# ADULT AND JUVENILE FISH FACILITIES MONITORING REPORT
# LOWER GRANITE DAM
# 2010

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## INTRODUCTION

This report summarizes the operation and maintenance of the adult fish passage facility at Lower Granite Dam in 2010, including the results of inspections completed by fisheries personnel from March 1 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 2010. 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 2010 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.

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

During 2010, the adult fishway system was all or partially dewatered from January 4 until February 2 for maintenance purposes. The ladder portion of the fishway was dewatered on January 4. Powerhouse crews began draining the powerhouse channel portion of the ladder on January 5. Unfortunately some problems developed and a bulkhead was not put into place between the diffuser 13 supply conduit and the fish pump discharge chamber. In addition a bulkhead was not installed at fish pump #3. The result was that both the powerhouse and spillway sections of the ladder were dewatered during the evening hours of January 5-6. We arrived to find both sections down to concrete with little water remaining. An emergency fish salvage operation took place. The biggest loss was six adult steelhead. The remaining fish in both sections of the channel were salvaged and released at Illia Landing below the dam. The only loss during this operation was one additional adult steelhead.

Powerhouse crews initiated dewatering of the fish ladder on January 2 by shutting down fish pumps two and three approximately 48 hours prior to beginning the operation. On January 4 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 January 4. The only fish encountered was a clipped adult steelhead which was transported to Offield Landing and released.

Per the earlier paragraph, both the powerhouse and spillway sections of the adult fishway channel were fully dewatered on the morning of January 6. The following fish were removed from these sections of the channel: six adult hatchery steelhead (dead), six adult hatchery steelhead (alive), one juvenile chinook (dead), one juvenile chinook (alive), two adult channel catfish (dead), and six adult channel catfish (alive). All live fish were loaded onto a pickup truck fish tank and released below the dam at the Illia Landing boat launch. One of the adult steelhead died during transport but all other fish were released alive at Illia.

Normal preventative maintenance was conducted on the adult fishway system between January 4 and February 3, 2010. This included routine electrical and mechanical maintenance on: the south shore, north powerhouse, and north shore weir gates, fish counting machinery, the diffuser 14 make-up water valve, the adult fish trap, the fishway lighting system under the spillway, the three fish pumps, the FSC board, the make-up water valves and control, fishway channel diffusers, and the service room. Diffuser gratings in each section of the fishway were examined by project biologists and maintenance personnel during the January-February dewatering period. All gratings were found to be in serviceable condition with the exception of the diffuser 14 grating which is fractured in places and needs to be replaced. Water up of the adult fish ladder and collection channel took place on the afternoon of February 3 without incident. Ladder

operations proceeded according to normal protocol through the spring, summer, and fall of 2010. No incidents developed that required dewatering of any portion of the ladder.

## Modifications

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.

The adult fish ladder and fish trap functioned well during 2010 with few repairs needed. The replacement of the controller valve for diffuser 14 in the adult fish ladder improved the water flow to the adult trap. Following installation in November of 2009, extensive flow tests were conducted. During the tests, it was possible to run all six adult holding tanks at the adult trap with a sufficient flow of water down to a forebay elevation of 734.2 feet. This allowed for improved holding of adult chinook during the 2010 field season. About the only modification made to the trap complex in 2010 was some welding done on the chutes to the truck loading hoses.

## Operations and Maintenance

Auxiliary Water Supply:

During 2010, fish pumps 2 and 3 were run to supply water to the adult fish ladder diffuser system. Fish pump 1 was bulkheaded off. All three fish pumps were out of service from January 2 to February 2, 2010 for routine annual maintenance while the adult fish ladder was out of service. In addition, there were two outage periods (Table 9 below) that involved two or more calendar days during 2010. The longer outage was lower bearing repair work on fish pump 1 which took place from November 4 until November 18. The other outage took place shortly after the ladder was returned to service immediately following the annual maintenance period. A large log was found lodged in the powerhouse portion of the fishway collection channel and the channel had to be dewatered in order to remove it. Fish pumps 2 and 3 were shut off on February 10 and 11 to facilitate this operation.

Table 9. Fish pump outages at Lower Granite Dam, 2010.*

| Affected Pump(s) | Dates | Reason for Outage/Comments |
|---|---|---|
| Pumps 1, 2 & 3 | 1/02 – 2/01 | Fishway outage |
| Pumps 2 & 3 | 2/10 – 2/11 | Fishway outage to clear debris from channel |
| Pump 1 | 11/04 – 11/18 | Lower bearing repair work |

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

Adult Fish Trap Operations:

During the 2010 fish season, the adult fish trap at Lower Granite Dam was operated continuously between March 1 and November 18 with the exception of the August 13 to August 21 time period. During this time period, the trap was out of operation due to water temperatures in excess of 70°F. The trap was taken out of operation at 0900 hours on August 13. Actual trapping operations resumed at 1105 hours on August 22 and continued until cold weather conditions developed in mid November.

