ADULT AND JUVENILE FISH FACILITIES MONITORING REPORT
LOWER GRANITE DAM
2013

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February 2014

INTRODUCTION

This report summarizes the operation and maintenance of the adult fish passage facility at Lower Granite Dam in 2013, including the results of inspections completed by fisheries personnel from March 4 to December 31. The report also summarizes operation and maintenance of the juvenile fish passage facilities and includes an overview of the collection, transportation, and bypass of migrating juvenile salmon and steelhead at Lower Granite Dam in 2013. More detailed information on juvenile fish collection and transportation activities at Lower Granite Dam can be found in the Walla Walla District's Juvenile Fish Transportation Program 2013 Annual Report.

ADULT FISH FACILITIES

Facility Description

Adult fish passage facilities at Lower Granite Dam consist of an adult fish ladder (adjacent to the dam on the south shore of the river), an adult fish trap located in the fish ladder, two weirgate entrances on the south shore of the river (SSE-1 & 2), a powerhouse collection system comprised of ten floating orifice gates, three north powerhouse entrance gates (NPE-1, 2, 3), a channel under the tailrace deck and spillway connecting all three entrances to the ladder, three north shore entrances (NSE-1, 2, 3), and an auxiliary water supply system. The fishway ladder itself is comprised of a series of pools and weirs and covers a horizontal distance of approximately one-quarter mile while rising a vertical distance of about 100 feet.

During standard fishway operation, the two south shore weir gate entrances are open all the time. Four of the ten floating orifice gates are left open at any one time (gates 1, 4, 7, and 10). Two of the three north powerhouse entrances are normally operated (usually entrances 1 and 2). At the north shore, only the two downstream entrances are normally open at any one time.

Auxiliary water is supplied to the fishway by means of three electric motor-driven turbine pumps that take water from the tailrace area and pump it to floor diffusers located along the tailrace collection channel. Two pumps are operated at any one time and the third pump is kept as a spare and rotated

occasionally with one of the other two pumps to even the operational wear. The water supply to the fish ladder proper (approximately 75 cfs) is supplied by gravity flow from the forebay through the fishway exit and upper ladder diffuser.

Automated Fishway Control System

The Lower Granite automated adult fishway control system consists of a Dell 486 computer with a 60-IBM/N card installed and a SIXNET remote terminal unit (RTU). The Dell Optiplex GX-1 computer is located in the powerhouse control room and the RTU300 is mounted adjacent to the existing fishway system control (FSC) board. The computer is used to change the control parameters of the RTU, and provides data acquisition and storage. The RTU controls the six fishway weirgates according to set points that either control the gate at depth below tailwater or a channel to tailwater head differential. NOTE: this controller system, located in the control room, broke down early during the 2011 inspection season. A trouble report was submitted. At this time it appears unlikely this system can be repaired.

The fishway control system provides the following information to the computer: 1) channel water elevation at all three pairs of entrance weirs in feet above mean sea level (MSL), 2) elevation of all six weirgates in feet above MSL, 3) tailwater elevations at three locations in feet above MSL, 4) depth of each weirgate below tailwater in feet, 5) the difference between channel water elevation and tailwater elevation in feet, and 6) the elevation of the fish attraction water pump discharge chamber above MSL.

This control system was installed between 3 January and 28 February, 1994. The system was programmed to control SSE-1 and SSE-2 at eight feet below the south shore tailwater, NPE-1 and NPE-2 at eight feet below the north powerhouse tailwater, and NSE-1 and NSE-2 were set to maintain the north shore channel one foot above the north shore tailwater elevation. (Lack of sufficient water at the north shore prevents NSE-1 and NSE-2 from being set at seven feet below tailwater. Weir depths are sacrificed to maintain the one foot of head differential.) Gate position is sensed by existing Selsyn technology inputting to an INCON model 1255 position monitor that provides gate level accuracy to .01 foot mean sea level (MSL).

Fishway collection channel elevations near the weirgates at the south shore, north powerhouse, and north shore are measured by a Milltronics multiranger plus ultrasonic level transducers which provide a 25 foot measuring range. The ultrasonic transducers are mounted at elevation 650 MSL and thus provide an accurate level indication to elevation 625 MSL (the lowest level in the fish channel). Tailwater elevations at the north powerhouse and north shore are also monitored by ultrasonic transducers, while the south shore is monitored by Selsyn technology similar to the weirgate levels.

Operation and Maintenance

The adult fishway system was dewatered early for the 2013 winter outage in mid-December 2012 due to the need to install numerous new gratings and allow a contractor to make ladder modifications for lamprey. The ladder portion of the fishway was dewatered on December 18, 2012. Powerhouse crews dewatered the powerhouse channel portion of the ladder on December 19. The

spillway section of the ladder was not dewatered until January 31, 2013 and leaking bulkheads at the north shore entrances made the fish salvage efforts difficult.

Powerhouse crews initiated dewatering of the fish ladder @1200 hours on December 16, 2012 by shutting down fish pumps two and three approximately 45 hours prior to beginning the planned operation. On December 18, 2012 bulkheads were placed in the fish ladder exit to stop the flow of water down the ladder. The drain at diffuser 14 was left closed to keep a small amount of water in the ladder until all the fish could work their way down to the junction pool. Dewatering of the adult fish ladder section only was completed on December 18. Numerous adult shad were stranded in the corner pool of the ladder during the initial dewatering and an additional salvage operation was conducted the following day to remove these fish. For the December 18-19 ladder section dewatering the following fish were removed: 112 adult American shad, one wild rainbow trout, one unclipped steelhead smolt, and two unclipped Chinook smolts. All fish from both days were released alive at Offield Landing.

The powerhouse section of the adult fishway channel was dewatered on December 19, 2012. The following fish were removed from the powerhouse portion of the ladder: seven adult clipped steelhead, nine unclipped Chinook smolts, two bridge-lipped suckers, and one peamouth. All recovered fish were trucked above the dam and released alive at Offield Landing.

The spillway section of the adult ladder complex was not dewatered until January 31, 2013. Lower Granite JFF personnel went into that section of the ladder by manbasket and attempted to salvage fish using established methods. Flows in that section of channel were very high due to leaking bulkheads at the north shore fishway enterances and JFF personnel were not able to move the panel crowders and other salvage items to the far end of the channel. Lots of wood and other debris moving down the channel also made things difficult. No fish were recovered during this operation.

Normal preventative maintenance was conducted on the adult fishway system between December 18, 2012 and February 27, 2013. In addition the following work was also accomplished: 1) replaced the grating on diffusers 8-13, 2) repainted the picketed leads and replaced them, 3) reattached loose sections of the fallback fence, 4) performed maintenance on the AWS pumps, 5) replaced the brushes on the cleaning system at the public fish viewing window, 6) adjusted the limit switches on the fish viewing window, 7) installed the north powerhouse fishway entrance 3 bulkhead, and 8) removed debris from the ladder and the powerhouse channel.

Modifications

Extensive modifications to the adult fish trap complex at Lower Granite, operated by NOAA-Fisheries, were completed during the winter of 2007. The modifications included: expansion of the platform area; modifying the anesthesia system to provide for an additional four holding tanks; installing a pivoting flume system to route fish to the anesthesia tanks; adding two sorting tanks behind the anesthesia tanks for the working up/sorting of hatchery fish; adding four more adult holding tanks for fall chinook broodstock collection; adding a flume system to route fish to the holding tanks; adding additional electrical outlets for PIT-tag scanning and providing an additional pipe in the forebay to add the extra water needed to operate the expanded trap facilities. Three minor modifications to the adult trap system took place in 2013. A problem electrical outlet (at shin height) that was subject to being struck by workers was moved to a better location. Another electrical outlet on the floor was removed

due to being a tripping hazard and not replaced. In addition, a piece of 12" x 20" grating located near the false weir at the entrance to the trap was replaced due to wear.

In addition to the fish trap modifications were also made to the upper portion of the adult ladder to improve lamprey passage. Rectangular orifices were cut in the upper ladder weir sections. These orifices were cut at the floor level of the ladder and fitted with stainless steel inserts which allowed an opening of 16" x 2.5". Nearly all of the work was completed in 2013 with the exception of a single orifice. The contractor ran into trouble cutting this orifice due to a steel pipe in the way and is scheduled to complete this work during the 2013-2014 winter outage period.

