ***	*** ***	*** ***	*** ***	0 0.0	0 0.0	0 0.0
Ladder Weirs	166 *** 170	97.6 ***	4 2.4	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0
Counting Station	170 *** 170	100.0 ***	*** ***	*** ***	*** ***	0 0.0	0 0.0	0 0.0
Coll. Channels								
North Shore Entrance	167 *** 170	98.2 ***	2 1.2	0 0.0	1 0.6	0 0.0	0 0.0	0 0.0
South Powerhouse Entrance	164 *** 170	96.5 ***	2 1.2	2 1.2	2 1.2	0 0.0	0 0.0	0 0.0
South Shore Entrance	162 *** 170	95.3 ***	3 1.8	2 1.2	3 1.8	0 0.0	0 0.0	0 0.0
Weir Depths								
NSE-1[2]	166 Not Applic. 170	97.6 ***	1 0.6	2 1.2	1 0.6	*** ***	*** ***	*** ***
NSE-2[2]	166 Not Applic. 170	97.6 ***	0 0.0	3 1.8	1 0.6	*** ***	*** ***	*** ***
SPE-1[2]	39 124 170	22.9 72.9	0 0.0	1 0.6	6 3.5	*** ***	*** ***	*** ***
SPE-2[2]	40 125 170	23.5 73.5	0 0.0	0 0.0	5 2.9	*** ***	*** ***	*** ***
SSE-1[2]	70 97 170	41.2 57.1	0 0.0	1 0.6	2 1.2	*** ***	*** ***	*** ***
SSE-2	166 Not Applic. 170	97.6 ***	0 0.0	0 0.0	0 0.0	*** ***	*** ***	*** ***

[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 Monumental Dam consist of: vertical barrier screens (VBS), standard length submersible traveling screens (STS), twelve inch orifices, collection channel that terminates in a dewatering structure, transport flume, separator, and fish distribution system. The distribution system includes: Passive Integrated Transponder (PIT) tag bypass, sampling facilities, holding facilities, and barge and truck loading capabilities.

Each of the 18 bulkhead slots contains two orifices for diverting fish into the collection channel. Eighteen to 21 orifices are open at any one time with a minimum of one orifice open in all bulkhead slots of operating units. Lights are directed at each open orifice to enhance fish movement into the collection channel. The collection channel terminates at the primary dewatering structure where all but 30 cfs flow is removed. The remaining 30 cfs flow and fish are routed through the transport flume to the separator. Upon reaching the separator, adult and non-target fish are released to the river and juvenile fish pass below the separator bars and enter the distribution system. The distribution system directs the fish to their target locations.

Facility Modifications

No modifications were made to the Lower Monumental JFF and support equipment in 2018.

Operation and Maintenance

Turbine Operations

Efforts were made to operate all turbine units within one percent of peak efficiency from April 1 to October 31. Deviations were infrequent and brief or required by BPA. Below is a summary of unit outages and causes from March 1 through December 31.

Table 3. Summary of unit outages and cause at Lower Monumental Dam, 2018.

Unit	Dates out of service	Reason out of service
All Units	March 26-29	STS installation
All Units	Monthly(2-3 days)	STS/VBS inspection/hub tapping on fixed blade units
All Units	March 20 - 22	Trash rack raking (6-8 hrs/day alternating units)
All Units	December 17 - 18	STS removal
Unit 1	All Year	Contractor continuing rehab/rewind
Unit 2	July 26	BPA outage
	October 23	Forced outage due to line lockout/trip

