

**ADULT FISHWAY INSPECTIONS  
ON THE COLUMBIA AND SNAKE RIVERS**

**2013 ANNUAL REPORT**

**David A. Benner,  
Field Operations Coordinator  
Fish Passage Center**



**A Collaborative Program of  
United States Fish and Wildlife Service  
Oregon Department of Fish and Wildlife  
Washington Department of Fish and Wildlife  
Idaho Department of Fish and Game  
National Oceanic and Atmospheric Administration**

**May 2014**

# Table of Contents

INTRODUCTION .....	1
BACKGROUND .....	1
GENERAL RESULTS.....	4
SUMMARY BY PROJECT .....	6
CORPS OF ENGINEER DAMS .....	6
Bonneville Dam .....	7
The Dalles Dam .....	12
John Day Dam .....	15
McNary Dam .....	18
Ice Harbor Dam .....	21
Lower Monumental Dam .....	24
Little Goose Dam .....	27
Lower Granite Dam .....	30
PUBLIC UTILITY DISTRICT PROJECTS.....	34
Priest Rapids Dam .....	34
Wanapum Dam .....	37
Rock Island Dam .....	40
Rocky Reach Dam .....	43
Wells Dam .....	46
GENERAL PROJECT RECOMMENDATIONS .....	48
SUMMARY OF FISHWAY CRITERIA .....	49
SUMMARY OF 2013–2014 COLUMBIA/SNAKE RIVER FISHWAY OUTAGES .....	50
ACKNOWLEDGMENTS .....	51

APPENDIX A: PROJECT PHOTOGRAPHS

1. Bonneville Dam ..... A-1  
2. The Dalles Dam ..... A-5  
3. John Day Dam..... A-7  
4. McNary Dam ..... A-10  
5. Ice Harbor Dam..... A-15  
6. Lower Monumental Dam..... A-20  
7. Little Goose Dam..... A-23  
8. Lower Granite Dam ..... A-25  
9. Priest Rapids Dam..... A-29  
10. Wanapum Dam ..... A-31  
11. Rock Island Dam..... A-34  
12. Rocky Reach Dam ..... A-37  
13. Wells Dam ..... A-39

# **FISHWAY INSPECTIONS AT COLUMBIA AND SNAKE RIVER DAMS, 2013**

## **INTRODUCTION**

This season was the 29th year of a continuing fish passage facilities inspection program that was coordinated through the Fish Passage Center (FPC) at 13 hydroelectric dams located on the Snake and Columbia rivers. These projects were inspected on a monthly basis by Federal or State Fish Agency personnel to assure that fish facilities were being operated according to established criteria documented in the Corps of Engineer (COE) Fish Passage Plan (FPP), or in the Fishery Operating Plans for the Public Utility District (PUD) projects in the Mid-Columbia. This report summarizes results obtained from the individual project inspections during the 2013 fish passage season.

The inspection program spans from April through October at all projects, with an additional inspection in March and/or November at the four lower Columbia projects. These months encompass the main passage season for adult and juvenile fish at the mainstem dams. The objective of a fishway inspection is to assess passage conditions at the time of the inspection and assure that facilities are operating according to established criteria. The agency inspector is responsible for coordinating immediate problems or out-of-criteria conditions to project personnel for resolution. The individual inspection reports and this final Report by the FPC operations coordinator will serve to alert the operating agency of problems that were noted during the inspections and areas that may require resolution.

## **BACKGROUND**

Adult fish passage facilities were incorporated into 13 mainstem Columbia and Snake River dams as early as 1933 at Rock Island Dam with the latest dam construction at the Bonneville new powerhouse in 1981. Upstream passage of adult salmonids was blocked in the Columbia River with the completion of Grand Coulee Dam by 1938, and in the Snake River at Brownlee Dam in 1958 (Figure 1). Mainstem passage issues were addressed as each dam was built to assure that salmon species could pass and migrate safely to upstream spawning areas. Criteria were developed and refined through the years to achieve known hydraulic conditions within a fishway that were basically within the fishes' swimming abilities. In addition, research studies or modeling studies have been accomplished that have shown areas in the fishways where passage problems existed; be it potential migration delays or, in extreme cases, mortality of upstream migrating adult fish. Most passage problem areas have been addressed and in recent years, mostly refinement and improving passage timing of adult fish through individual fishways has become a primary goal.

The COE and PUDs are to operate their fish facilities within standards in the agreed upon Fish Passage Plan at COE projects or according to standards to meet the NOAA Fisheries Biological Opinions (BiOp) and/or Habitat Conservation Plans (HCP) at the PUD projects. The operating agencies are responsible for maintenance of the fish facilities and for operating them at the agreed upon criteria year round, with special or annual maintenance accomplished during the winter maintenance period. Planned fishway outages occur mainly when adult fish passage is minimal, during the winter season. Repairs and other maintenance issues that could affect passage of adult fish during the fish passage season require special coordination between the operating entities and the fishery agencies and tribes.