Operations and Maintenance

Auxiliary Water Supply:

When the adult fish ladder complex was watered up in February 2013, fish pumps two and three were initially run to supply water to the adult fish ladder diffuser system. At the initial water up, fish pump 1 was out of service for a motor rewedge. Fish pump one was brought back on line on April 22 following repairs. On May 15 at 1543 hours, following a maintenance operation to replace a leaking O-ring, fish pump one tripped offline. An evaluation by the electrical crew found that the pump had failed due a burnt up starter coil and circuit board. By May 16 at 0730 hours fish pump two's discharge bulkhead had been removed and the fishway resumed normal two pump operation. Fish pump one remained out of service until parts were procured – the pump was declared available for service at 0800 hours on June 4. The three fish pumps were then run in varying two pump combinations during early June through the mid-September time period without further incidents. On September 15 at 0910 hours fish pump three tripped offline. During attempts to restart the pump the starter failed. An electrician was called in and replaced the parts with those from fish pump two. Fish pump three was then successfully restarted at 1150 hours and returned to service. Fish pump two was declared out of service awaiting replacement parts. Replacement parts (coil and circuit board for a starter) arrived in early October and were installed in fish pump two. Bulkheads were removed and fish pump two was brought back on line for testing on October 9. The test was successful and fish pumps one and three were returned to service. Fish pump two was returned to standby mode. All fish pumps were declared operational by 1552 hours on October 9. Spare starter coils and circuit boards are now kept as stock warehouse items. With the exception of changing fish pump one's speed from slow to fast mode on October 31, there were no other fish pump issues during 2013 and fish pumps one and three ran without interruption during the duration of the season.

Table 1. Fish pump outages at Lower Granite Dam, 2013.*

Affected Pump(s)	Dates	Reason for Outage/Comments
Pumps 1, 2 &3	1/01 - 2/28	2012/2013 Fishway outage/Fish pump 1 motor rewedge
Pump 1	2/28 - 4/22	Motor rewedge
Pump 1	5/15 – 6/4	OOS due to burnt up circuit board and starter coil/waiting for replacement parts
Pump 2	9/15 – 10/09	OOS due to borrowed starter coil and circuit board
Pumps 1, 2 &3	12/16/12 – 12/31/12	2013 Early fishway outage for grating replacement and contractor lamprey orifice installations

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

Adult Fish Trap Operations:

During the 2013 fish season, the adult fish trap at Lower Granite Dam was operated between March 4 and November 24. It was necessary to take the trap out of service for an extended time due to water temperatures exceeding 70 degrees F. On July 3 at 0845 the adult fish trap was shut down as the water temperatures reach 70 degrees F for the first time. The water temperature dropped during the night and trapping resumed on July 4 at 0615. On July 10 at 0745, the trap was again shut down due to water temperatures exceeding 70 degrees F. On July 25 and 26 there was an attempt to operate the trap to collect sockeye for transport to southern Idaho. The attempt was not successful, so trapping remained suspended until September 23 when the water temperatures dropped below 70 degrees F. During 2013 the adult fish trap sample rate was set at a 15% sample rate for the start of the season but was increased to 18% on April 23. On September 23 the sample rate was lowered to 12%, raised to 15% on October 2, and raised to 20% on October 9 to accommodate the brood needs of the hatcheries.

Numerous activities took place at the adult trap during the course of the 2013 season. One of every 20 hatchery steelhead had a scale and genetic sample taken from them. All previously PIT-tagged fish, regardless of origin, had a scale and genetic sample taken during the entire year. All wild steelhead without a PIT tag had one implanted, along with scale and genetic samples taken for the entire trapping season. Later in the season, scale samples were taken from one out of every five hatchery Chinook. Sort by code Lemhi origin Chinook were also radio-tagged and scale and genetic samples taken during the course of the spring and summer.

Collection of adult fall Chinook for transport to Lyons Ferry Hatchery began on September 24. Typically this would start on August 18. With the high water temperatures, the first 4 weeks of the fall Chinook run was missed. Both Lyons Ferry Hatchery and Cherry Lane Hatchery were able to reach brood stock goals in early November. The final transport of adult fall Chinook to Lyons Ferry Hatchery took place on November 18.

A grand total of 6,434 fall Chinook were hauled by personnel at the adult trap. Out of this total, 2,323 were hauled to the hatcheries and 4,111 were released back into the fish ladder. Lyons Ferry Hatchery received a total of 1,817 fall Chinook (1,295 adults, and 522 jacks). The Nez Perce Hatchery

at Cherry Lane received a total of 506 fall Chinook (458 adults, and 48 jacks). Following the conclusion of adult activities, the adult fish trap complex was dewatered for the winter on November 24.

During 2013, the following species and numbers of fish (by clipped and unclipped designation) were handled by personnel working at the Lower Granite adult fish trap complex: sockeye (9 clipped, 39 unclipped), coho (19 clipped, 569 unclipped), steelhead/spring (616 clipped, 61 hatchery non-clipped, 460 wild unclipped), steelhead/ fall (9,286 clipped, 738 hatchery non-clipped, 3,162 wild unclipped), Chinook spring/summer (7,502 clipped, 712 non-clipped coded wire tagged, 3,323 non-clipped with no wire tag), Chinook fall (1,032 clipped, 1,129 clipped coded wire tagged, 3,287 unclipped, 986 unclipped coded wire tagged).

Special Operations to Mitigate the Temperature Differential between the Adult Ladder Exit and Tailrace

In 2013 a combination of warm water temperatures in the adult fish ladder (especially the substantial differential between the high temperatures at the ladder exit and up to six degrees F lower temperatures at the entrances) and the special operations noted below did not enable the NOAA adult fish trap to operate from July 10 to September 23. System Operational Request #2013-4 was drafted by the TMT on July 23 to increase adult passage and reduce the water temperature in the LGR fish ladder. The SOR directed the COE to take immediate actions that could potentially increase adult passage and decrease the water temperature in the adult ladder.

Following this directive, the COE through the TMT and FPOM processes coordinated several different dam operation strategies trying to draw cooler water and/or fish into the adult fish ladder and were met with limited success. The Turbine Unit priority was changed to make Unit #1 the priority Unit to provide more attraction flow to the adult ladder entrance. The project stored water during the night to run Unit #1 or two Units during the day depending on total inflow, since most adults pass the fish ladder during daylight hours. Emergency auxiliary pumps (installed for the reservoir draw down test in 1992) were operated from July 25 through September 18 to provide cooler water to the fish ladder exit, since their intakes are around 30 feet deep. Emergency auxiliary pumping operations provided cooler water to the fish ladder but when in use diffuser 14 closed too much to provide sufficient water to allow operation of the NOAA trap. During September water temperatures cooled and adult fish began to more freely pass the adult ladder and the trap became operational on the morning of September 23.

Adult Fishway Inspections

Methods:

A total of 138 physical inspections of the adult fishway complex were conducted at Lower Granite between 4 March 2013 and 31 December 2013. This averaged out to slightly under 3.2 inspections per week during the fish passage season. The routine inspections during 2013 were conducted by COE fisheries personnel stationed at Lower Granite Dam. Once per month, inspections were also conducted in conjunction with Oregon Department of Fish and Wildlife personnel stationed at Little Goose Dam. Following inspections, out of criteria readings or other problems were reported to

powerhouse personnel for correction. Powerhouse operators also conducted their own inspections of the adult fishway system to help ensure proper operation.

The inspections were conducted in order to maintain the adult fishway within established operating criteria and to monitor long-term trends in operation. Inspections were not scheduled on a daily or hourly basis but rather an attempt was made to make at least three inspections per week on a no more than once per day basis. Other than avoiding inspections after lockages or other events that could impact staff gauge and weir gate readings, all inspections were made without regard to operational conditions.

Visual inspections of the adult fishway system were conducted by walking through the facility, observing fish passage conditions, and examining each criteria point. Staff gauge readings were taken at the picketed leads, viewing room pool, forebay, adult fishway exit, diffuser 14, and collection channel/tailwater areas adjacent to the entrance weirs. Weir entrance readings were also recorded on each inspection: two at the south shore entrances (SSE-1 and SSE-2), two at the north powerhouse entrances (NPE-1, NPE-2), and two at the north shore entrances (NSE-1 and NSE-2). All readings were taken to the nearest tenth of a foot.

Established operating criteria have long been used for each portion of the fishway. The difference between the elevation reading at the upstream staff gauge (picketed leads) and fish viewing room pool staff gauge should be no more than 0.3 feet. There should be no more than 0.5 feet of head between the adult fishway entrance and the forebay level. The water depth over the ladder weirs (measured at diffuser 14) should be within 1.0 to 1.3 feet. Head differentials at all fishway entrances (differential between entrance bay elevation and tailwater elevation) should be 1.0 to 2.0 feet. Weir depth readings (difference between the weirgate elevation reading and the tailwater level) should be 7.0 feet or greater at the north shore and 8.0 feet or greater at the south shore and north powerhouse.

Readings from each visual inspection were recorded on a standardized form and reviewed for out of criteria readings or other problems. Information from the fishway control system board (FSC Board) was also reviewed and used to supplement the information from visual inspections. When problems were found within the fishway, powerhouse operators were notified and asked to correct them within the limitations of the system.

Inspection Results:

Data from each physical inspection during 2013 was entered into an updated Excel program for analysis. The program evaluated criteria points on a per inspection basis and, when things were out of criteria, recorded the amount out of criteria by tenth of a foot blocks. The program also provided information on the percentage of time that an inspection point met criteria for the entire inspection year. Summary data was automatically copied into an Excel table by the program. This Excel table was later copied into a Word table (Table 2 below) for inclusion in this report and references to inspection results refer to data listed in this table.