Unit 3	March 5	Validation testing
	June 5	Trash rack raking
	June 25 – October 18	6 year overhaul/blade seal replacement
	October 23	Forced Outage due to line lockout/trip
Unit 4	February 12, 2018 – March 29	Stator ground
	March 29 – April 10	VBS structure failure.
	June 20	Trash rack raking
	July 26	BPA outage
	September 19 - 2019	Inspection of Oil Governor System/blade seal replacement/annual/cavitation Repair
Unit 5	March 22	Oil leak investigation
	April 24	Tail log install
	June 19 – 20	Trash rack raking
	July 26 – August 2	Doble testing
	October 22 – November 1	XJ breaker maintenance and annual maintenance
	November 21 - 26	Oil seals
Unit 6	March 27	Validation Ttesting
	April 23 – May 11	Annual maintenance and return to Kaplan
	May 14 – 15	Faulting differential trip/CO2 discharge
	June 19	Trash rack raking
	June 28 – July 3	Troubleshoot oil governor
	July 26 – August 6	Doble testing
	October 23	Forced outage due to line lockout/trip
	November 21 – 28	Oil seals

Debris/Trash Racks

In 2018, trash rack raking occurred March 20 – 22 and June 19 - 20. Several semi-truck loads of debris were removed during each effort.

Submersible Screens

The STS's were inspected and tested on March 22, 2018 and all but one were installed from March 26 through March 29, 2018. STS in gatewell 4A, which could not be installed due to a loose VBS frame, was remedied and later installed April 10, 2018. After installation, inspection was done monthly through November, by underwater video camera. On April 5, 2018, loose and missing mesh clips and mesh separated from the framework were found on STS's in slots 5 B and 5C. They were replaced with spare screens on April 6, 2018. On May 2, 2018, loose and missing mesh clips were found on STS in slot 4A. It was replaced with a spare screen on May 2, 2018. On May 3, 2018, loose and missing mesh clips were found on STS in slot 5C. It was replaced with a spare screen on May 3, 2018

STSs are usually operated in "cycle" mode when the average fork length of subyearling Chinook and/or sockeye salmon is greater than 120 mm, and in continuous "run" mode when either is less than 120 mm. In 2018, the STS's were placed in continuous run mode on May 9 with average

lengths of collected fish being greater than 120mm and changed back to cycle mode on July 11 due to average lengths of collected fish being less than 120mm.

Vertical Barrier Screens

The vertical barrier screens (VBSs) were inspected by underwater video camera on August 1 and 2. Additionally, they were spot-checked monthly during STS inspections. The VBS frame for gatewell 4A came loose during STS installation in March. Divers found the bolts of the upper-most section rusted away. The gatewell was dewatered to repair the frame and it returned to service April 10, 2018. The VBS in gatewell 4C was also found to have a bent top plate on the uppermost portion of the screen. On December 3, while unit 4 was out for repair, project biologist inspected 4C VBS via man basket and confirmed the problem. The plate was welded back into place by powerhouse mechanical crew correcting the issue.

Gatewells

During the 2018 season, gatewells exceeded 50% debris criteria on 2 days; June 11 and November 27. When debris coverage over 50% was reported, the powerhouse crew promptly removed the debris by dipping the gatewells.

Orifices/Collection Channel

During the 2018 season, the number of open orifices varied from 18 to 21 according to forebay level. With the Lower Monumental reservoir at minimum operating pool, water discharge through an orifice is reduced. During this period, extra orifices were opened to supply additional water to the adult fishway. Orifices were cycled and backflushed with air daily to remove debris. Orifices 17 and 18 were found to have a log protruding through them on May 31 and June 4, respectively. Powerhouse maintenance crews were informed and the logs were removed. Orifice lights were also checked daily. If a light was not working, flow was directed to the other orifice in the slot until repairs could be made.

Primary Dewatering Structure

The compressed air screen cleaner functioned well throughout the 2018 season. The mechanical screen cleaner intermittently malfunctioned from July 4 until the end of the season. Electricians identified the problem and plan on replacing antiquated PLC’s and rotary switches when funding/time permits. This problem had little impact on keeping debris off of the incline screen, as the bubbler was still operating and technicians were able to run the brush manually during their shifts.