At the COE and PUD dams, project personnel are required to daily inspect adult fish facilities. Most adult fishways operate in an automatic mode and require no manual adjustments unless the equipment malfunctions. All fishways can be operated in Manual Mode should the automatic control system malfunction. Project operators or fishway attendants will normally restore an out-of-criteria item in the fishway as soon as the discrepancy is found or a Trouble Report issued if the problem requires additional mechanical, electrical, or other support to repair the item.

The State and Federal fishway inspectors schedule an inspection of the fish facilities with project personnel and check into the project office or with the project biologist prior to initiating an inspection. The inspectors are responsible for contacting project operations personnel to review the inspection and coordinate problems that require correction. A completed copy of the inspection report can be left at the project or later sent to the COE project operations biologist or PUD personnel. The FPC fishway coordinator receives a copy of the inspection report, reviews it, and then follows up on problem areas that were earlier noted or discussed with the COE project or district fish biologists.

*Key items recorded during an inspection include:*

- *Powerhouse operations including number of turbines operating and at what Megawatt or flow level, number of spill bays operating and quantity of spill, water temperature and turbidity,*
- *Weir gate depths or width of gate opening at the main fishway entrances,*
- *Hydraulic head differentials at the entrances and along the channels,*
- *Water velocities in the collection or transportation channels,*
- *Head differentials across trashracks and picketed leads,*
- *Depth of water over the fish ladder weirs,*
- *Condition or readability of staff gages or water level sensors and related controlling equipment for the fishway elevations,*
- *A comment section to list special conditions or out-of-criteria areas, and where applicable, inspections of juvenile fish facilities are normally completed while on site.*

The Fish Passage Center has been coordinating fishway inspections at the mainstem Columbia and Snake River projects since 1984. The 2013 season was a continuation of the long-term inspection program that the State and Federal fish agencies have endorsed since the 1960s. Funding for the inspection program is provided from Idaho Department of Fish and Game (IDFG), Oregon Department of Fish and Wildlife (ODFW), Washington Department of Fish and Wildlife (WDFW), National Oceanic and Atmospheric Administration (NOAA), and the United States Fish and Wildlife Service (USFWS).



**Figure 1.** Dams in the Columbia and Snake River Basins.

<b>Dam</b>	<b>Year in Service</b>	<b>Miles to Mouth</b>	<b>Gross Head (Feet)</b>	<b>Miles of Reservoir</b>	<b>Operator</b>	<b>Adult Fish Passage</b>
Bonneville	1938	146	65	45	COE	Yes
The Dalles	1957	192	85	24	COE	Yes
John Day	1968	216	105	76	COE	Yes
McNary	1953	292	75	61	COE	Yes
Priest Rapids	1959	397	82	18	Grant PUD	Yes
Wanapum	1963	416	84	38	Grant PUD	Yes
Rock Island	1933	453	54	21	Chelan PUD	Yes
Rocky Reach	1961	474	93	42	Chelan PUD	Yes
Wells	1967	515	72	30	Douglas PUD	Yes
Chief Joseph	1955	545	177	51	COE	No
Grand Coulee	1941	597	343	151	BOR	No
Ice Harbor	1961	334	100	32	COE	Yes
Lower Monumental	1969	366	100	29	COE	Yes
Little Goose	1970	395	100	37	COE	Yes
Lower Granite	1975	432	98	39	COE	Yes
Hells Canyon	1967	571	210	22	Idaho Power	No
Oxbow	1961	597	120	12	Idaho Power	No
Brownlee	1958	609	272	57	Idaho Power	No

## **GENERAL RESULTS**

With few exceptions, the Fish and Wildlife Agencies inspected adult fish facilities at 13 mainstem Columbia and Snake River dams on a monthly basis from March/April through October/November. Fish agency inspection reports and results were normally coordinated with COE and PUD operations biologists or operations personnel at the time of the inspection.

*Factors affecting fishway operations and/or the ability to inspect fishways at the mainstem dams during the 2013 fish passage season are listed below:*

- The January to July runoff volume at The Dalles Dam was approximately 97.7 million acre-feet or 96 percent of normal (1981–2010) and the April to August runoff volume at Lower Granite Dam was approximately 14.7 million acre-feet or 70 percent of normal (1981–2010). There was spill at most projects during the spring and summer months to improve passage conditions for the juvenile fish migrations in the Snake and Columbia rivers.
- At Bonneville Dam: head differential readings were below criteria at the Bradford south entrance during three of nine inspections in 2013 along with a low gate depth reported during the March inspection; gate depths were below criteria at the A-branch entrance during both the March and June inspections and head differential was low during the May inspection; the B-branch entrance was out of head differential criteria during the September inspection and no reading could be obtained due to unreadable staff gauges and the PLC being out of service during the July inspection; not clean staff gauges were reported during three of nine inspections at B-branch in 2013; at the Cascade Island entrance, staff gauges were reported as not clean during six of nine inspections and no readings for head differential could be obtained during the July inspection due to non-clean staff gauges and out of service PLC; Fish Turbine Unit Two (F2) was out of service during the October and November inspections; during the May inspection several Washington Shore north floating orifice gates were stuck and overtopping; the Washington Shore Fishway exit was reported as not clean during the October inspection.
- At John Day Dam: Fish Pump #2 was out of service during the July fishway inspection (the south shore fishway was still able to achieve all fishway criteria during this inspection); all north fishway pumps were offline during the March inspection resulting in the fishway being at orifice flow and no readings were obtained.
- At McNary Dam: Fish Pump #2 was out of service during the entire 2013 inspection season (the project did meet gate depth and head differential criteria during all of 2013 with two pumps); the southern collection channel velocity was below the 1.5 fps criteria during all inspections in 2013; the Washington Shore exit was reported as not clean during the April fishway inspection.
- At Ice Harbor Dam: multiple gate depths did not meet criteria, however in all cases, gates were operated as low as possible (on sill); during the May inspection the head differential at NFE-2 was below criteria (0.8 feet); multiple staff gauges during the last inspection of the year (October) were reported as not legible.
- At Lower Monumental Dam: Multiple entrance gate depths were below criteria (in all cases entrances were operated as low as possible on sill); debris build-up at the North Shore picketed leads during both the August and October inspections.