Table 2. Summary of adult fishway inspections at Lower Granite Dam, 2013.[1]

			------Not Enough Depth------			-------Too Much Depth-------		
Criteria and 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**
South Channel	0	0.0	***	***	***	***	***	***
Water Velocities	***	***	***	***	***	***	***	***
	138							
Differentials								
Ladder Exit	138	100.0	***	***	***	0	0	0
	***	***	***	***	***	0.0	0.0	0.0
	138							
Ladder Weirs	138	100.0	0	0	0	0	0	0
	***	***	0.0	0.0	0.0	0.0	0.0	0.0
	138							
Counting Station[3]	138	100.0	***	***	***	0	0	0
	***	***	***	***	***	0.0	0.0	0.0
	138							
South Shore Entrance	138	100.0	0	0	0	0	0	0
	***	***	0.0	0.0	0.0	0.0	0.0	0.0
	138							
North Powerhouse Entrance	133	96.4	3	1	1	0	0	0
	***	***	2.2	0.7	0.7	0.0	0.0	0.0
	138							
North Shore Entrance	118	85.5	5	8	7	0	0	0
	***	***	3.6	5.8	5.1	0.0	0.0	0.0
	138							
Weir Depths								
SSE-1[2]	138	100.0	0	0	0	***	***	***
	0	0.0	0.0	0.0	0.0	***	***	***
	138							
SSE-2[2]	136	98.6	0	0	2	***	***	***
	0	0.0	0.0	0.0	1.4	***	***	***
	138							
NPE-1[2]	49	35.5	0	0	0	***	***	***
	89	64.5	0.0	0.0	0.0	***	***	***
	138							
NPE-2[2]	49	35.5	0	0	0	***	***	***
	89	64.5	0.0	0.0	0.0	***	***	***
	138							
NSE-1	1	0.7	0	0	137	***	***	***
	0	0.0	0.0	0.0	99.3	***	***	***
	138							
NSE-2	7	5.1	2	9	120	***	***	***
	0	0.0	1.4	6.5	87.0	***	***	***
	138							

[1] Data are from Appendix 5.
[2] "On sill" means the weirgate is bottomed out on its sill due to low tailwater conditions and within criteria at this location.

South Shore Channel Water Velocities

Velocity Meter Readings:

Present criteria stipulate that channel velocities (transportation velocity) in the junction pool area of the adult fishway at Lower Granite be 1.5 – 4.0 feet per second or greater. When the meter was installed at Lower Granite it was put in a part of the channel that had the lowest velocities to monitor the worst-case situation. Consequently, readings are lower in that area then they would be in other locations. During early 2006, modifications were made to the lower weirs in the adult fish ladder and the channel in the junction pool was also narrowed by adding a steel wall inside the existing structure. It was thought that this would help improve channel velocities. Velocities did improve somewhat but not enough to reach the criteria level.

At Lower Granite, six readings are taken from the velocity meter during each fishway inspection and recorded on the inspection form. The six readings are then averaged and the average velocity used as the reading for that inspection. During 2013, readings at the meter in the junction pool were out of criteria on all 138 inspections that were conducted by COE project biologists. Readings ranged from 0.79 fps to 1.23 fps in 2013 compared to 0.85 fps to 1.27 fps in 2012, 0.73 fps to 1.22 fps in 2011, 0.79 fps to 1.14 fps in 2010, 0.58 fps to 1.19 fps in 2009, and 0.70 fps to 0.90 fps in 2005 (prior to junction pool modifications). The average velocity reading during 2013 was 1.03 fps throughout the duration of the entire season.

Head Differentials

Ladder Exit:

There should be no more than 0.5 feet of head between the trashracks and fish ladder exit according to the Fish Passage Plan. The head differential readings for this criteria point were within criteria (0.5 feet or less) on all of the 138 inspections in 2013. All of the readings during the season showed either no differential or 0.1 feet of differential. This area was within criteria 100% of the time.

Ladder Weirs:

Water for the adult fish ladder is supplied by gravity flow from the reservoir through the ladder exit and also through a diffuser below the water control section. The amount of water added to the ladder through the diffuser depends on the elevation of the Lower Granite reservoir, with more water being added through the diffuser as the reservoir lowers. The water supply for the adult fish trap is tied into the diffuser and also affects the amount of water available for ladder operations when the reservoir is operated at minimum operating pool (MOP).

According to the Fish Passage Plan, 1.0 to 1.3 foot of water should flow over the top of the ladder weir at diffuser 14. Readings are taken from a staff gage that measures elevation (the top of the ladder weir is at elevation 727.0 feet). Hence, the acceptable range of readings falls between 728.0 feet and 728.3 feet. This inspection point was within criteria 100% of the time during 2013. By contrast it

was within criteria 94.3% of the time during 2012, 81.1% of the time in 2011, 87.8% during 2010 and 85.1% of the time during 2009.

Counting Station:

Gratings (picketed leads) separate the area between the staff gage above the fish viewing window and the staff gage below the fish viewing window (counting station). Criteria calls for no more than 0.3 foot of differential between the two staff gage readings. In 2013 this inspection point remained within criteria 100% of the time.

South Shore Fishway Entrance Head Differentials:

South powerhouse fishway entrance head differential readings should range from 1.0 to 2.0 feet between the channel entrance and the tailwater level at the fishway entrance. There were no out of criteria readings during the 2013 fishway inspections. This inspection point remained within criteria 100.0% of the time during 2013.

North Powerhouse Fishway Entrance Head Differentials:

North powerhouse fishway entrance head differential readings should range from 1.0 to 2.0 feet between the channel entrance and the tailwater level at the entrance. During 2013 this inspection point was out of criteria five times. There were three readings 0.1 feet below criteria, one reading greater than 0.1 feet below criteria and one reading greater than 0.2 feet below criteria. This inspection point was within criteria 96.4% of the time during 2013.

North Shore Fishway Entrance Head Differentials:

The criteria range for head differential readings at the north shore fishway entrances is also between 1.0 and 2.0 feet. Under the present situation, two fish pumps cannot supply enough water to the north shore to maintain both head differential readings and weir depths. This situation has also been exacerbated due to operation during minimum operating pool (MOP) conditions in the tailrace. Standard operational policy has been to sacrifice weir depth readings in order to maintain at least 1.0 foot of head differential. During 2013, the head differential readings were out of criteria 20 times. There were five readings 0.1 feet below criteria, eight readings 0.2 feet below critiera, and seven readings greater than 0.2 below criteria. The failure of weirgate NSE-1 and the need to dog it off at a compromise level contributed to the higher than usual out of criteria readings this year. During 2013, this inspection point was within criteria 85.5% of the time.

Fishway Entrance Weir Depths

South Shore Entrances 1 and 2, Weir Depths

The south shore fishway system at Lower Granite consists of two fishway weir entrances: south shore entrance one (SSE-1) and south shore entrance two (SSE-2). Present criteria calls for a weir depth level of 8.0 feet or greater between the tailwater elevation and elevations at the south shore fishway entrance weir gates. South shore gates were considered to be "on sill" and bottomed out whenever the tailwater elevation was 633.0 feet or less. This is usually not too much of a problem at the south shore gates and did not occur in 2013.

Weir gate depths are considered to be out of criteria whenever there is enough tailwater elevation to allow the weir gates to move off their sills and readings are not 8.0 feet or greater. During 2013, SSE-1 was never out of criteria (per the physical readings off the weir gate dial). During 2013, SSE-1 remained within full criteria 100% of the time.

During 2013, SSE-2 was out of criteria two times. Both times the gate was greater than 0.2 feet below criteria (0.5 and 0.6 feet respectively). These occasions occurred on December 7 - 8 and were caused by the failure of a starter on the weir gate motor. The starter was replaced and the gate was back in criteria on Monday December 9.

North Powerhouse Entrances 1 and 2, Weir Depths

Like the south shore, criteria at the north powerhouse fishway entrances also requires weir depths of 8.0 feet or greater. The north powerhouse fishway system at Lower Granite consists of two operating fishway entrances: north powerhouse entrance one (NPE-1) and north powerhouse entrance two (NPE-2). North powerhouse gates were considered to be "on sill" whenever the adjacent tailwater elevation was 636.0 feet or less. At this level, both gates "bottom out" and rest on their respective sills. During 2013, this occurred on a near constant basis from April 1 until September 1 due to operation of the Little Goose pool at the minimum operating level most of the time. In all, both NPE-1 and NPE-2 were on sill 89 times during the season. Readings that were on sill were considered to be within criteria because nothing could be done about the minimum operating pool levels (MOP), which caused the condition.

Weir gates are considered to be out of criteria whenever there is enough tailwater elevation to allow the gates to move off their sills and readings are not 8.0 feet or greater. Neither NPE-1 or NPE-2 was out of criteria during 2013. During 2013, both gates remained within full criteria 35.5% of the time and were on sill 64.5% of the time.

North Shore Entrances 1 and 2, Weir Depths

Present criteria at the north shore fishway entrances stipulates a weir depth reading of 7.0 feet or greater at both entrances. With the exception of heavy spill conditions, there is seldom enough tailwater elevation to maintain both weir depths and head differentials. It is a standard operational practice to sacrifice weir depths in order to maintain at least 1.0 foot of head differential at the north shore.