Wet Separator/Distribution and Sampling Systems

Sudden water level drops at the separator were not a problem this year. Water level remained fairly consistent at the separator with manual operation of the automated weirs of the primary dewaterer. As has been the case for the last few years, the separator was operated at a higher water level to assure no problem with exposed separator bars would occur.

PIT-tag diversion gate position sensors were installed several years ago. These sensors act to prevent the over-travel problem that previously occurred, and by so doing, they eliminated gate failure problems caused by metal fatigue.

Barge Loading Operations

Fish were transported by barge from April 24 through August 14. Barge loading at Lower Monumental occurred without any issues during the 2018 transport season.

Truck Loading Operations

Juvenile fish were scheduled to be transported by truck from August 16 to October 1. Per 2018 Fish Passage Plan, the Lower Monumental trucking schedule is contingent upon fish numbers. Saturday, August 18, was the third consecutive day with less than 50 smolts collected, therefore trucking ceased after the second trip. Truck transport never resumed in 2018.

AVIAN PREDATOR MONITORING

Areas of avian predation monitoring included: forebay, turbine discharge, spillway discharge and JFF bypass outfall. Deterrent measures included: bird wires across the tailrace of the powerhouse, water cannon sprinklers at the exit of the bypass outfall pipe, bird deterrent spikes at common perching areas, and hazing (April 1 through June 2) under the animal control contract with Wildlife Services (WS). Two shift hazing coverage (daylight to dusk) occurred from May 6 to June 2. Water cannon sprinklers at exit of bypass outfall pipe were taken out of service on June 11 due to water cannon sprinkler failure, which could not be repaired during the season.

Avian predators tend to rest in the forebay and chase juvenile fish as they jump. They also spend time perched on the lock wall facing the tailrace. At the downstream navlock guidewall, bird wires were added along the top rail of the handrail during winter 08-09 which effectively reduced the perching previously seen there, however, to a great extent the perching only relocated to the deck in front of the handrails.

The following data is based on bird counts taken in two separate procedures (limited to April 1 through October 1). The first procedure takes place during fish ladder inspections with supplemental counts by WS on days with no ladder inspection. The second procedure is from daily observations of the tailrace area taken at approximately 11:00 hours each day as specified in the Avian Action Plan.

1. Fish Ladder Inspection/APHIS supplemented Bird Monitoring

Fish ladder inspections were conducted three to six times per week at Lower Monumental Dam to ensure ladders were operating within criteria and for training purposes. These inspections were conducted at random times and contain counts during active bird hazing as well as in its absence. On Mondays and Thursdays (April 1 through June 2) WS contracted employees collected bird information in the same format as the ladder inspection data and this information

was added to the spreadsheet for inclusion in this report. During daylight hours, gulls were present if hazing was not occurring. High juvenile fish numbers passing the dam via spill related to higher gull numbers. In the absence of hazing, gulls appeared to be fairly effective at feeding in the tailrace areas. Each ladder inspection included an avian predator count section for five areas that included: forebay (FB), spillway (SWT1), under the bird wires of the turbine discharge (PHT1), downstream of the birdwires below the turbine discharge (PHT2), and lastly the juvenile bypass outfall (JFOF). Each area included counts of both foraging and resting birds. The following summarizes the data collected from April 1 through October 1 of the 2018 operating year. The averages offered in each category include all data through the time period; it is an average of all the Fish Ladder Inspection/WS supplemented Bird Monitoring Inspections for that condition (feeding/resting) in each zone.

Gulls

Gull numbers were highest from April 9 through May 22. There were also smaller peaks in gull activity spread into late September. In all areas, gull numbers dropped after June 19 as juvenile salmonid numbers became increasingly sparse. Gull numbers increased again later in the year in response to increasing numbers of out-migrating juvenile American shad.