- At Little Goose Dam: Multiple entrance gate depths were below criteria (in all cases entrances were operated as low as possible on sill and weirs at fixed elevation at the North Shore fishway); Fish Pump #3 was out of service during the first four inspections of 2013; during the September inspection, it was noted that one panel of the fall-out fence appeared to be missing.
- At Lower Granite Dam: Multiple entrance head differentials were below criteria; established shrubbery on the exit debris containment structure made it difficult to inspect the exit (the exit was reported as clean during all inspections); over the summer of 2013, adult passage at Lower Granite Dam was impeded by excessive water temperatures in the ladder creating a large temperature differential between the ladder and the tailrace water, adults passing through the ladder did respond to the initiation of two emergency pumps that drew in cooler water to the fishway (see summary under Lower Granite).
- At Priest Rapids Dam: the water velocity in the collection channel was slightly below criteria during the August inspection; the head differential at RSE-1 was slightly below criteria during the May inspection.
- At Rock Island Dam: during the August inspection, all right bank entrances recorded head differentials slightly below criteria.
- At Wells Dam: several staff gauges were reported as not clean or readable during the October inspection.



## **SUMMARY BY PROJECT**

Fishway inspections by the State and Federal fishery agencies were completed at the 13 mainstem dams between March and October with NOAA inspecting Bonneville, McNary, Priest Rapids, and Wanapum dams; WDFW inspecting Rock Island, Rocky Reach, and Wells dams; and ODFW inspecting The Dalles, John Day, Ice Harbor, Lower Monumental, Little Goose and Lower Granite dams.

<b>AGENCY</b>	<b>INSPECTOR</b>	<b>DAMS INSPECTED</b>
NOAA	Aaron Beavers	Priest Rapids & Wanapum
NOAA	Gary Fredricks	Bonneville
NOAA	Jeff Brown	McNary
ODFW	Howard Takata	The Dalles & John Day
ODFW	Anne Dowdy/Ruth Shearer	Little Goose & Lower Granite
OFFW	Anne Dowdy/Ruth Shearer	Ice Harbor & Lower Monumental
WDFW	Ryan Flynn and Crew	Wells
WDFW	Solorio and Crew	Rock Island & Rocky Reach

Results from inspections are summarized by project below. Dates of inspections and problem areas are noted as well as special activities that occurred during the year. Criteria used to evaluate operations of a fishway are found in the FPP or Operating Plans for each project.

## **CORPS OF ENGINEER DAMS**

The four lower Columbia River dams, Bonneville to McNary dams, and the four Snake River dams, Ice Harbor to Lower Granite dams comprise the COE projects that were constructed with adult fishways incorporated into their original designs. Fish turbines or fish pumps along with gravity-flow systems were integrated into the fishway designs to supply water to the adult fishways. These eight COE dams have collection channels across the downstream face of the powerhouses with main fishway entrance gates at each end of the channel. Along the face of the collection channel, openings (orifice or sluice gates) were provided to allow entrance for adult fish approaching and passing along the powerhouses. In recent years, many of these collection channel gates have been closed and only the main entrance gates located at each end of the powerhouse are now operated. Most spill schedules have been modeled at the COE's hydraulic laboratory in Vicksburg, Mississippi, and were designed to improve juvenile passage at the dams, reduce high levels of dissolved gas entrainment in the tailwater at the projects, and still provide good passage conditions for adult fish approaching the projects. In many cases, the juvenile and adult spill schedules are similar. Normally, the COE has Project biologists stationed at each dam that complete fishway inspections on a daily basis.

## **BONNEVILLE DAM (photographs on page A-1)**

Bonneville Dam has two powerhouses: the original powerhouse (PH1) constructed in the late 1930s and located on the Oregon shore or south shore of the Columbia River, and the new powerhouse (PH2) completed in 1980/81 and located on the Washington or north shore of the Columbia River. PH1 consists of ten main turbine units while PH2 has eight main turbine units and two smaller fish turbines that supply auxiliary water to the Washington shore fishway. Between the two powerhouses is the spillway (part of the original construction) that incorporates 18 spillbays to pass excess or designated flow past the project. Gravity-flow water supplies flow to the main fishway entrances at PH1 and the spillway entrances. At PH2, the two fish turbines each supply a maximum of 5,000 cfs of water to the auxiliary water system that distributes flow to the four main entrances and the orifice gates along the powerhouse collection channel.