Because of these unusual operating conditions, and the emphasis on maintaining head differentials, weir depth readings are almost always below the desired level. This changed somewhat during the 2011 season and continued in 2013 and was caused by the failure of NSE-2 on May 31 2011. In order to deal with this problem, the gate at NSE-2 has been dogged off at a compromise level of 630.0 feet. NSE-1 met the 7 foot (or greater) depth criteria level on one occasion while NSE-2 met the depth criteria on seven occasions. In the case of NSE-1, all out of criteria depth readings were greater than 0.2 feet below the acceptable criteria level. In the case of NSE-2 there were eleven out of criteria readings within 0.2 feet below the acceptable depth level and one hundred twenty readings were greater than 0.2 feet below criteria. During 2013, NSE-1 met criteria 0.7% of the time and was out of criteria 99.3% of the time. NSE-2 met criteria only 5.1% of the time and was out of criteria 94.9% of the time.

Automated Versus Visual Inspection Results

Readings from the computer system (fishway system control board) were valuable in obtaining an "overall picture" of the functioning of the adult fishway and served as a supplement to the actual visual inspections. During most of the year, the readings between the actual visual inspections and the automated system were reasonably close. The Corps biologists attempted to accurately read staff gauges to the nearest 0.1 foot but discrepencies did occasionally occur. The biggest factors were frequent wave action which made accurate staff gauge readings difficult and the slight time differences between the physical reading and recording the reading off the fishway system control board. During periods of high spill and wind the automated system was particularly valuable and enabled us to monitor the north shore weir gates without becoming drenched.

Recommendations for 2014

1. Repair the damaged weirgate at NSE-1 with a new gate and control system.
2. Consider replacing all the weirgates with a new improved system as parts are difficult to obtain for the existing gates.
3. Continue monitoring of the electronic fishway readings (FSC board) to ensure that electronic fishway readings match physical conditions.
4. Replace the adult fishway control system (located in the control room) with a new system as the old one appears to irreparable.
5. Continue monitoring of the adult trap water demand to ensure that things are operating as planned (following the installation of the new diffuser 14 butterfly valve) and that enough water is available to operate the full range of adult holding tanks during the critical fall period.

JUVENILE FISH FACILITIES

Facility Description

The juvenile fish passage facilities at Lower Granite Dam consist of extended-length submersible bar screens (ESBSs) to divert fish away from turbines, vertical barrier screens, orifices to divert fish from bulkhead slots and fish screen slots, a collection channel and underground pipe to transport fish from the dam to the collection facility, an inclined screen primary dewatering system, a single-stage wet separator and fish distribution system, fish holding raceways, sampling facilities, and barge and truck loading facilities.

Each of the bulkhead slots and fish screen slots (gatewells) has 2 orifices leading into the collection channel. Bulkhead slot orifices are 10 inches in diameter and fish screen slot orifices are 8 inches in diameter. The hydraulic capacity of the collection channel and pipe do not allow all orifices to be open at once. Under normal operation, 18 bulkhead slot orifices (one per slot) and up to six fish screen slot orifices are open at any one time. Fish screen slots and Wagner Horns had closure devices installed during 1995. Cables broke on some of the Wagner Horn closures shortly after construction and allowed the devices to fall off. Replacement took place during 1996. However, not all the fish screen slot closures are 100% effective in deterring fish from moving into the slots. Consequently fish screen slot orifices are run on an alternate basis throughout the season to allow trapped fish an escape route into the collection gallery.

Depending on the amount of debris moving through the system, the bulkhead slot orifices are normally backflushed with air every three hours around the clock to clear debris during the actual fish collection season. Lights are directed at each open orifice to enhance fish attraction into the collection channel. Water and fish from the collection channel are carried underground through a 42-inch diameter gravity flow pipe to the collection facility approximately 1/4 mile downstream from the dam. Upon reaching the facility, most of the water is eliminated through an inclined screen and the remaining water and fish flow into the separator. Small fish pass through the separator bars and are collected while large fish and woody debris are returned to the river. Collected fish are then routed directly to a barge, bypassed back to the river, placed in a raceway for later transport, utilized for research, or become part of the sample.

Facility Modifications

Facility Modifications

The following modifications and work were made to the Lower Granite Juvenile Fish Facility and barges prior to the 2013 season:

1. Refurbished the sample diversion slide gates per PSMFC guidelines.
2. Had the problem fish counters repaired by Smith Root.
3. Sealed the base of the tank partition to the floor in the sample holding tank.
4. Repaired/replaced problem pneumatic gate valves on the raceways.

5. Repaired the highly eroded concrete on the floor of the separator upwell (powerhouse mechanical crew).
6. Installed a drain on the 42-inch pipe from the 8th floor gallery to allow full pipe dewatering for post season ROV inspections (powerhouse mechanical crew).
7. Replaced the 24-inch knife gate valve on the separator.
8. Evaluated the oxygen monitoring system on the barges and ordered a replacement system to be installed late FY 2013.
9. Replaced copper fittings and injectors on Cat engines on Barge 8106.
10. Replaced the hatch covers on Barge 8107 in attempt to stop leaks into barge hull void.
11. Repaired the seals on the sample holding tank anesthetizing bins.
12. Refurbished all the oxygen probes for the Point Four and YSI systems.
13. Cleaned up the counter tunnel wire connections in the separator control room.

River Conditions

Flows in the Snake River during the 2013 season were well below average. Flows were the second lowest in the last five years during April and May, the lowest in the last five years during June, July, August and September and the second highest in the last five years in October. Flows for entire the juvenile fish collection period running from March 26 through October 31 averaged 41.7 kcfs. Flows exceeded the Biological Opinion target of 100 kcfs on only 8 dates during 2013 and never came close to reaching the 200 kcfs mark. River flows for the last few days of March were between 27.2 and 39.2 kcfs – well below the norm. Flows in April averaged 56.4 kcfs and ranged between 42.0 kcfs and 75.2 kcfs. In May, river flows averaged 82.2 kcfs and ranged between 54.1 kcfs and 137.5 kcfs. The peak flow of the season occurred on May 15 when flows reached 137.5 kcfs. River flows in June averaged 56.3 kcfs and ranged between 40.5 kcfs and 74.4 kcfs. River flows in July averaged 33.3 kcfs and ranged between 21.4 and 52.0 kcfs. August flows averaged 22.1 kcfs and ranged from 17.7 kcfs to 26.3 kcfs. River flows were only slightly lower in September averaging 20.4 kcfs and ranging from 15.6 to 25.3 kcfs. Daily flows in October averaged 23.3 kcfs and ranged up to 34.4 kcfs. The season's low flow date occurred on October 28 and was 13.7 kcfs. The flow on October 31, the last day of the collection season, was 18.1 kcfs.

Operations and Maintenance

Collection and Transport Operations

The fish facility was placed in secondary bypass mode (fish routed over the separator and through the long outfall pipe to mid-river) when the system was first watered up on March 18. Biological technicians were on duty 24/7 the same day to monitor the system. This was done to prevent lamprey and juvenile salmonids from possibly being stranded on the inclined screen. Collection for lab sampling began at 0700 hours on March 25. All fish, except those collected and transported for research purposes, were bypassed to the river until the evening of April 22 when an estimated 15,000 juveniles were diverted to a raceway for NOAA fisheries transport research marking operations. Approximately 15,000 juveniles were again diverted to a raceway for NOAA for transport marking operations on the

evening of April 25. Raceway collection for general transport operations began at 0700 hours on April 27.

An estimated 3,894,569 juvenile salmonids were collected at Lower Granite Dam during the 2013 operating season. The 2013 species collection included: 1,362,720 clipped yearling chinook, 502,542 unclipped yearling chinook, 173,989 clipped subyearling fall chinook, 319,566 unclipped subyearling chinook, 1,058,688 clipped steelhead, 386,214 unclipped steelhead, 27,395 clipped sockeye/kokanee, 15,377 unclipped sockeye/kokanee and 48,078 coho. Fewer fish were collected for all species groups in 2013 compared to 2012 except for coho and clipped sockeye. Clipped sockeye had the highest number of fish collected in the last five years while clipped and unclipped subyearling fall Chinook had the lowest collection in the last five years. Clipped and unclipped yearling Chinook, clipped and unclipped steelhead and unclipped sockeye/kokanee all had the second lowest collection in the last five years.

Peak collection dates during 2013 were quite a bit different than the long-term average (Table 3). The peak collection day of May 13 (244,000) is the second latest in the last five years and was also the peak day for several species. Clipped yearling Chinook (129,641) peaked on May 8. Unclipped yearling Chinook collection (37,800) peaked on May 13 and is basically tied with 2011 as the latest peak collection day in the last five years. Clipped (89,200) and unclipped steelhead (42,400) collection peaked on May 13, the second latest peak collection day in the last five years. Clipped subyearling fall Chinook collection (20,100) peaked on June 9, the second latest peak collection day in the last five years. Unclipped subyearling fall Chinook collection (20,800) peaked on June 9 the same day as clipped subyearling fall Chinook, and that is the lastest day in the last five years. Clipped sockeye collection (13,000) peaked on May 16, the third earliest peak collection day in the last five years. Unclipped sockeye collection (4,600) peaked on May 17, the earliest peak collection day in the last five years. Coho collection (9,400) peaked on May 14, the second earliest day in the last five years. All species groups' peak collections occurred before the peak flow date of May 15 except for clipped and unclipped sockeye/kokanee and clipped and unclipped subyearling fall Chinook.