Gull numbers feeding in the forebay (**FB**) ranged from 0 to 16 (April 16) and averaged 0.64. Gull numbers resting in the FB ranged from 0 to 110 (August 31) and averaged 6.46. FB gulls are typically seen resting on the navigation lock guide wall.

Gull numbers feeding in the spillway (**SWT1**) ranged from 0 to 60 (May 3) and averaged 5.7. Gull numbers resting in SWT1 ranged from 0 to 130 (August 24) and averaged 1.81. SWT1 gulls are typically seen avoiding the pyrotechnics of the hazers firing over the spillway discharge from the navigation lock deck (elevation 536).

Gull numbers feeding in the power house tailrace under the bird wires (**PHT1**) ranged from 0 to 11 (July 7) and averaged 0.49. Gull numbers resting in PHT1 ranged from 0 to 7 (October 1) and averaged 0.16. PHT1 gulls are only typically seen when the hazer is not present.

Gull numbers feeding in the power house tailrace downstream of the bird wires (**PHT2**) ranged from 0 to 21 (April 28) and averaged 1.88. Gull numbers resting in PHT2 ranged from 0 to 40 (July 18 and 21) and averaged 1.08. PHT2 gulls are also only typically seen when the hazer is not present.

Gull numbers feeding at the juvenile bypass outfall (**JFOF**) ranged from 0 to 27 (May 3) and averaged 1.66. Gull numbers resting at JFOF ranged from 0 to 7 (July 9) and averaged 0.05. JFOF gulls are typically seen when large numbers of juvenile salmonids are bypassed.

Hazing was effective at moving gulls out of the area. Two shifts were used to provide daylight to dusk coverage through the historic peak of salmonid outmigration. The second shift of hazing was equally as effective as the morning shift. On days when hazing was not occurring but fish passage numbers were high, the birds returned and resumed normal feeding behaviors. Gull

numbers correlated well with the peak of the juvenile fish outmigration this season, as has been the rule in the past, but this season as a whole had relatively low total gull numbers.

Cormorant

Cormorant numbers were fairly consistent throughout the season. Fall and winter cormorant numbers tend to be higher than those during the juvenile salmonid outmigration.

Cormorant numbers feeding in the forebay (**FB**) ranged from 0 to 6 (April 16 and May8), and averaged 0.36. Cormorant numbers resting in the FB ranged from 0 to 11 (April 30), and averaged 0.81. FB cormorants are commonly seen foraging and are impervious to hazing.

Cormorant numbers feeding in the spillway (**SWT1**) ranged from 0 to 15 (August 17) and averaged 0.52. Cormorant numbers resting in SWT1 ranged from 0 to 35 (September 14 and 28), and averaged 1.24. SWT1 cormorants are not effectively prevented from foraging by the pyrotechnics of the hazers.

Cormorant numbers feeding in the power house tailrace under the bird wires (**PHT1**) ranged from 0 to 4 (September 21), and averaged 0.13. Cormorants were not seen resting in the PHT1. PHT1 cormorants come and go and are impervious to hazing.

Cormorant numbers feeding in the power house tailrace downstream of the bird wires (**PHT2**) ranged from 0 to 14 (September 5) and averaged 0.65. Cormorant numbers resting in PHT2 ranged from 0 to 4 (April 9), and averaged 0.11. PHT2 cormorants also come and go and are impervious to hazing.

Cormorant numbers feeding at the juvenile bypass outfall (**JFOF**) ranged from 0 to 2 (May 8) and averaged 0.02. Cormorant numbers resting in JFOF ranged from 0 to 5 (May 8) and averaged 0.04.

Terns

Tern numbers were very low throughout the season. Only 4 sightings occurred.

Tern numbers feeding in the forebay (**FB**) ranged from 0 to 2 (May 31), and averaged 0.01. Terns were not seen resting in the FB.

Terns were neither seen feeding nor resting in the spillway (**SWT1**).

Terns were neither seen feeding nor resting in the power house tailrace under the bird wires (**PHT1**).