During the initial phase of trap operation, the trap was operated at a 15% sample rate to examine the last phase of the steelhead run for A and B run composition and for hatchery-wild determination. Wild steelhead were PIT-tagged and genetic and scale samples taken. In addition, scale samples were taken from one out of every 25 hatchery steelhead. University of Idaho personnel took blood samples on wild adult steelhead at the trap through March 23. The adult trap sample rate was reduced to 4% on April 18. In addition to the previously mentioned work, one of every seven hatchery chinook were PIT-tagged and scale samples and genetic materials taken. Two sort-by-code projects were also initiated: 1) divert up to 15 Lemhi-Origin chinook for radio-tagging, and 2) recover chinook that were acoustic-tagged in the estuary to check the recovery status of the surgery and take reference photos. Beginning in early June, all hatchery coded wire tagged chinook were also scale sampled.

Idaho Fish and Game personnel began the transport of sockeye adults from the adult fish trap to Eagle Hatchery on July 1. This work was continued through July 15 with a total of 19 adult sockeye (11 females, 8 males) transported. There were no sockeye mortalities during transport to Eagle. In addition, University of Idaho personnel collected adult American shad from the trap in July. The goal was to collect 100 adult shad for genetic evaluation to see what component of the shad run that crosses Bonneville Dam makes it upstream to Lower Granite Dam (96 females and 4 males were collected).

Immediately following water-up of the adult trap on August 22 (after a brief closure due to high water temperatures), the trap sample rate was set at 12% (this was later reduced to 10% on September 18). One of every 20 hatchery steelhead and all wild PIT-tagged steelhead were scale-sampled. Scale samples and genetic samples were taken from hatchery PIT-tagged steelhead. Transport of fall chinook to Lyon's Ferry Hatchery and the Nez Perce Hatchery at Cherry Lane began in late August. Seventy percent of the

chinook were transported to Lyon's Ferry and the remaining 30% went to Cherry Lane. The Nez Perce hauled fish on Sundays and Mondays and Lyon's Ferry hauled fish Tuesday through Saturday. The Nez Perce met their quota in late September. Transport operations to Lyon's Ferry continued when numbers warranted. This operation ended on November 16. A total of 2,789 fall chinook (2,343 adults and 446 jacks) was hauled to Lyons Ferry Hatchery. The Nez Perce Tribal Hatchery received 1,040 fall chinook (1,026 adults and 14 jacks). A total of 9,873 fall chinook were actually handled for this operation of which 3,829 were transported to the hatcheries and 6,044 released back into the ladder.

## Adult Fishway Inspections

Methods:

A total of 147 physical inspections of the adult fishway complex were conducted at Lower Granite between 1 March 2010 and 31 December 2010. This averaged out to nearly 3.4 inspections per week during the fish passage season. The routine inspections during 2010 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 2010 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 1 below) for inclusion in this report and references to inspection results refer to data listed in this table.

Table 1. Summary of adult fishway inspections at Lower Granite Dam, 2010.[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 | *** | *** | *** | *** | *** | *** | *** | *** |
| | 147 | | | | | | | |
| **Differentials** | | | | | | | | |
| Ladder Exit | 147 | 100.0 | *** | *** | *** | 0 | 0 | 0 |
| | *** | *** | *** | *** | *** | 0.0 | 0.0 | 0.0 |
| | 147 | | | | | | | |
| Ladder Weirs | 129 | 87.8 | 18 | 0 | 0 | 0 | 0 | 0 |
| | *** | *** | 12.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0 |
| | 147 | | | | | | | |
| Counting Station | 147 | 100.0 | *** | *** | *** | 0 | 0 | 0 |
| | *** | *** | *** | *** | *** | 0.0 | 0.0 | 0.0 |
| | 147 | | | | | | | |
| South Shore Entrance | 146 | 99.3 | 0 | 1 | 0 | 0 | 0 | 0 |
| | *** | *** | 0.0 | 0.7 | 0.0 | 0.0 | 0.0 | 0.0 |
| | 147 | | | | | | | |
| North Powerhouse Entrance | 147 | 100.0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | *** | *** | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | 147 | | | | | | | |
| North Shore Entrance | 144 | 98.0 | 2 | 0 | 1 | 0 | 0 | 0 |
| | *** | *** | 1.4 | 0.0 | 0.7 | 0.0 | 0.0 | 0.0 |
| | 147 | | | | | | | |
| **Weir Depths** | | | | | | | | |
| SSE-1[2] | 114 | 77.6 | 10 | 2 | *** | *** | *** | *** |
| | 21 | 14.3 | 6.8 | 1.4 | *** | *** | *** | *** |
| | 147 | | | | | | | |
| SSE-2[2] | 120 | 81.6 | 6 | *** | *** | *** | *** | *** |
| | 21 | 14.3 | 4.1 | *** | *** | *** | *** | *** |
| | 147 | | | | | | | |
| NPE-1[2] | 48 | 32.7 | 1 | 4 | 3 | *** | *** | *** |
| | 91 | 61.9 | 0.7 | 2.7 | 2.0 | *** | *** | *** |
| | 147 | | | | | | | |
| NPE-2[2] | 47 | 32.0 | 0 | 2 | 7 | *** | *** | *** |
| | 91 | 61.9 | 0.0 | 1.4 | 4.8 | *** | *** | *** |
| | 147 | | | | | | | |
| NSE-1 | 0 | 0.0 | 0 | 0 | 126 | *** | *** | *** |
| | 21 | 14.3 | 0.0 | 0.0 | 85.7 | *** | *** | *** |
| | 147 | | | | | | | |
| NSE-2 | 0 | 0.0 | 0 | 0 | 126 | *** | *** | *** |
| | 21 | 14.3 | 0.0 | 0.0 | 85.7 | *** | *** | *** |
| | 147 | | | | | | | |

[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 increased 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 2010, readings at the meter in the junction pool were out of criteria on all 147 inspections. Readings ranged from 0.79 fps to 1.14 fps in 2010, compared to 0.58 to 1.19 in 2009, 0.88 to 1.10 fps in 2008, 0.77 fps to 1.2 fps in 2007, and 0.70 fps to 0.90 fps in 2005 (prior to junction pool modifications). The average velocity reading in the junction pool area was 0.95 fps during 2010.