Table 3. Annual peak collection days at LGR, 2009-2013.

	Yearling Chinook		Subyearling Chinook		Steelhead		Sockeye/Kokanee		Coho	
	Clipped	No Clip	Clipped	No Clip	Clipped	No Clip	Clipped	No Clip	All	Total
2009	15-May	26-Apr	29-May	30-May	24-Apr	24-Apr	20-May	21-May	21-May	24-Apr
	112,000	29,000	13,600	21,600	182,000	68,400	3,200	1,200	8,200	322,800
2010	28-Apr	28-Apr	5-Jun	5-Jun	21-May	21-May	6-Jun	21-May	20-May	21-May
	73,800	25,200	23,700	40,200	81,800	23,600	400	800	4,800	183,000
2011	12-May	12-May	19-Jun	28-May	3-Apr	12-May	25-May	22-May	12-May	12-May
	165,200	33,800	12,550	25,600	160,139	48,000	4,800	2,300	5,200	375,600
2012	26-Apr	26-Apr	4-Jun	5-Jun	26-Apr	26-Apr	9-May	18-May	18-May	26-Apr
	135,000	69,400	15,000	20,800	119,000	37,400	200	5,200	6,300	362,200
2013	8-May	13-May	9-Jun	9-Jun	13-May	13-May	16-May	17-May	14-May	13-May
	129,641	37,800	20,100	16,225	89,200	42,400	13,000	4,600	9,400	244,000

During 2013 fish barging operations began slightly earlier than in recent years. Only one research barge (transport evaluation) was sent out prior to the initiation of normal barging operations. That barge departed Lower Granite on April 26. With the exception of the fish collected for the April 26 research trip, all fish other than sample fish were returned to the river by way of secondary bypass (bypass through the outfall pipe to the river). Fish were collected for numerous other studies after general collection began but this had no effect on the general operation of the facility. After normal collection activities began, these fish were handled as part of the regular collection and diverted to the upstream raceways for marking operations. General every-other-day fish barging operations at Lower Granite began on April 28. Every day barging of fish at Lower Granite began on May 2 and continued unimpeded through June 3. Every-other-day barging of fish at Lower Granite then resumed and continued unimpeded through August 16.

Every other day trucking operations began on August 18 and continued until October 31. Unlike recent years, it was necessary to use the semi at Lower Granite on a fairly frequent basis during 2013. Some of this was due to the cessation of the fall transport study by NOAA-fisheries which in recent years had diverted quite a few would be transported fish from the sample and marked them for in-river release. This increased the number of fish transported well past the midi-tankers capacity on several occasions. In all a total of 11 trips were made with the semi during 2013. Due to a manpower shortage and high fish collection numbers, Lower Granite personnel transported fish from Little Goose on September 5, 7, 9 and October 1 and 7.

As per previous years, fish collected at Little Goose Dam and Lower Monumental Dam were also loaded onto fish barges that originated from Lower Granite Dam during the 2013 season. This year no fish were barged from McNary Dam. The total number of fish barged from the two other sites during the 2013 season was: Little Goose Dam (2,573,039) and Lower Monumental Dam (1,095,459).

An estimated 3,211,877 juvenile salmonids (82.5% of fish collected) were transported from Lower Granite in 2013. This is considerably higher than during 2012 when an estimated 2,674,880 juvenile salmonids (46.0% of fish collected) were transported from Lower Granite and during 2011 when 61.4% of the fish were transported. In 2013 the low flows reduced the number of fish bypassed by spill before barge transportation operations began. The numbers of fish and the percentages transported of each species group in 2013 were: 1,176,085 clipped yearling Chinook (86.3%), 378,627 unclipped yearling Chinook (75.3%), 161,460 clipped subyearling fall Chinook (92.8%), 317,263 unclipped subyearling fall Chinook (99.3%), 754,422 clipped steelhead (71.3%), 333,526 unclipped steelhead (86.4%), 27,386 clipped sockeye (100.0%), 15,300 unclipped sockeye/kokanee (99.5%) and 47,808 coho (99.4%). All species groups had a higher percentage of fish transported in 2013 compared to 2012 except for clipped subyearling fall Chinook, unclipped subyearling fall Chinook and unclipped sockeye.

The physical operation of the transport barges and transport trucks went reasonably well during the 2013 season. There were a couple of operational towboat problems that slightly delayed the release of fish at the designated site but no serious mechanical problems developed with barges or trucks. The tug Umatilla with the loaded fish barge 8105 had an engine failure on the afternoon of June 8. The tug Cascades was diverted to John Day Dam to pick up the Umatilla's loaded barge. The fish should have been released on the evening of June 8 but due to the breakdown were released at 1300 hours on June 9. On the trip that departed Lower Granite on July 7, the towboat Liberty developed problems with the

starboard engine. The towboat's engine was successfully repaired at Pasco, WA on the return trip to Lower Granite following fish release.

Bypass

The fish facility was placed in secondary bypass mode (fish routed over the separator and through the long outfall pipe to mid-river) when the system was first watered up on March 18. Biological technicians were on duty 24/7 the same day to monitor the system. This was done to prevent lamprey and juvenile salmonids from possibly being stranded on the inclined screen. Collection for lab sampling began at 0700 hours on March 25. All fish, except those collected and transported for research purposes, were bypassed to the river until the evening of April 22 when an estimated 15,000 juveniles were diverted to a raceway for NOAA fisheries transport research marking operations. Approximately 15,000 juveniles were again diverted to a raceway for NOAA for transport marking operations on the evening of April 25. Raceway collection for general transport operations began at 0700 hours on April 27.

When the separator inclined screen becomes highly clogged with small debris brush cleaning is ineffective and it is necessary to dewater the screen in order to clean it. There were a total of six cleaning events during 2013 with an average duration of 30 minutes per cleaning. During these cleaning events no estimate was made of the number of fish bypassed because the fish are bypassed before encountering the sampling system (Primary Bypass). Following the end of fish sampling, the facility was placed into secondary bypass on October 31 at 0700 hours to prevent juvenile fish and lamprey from becoming impinged on the separator inclined screen and also so that fish could be routed through the PIT-tag interrogation system. Fish were routed through the secondary bypass until the afternoon of December 5 when the collection gallery and juvenile fish system were dewatered for the winter due to very cold temperatures and concerns with freezing pipes and valves.

In 2013, 678,827 smolts (17.4% of those collected) were bypassed from the LGR Juvenile Fish Facility compared to 3,133,048 in 2012, 2,429,798 in 2011, 247,129 in 2010, and 2,465,023 in 2009 (Table 2). The number and collection percentage of smolts bypassed by species group in 2013 included: 184,931 clipped yearling Chinook (13.6%), 123,327 unclipped yearling Chinook (24.5%), 12,212 clipped subyearling fall Chinook (7.0%), 1,485 unclipped subyearling fall Chinook (0.5%), 303,992 clipped steelhead (28.7%), 52,616 unclipped steelhead (13.6%), 0 clipped sockeye/kokanee (0.0%), 54 unclipped sockeye/kokanee (0.4%) and 210 coho (0.4%). An estimated 615,528 juvenile salmonids, 15.8% of the total collection, were bypassed from March 26 to April 27 before the start of general transport operations (this figure includes both facility and research bypassed fish). By contrast during 2012 an estimated 3,088,372 juvenile salmonids, 53.1% of the total collection, were bypassed from March 26 to May 1, before the start of the general transport season. During 2011 27.1% of the total collection (1,709,591 smolts) was bypassed from March 26 to May 1.

As part of five research studies, 76,796 smolts were bypassed from LGR during 2013. The National Marine Fisheries Service (NMFS) Survival Study PIT-tagged and bypassed 36,507 smolts: 11,545 unclipped yearling Chinook, 17,424 clipped steelhead and 7,538 unclipped steelhead. The USGS, USFWS, Pacific Northwest National Laboratory (PNNL) and NMFS "Investigating passage of ESA-listed fall Chinook salmon at Lower Granite Dam during winter when the fish bypass system is not

operated" study bypassed 14 non-target smolts and 40 previously PIT-tagged holdover subyearling fall Chinook from the SBC tanks. The Idaho Fish and Game Genetic Stock Index study bypassed 690 unclipped, non-CWT yearling chinook and 271 unclipped, non-fin eroded and non-CWT steelhead. The NMFS study to monitor the behavior and survival of wild spring/summer Chinook salmon in the Snake River basin bypassed 154 previously PIT-tagged unclipped yearling Chinook and 35 non-target fish. Blue Leaf Environmental, Biomark and UC Davis bypassed 36,948 fish into Unit #5 gatewells or directly into the collection channel including 11,253 clipped yearling Chinook, 12,212 clipped subyearling fall Chinook, 12,058 clipped steelhead and 1,425 lamprey. Another 50 fish were rejected for their study and bypassed including 42 clipped yearling Chinook, six clipped steelhead and two lamprey. From the SBC part of their study they bypassed 141 fish including 36 clipped yearling Chinook, 22 unclipped yearling Chinook, 82 clipped steelhead and one unclipped steelhead before the start of general transportation. They also bypassed 1,946 (852 clipped yearling Chinook and 1,094 clipped steelhead) of their PIT-tagged fish from the SBC tanks that were released into the gatewells and subsequently recaptured in the SBC tanks before the start of general transport and technically these fish were collected twice and bypassed twice from LGR.