Tern numbers feeding in the power house tailrace downstream of the bird wires (**PHT2**) ranged from 0 to 1 (June 16) and averaged 0.01. Terns were not seen resting in the power house tailrace downstream of the bird wires (**PHT2**). PHT2 tern observations are extremely rare.

Tern numbers feeding at the juvenile bypass outfall (**JFOF**) ranged from 0 to 1 (April 3) and averaged 0.01. Terns were not seen resting at the juvenile bypass outfall (**JFOF**). JFOF tern observations are also extremely rare.

Grebe

Grebe numbers were highest from May 17 to July 16.

Grebe numbers feeding in the forebay (**FB**) ranged from 0 to 4 (May 17) and averaged 0.09. Grebe numbers resting in the FB ranged from 0 to 2 (June 10) and averaged 0.03. FB grebes are often underwater and are hard to accurately count.

Grebe numbers feeding in the spillway (**SWT1**) ranged from 0 to 1 (August 8) and averaged 0.01. Grebes were not seen resting in SWT1. SWT1 grebes are not effectively prevented from foraging by the pyrotechnics of the hazers.

Grebes were neither seen feeding nor resting in the power house tailrace under the bird wires (**PHT1**). PHT1 grebes are often underwater and are hard to accurately count.

Grebe numbers feeding in the power house tailrace downstream of the bird wires (**PHT2**) ranged from 0 to 1 (June 17). Grebes were not seen resting in the power house tailrace downstream of the bird wires (**PHT2**). PHT2 grebes are also often underwater and are hard to accurately count.

Grebe numbers seen feeding at the juvenile bypass outfall (**JFOF**) ranged from 0 to 2 (July 16). Grebes were not seen resting at the juvenile bypass outfall (**JFOF**). JFOF grebe observations are extremely rare.

Pelicans

Pelicans were first present on April 9 and last seen in all areas on September 3.

Pelican numbers feeding in the forebay (**FB**) ranged from 0 to 6 (April 30) and averaged 0.22. Pelican numbers resting in the FB ranged from 0 to 6 (April 17) and averaged 0.17. FB pelicans are typically seen cruising as a group; generally along the north shoreline.

Pelican numbers feeding in the spillway (**SWT1**) ranged from 0 to 14 (May 29) and averaged 0.63. Pelican numbers resting in SWT1 ranged from 0 to 6 (June 10) and averaged 0.18. SWT1 pelicans typically are not impacted by the pyrotechnics of the hazers firing to prevent gulls and cormorants from feeding.

Pelican numbers feeding in the power house tailrace under the bird wires (**PHT1**) ranged from 0 to 4 (July 14) and averaged 0.11. Pelican numbers resting in PHT1 ranged from 0 to 5 (July 13) and averaged 0.32.

Pelican numbers feeding in the power house tailrace downstream of the bird wires (**PHT2**) ranged from 0 to 5 (July 4) and averaged 0.21. Pelican numbers resting in PHT2 ranged from 0

to 7 (May 7) and averaged 0.42. PHT2 pelicans typically are not bothered by the pyrotechnics of the hazers firing to prevent gulls and cormorants from feeding.