## 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 147 inspections in 2010. Nearly all of the readings showed either no differential or 0.1 feet of differential. This area was within criteria 100.0% 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 out of criteria 18 times during 2010. All 18 out of criteria readings were 0.1 feet below the 1.0 foot minimum over-flow criteria level. Court ordered spill, pool elevations near MOP, and operation of the adult trap water supply accounted for the majority of out of criteria readings. This inspection point was within criteria 87.8% of the time during 2010. By contrast, it was within criteria 85.1% of the time in 2009, 95.4% during 2008 and 62.0% of the time during 2007. Installation of a new diffuser 14 controller valve during November of 2010 helped increase the flow of water and seemed to improve conditions during 2010.

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 2010 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 was only one out of criteria readings during the 2010 fishway inspections. This occurred on April 7 and the reading was 0.2 feet high. This inspection point remained within criteria 99.3% of the time during 2010.

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. Readings remained within the criteria range during all inspections in 2010 (100% in criteria.)

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, fish pumps two and three 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 2010 this inspection point was out of criteria three times. The out of criteria readings occurred on June 6 (0.1 feet high), June 11 (0.3 feet high), and November 23 (0.1 feet low). During 2010, this inspection point remained within criteria 98.0% 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" whenever the tailwater elevation was 633.0 feet or less. This is usually not too much of a problem at the south shore gates. During 2010 operation of the Little Goose pool during the summer months dropped the Lower Granite tailrace to 633.0 feet or lower on 21 occasions. Sill events took place in April, July, and August.

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. During 2010, SSE-1 was out of criteria 12 times (per the physical readings off the weir gate dial). Of the 12 out of criteria readings, there were 10 readings in which weir depths were 0.1 feet below criteria and 2 readings in which weir depths were 0.2 feet below criteria. There were 21 instances in which SSE-1 was on sill. During 2010, SSE-1 remained within full criteria 77.6% of the time and was on sill 14.3% of the time.

SSE-2 was out of criteria six times during 2010. All six out of criteria readings were only 0.1 feet below criteria. Like SSE-1, SSE-2 was on sill 21 times during the 2010 inspection season. During 2010, SSE-2 remained within full criteria 81.6% of the time and was on sill 14.3% of the time.

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

2010, this occurred on a near constant basis from March 24 through September 25 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 91 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. NPE-1 was out of criteria eight times and NPE-2 was out of criteria nine times during 2010. Of the eight times that NPE-1 was out of criteria, there was one reading in which the weir depth was 0.1 feet below criteria, four readings in which weir depths were greater than 0.2 feet below criteria, and three readings in which weir depths were greater than 0.2 feet below criteria. (During 2010, NPE-1 remained within full criteria 32.7% of the time and was on sill 61.9% of the time.) Of the nine times that NPE-2 was out of criteria, there were zero readings in which weir depths were 0.1 feet below criteria, two reading in which the weir depth was 0.2 feet below criteria, and seven readings in which weir depths were greater than 0.2 feet below criteria. During 2010, NPE-2 remained within full criteria 32.0% of the time and was on sill 61.9% 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 continued to be the case during 2010. Of the 147 fishway inspections that were conducted on north shore entrance one (NSE-1) and north shore entrance two (NSE-2), the gates were on sill (tailwater elevations at or below 633.0 feet) on 21 occasions. The gates were considered out of criteria on the other 126 inspections. In the case of both gates, all readings were greater than 0.2 feet below the acceptable criteria level. During 2010, both NSE-1 and NSE-2 were in full criteria 0% of the time and on sill 14.3% 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 2010

1. Provide crane support to allow for monitoring of the north shore fishway entrances during the time period the north shore elevator is out of service.
2. Continue monitoring of the electronic fishway readings (FSC board) to ensure that electronic fishway readings match physical conditions.
3. 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 to four 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 2010 season:

1. Refurbished the sample diversion slide gates per PSMFC guidelines.
2. Replaced the pneumatic gate valve on raceway #4.
3. Rebuilt the snorkel seals on the barge loading boom and replaced the flexible hose.
4. Replaced the rope and sign at the separator outfall (boater BRZ).
5. Rebuilt the upstream raceway valves.
6. Constructed an aluminum bin, water supply, and pipe to the new kelt holding tanks.
7. Poured a concrete slab for the new kelt tanks.
8. Set the new kelt tanks (from the University of Idaho) into place on the concrete slab.
9. Constructed a security fence around the kelt facility.
10. Changed the orientation of the boom winch so that the bearings get oil.
11. Added fire extinguisher boxes to the outside of the engine house on all barges.
12. Installed new strainer seals on fish barges 2127 and 2817.
13. Repaired the oil filter housing leaks on engines #2 and # 4 on fish barge 8106.
14. Replaced the plunger in the starboard center hold on fish barge 8107.
15. Repaired the deck wash system on fish barge 8107.
16. Replaced the drive line u-joints on all the fish barges.