Turbine Operations

During 2013, turbine units 1-6 were unavailable for service a total of 11,327.8 hours per the Ombil status hours database. Given a possible 52,560 operating hours for all six units over the course of a 365 day year this computes to an overall unit availability factor of 78.5%. The 2013 availability factor on a per unit basis was: turbine unit 1 (89.8%), turbine unit 2 (79.1%), turbine unit 3 (89.3%), turbine unit 4 (84.8%), turbine unit 5 (60.0%) and turbine unit 6 (67.8%). The biggest outage factor for all the units was the extensive powerhouse roof repair work which took place in August and September and resulted in minimal generation during that time period. Some other major outage items on a per unit basis are as follows. Unit 1 was out of service 242.15 hours of annual maintenance and 73.67 hours for vibration testing. Unit 2 was out of service 1,345.47 hours for a six year overhaul. Unit 3 shows 582.35 hours of outages for annual maintenance. Unit 4 was out of service 583.00 hours of annual maintenance and 189.15 hours for governor problems. Unit 5 had 2,411.12 hours of outages for cavitation repair and a combined total of 610.37 hours for annual maintenance. Unit 6 (limited Ombil entries) was out of service starting from June 24 through December 31 for cavitation repair followed by annual maintenance.

The majority of fish-related outages were due to fish screen installation and removal activities and video inspections of the VBSs and ESBSs. To determine the outage hours the Ombil Data base was queried for the 1 January to 31 December 2013 time period. Unit 1 had a total of 157.9 hours of fish-related outages. The biggest factors were moving an ESBS to unit 2B and VBS repair work in the B-South slot. Unit 2 had a total of 38.8 hours of fish-related outages and the biggest factor was 20.1 hours related to ESBS problems in slot 2B. Unit 3 had a total of 72.9 hours of fish-related outages and ESBS problems in April were the biggest factor followed by ESBS slot troubles in slot 3B later in the season. Turbine unit 4 had a total of only 23.1 hours of fish-related outages. The biggest listed factor was ESBS installation in March. Per Ombil unit 5 had only 12.3 hours of fish outages and VBS inspection/slip ring cleaning was the biggest factor listed. Unit 6 is said to have had 533.7 hours of fish-related outages with ESBS removal between 11 April and 2 May accounting for nearly all the hours.

Other items that accounted for the Ombil fish-related outages during 2013 including monthly VBS inspections, gatewell dipping to determine if modified ESBSs from John Day Dam descaled fish at a greater rate than our standard ESBSs, moving ESBSs from one slot to another, and correcting ESBS scrub brush problems. Trash rack raking on the units took place in late February and a total of 29.0 Ombil-listed hours of raking took place (these hours were not included in fish-related outages).

Forebay Debris/Trashracks

Forebay debris during the 2013 season was relatively light due to lower than average flow conditions. Initial trash rack raking operations were completed February 25-28, 2013. A debris spill to clear debris from the forebay was authorized and took place on March 12. During most of the season forebay debris levels were moderate and debris drifted back and forth with the wind. Due to concerns with elevated descaling rates in the lab during August the unit 2 and unit 5 trashracks were raked on August 27 and a fair amount of "Christmas Tree Like" debris was removed from the trash rack in front of gatewell slot 5B. Due to continued high descaling rates, it was recommended that the powerhouse also pursue raking the trash racks on units 1, 3, and 4 before the completion of the powerhouse roof repairs. Additional trash raking operations took place on September 10 and the trashracks on units 1, 3, and 4 were raked. Some light debris was removed with the highest concentration found in front of gatewell slot 4B. No further trash rack raking took place during 2013.

Extended-Length Submersible Bar Screens (ESBSs)

All operating turbine units were equipped with ESBSs during the 2013 fish passage season. Winter maintenance of the screens by the powerhouse mechanics was ongoing in late February and early March. A physical inspection of the screens was conducted by fish facility personnel in mid March - immediately prior to installation. No significant problems of any kind were detected. Installation of fish screens in all operating units (Units 1,2,3,4,6) was completed on March 18-20. The screens were then operated throughout the 2013 season according to established protocols. Due to very cold weather conditions, the last of the screens were raised for the season on December 4-5.

Every attempt was made to conduct video inspections of the ESBSs during the course of the fish season as outlined in the Fish Passage Plan. While it is possible to get a good view of the VBSs with the existing video equipment, it is more difficult to get an accurate assessment of the ESBSs due to the limited amount of screen area detectable on the camera. Video inspections took place April 19-20, May 17-18, June 14-15, August 23, and October 25-26. No problems with the ESBSs were detected on these inspections. (Per the Fish Passage Plan, it is not necessary to conduct video inspections during July and September.)

Operation of the standard ESBSs was relatively trouble-free during the 2013 season at Lower Granite (probably due to 2013 being a low flow year with reduced debris). Nevertheless there were a couple of ESBS issues that developed. On April 3 a failed transducer on the ESBS in slot 3B caused a unit outage of approximately one day. On May 20 a failed fish screen in slot 2B caused an outage of approximately one day which was resolved by replacing the failed screen with a replacement screen from unit 1.

All ESBSs at Lower Granite are equipped with a brush cleaning system which can be adjusted for various cleaning cycles. Lower Granite's scrub brushes can be individually set to clean the screens at the following interval times: 15 minutes, 1 hour, 2 hours, and 4 hours. During most of 2013 the brush cleaning times on all ESBSs were set for one cycle every hour. There were relatively few issues with the scrub brushes during 2013.

During routine examination of the fish screens in September and October of 2012 it was determined that Lower Granite's ESBSs were bent in several units. Damaged fish screens were eventually found in slots 1C, 2B, and 5C. Lower Granite was eventually able to acquire replacement ESBS screens from John Day Dam. The John Day screens were slightly different from the ESBSs in long-term use at Lower Granite due to having 1/16 inch spacing compared to 1/8 inch spacing on the standard screens in use at Lower Granite. Because of this and due to concerns with the harmonics of the John Day screens, the existing holes in the top three rows of perf plates behind the John Day screens were enlarged. Concerns developed regarding the use of John Day screens at Lower Granite and their possible impact on fish condition. As a result testing was conducted in 2013.

Gatewell dipping operations took place in May, June, and July of 2013 in attempt to determine if the modified replacement fish screens obtained from John Day Dam caused increased fish descaling rates in comparison to the extended length (ESBS) fish screens in long-term use at Lower Granite. Initially a John Day test screen was installed in the C slot on turbine unit 6 only and standard ESBSs were put in the A and B slots. Gatewell dipping operations to see if there was a noticeable difference between the screens began on May 9 and was conducted again on May 16 and May 23. The goal was to look at 100 smolts from each gatewell on each day. The results indicated there was not an increase in descaling with the John Day screen installed in slot 6C and standard ESBSs installed in slots 6A and 6B.

Due to additional concerns with the possible impacts of the John Day Screens on summer run fish, testing was again conducted in late June and July of 2013. This time the John Day test screens were installed in the B and C slots of turbine unit 3 while a standard screen was left in the A slot. All three slots were gatewell dipped on June 27, July 2, and July 18 with a goal of examining 35 fish from each slot. The results indicated a lower descaling rate for the John Day screens in the B and C slots than the standard ESBS screen in slot A. In addition all three slots in unit 2 (equipped with standard screens) were dipped to compare descaling with slots 3B and 3C. The comparison again indicated a lower descaling rate in the gatewell slots with the John Day screens.

Vertical Barrier Screens (VBSs)

New vertical barrier screens (VBSs) were installed in all turbine units during 1996. These screens have panels of plastic mesh on the front and 25% open area perforated plate on the back. In April of 2005, three experimental VBSs were installed in unit 4 and these screens remained in place during the entire 2013 fish season. Minor problems (missing rivets or loose straps) have been detected on VBS video inspections in recent years but a tight schedule for the mechanical crew has made correcting these minor problems difficult. VBSs were video inspected in conjunction with ESBSs

during the 2013 fish passage season. There were a few minor items found but nothing of real concern until the October 25-26 video inspection when a large tear was found in a VBS in slot 1B about 50 feet down. The tear was quickly repaired by the mechanical crew during the October 29 – November 1 time period.