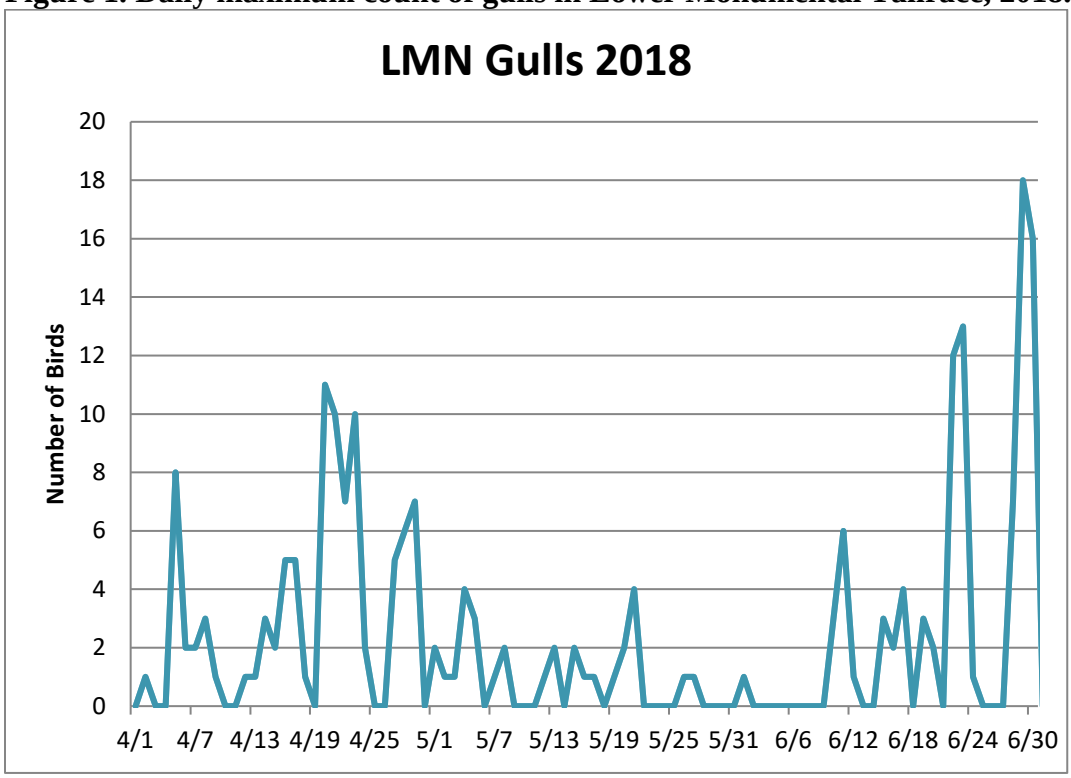
The number of pelicans feeding at the juvenile bypass outfall (**JFOF**) ranged from 0 to 4 (May 3) and averaged 0.14. Pelican numbers resting at JFOF ranged from 0 to 2 (July 9, July 16 and August 1) and averaged 0.06. JFOF pelicans are typically seen when large numbers of juvenile salmonids are bypassed.

2. Tailrace Bird Monitoring of Lower Monumental Dam (Avian Action Plan)

Single daily counts of gulls, cormorants and terns occurred between the hours of 1100 and 1300 each day from April 1 through June 30 as per the Avian Action Plan. Maximum counts with date of occurrence, average count through the April 1 through June 30 period, and a graph of the daily counts for each species throughout the period are as follows (Figures 1-2).