In recent years, numerous improvements have been installed in Bonneville Dam fishways intended to aid in the passage of adult Lamprey. In 2002, a Lamprey Passage System (LPS) was designed and installed in the Bradford Island fishway exit. In 2004, the Bradford Island LPS was extended to the forebay and added PIT-tag readers and resting boxes. In 2007, a dual ramp LPS was installed in the Auxiliary Water Supply (AWS) channel of the Washington Shore Fishway. Also in 2007, nighttime tests were conducted at Washington Shore Entrances that compared standard head differentials (1–2 feet) versus reduced head differentials (0.5 feet) in an effort to evaluate if reduced entrance velocities would improve lamprey entrance rates. Results of the 2007 tests showed some variation in the number of lamprey entering the ladder during reduced nighttime head differentials between the north and south entrances; as a result, the tests were repeated in 2009 with more study blocks.

At the Cascade Island fishway, “keyhole” entrance weirs were installed in 2009 and intended to aid lamprey in entering the ladder by providing a wider opening at the bottom of the weir with reduced entrance velocities making it easier for lamprey to negotiate. In addition to the modified entrance weir, rock floors, a PIT-tag reader, and a prototype LPS were added to the Cascade Island ladder in 2009.

More recent improvements (2010/2011) to the Bonneville Dam fishways intended for lamprey include raising the Washington Shore picketed leads by 1.5 inches along with adding a ramp up to the base of the picketed leads to improve the use of the LPS in the AWS channel and to reduce the use of the serpentine section of the Washington Shore fishway (known problem area for lamprey). The picketed leads at the Washington Shore count station were replaced in 2012 with ¾-inch gap pickets.

Over the winter maintenance period of 2012/2013, several notable lamprey improvements were made at Bonneville Dam.

1. Bonneville Washington Shore entrance Lamprey Flume: Installed the prototype Lamprey Flume System (LFS) at the North Downstream Entrance intended to provide a bypass route around the fishway. A conventional Lamprey Passage Structure (LPS/lamprey ramp) connects to the terminus of the LFS and terminates in a holding tank on the tailrace deck.
2. Bonneville Cascade Island LPS modifications: Being converted into a fully volitional passage route with an exit directly into the forebay, adjacent to the Cascades Island fish ladder exit.

During the 2012/2013 winter maintenance period at the Washington Shore fishway, in an effort to maintain a functional Washington Shore fishway and AWS, the Fish Unit forebay area was dredged. This dredging will reduce the potential for sediment/debris impacts to the Washington Shore AWS. Lastly, improvements were made to the Adult Fish Facility during the 2012/2013 winter maintenance period.

Nine adult fishway inspections have taken place at Bonneville Dam:

<b>Date</b>	<b>Inspector(s), Agency</b>
March 15, 2013	Gary Fredricks (NOAA)
April 12, 2013	Gary Fredricks (NOAA)
May 10, 2013	Gary Fredricks (NOAA)
June 7, 2013	Gary Fredricks (NOAA)
July 5, 2013	Gary Fredricks (NOAA)
August 2, 2013	Gary Fredricks (NOAA)
September 26, 2013	Gary Fredricks (NOAA)
October 25, 2013	Gary Fredricks (NOAA)
November 22, 2013	Gary Fredricks (NOAA)

### **Bradford Island (PH1) Fishway**

The auxiliary water supply to the fishway is gravity-flow water from the forebay of the project. The auxiliary water source normally supplies required flow to meet fishway criteria through high and low tailwater elevations. The Bradford Island Fishway main entrances are operated in pairs (i.e., Gate 2 and Gate 64, or Gate 1 and Gate 65 depending on tailwater elevation).

### **PH1 Inspections**

Weir Gate 1/2, located at the south end of PH1, had head differentials (site reading) that ranged between 0.1 ft and 1.6 ft and met criteria (1.0 ft) during six of nine fishway inspections in 2013. The gate depths at Weir 1/2 ranged from a low of 2.5 ft to a high reading of 12.2 ft for the season. The gate depth was less than 8 ft during three of the nine inspections (March, September, and October). At tailwater elevation 13.5 ft or less, gate depth of 8 ft or > will exceed conduit pressure of 10 psi. With the sill at elevation 2 ft, any tailwater less than 10 ft will also result in gate depths of less than 8 ft. The Bonneville southern powerhouse tailwater was very close to 10 feet during both the September and October inspections.

Weir Gate 64/65 was operating during each inspection in 2013. The gate depths at the A-Branch entrance (Gate 64/65) ranged from 1.8 ft to 8.8 ft, with head differentials through the season ranging from 0.9 ft to 2.1 ft. The gate depth was less than 8 ft during four of the nine inspections (March, June, September, and October inspections). The head differential at the A-branch entrance was within criteria (1.0–2.0 feet) during all inspections in 2013, with the exception of the May 10, 2013, fishway inspection.