### River Conditions

Flows in the Snake River during the 2010 season were considerably better than expected due to late spring moisture making up for a low winter snowpack (Table 3). Flows exceeded the Biological Opinion target of 100 kcfs on 21 dates during 2009 and reached the 200 kcfs level on three dates. River flows for the last few days of March

were between 21.9 and 36.8 kcfs – well below the norm. Flows in April averaged 41.2 kcfs and ranged between 23.9 kcfs and 73.8 kcfs. In May, river flows averaged 66.6 kcfs and ranged between 47.0 kcfs and 108.1 kcfs. River flows in June were much higher than May – averaging 128.2 kcfs and ranging between 75.4 kcfs and 208.5 kcfs. The peak average flow of the season occurred on June 6 at 208.5 kcfs. River flows in July averaged 49.8 kcfs and ranged between 38.0 and 76.2 kcfs. August flows averaged 30.6 kcfs and ranged from 24.1 kcfs to 42.7 kcfs. River flows first dropped below 20 kcfs on September 21 and averaged 24.2 kcfs for the month of September. The season's low flow occurred on October 18 at 14.7 kcfs. Daily flows in October averaged 20.0 kcfs and peaked at 27.7 kcfs. The flow on October 31, the last day of the collection season, was 18.3 kcfs.

## Operations and Maintenance

Bypass and Transport Operations

The juvenile fish bypass gallery was watered up on March 17. Fish were bypassed through the 72-inch pipe at the base of the separator (primary bypass) until 0700 hours on March 25, when the separator was watered-up and fish sampling (only) activities began. With the exception of sample fish, all fish were bypassed back to the river until late April. As has been the case in recent years, the early trucking portion of fish transportation was eliminated in 2010 due to sufficient river flows. Fish barging operations from Lower Granite followed a somewhat different schedule than in recent years. The first research barge departed Lower Granite on April 22. Collection for general transport began on April 23 and every other day barging began on April 24. Every day barging quickly followed on April 26. Collection activities did take place to provide research fish for NOAA-Fisheries marking operations prior to the beginning of collection for transport but only for one trip. Fish were collected for marking for the Skamania Index Barge Study (transport study). Fish were collected 2-3 days before the actual transport date in order to allow the marking crews time to mark and handle the fish. Skamania index barging took place on April 22 (prior to regular barging). When fish were not being collected for research, 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. Both 4000 and 2000 series fish barges were direct-loaded at Little Goose Dam during the month of May. Due to regional concerns over juvenile fish migration times, this operation did not start at Little Goose until May 2 and it concluded on May 26. The first day with out a scheduled fish barge at Lower Granite was May 29. Every-other-day barging operations then ran uninterrupted from June 1 through August 16. Collection ended at 0700 hours October 31.

An estimated 3,645,277 juvenile salmonids were collected at Lower Granite Dam during the 2010 operating season. The 2010 species collection included: 1,193,654 clipped yearling chinook, 428,713 unclipped yearling chinook, 176,115 clipped subyearling fall chinook, 454,408 unclipped subyearling chinook, 1,008,668 clipped steelhead, 349,497 unclipped steelhead, 1,925 clipped sockeye/kokanee, 3,932 unclipped sockeye/kokanee and 28,365 coho (Table 8). In general fish collection numbers were well below the 2009 level. Unclipped subyearling chinook was the only species group in which collection was higher than in 2009. Collection numbers decreased significantly for all other species groups. Daily collection and river flow information is provided in Appendix 1, Table 1.

Peak collection dates during 2010 were considerably different from previous years with fish numbers for several species peaking out of the norm (Table 9). The peak total daily collection of 183,000 occurred on May 21 – about two weeks later than normal. May 21 was also the peak collection date for unclipped sockeye/kokanee (800), clipped steelhead (81,800), and unclipped steelhead (23,600) . It is the latest peak collection day in five years. Both clipped and unclipped subyearling fall Chinook collections peaked on June 5 and each was the third latest in the last five years. Clipped and unclipped steelhead and clipped and unclipped sockeye collections peaked the latest in the last five years and the combined coho peak collection day was the second latest in the last five years.

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 44.4% of the smolts (approximately 1,499,663 smolts out of 3,378,007 smolts barged from Lower Granite) were direct loaded onto fish barges at Lower Granite during the 2010 season. This figure has been both higher and lower in previous years and is dependent on a number of factors. As in 2007-2009, a factor limiting direct loading of barges was the need to divert large numbers of smolts to the upstream raceways to accommodate research marking operations during the peak of the juvenile outmigration. Other factors which limited direct barge loading were: a late April start in general barging operations, high river flows in late May and June (which made direct barge loading hazardous), and occasional late arrival times of returning fish barges.

As per previous years, fish collected at Little Goose Dam, Lower Monumental Dam, and McNary Dam were also loaded onto fish barges that originated from Lower Granite Dam during the 2010 season. The total number of fish barged from these other sites during the 2010 season was: Little Goose Dam (2,712,797), Lower Monumental Dam (1,056,402), and McNary Dam (300,428).