Gatewells

Gatewells were inspected during adult fishway inspections throughout the 2013 season for debris buildup, oil, dead fish, unusual concentrations of live fish, or anything else out of the ordinary. As in previous years, extended length bar screens and modified vertical barrier screens noticeably increased the turbulence in the gatewells. This caused debris to tumble around in the gatewells and exit through the orifices, rather than accumulate on the gatewell surfaces. Another factor in the lack of gatewell surface debris buildup was that gatewell drawdown with ESBSs was greater than with the earlier 20 foot traveling screens, putting the orifice closer to the surface, especially under minimum operating pool conditions. As was the case from 1998 - 2012, constant debris movement through the orifices prevented the need for extensive gatewell cleaning during 2013. In addition, since 2013 was a relatively low flow year, there was not as much debris moving through the system as in some recent years.

Some larger debris was removed from individual gatewell surfaces with a small hand dipping basket when it appeared that it might cause problems with movement through the collection gallery orifices. This operation first took place during initial water-up in late March and continued throughout the season as circumstances warranted. Gatewell dipping took place only when the units were shut down for maintenance or were off line due to lack of water for generation. During nearly all of the 2013 collection season, surface debris coverage on the gatewells easily averaged less than 1%.

Orifices and Collection Channel

The Lower Granite juvenile collection channel was watered up on March 18, 2013 to accommodate fish screen installations. Bulkhead (downstream) slot orifices were operated in the usual manner during 2013 with at least one orifice per gatewell slot opened to divert fish into the collection channel. Based on gatewell dipping results from 2007, an orifice from slot 5B was also left open during the entire 2013 fish collection season to ensure fish moved out of it safely. Orifices from the other fish screen slots were operated when hydraulic conditions in the gallery permitted.

A prototype broad crested weir and a prototype 14-inch orifice were installed in gatewell slot 5A during the winter of 2012-2013 and tested during the spring/summer of 2013. Biological evaluation of these structures took place from April 15 – June 30 by personnel from UC Davis, Biomark, and Blue Leaf Environmental. Due to problems with the outflow hitting a support beam, the 14-inch orifice was modified on April 22 and fitted with a 20-degree mitered bend which deflected the outflow downward into the collection channel flow. In addition, the north makeup water valve in the collection channel was closed during testing and the south makeup water valve was adjusted to maintain the channel elevation at between 727 and 728 feet which also helped prevent outflow from the orifice from striking the support beam.

The air backflush orifice cleaning system continued to work reasonably well during 2013 and there were no significant maintenance issues of any kind. Due to the variability of the debris moving through the system, fish facility personnel maintained a rigorous schedule of backflushing orifices every three hours around the clock from late March through the cessation of fish collection activities on the last of October. After that time, orifice flushing activities were slightly reduced but still maintained on a regular basis to ensure no orifices were plugged and impeding fish passage. This operation continued until the last of the fish screens were pulled on December 4-5. *Note: The fish screens were removed earlier than normal in 2013 due to very cold weather conditions developing earlier than normal. As soon as possible the orifices in the collection gallery were also closed. The fish facility was beginning to freeze up and continued operations would likely have resulted in severe frost damage.*

Primary Dewatering Structure

Lower Granite's primary dewatering structure consists of an inclined screen of stainless steel mesh, supported by heavy bar screen, just upstream from the porosity control perforated plate for the separator. There is no mechanical cleaning device on this screen. It is cleaned with a long handled brush or scraper at periods ranging from every hour to once or twice per day dependent on the amount of debris moving through the system. Debris buildup is usually not a problem. Exceptions are during periods of high wind when tumbleweed and other plant materials are blown into the river or during periods of high river flow when an excessive amount of small woody debris, such as wood chips or pine needles, is in the river. Debris spills can also dislodge fine material which can pass into the juvenile fish system and cause problems. In addition small invertebrates in the river can also plug the screen and make cleaning very difficult. During mid to late May 2013, debris levels across the separator were high at times resulting in the need to clean the screen on an hourly basis to prevent clogging.

When the inclined screen on the separator system becomes severely clogged with debris, it is necessary to go into primary bypass mode by closing the dewatering valve below the screen and opening the 72-inch bypass valve. This takes pressure off the top of the inclined screen and allows debris to either float off or be brushed off. Typically it takes about 20 - 30 minutes of time to go through the entire cleaning procedure during which time fish are bypassed back to the river through the pipe at the base of the separator (primary bypass). During 2013 it was necessary to dewater the separator on six different occasions to clean the inclined screen due to debris impingement. Cleaning events took place on May 15 (twice), May 16, May 17 (twice) and on September 15. Cleaning was done with a combination of power-washing and brushing the loose debris up the screen where it could be placed in trash baskets for removal. Cleaning the inclined screen is often a compromise as drawing the water down on the screen far enough to clean it results in a loss of water to the fish facilities. Consequently cleaning is nearly always a hurry up event in attempt to clean enough to solve the problem and at the same time avoid a fish loss.

Due to continued concerns with cleaning the inclined screen (and two injuries associated with hand brushing the screen during 2013) an air-burst cleaning system is being installed during the 2013-2014 winter maintenance period. The air supply will be from an accumulator tank which will be charged with the existing facility air compressors. Two air burst panels will be utilized and a sustained air burst of several seconds should be possible. Hopefully this will greatly reduce the need to dewater

the inclined screen for cleaning purposes. In addition, a new primary dewaterer for the facility will be installed during the Phase 1A fish facility construction which will be equipped with cleaning systems which should greatly reduce the need for hand cleaning.

Separator

The separator at Lower Granite is a single stage separator and currently has no provision for size separation of juvenile fish. The separator continued to function well for the most part during the 2013 season. Fluctuating water levels in the collection gallery caused very frequent adjustment of the 42-inch control valve early in the season. Some of this was due to the testing of the 14-inch orifice and the prototype weir in the collection gallery. The south shore makeup water valve in the gallery is set to control the gallery within a certain range and did not always adjust properly in relation to the operation of these structures and this was reflected downstream at the separator. Later in the season the south shore makeup water valve became clogged with debris and was manually locked out for the duration of the season. Water levels in the gallery then varied with the forebay elevation and required frequent adjustment of the gallery orifices to keep the gallery at the proper level. This also resulted in the need to adjust the 42-inch separator valve on a frequent basis.

While 2013 was a relatively light debris year, there were still a few periods of time when high levels of debris became an issue at the separator. The increasing debris gradually plugged the inclined screen resulting in the need to adjust the 42-inch dewatering valve to reduce the water flow off the inclined screen and into the separator. Debris also became an issue after it passed through the separator bars and reached the separator exits. When debris became an issue the separator exits and bar screen dewaterer were checked on an hourly basis by the separator technicians. Descaling of juvenile fish became quite severe during late August and September of 2013 and the JFF staff became very concerned that some descaling might be taking place in the separator system. Consequently the water level was lowered in the separator on several occasions and the separator bin area checked to see if debris had built up to any extent. A few sticks were removed each time but nothing to the extent that would have caused the descaling in the lab being seen at the time.

As has been the case during recent years, during 2013 small Chinook jacks caused some problems by falling through the separator bars and ending up in the sample. This is especially problematic because the jacks tend to thrash around quite a bit while being anesthetized and can potentially injure the much smaller juvenile fish in the anesthetizing bins. In addition, jacks could potentially be caught by anglers soon after release and should not be consumed early on due to the possible latent effects of MS-222. In order to prevent jacks from entering the sample, an additional set of separator bars with a smaller spacing were place on top of the existing separator bars on the morning of September 25. These bars were removed after the end of fish collection and sampling activities after the system had been switched back to secondary bypass mode. The additional bars measure 1 inch in diameter, are constructed of rigid wall aluminum tubing, and are spaced approximately 1 1/16 to 1 1/8 inches apart. They are built in three full length panels and secured in place overlaying the existing separator bars. These bars were effective in keeping nearly all the jacks out of the sample in 2013 and generally required little maintenance. The only item of real concern was that on occasion some debris did become entrained between the jack bars and regular bars. This required the short term removal of a section of jack bars to remove the debris.

As in recent seasons the separator was also operated in the standard mode (water over the bars) to monitor for late season PIT-tagged juveniles passing through the system in November and December of 2013. (Unlike some other sites, Lower Granite does not have a full flow bypass with PIT-tag detection for juvenile fish. PIT-tag detection of juveniles normally ceases with the end of separation activities on the last of October.) No sampling or handling of juvenile fish took place during the extended separator operations. They were simply routed through the separator and out the long bypass pipe back to the river (secondary bypass) until the afternoon of December 5 when the juvenile collection system was dewatered for the season due to very cold temperatures and the high possibility of frost damage at the JFF. The JFF maintenance crew kept electric/diesel heaters available for use at the separator and other exposed pipe areas during November and early December. Separator personnel started the heaters whenever overnight temperatures dropped to the mid 20F and concerns developed with pipes freezing. Due to colder than normal temperatures, the diesel heaters were run on several occasions during November and early December.