South Spillway or B-branch Fishway and the North Spillway or Cascades Island Fishway are part of the original fishway system at Bonneville Dam. Gravity flow water is supplied from the forebay, through a diffusion system and exits through the downstream entrance gates at the lower end of the fish ladder. Both fishways have similar main entrances (design-wise) with side and downstream entrances that operate as continuously open free-flowing vertical slots. Adjacent to each entrance is a spillbay (1 or 18) that is operated at a minimum of 4–6 inches open and passes about 1.8 Kcfs of water. Each main entrance is operated to meet the head differential criteria of 1.0 to 2.0 ft with a preferred head differential of 1.5 ft.

The B-branch Fishway (South Spillway) head differentials ranged between 0.8 and 1.7 feet and were within criteria during seven of nine inspections in 2013 (out of criteria during the September 26, 2013, inspection and no readings obtained during the July inspection due to the PLC being out of service along with unreadable staff gauges).

The Cascades Island (North Spillway) entrances were operated continuously throughout the fish passage season. For the 2013 inspections, head differentials for the Cascades Island fishway ranged from 1.4 to 1.6 ft and were operated within criteria during all inspections that readings were available (no readings

obtained during the July inspection due to the PLC being out of service along with unreadable staff gauges).

**Fish Ladder:** Depth of water measured over the Bradford Island fish ladder weirs ranged from 1.0 to 1.3 ft. The Bradford Island weirs were within criteria during all inspections in 2013. The depth of water measured at A-Branch ranged from 1.1 ft to 1.4 ft during the year, meeting criteria during all inspections in 2013. The depth of water measured at the B-Branch ranged from 1.0 ft to 1.3 ft during the 2013 fishway inspection season, meeting criteria during each inspection. At the Cascades Island fish ladder, water depth over the weirs ranged from 0.9 ft to 1.3 ft; readings were within criteria during all nine inspections of 2013. The fish ladder exit at Bradford Island was reported as clean during all nine inspections in 2013.

### **PH2 Fishway**

Fish Turbine Units F1 and F2 each supply a maximum of 5,000 cfs of water to the four main entrances and 12 orifice gates along the powerhouse collection channel. Other than F2 being out of service during the October and November inspections, both fish turbines operated satisfactorily throughout the fish migration season in 2013.

Head differentials measured at the main entrances, North Upstream, North Downstream, South Upstream, and South Downstream ranged between 1.2 ft and 2.4 ft at the North entrance gates with the South entrance gates reporting head between 0.8 ft and 1.8 ft. Most readings at both the South and North shores were equal or greater than the 1.0 ft minimum with the exception of the September inspection when SDE was at 0.8 feet, slightly below criteria. Both the NUE and NDE entrances were closed during the October inspection for lamprey flume work and during the November inspection the NUE remained closed due to work on F-2. Gate depths at the Washington Shore Fishway ranged between 7.8 ft and 14.7 ft for the season. Gate depth criteria at the Washington Shore Fishway is dependent upon the tailwater elevation. At tailwater elevations greater than 14 feet, the depths over the Washington Shore Entrances should be 13 feet or greater; at a tailwater below 14 feet entrance gates should be fully lowered. In 2013, all Washington Shore gates were operated to criteria, given tailwater depths.

Along the Washington Shore powerhouse collection channel, floating orifice gates were operated well throughout the March, April, June, July, August and September inspections. During the May 10, 2013, fishway inspection, the inspector noted several of the north floating orifice gates to be sticking and overtopping. During the October inspection, only the south floating orifice gates were open due to lamprey flume work. Lastly, during the November inspection, floating orifices were closed along with the NUE entrance due to work being performed on F-2.

**Fish Ladder:** The fish ladder exit and the serpentine section of the Washington fish ladder was reported clear of debris during eight of nine inspections during 2013. During the October inspection, the Washington Shore fishway exit was reported as not clean. Water depth measured over the Washington fish ladder weirs was 0.9 ft to 1.0 ft at Weir 67 and was within the required range for all inspections in 2013 when the ladder was in service.