Late season trucking operations at Lower Granite began on August 18 and continued every other day through October 31. Due to low fish numbers, trucking operations resumed using the pickup-mounted midi-tanker. Fish numbers later increased to the point that it was necessary to utilize the semi for late season fish transport. During 2010 fish transport using the semi took place on September 19, September 21, October 3,

October 5, and October 9. The October 3 and 5 trips were piggyback operations with Little Goose.

Following the cessation of fish transportation activities in October, the fish facility was switched over to secondary bypass (all juvenile fish routed through the separator bars and out the extended pipe to mid-river) and operated in that mode until December 15. This was done to monitor PIT-tagged juvenile salmonids moving through the river system in late fall. (Since Lower Granite does not have provision to monitor PIT-tags through a full-flow bypass system, it is necessary to keep water over the separator bars for this purpose.) The separator was switched to primary bypass on the morning of November 22 due to extremely cold temperatures and the probability of frost damage to the separator. It was switched back to secondary bypass after temperatures on the morning of November 26 after weather conditions moderated. Secondary bypass then continued unimpeded through December 15.

Approximately 16,594 juvenile salmonids, 0.4% of the fish transported from Lower Granite in 2010, were transported by truck (Table 8). In addition, an additional 1,767 juveniles were transported by truck when Lower Granite combined fish trucking operations with Little Goose beginning on October 3 and October 5. During 2009, 6,700 juvenile salmonids, 0.2% of the fish transported in 2009, were transported by truck compared to 17,178 in 2008 (0.4%), 7,555 in 2007 (0.3%), 6,751 (0.1%) in 2006, and 66,396 (0.6%) in 2005. A continuing factor in the low percentage of fish transported by truck in 2010 was an extensive late season transport evaluation by NOAA-Fisheries which removed many fish which would have been transported and put them back into the river. The numbers of fish trucked in 2010 and the percentages of the total transported for each species group were: 16 clipped yearling Chinook (<0.1%), 6 unclipped yearling Chinook (<0.1%), 72 clipped subyearling fall Chinook ((<0.1%), 16,403 unclipped subyearling fall Chinook (3.7%), 2 clipped steelhead (<0.1%), 14 unclipped steelhead (<0.1%), 0 clipped sockeye/kokanee (0.0%), 64 unclipped sockeye/kokanee (1.6%) and 17 coho ((<0.1%).

The physical operation of the barges and towboats proceeded smoothly during the 2010 season. There were no mechanical problems that prevented the normal transportation and release of fish at the designated release points. Nevertheless, as is to be expected of any large-scale operation involving considerable equipment operated over a lengthy period of time, there were a few minor operational problems. Most of the barge-related problems during 2010 were of a minor mechanical and involved items such as the deck wash systems or replacing engine gauges. Electrical problems mainly involved the oxygen monitoring system and engine alarm systems. In all cases, the portable YSI oxygen/temperature monitoring systems proved invaluable and allowed for proper monitoring of oxygen and temperatures whenever there were problems with the main Point Four system.

Bypass

The LGR collection gallery was watered up on March 17. All fish were initially diverted out the large pipe at the base of the separator (primary bypass). This operation continued until 0700 hours on March 25 when the separator was watered up and sampling activities began. At that time, all fish were bypassed back to the river through the bypass outfall pipe to the river (secondary bypass). The system was operated in secondary bypass mode with the exception of periods of time when it was necessary to load fish into the upstream raceways to accommodate research marking for an April 22 barge trip. General fish collection (for transportation) began on April 23 and continued until 0700 hours on October 31 when the facility was placed back into secondary bypass mode (smolts diverted out the outfall pipe to mid-river) to monitor for PIT-tagged juvenile fish. On November 22 at 0940 hours the juvenile fish collection system was switched to primary bypass operation because of an extended period of extreme cold weather. The facility returned to secondary bypass mode at 0830 hours on November 26 when temperatures moderated. The juvenile fish collection system was operated in the secondary bypass mode until 0930 hours on December 16, when the system was put into primary bypass mode. The juvenile fish collection gallery and collection/transportation facility were dewatered for the season on the morning of December 21.

In 2010, an estimated 247,129 smolts (6.8% of those collected) were bypassed from the LGR Juvenile Fish Facility compared to 2,465,023 fish in 2009. The number and percentage of smolts bypassed by species group in 2010 (percentage of the total number of fish bypassed) included: 161,676 clipped yearling Chinook (65.4%), 30,184 unclipped yearling Chinook (12.2%), 33 clipped subyearling fall Chinook (<0.1%), 6,880 unclipped subyearling fall Chinook (2.8%), 31,194 clipped steelhead (12.6%), 17,151 unclipped steelhead (6.9%) and 11 unclipped sockeye/kokanee (<0.1%). An estimated 71,789 juvenile salmonids, 2.0% of the total collection were bypassed from March 26 to April 23, before the start of the general transport season. In 2009, an estimated 2,340,376 juvenile salmonids, 35.5% of the total collection were bypassed from March 26 to May 1.