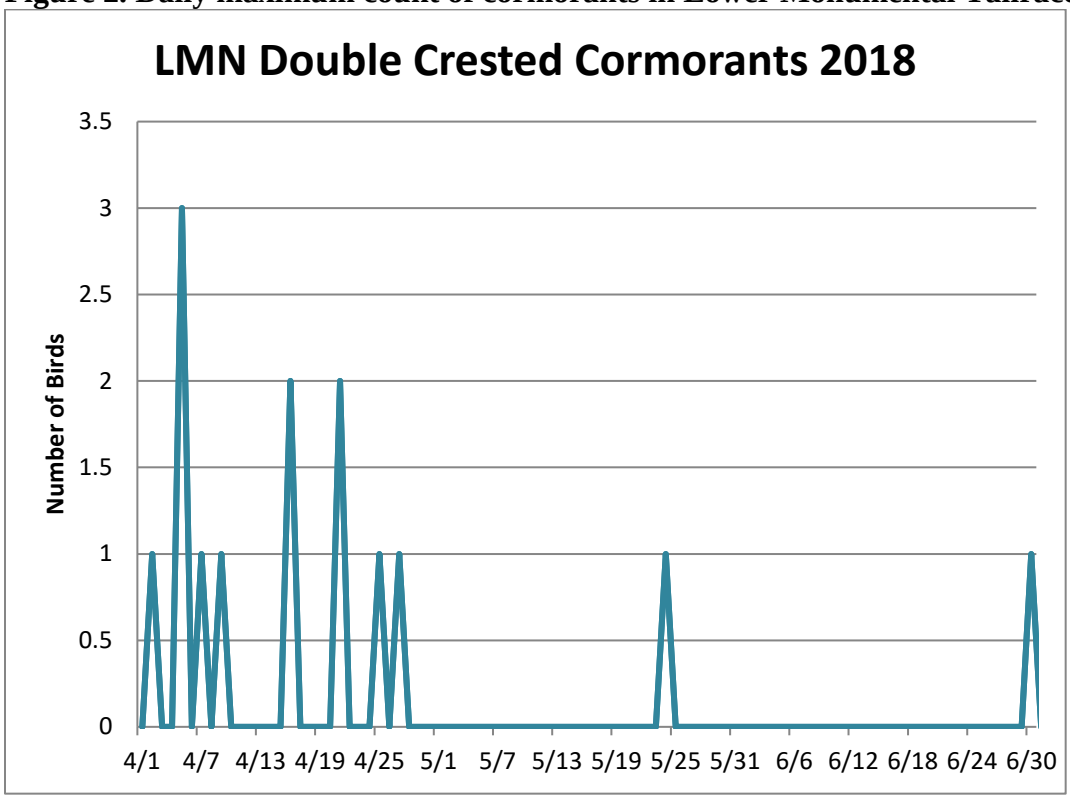
The maximum number of gulls was 18 (June 29) with a daily average of 2.36.

Figure 1. Daily maximum count of gulls in Lower Monumental Tailrace, 2018.



The maximum number of cormorants was 3 (April 5) with a daily average of 0.15.

Figure 2. Daily maximum count of cormorants in Lower Monumental Tailrace, 2018.



No terns were seen during the Avian Action Plan bird monitoring in the tailrace.

Cooling Water Strainer Counts

Turbine unit cooling water strainers were examined for biologic content once per month from January until June 2018. Species content included lamprey, salmon species, steelhead, prawn, and a final category titled "other" which included all other species. The vast majority of other species were American shad. The number of each group and percent of the total of individuals of all groups combined was: juvenile lamprey 263 (70.70%), salmon species 90 (24.19%), steelhead 9 (2.42%), prawn 1 (0.27%) and other 9 (2.42%).

Timing of the entry of each group into the strainers represents migration timing coupled with susceptibly of being drawn into the cooling water system for each group at that growth stage. Juvenile lamprey were generally present from February through May with numbers peaking at 99 in March. Salmon species were generally susceptible only in May and June peaking at 44 in May. Steelhead are rarely seen in the strainers with a total of 9 for the entire year. Prawns were present only in April at 1. "Others" were rarely seen in the strainers with a total of 9 for the entire year. The vast majority of all groups were no longer living when collected. The percent of each group released alive was: lamprey 6.08%, salmon species 0%, steelhead 22.22%, prawn

0%, and other 0%. Probability of any individual being alive at the time of strainer cleaning was likely more related to time of entry rather than which unit's strainer it was found in.

Recommendations

1. Install a shear boom across the forebay to direct debris to the spillway during the high flow/high debris period to reduce orifice fouling and associated fish injury.
2. Research converting the pipe system between the PIT facility counter tanks and the PIT facility holding tank exits with an open system that eliminates the need to hold fish in the PIT system holding tanks.
3. Repair primary outfall pipe expansion joint issue.

APPENDIX

Appendix 1. Lower Monumental Adult Fishway Inspections, 2018. (spreadsheet)