**Table 1. Pertinent Data for Fish Facility Inspections in 2013 at BONNEVILLE DAM.**

CRITERIA ITEMS	DATE OF INSPECTION									
	<u>15-Mar</u>	<u>12-Apr</u>	<u>10-May</u>	<u>7-Jun</u>	<u>5-Jul</u>	<u>2-Aug</u>	<u>26-Sep</u>	<u>25-Oct</u>	<u>22-Nov</u>	
<b><u>Bradford Island Fishway</u></b>										
<b><u>Bradford Island Entrances</u></b>										
Criteria: (Head Differ. = 1.0-2.0 ft); (Weir Depth + 8 ft or >); (Depth over ladder weirs = 1-1.3 ft); (Velocity + 1.5-4.0 ft)										
Head at A-Branch entrance	ft	1.2	1.8	0.9	1.2	1.2	1.3	2.1	1.4	1.6
Depth over Gate 64/65	ft	7.1	8.6	8.4	1.8	8.8	8.1	6.5	6.8	8.4
Head at South ph entrance	ft	0.1	1.3	0.7	1.0	1.4	1.4	1.6	1.0	0.9
Depth over Gate 1/2	ft	2.5	12.2	11.6	10.4	9.4	9.1	6.4	7.2	8.8
Channel Velocity	fps	2.6	2.6	2.0	2.5	2.6	2.5	2.8	2.6	2.5
Depth- Bradford Is. ladder weirs	ft	1.1	1.0	1.0	1.3	1.0	1.0	1.0	1.1	1.0
Depth - A-Branch ladder weirs	ft	1.2	1.1	1.1	1.4	1.1	1.1	1.1	1.1	1.1
Exit clean (Yes or No)		yes	yes	yes	yes	yes	yes	yes	yes	yes
<b>B-Branch Entrance</b>										
Head at B Branch entrance	ft	1.7	1.5	1.3	1.1	NA	1.6	0.8	1.3	1.5
Staff gages clean		no	yes	yes	yes	no	no	yes	yes	yes
Depth over ladder weir	ft	1.0	1.1	1.0	1.3	1.0	1.1	1.0	1.0	1.1
<b>Cascades Island Entrance</b>										
Head at main entrance	ft	1.6	1.4	1.5	1.5	NA	1.6	1.5	1.5	1.5
Staff gages clean		no	yes	yes	no	no	no	no	yes	no
Depth over ladder weir	ft	1.0	1.0	1.1	1.3	1.0	0.9	1.0	1.0	1.0
<b><u>Washington Shore Fishway</u></b>										
<b>WA Shore Entrance:</b>										
Depth over entrance weir (Criteria = 13.0 ft or >)										
NUE	ft	11.4	13.0	13.5	13.5	13.6	11.7	9.7	NA	closed
NDE	ft	11.3	13.1	13.7	13.4	13.7	11.7	9.7	NA	11.0
SUE	ft	11.3	13.0	13.7	13.4	13.5	12.7	9.6	8.8	12.1
SDE	ft	11.3	13.0	13.8	14.5	14.7	12.7	8.7	7.8	11.0
Head at entrance (Criteria = 1.0-2.0 ft)										
NUE	ft	1.8	2.1	2.4	1.7	1.4	1.5	1.8	NA	NA
NDE	ft	1.3	1.8	2.1	1.6	1.2	1.3	1.5	NA	1.4
SUE	ft	1.2	1.5	1.8	1.4	1.2	1.2	1.0	1.1	1.0
SDE	ft	1.1	1.6	1.8	1.1	NA	1.0	0.8	1.0	2.0
Depth over ladder weir (67)	ft	0.9	0.9	1.0	1.0	0.9	0.9	1.0	1.0	1.0
Channel Velocity (Elect. Meter)		NA	NA	NA	NA	NA	NA	NA	2.3	NA
Ladder exit clean		yes	yes	yes	yes	yes	yes	yes	No	yes
Staff gages clean		yes	yes	yes	yes	no	yes	yes	yes	yes
<b>Comment # (if applicable)</b>		1	2			3	4	5	6	7
<b>Comments:</b>										
1.PH1 south entrance differential low-notified project.										
2. Casc. Is. Side entrance banging loudly.										
3. B-branch and Cascade Island PLC OOS, multiple dirty/missing staff gauges, no readings obtained at multiple locations.										
4. PH1 staff gauges unreadable, ITS openings low,										
5. No Readable TW gauge for CI Fishway										
6. NUE and NDE closed for lamprey flume work, DSM out and only south FOG in operation due to lamprey work, PH2 exit not clean, F2 OOS for rehab.										
7. PH 1 tailwater staff gauges not visible, FV 3-9 needed cleaning, Fish Unit #2 (F2) OOS for re-hab, floating orifices and NUE closed for F2 work.										

## Summary and Recommendations

Areas of note at Bonneville Dam in 2013:

- Head differential readings were below criteria at the Bradford south entrance during three of nine inspections in 2013 (March, May, and November), low gate depth reported during the March inspection.
- At the A-branch entrance, gate depths were below criteria during both the March and June inspections and head differential was low during the May inspection.
- The B-branch entrance was out of head differential criteria during the September inspection and no reading could be obtained due to unreadable staff gauges and the PLC being out of service during the July inspection. Not clean staff gauges were reported during three of nine inspections at B-branch in 2013.
- At the Cascade Island entrance, staff gauges were reported as not clean during six of nine inspections and no readings for head differential could be obtained during the July inspection due to non-clean staff gauges and out of service PLC.
- Fish Turbine Unit Two (F2) was out of service during the October and November inspections.
- During the May inspection several Washington Shore north floating orifice gates were stuck and overtopping.
- The Washington Shore Fishway exit was reported as not clean during the October inspection.
- As stated last year, many staff gauges around the Bonneville fishways are broken or missing. Some of the gauges are visible at certain tailwater elevations and not at others, while other gauges, particularly at the spillway and NDE at the Washington Shore Fishway, are missing altogether. These unreadable/broken/missing staff gauges combined with failures of the PLC systems can make it difficult to determine if the project fishways are within criteria. There appears to be a need for an overhaul of the older components of the adult passage system at Bonneville.