As part of seven research studies, 177,795 smolts were bypassed from LGR in 2010. The National Marine Fisheries Service (NMFS) Survival Study PIT-tagged and bypassed 47,932 smolts: 309 clipped yearling Chinook, 17,052 unclipped yearling Chinook, five unclipped subyearling fall Chinook, 17,627 clipped steelhead and 12,939 unclipped steelhead. The NMFS Extra Mortality study bypassed 122,563 clipped yearling Chinook smolts. The NMFS Fall Chinook Late Season Transportation Study bypassed 33 clipped and 5,825 unclipped subyearling fall Chinook, 64 clipped yearling Chinook and four clipped steelhead. The United States Fish and Wildlife Service (USFWS), NMFS, Nez Perce Tribe (NPT) and the United States Geological Survey (USGS) Post Release Performance of Subyearling Fall Chinook Study bypassed 663 smolts: 18 clipped yearling Chinook, 25 unclipped yearling Chinook, 249 clipped subyearling fall Chinook, 354 unclipped subyearling fall Chinook, 14 clipped steelhead and three unclipped steelhead. The Kintama acoustic tracking array for studying ocean survival and movements of Columbia River salmon study bypassed 361 clipped yearling

Chinook and 13 unclipped yearling Chinook. The United States Geological Survey (USGS), United States Fish and Wildlife Service (USFWS), Pacific Northwest National Laboratory and the University of Washington fall Chinook habitat use study bypassed 337 unclipped subyearling fall Chinook.

Smolts were bypassed for one hour on September 19 and September 21 to clean the separator inclined screen (primary dewaterer). During these cleaning events, no estimate can be made of the number of fish bypassed because the fish are bypassed before encountering the sampling system (Primary Bypass). The incline screen seemed to be plugged with bryozoans and various fine debris, rather than pine needles or tumbleweeds as in previous years.

Turbine Operations

Turbine unit operating priorities at Lower Granite were changed slightly during 2010. Operational guidelines at Lower Granite are now turbine units 1, 2, 3, then 4-6 (in any order), 24 hours per day, from March 1 through December 15. From December 16 to February 28, any unit may be run 24 hours per day without regard to order. Turbine unit operating priority may be coordinated differently to allow for fisheries research activities, construction, or project maintenance activities. The project followed the new normal turbine unit operation as outlined in Table LWG-5 in the Fish Passage Plan during 2010.

During 2010, turbine units 1-6 were unavailable for service 16,263.56 hours out of a possible 52,560 operational hours. This computes to an overall availability factor of 69.06%. This is quite a bit worse than in 2009 when the availability factor was 86.9%. The lowered availability factor was caused largely by the extensive January – December outage on unit 3 which included a stator rewind. Unit 3 was out of service a total of 8,456.8 hours due to this operation. The 2010 availability factor on a per unit basis was: turbine unit 1 (68.9%, turbine unit 2 ( 93.1%), turbine unit 3 (3.5%), turbine unit 4 (61.5%), turbine unit 5 (92.7%), and turbine unit 6 (94.8%). Turbine unit 1 was unavailable for service a total of 2,728.9 hours for various reasons. The biggest outage factor was annual maintenance which required 1,924.1 hours. Turbine unit 2 was unavailable for service 601.4 hours. The biggest outage factor was annual maintenance in October. Turbine unit 3 was unavailable for service nearly the entire year with a total of 8,456.8 hours attributed to a rewind and comprehensive overhaul. Turbine unit 4 was unavailable for service a total of 3,376.1 hours. The biggest outage factor was annual maintenance from August through November which required 2,728.3 hours. Turbine unit 5 was unavailable for service a total of 641.0 hours. The biggest outage factor was annual maintenance in July which required 556.7 hours. Turbine unit 6 was unavailable for service a total of 459.4 hours. The biggest outage factor was annual maintenance activities in December which used up 393.8 hours. In general, turbine unit availability was highest during the months of March – June and lowest during August – November.

Fish-related work did not cause much turbine unit unavailability during 2010. Nearly all fish-related outages were due to fish screen installation and removal activities

and video inspections of the VBSs and ESBSs. Per the Ombil database sytem there were approximately 95 hours and 42 minutes (95.7 hours) of direct fish-related turbine unit outages during 2010. By comparison during 2009 and 2008 there were a recorded 131.6 hours, and 103.1 hours of outages, respectively. During 2010, there were also approximately 25 hours of unit outages related to trash raking activities in late February which were not included in the fish-related outages. Per Ombil, the following outage hours were directly related to fish work in 2010: Unit 1 (17.8 hours), unit 2 (20.6 hours), unit 3 (none, unit out of service nearly all year), unit 4 (21.4 hours), unit 5 (19 hours) and unit 6 (16.9 hours).

Forebay Debris/Trashracks

Tashracks were raked for debris February 22-24, 2010. It initially appeared as if 2010 was going to be a low flow year but late season moisture quickly changed the situation and flows reached 200 kcfs for a few days in early June. The high flows resulted in some accumulation of debris in the forebay. Most of this debris was eventually spilled downstream through the RSW. Although debris levels were problematic at the juvenile fish facility during June, it was not necessary to rake trash racks a second time in 2010. Frequent inspection of the gatewells and hand dipping of debris off the gatewell surfaces helped prevent problems at the fish facility.

Extended-Length Submersible Bar Screens (ESBSs)

All operating turbine units were equipped with ESBSs during the 2010 fish passage season. Winter maintenance on the screens was ongoing in late February and early March and an inspection of the screens was conducted in mid-March - just prior to installation. No significant problems of any kind were detected. Installation of fish screens was completed in all units by March 23.