Sample System/PIT Tag System

The sample system at Lower Granite consists of two slide gates located in the bottom of the separator exit flumes a few feet downstream of the separator, a large slide gate which separates PIT-tagged fish from sample fish, a PIT-tag tank and routing system to a holding tank or the river, a sample tank with four operational 4-inch counter tunnel exits, an enclosed pipe that carries fish from the sample tank to a sample holding tank which is divided into two equal halves (each with two pre-anesthetizing chambers). The two primary slide gates, which are controlled by a touch pad calibrated to within 0.001%, also act as PIT-tag diversion gates. The system has the capability to send PIT-tagged fish that exit the separator during a sample either to the sample or to the river. Most of the time, the system is set so the sample overrides the PIT-tag diversion system, sending PIT-tagged fish to the sample instead of being diverted back to the river. During 2013 this occurred from startup on March 25 until 0700 hours on July 16 when the system was switched over to “divert during sample mode”. (In this mode the sample is over-ridden to allow PIT-tagged fish to be diverted while a sample is in progress.) The system was operated in divert during sample mode until the end of normal separator operations on October 31.

At the start of the season on March 25 the sample gates were set to divert 10% of the fish to the sample while the remaining fish were diverted back to the river through the bypass outfall pipe. Sample rates varied between 0.5% and 10% during the peak of the fish collection season depending on fish numbers and the need to supply sample fish for the evaluation of the overflow weir and 14-inch orifice in the collection gallery. The slide gates were set to divert fish to the sample tank four to six times per hour during the course of the season until August 16 when the system was switched to a 100% sample rate due to lower fish numbers and also in order to help facilitate truck loading operations. The sample rate remained at 100% until 0700 hours on September 5 when the sample rate was lowered to 50% due to an increase in collection numbers. The sample rate remained at 50% until September 10 when the rate was increased back to 100% at 0700 hours due to a decrease in fish collection numbers. Sample rates remained at that level through the duration of September and then bounced around between 25% and 100% for the duration of the season. The sample rate on October 31, the last day of the collection

season, was 50%. During the course of the season, the sample system only needed minor adjustments in air pressure and gate timing by Pacific States Marine Fisheries Commission personnel.

A new slide gate system with PIT-tag detection capabilities was added to the flume leading to the upstream raceways and bypass outfall pipe during the 2007 winter outage period. This system was installed by NOAA-Fisheries and PSMFC personnel in March of 2007. The system now has four modes: 1) bypass marking, 2) bypass, 3) general collection, and 4) marking. When the system is in bypass marking mode all fish are diverted to the raceways for marking purposes except sort by code fish which are bypassed back to the river. When the system is in bypass mode all fish are diverted through the bypass outfall pipe (secondary bypass) to the river. When the system is in general collection mode, fish are diverted down the flume to the east raceways for normal collection and marking activities. And finally when the system is set for marking mode, previously PIT-tagged fish (sort by code) are diverted to raceway 10 through an additional pipe to avoid being handled again. Untagged fish are routed down the flume for normal marking activities. This system continued to work well during 2013.

Barge/Truck Loading Operations

It has long been the policy at Lower Granite to try and load as many fish as possible directly onto fish barges to avoid raceway loading/holding. Direct loading of smolts onto waiting fish barges (rather than into raceways) is felt to be highly beneficial to the fish by eliminating secondary handling and related stress factors. An estimated 33.9% of the smolts (approximately 1,073,950 smolts out of 3,171,062 smolts barged from Lower Granite) were direct loaded into barges during 2013. By comparison direct barge loading percentages for some recent years were 2012 (12.4%), 2011 (43.4%), 2010 (44.4%), and 2009 (32.5%).

Truck loading operations at Lower Granite went relatively well during 2013. As per recent years, there was no early season trucking. Trucking operations began immediately after fish barging ended and ran from August 18 until October 31. NOAA-Fisheries did not conduct the late season transport evaluation during 2013 and this increased the number of fish transported from recent years as NOAA had frequently marked a relatively high number of fish for return back to the river as well as transport. Consequently, it was necessary to use the semi on more days during 2013 than might have been expected. Fish were diverted from the lab directly onto the waiting midi-tanker or semi reducing fish handling operations.

Avian Predation

Control Measures

Predator marks caused by birds, characterized by a distinct V-shaped descaling pattern on both sides of a fish were the most common predator mark (70.6%) compared to 24.4% caused by fish and 5.0% caused by lamprey. Although clipped sockeye exhibited the highest percentage of predator marks by number examined, clipped steelhead and unclipped subyearling fall Chinook had the largest

percentage of total predation marks at 31.2% and 24.9% respectively. Normally, the larger clipped and unclipped steelhead smolts have the most predation marks due to bird bites.

Bird wires in the Lower Granite Dam tailrace area were replaced by USDA Wildlife Services personnel during March, 2004 (immediately prior to the beginning of the 2004 fish season). To help ensure the wires were less susceptible to damage by watercraft, braces were built on the powerhouse tailrace deck during 2006 to raise the wires higher above the water. Six anchor points were built and the extended braces were installed on the tailrace deck by Corps of Engineers personnel. Several bird wires were replaced by USDA-APHIS personnel in September 2010. Two bird wires broke late in 2012 and they were replaced before the 2013 collection season began. The bird wire deterrent system continued to work well during the 2013 season.

Avian predation control measures at Lower Granite Dam in 2013 were similar to those conducted during 2004-2012. The actual hazing period in 2013 ran from April 1 through June 30. This is slightly reduced from some earlier years and was done to allow for full daylight hazing efforts during the period of time the most juvenile fish were being spilled over the dam. Hazing took place 16 hours per day (essentially dawn to dusk) between April 21 and June 1. This appeared to be highly effective and stopped the problem we have had during earlier years of gulls returning to feed after the control agent left for the day. An individual agent was assigned to Lower Granite Dam during the normal work week and was able to devote his entire time to controlling avian predation at this site. Additional agents filled in to allow for 16 per hour week day coverage and 16 hour day weekend coverage during the April 21 to June 1 period. The control measures utilized included: 15 mm pyrotechnics, long-range rockets, and fused rope salutes. At least for the near term propane canons will no longer utilized at Lower Granite because of safety concerns. Limited lethal take of gulls and cormorants by APHIS personnel stationed at Lower Granite is presently in the approval process for the upcoming 2014 season.

Gull Counts

Gull counts initially began at Lower Granite Dam during 1999 and continued each succeeding year including 2013. Utilizing binoculars, technicians assigned to the separator were instructed to count all gulls visible in the tailrace area (an area immediately below the dam to a defined point approximately one half mile downstream). Counts were made twice daily; at approximately one half hour after sunrise and then again at approximately one half hour before sunset. Daily count data was recorded on forms and entered into an Excel spreadsheet for later evaluation. General gull counting began on March 18 and continued through October 31. In addition, counts were extended through December 15 to take advantage of the additional monitoring opportunity due to late season separator operations. During the general March 18 to October 31 counting period a total of 2,748 gull sightings were recorded. This is considerably more than in 2012 when 1,360 gull sightings were recorded over the same time period. An additional 93 sightings were reported during the 2013 extended count period.

During the March 18 – October 31, 2013 time period slightly more gulls were seen on morning counts (1,474) than on evening counts (1,274). The highest count day for gulls during 2013 was on May 14 when a total of 80 were counted on the combined morning and evening counts. This is a day after the May 13 peak collection date at the JFF for all species combined.

Recommendations

1. Install a generator to power the fish facility during electrical outages.
2. Dependent on the full extent of the Phase 1 fish facility upgrade, refurbish the existing separator.
3. Install an airburst cleaning system underneath the inclined screen to help in debris removal.
4. Replace the cracked barge fish hold plungers with new prototype metal plungers.
5. Install ballast material in the voids of fish barges 4394 and 4382 to avoid the need to add/remove river water for ballast.
6. Paint the hulls on the 8000 series fish barges as soon as funding becomes available.
7. Refurbish the concrete on the raceway interiors with a new sac-rub finish (pending a new JFF).
10. Replace the aging lab chiller system with an improved system.
11. Install or remove push knees (as needed) on the fish barges and explore a new bumper system to use in place of the present cable and tire system.
12. Cover the upstream raceways to provide shading for juvenile fish.
13. Consider the purchase of a 1,000 gallon (well insulated) fish tank that could be mounted on a flatbed truck and used for fish transport as this would reduce the need for the rental semi tractors.

Acknowledgements

A total of 21 people were employed in various capacities at the Lower Granite Juvenile Fish Facility during 2013. Corps of Engineers biologists in charge of collection and transportation activities were Mike Halter (project fishery biologist) and Ches Brooks (assistant project fishery biologist). Corps technicians assigned to the barges were: John Dammann, Gene Sprofera, Robert Traufer, and Dan Caldwell. Corps separator technicians were: Robert Horal, Mike Casten, Cady Tyron, and Joel Dirks. The Corps maintenance staff consisted of Jeremy Krewer (term) and Robert Enzi. Raymond Cooper served as the engineering equipment operator leader. Mike Knapp served as the heavy mobile equipment operator. Truck transportation operations to below Bonneville Dam were shared by Raymond Cooper, Mike Knapp, and Robert Enzi.

Washington Department of Fish and Wildlife (WDF&W) Biologists in charge of COE Transport Oversight Contract activities and Smolt Monitoring Program activities were Shawn Rapp (Task Order Biologist), Fred Mensik (SMP Supervisory Biologist), and Alan Martin (SMP Biologist). The WDF&W also employed Bill Fitzgerald, Sarah Smith, and Ann Blachly as sample technicians and Jeremy Wright as an anesthetist.