## THE DALLES DAM (photographs on page A-5)

The Dalles Dam was completed in 1957 with 22 main turbine units and two smaller turbine units. The two smaller turbines, Units F-1 and F-2, were part of the original construction and supply attraction flow water to the main fishway entrance gates on the Oregon fishway. The spillway is located between the powerhouse and north shore fishway and incorporates 20 spillbays to pass excess or designated flow past the project.

Approximately 5,000 cfs of water was originally distributed from these small turbines to the East, West, and South fishway entrances as well as to the orifice gates along the powerhouse collection channel. The closure of the orifice gates along the powerhouse collection channel in 2000 changed flow requirements to about 4,200 to 4,500 cfs to meet depth and head criteria at these main entrances. In the early 1990s, Wasco County PUD installed a small turbine on the old auxiliary water supply at the Washington shore fishway. This turbine normally supplies about 800 cfs through the diffusers to the operating entrance, usually Gate N-1.

In recent years, improvements have been implemented in The Dalles Dam fishways intended to aid in the passage of adult Lamprey. In the East Fish Ladder, ladder weir orifices have been chamfered (2-inch radius) in the lower section, lamprey plating has been installed, picketed leads have been raised 1.5 inches off the fishway floor, and the count slot slightly modified to provide better attachment points for lamprey. In the North Fish Ladder, ladder weir orifices have been chamfered (2-inch radius) and picketed leads have been raised 1.5 inches off the fishway floor.

Eight adult fishway inspections have taken place at The Dalles Dam:

<b>Date</b>	<b>Inspector(s), Agency</b>
March 21, 2013	Howard Takata (ODFW)
April 25, 2013	Howard Takata (ODFW)
May 22, 2013	Howard Takata (ODFW)
June 19, 2013	Howard Takata (ODFW) and David Benner (FPC)
July 31, 2013	David Benner (FPC)
August 21, 2013	Howard Takata (ODFW)
September 24, 2013	Wayne Van der Naald (ODFW)
October 28, 2013	Howard Takata (ODFW)

Results of the inspections are discussed below and listed in Table 2.

### **East Fishway Inspections**

The East fishway entrance gates (E-2 and E-3) were submerged 8.0 feet or greater on all inspections in 2013. Head differentials ranged from 1.4 ft to 1.6 ft. The East fishway entrances were operating within established criteria range for gate depths (8 ft or >) and head differentials met criteria during all inspections in 2013. The East entrances generally pass the majority of the fish at The Dalles.

The West fishway entrances (W-1 and W-2) were submerged 8.0 feet or greater on all inspections during 2013 when readings were obtained. It should be pointed out that the W-1 gate was out of service during the March fishway inspection; on this date W-3 was used in place of W-1. The West fishway could not be accessed during the April fishway inspection, therefore no gate depth or head differential reading was obtained. The gate depths ranged from 8.1 ft to 10.0 ft with head differential readings that ranged from 1.0 ft to 1.7 ft. Gate depth and head differential readings met the criteria at the West Entrances during all inspections in 2013.

Flow to the South fishway entrances (S-1 and S-2) occurs through a separate channel that originates in the junction pool and ends near the South end of the spill basin. S-1 and S-2 met weir depth criteria in all eight inspections in 2013, ranging from 8.0 ft to 9.0 ft. Head differentials ranged between 1.1 ft and 1.8 ft at S-1 and S-2, meeting criteria during all eight inspections.