Every attempt was made to coordinate 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 were conducted in April and May but were postponed on June 25 due to high water turbidity which prevented the camera operator from seeing anything. Rapidly improving conditions allowed for inspection of units 4-6 the following two days Video inspections were conducted jointly with VBS inspections during April, May, June, August, and October and no problems of any kind were detected on the ESBSs.

Operation of the ESBSs was relatively trouble-free during the 2010 season. Due to very high levels of debris passing through the system, it was necessary to increase the brush cycle times to once per hour in early June. This was backed off to once every 3-4

hours after debris levels dropped off. Turbine unit 4 was taken out of operation on July 29 to replace a cleaning brush on an ESBS. There were no other significant problems with ESBSs during the 2010 operational season. All screens were raised and dogged off for the winter maintenance by December 20.

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 2010 fish season. During 2010, VBSs were inspected with an underwater video camera per FPP guidelines in conjunction with a limited inspection of the ESBSs. A few minor VBS problems were detected on those inspections. On the April 23-25 inspection six rivets were found missing off a retaining strap that secures the screen material on a VBS in slot 6A North. On the May 23 inspection, a small hole was found in a screen in slot 6A south. No new problems were detected on subsequent video inspections. These two items should be repaired during the 2011 winter season.

Gatewells

Gatewells were inspected during adult fishway inspections throughout the 2010 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 - 2009, constant debris movement through the orifices prevented the need for extensive gatewell cleaning during 2010.

Some larger debris was removed from individual gatewell surfaces with a small dipping basket when it appeared that it might cause problems with movement through the collection gallery orifices. This operation first took place on March 24 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 2010 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 17, 2010 to accommodate fish screen installations. Bulkhead (downstream) slot orifices were operated in the usual manner during 2010 with at least one orifice per gatewell slot opened to divert fish into the collection channel. Upstream (fish screen slot orifices) were operated to provide additional water and fish guidance as hydraulic conditions allowed. During 2007, the upstream gatewells (fish screen slots) were dipped to see if any fish were present (gatewells and Wagner Horns were sealed in the mid 1990s). Very few fish were found with the exception of fish screen slot 5B where approximately 50 steelhead and 50 Chinook were removed. Consequently, an orifice from slot 5B was left open during the entire 2010 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.

The air backflush orifice cleaning system worked well during 2010 and there were no significant maintenance issues of any kind. Due to the variability of the debris moving through the system, the project maintained a schedule of backflushing orifices every 3 hours around the clock from late March through the cessation of fish collection activities in late 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 system was shut down for the season on December 21, 2010.

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. Small invertebrates in the river can also plug the screen and make cleaning very difficult. During early June 2010 , high river flows resulted 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 easily 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).

Debris impingement on the inclined screen was not as much of a problem during 2010 as it was during 2009 but a couple dewatering events were still necessary to clear debris from the screen after it became too plugged to function properly. This happened on September 19 and again on September 21. Each cleaning event took almost an hour due to the impingement of fine debris in the screen and the need to powerwash the screen to clean it sufficiently. Separator technicians were able to stay away from having to dewater the inclined screen most of the season by cleaning the screen on an hourly basis when high levels of debris were moving through the system. This was especially problematic during early to mid June when river flows were high. High winds on the evening of November 15 also put a lot of leaves and tumbleweed into the river which required frequent cleaning of the screen.

Separator

The separator at Lower Granite is a single stage separator and currently has no provision for size separation of juvenile fish. The separator functioned well during the 2010 season with the exception of the few periods of time when high levels of debris became an issue. It was necessary to check the separator exits more frequently than normal during June due to debris blockages. It was not necessary to partially dewater the separator bin (below the bars) to remove debris during 2010. After high debris levels dropped off in June, there were very few problems with the separator and related mechanisms. Both the 72-inch and 42-inch separator controller valves were replaced during the winter of 2003-2004 and they continued to perform flawlessly during the 2010 fish collection season. Operation of the separator in the normal collection/sampling mode took place from 0700 hours on March 25 through 0700 hours on October 31.

In 2010 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. (Unlike 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) through December 15. The JFF maintenance crew also had electric/diesel heaters available for use under the separator and other exposed areas. Maintenance and separator personnel started the heaters whenever overnight temperatures made frost damage likely. This provided an additional backup tool for freezing temperatures.

A serious clog developed in the separator secondary bypass line on the morning of November 8. JFF maintenance personnel were finally able to clear the line by running an

extended length of air hose down the pipe. After several efforts, the clog was finally cleared and a significant amount of material was flushed out the pipe to the river. Secondary bypass operations then continued without issue through the rest of the extended season.

Severe cold weather developed in late November and it was necessary to switch the separator system over to primary bypass at 0940 hours on November 22. Temperatures dropped into the zero range and frost damage would probably have occurred had we continued to operate in secondary bypass. The weather moderated enough that the separator was switched back to secondary bypass at 0830 hours on November 26. This interlude was the only interruption to late season monitoring for PIT-tagged juveniles. Weather conditions remained favorable enough to continue monitoring through December 15.

During 2010 we continued to observe small chinook jacks in the daily samples in September. Numbers this season did not reach the higher numbers that were observed in 2009 when the sample holding tank became crowded with the smaller jacks that managed to fall through the separator bars. When held in a sample tank with the much smaller juvenile fish they can injure the smaller fish – particularly when they thrash around in the anesthetizing bins. In order to alleviate this problem, we installed a set of smaller separator bars over the separator bin in 2009. The smaller bars were installed in September and removed following the end of collection activities in November. The bars measured 1 inch in diameter, were constructed of rigid wall aluminum tubing, and were spaced approximately 1 1/16 to 1 1/8 inches apart. They were built in three full length panels and secured in place overlaying the existing separator bars. Although it was discussed, we did not install them in 2010 due to the lower numbers of jacks crossing the separator and ending up in the sample holding tank.

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 2010 this occurred from startup on March 25 until the morning of August 4. From 0700 hours on August 4 until the end of normal separator operations on October 31, the PIT-tag

diversion system was set to divert all PIT-tagged fish and override the sample diversion gate.

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. Samples were taken 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. The sample rate remained at 100% for most of the extended season but was reduced to less than 100% on September 21, October 5-9, and October 11-13 due to too many fish in the sample and the lab not finishing the sample until late in the morning. This was impacting the departure of fish transport trucks to Bonneville. Weekly sample rates ranged from 0.500% to 50.000% prior to the 100% sample period. 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 between March 12 and March 21, 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 2010.

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. This decreases handling a second time and is thought to reduce the overall stress to the fish. During 2010, an estimated 44.4% of the smolts barged from Lower Granite (1,499,663 smolts out of 3,378,007 smolts barged) were direct loaded into barges at Lower Granite. This is somewhat better than in recent years. In 2009 approximately 1,338,413 smolts were direct loaded onto barges at Lower Granite out of a total of 4,112,943 barged (32.5%). Direct load percentages at Lower Granite for other recent years were: 2008 (38.8%), 2007 (24.5%), and 2006 (17.3%). The ability to direct load is dependent a number of factors including time of arrival of fish barges, spill patterns, total river flow and fish marking operations. The increased diversion of fish into the upstream raceways to accommodate NOAA-Fisheries research marking operations has significantly impacted the direct-loading of fish onto barges at Lower Granite in recent years.

## Avian Predation

Control Measures

Smolt monitoring personnel at Lower Granite check for bird predation marks in the daily subsample of juvenile smolts. Injuries associated with predators include wounds inflicted by other fish, birds, and lamprey. During 2010, predator wounds were observed on 0.8% of the smolts examined in the detailed subsample. By comparison the wounding rates were 1.0% in 2009, 1.0% in 2008, 0.8% in 2007 and 0.9% in 2006. Predator marks were highest on clipped steelhead (32.7%), unclipped subyearling fall Chinook (27.6%) and clipped yearling Chinook (16.1%). 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 (61.8%) compared to 30.9% for predator marks caused by fish. Similar to previous years the larger clipped and unclipped steelhead smolts had the most 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. This system continued to work well during 2010.

During routine fishway inspections in 2010, it was found that several bird wires needed to be serviced or replaced. Due to spill operations and a tight schedule by USDA-APHIS personnel, it was not possible to schedule repair work until early fall. Damaged or down bird wires were replaced by APHIS personnel on September 21, 2010. In addition, several wires were untangled without the need for replacement. Most had been tangled by sturgeon fishermen casting their lines over the wires and attempting to free them.

Avian predation control measures at Lower Granite Dam in 2010 were similar to those conducted during 2004-2009. Contract work was arranged with the USDA's Wildlife Services Branch to conduct a hazing operation at Lower Granite Dam from April to July. Actual hazing activities at Lower Granite began on April 11 and concluded on July 15. An individual agent was assigned to Lower Granite Dam and was able to devote his entire time to controlling avian predation at this site. The control measures utilized included: 15 mm pyrotechnics, long-range rockets, fused rope salutes, and propane canons.

Gull and Cormorant Counts

Gull counts initially began at Lower Granite Dam during 1999 and continued each succeeding year including 2010. 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 25 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 25 to October 31 counting period a total of 3,030 gull sightings were recorded. Slightly more gulls were seen on morning counts (1,686) than on evening counts (1,344). The highest numbers of gulls were observed on May 23 and May 24 when an estimated 400 gulls were recorded in the tailrace area.

During the extended November 1 through December 15 counting period, only 21 additional gulls were observed. A total of nine were observed on the morning counts and 12 on the afternoon counts. Clearly gulls moved out of the dam tailrace area late in the season when prey items were less available. Specific cormorant counts were not conducted at Lower Granite during 2010.

Recommendations

1. Install a generator to power the fish facility during electrical outages.
2. Refurbish the existing separator, inclined screen, sampling system, and major pvc pipes (if a new fish facility is not built in the next few years).
3. Tune up/recondition the Cat engines on barges 8105 and 8106 and develop a plan to tune/repair/overhaul engines on the remaining barges over a several year period.
4. Pour concrete to serve as ballast in fish barges 4394 and 4382. Paint exterior of both barges while concrete work is being done. (Try to contract this work in FY 2011).
5. Refurbish the concrete on the raceway interiors based on results from the test strips in raceway #10 – optional, pending new fish facility construction.
6. Paint exteriors of all fish barges.
7. Replace the lab chiller system. (The chiller for the recirculation system is unable to keep the recirculation water at spring/summer temperatures.)
8. Refurbish the chain drive system for the sample holding tank.
9. Increase size of catch basin which is used to drain water from garbage cans holding research fish from the sample.
10. Install or remove push knees (as needed) on the barges and explore a new bumper system to use in place of the present cable and tire system.