**Table 2. Pertinent Data for Fish Facility Inspections in 2013 at THE DALLES DAM.**

<b>CRITERIA ITEMS</b>									
		<b>DATE OF INSPECTION</b>							
<b>SOUTH SHORE FISHWAY</b>		<b><u>21-Mar</u></b>	<b><u>25-Apr</u></b>	<b><u>22-May</u></b>	<b><u>19-Jun</u></b>	<b><u>31-Jul</u></b>	<b><u>21-Aug</u></b>	<b><u>24-Sep</u></b>	<b><u>28-Oct</u></b>
<b><i>East Entrance:</i></b>									
<b>Depth over entrance weir</b>									
E-1 (gate set at elev. 83.5 ft)	ft								
E-2 (crit. = 8 ft or >)	ft	12.7	13.6	12.9	12.0	11.9	12.9	13.1	11.3
E-3 (crit. = 8 ft or >)	ft	12.6	13.5	12.9	11.9	12.0	12.9	13.0	11.6
Head at main entrance (crit. = 1-2 ft)	ft	1.5	1.5	1.6	1.4	1.6	1.6	1.4	1.6
Depth over ladr. weir (crit. = 1-1.3 ft)	ft	1.0	1.0	1.3	1.3	1.1	1.2	1.1	1.0
Ladder exit clean (yes or no)		yes	yes	yes	yes	yes	yes	yes	yes
Selsyns/PLC operating (yes or no)		yes	yes	yes	yes	yes	yes	yes	yes
Picket leads clean (yes or no)		yes	yes	yes	yes	yes	yes	yes	yes
<b><i>West Entrance:</i></b>									
<b>Depth over entrance weir</b>									
W-1 (crit. = 8 ft or >)	ft	OOS		10.0	8.1	8.4	8.2	8.3	8.2
W-2 (crit. = 8 ft or >)	ft	9.5	na	9.9	8.2	8.4	8.1	8.3	8.2
W-3 (crit. = 8 ft or >)	ft	9.5	na	na	na	na	na	na	na
Head at main entrance (crit. = 1-2 ft)	ft	1.5	na	1.7	1.5	1.5	1.1	1.4	1.0
<b><i>South Entrance:</i></b>									
<b>Depth over entrance weir</b>									
S-1 (Crit. = 8 ft or >)	ft	8.3	8.3	8.9	9.0	9.0	8.4	8.0	8.1
S-2 (Crit. = 8 ft or >)	ft	8.3	8.3	8.8	9.0	8.9	8.4	8.0	8.2
Head at main entrance (Crit. = 1-2 ft)	ft	1.4	1.4	1.8	1.5	1.5	1.4	1.4	1.1
<b>NORTH SHORE FISHWAY</b>									
<b><i>North Shore Entrance:</i></b>									
<b>Depth over entrance weir</b>									
N-1 (crit. = 8 ft or >)	ft	8.8	9.4	8.1	9.1	9.9	9.2	9.7	8.7
Head at main entrance (Crit. = 1-2 ft)	ft	1.4	1.3	1.4	1.3	1.2	1.3	1.2	1.4
Depth over ladr. weir (Crit. = 1-1.3 ft)	ft	1.0	0.8	1.0	1.0	1.0	1.0	1.1	1.0
Ladder exit clean		yes	yes	yes	yes	yes	yes	yes	yes
Selsyns operating		yes	yes	yes	yes	yes	yes	yes	yes
Picket leads clean		yes	yes	yes	yes	yes	yes	yes	yes
PUD trash rack clean (yes or no)		yes	yes	yes	yes	yes	yes	yes	yes
<b>Comment Number (if applicable)</b>		1	2	3	4				
<b>Comments</b>									
1. W-1 is OOS, W-3 being used.									
2. Could not access west entrance gauges.									
3. W-1 back in service.									
4. PUD screen differential high (PUD cleaned).									



**Fish Ladder:** The picketed leads located at the Oregon fish counting station were reported clear of debris on all inspections. The depth of water over the fish ladder weirs ranged between 1.0 ft and 1.3 ft during the season, meeting criteria on all inspections. The exit was reported clear of debris on all inspections.

### **North Shore Fishway Inspections**

At the Washington fishway, a single fish turbine supplies flow through a diffuser system and to the main fishway entrance. The turbine is screened and a juvenile bypass facility is incorporated in the design and operation of the facility. Wasco PUD has operated the facility since the early 1990s. The fishway equipment and associated facilities operated satisfactorily throughout the 2013 fish passage season. Flow was sufficient to meet gate depth and head differential criteria at the North Shore for all inspections this season.

The North entrance gate, N-1, was operated throughout the fish passage season. Gate depths ranged from 8.1 to 9.7 feet over the season. Head differentials at N-1 ranged from 1.2 to 1.4 ft. The Washington fishway was operated within criteria during all inspections in 2013.

**Fish Ladder:** The ladder exit was reported clear of debris on all inspections and the PUD trash racks were reported clear of debris on all 2013 inspections (with exception of the June inspection). The picketed leads were reported clear of debris during all inspections during the passage season. The depth of water recorded over the ladder weirs showed the fish ladder in proper criteria during seven of eight inspections with a range of 0.8 ft to 1.1 ft (out of criteria April 25, 2013).

### **Summary and Recommendations**

For the most part, the Oregon and the Washington fishways were operating at criteria during the fish facility inspections completed in 2013. One issue of note at The Dalles over 2013 was low depth over the north ladder weir during the April inspection.

### **JOHN DAY DAM (photographs on page A-7)**

John Day Dam is a COE-operated project that went on-line for power production in 1968 with 16 main turbine units and twenty spillbays located on the north end of the powerhouse. Major changes to the project have been the addition of spillway deflectors into the spillbays and the addition of a screened juvenile fish bypass system. The spillway deflectors allow additional flow to pass through spill without greatly increasing dissolved gas levels at the project.

Three turbine-driven pumps pull water from the tailwater of the dam and this water supplies attraction flow for adult fish passing the Oregon shore adult fishway. This water is supplied through a floor diffuser system and exits from one main entrance on the south shore and two main entrances at the north end of the powerhouse. The project can normally operate two of the three pumps to meet criteria levels of the main entrances as well as the floating orifice gates along the powerhouse collection channel. Six electric pumps are operable on the Washington shore to supply water to the diffusers located at the lower end of the fish ladder. However, a maximum of only four pumps (normally three pumps) can operate at any one time at the north shore. Beginning in 2000, only one main entrance gate at the north end of the spillway was operated rather than two as in previous years.

The exit section of the Oregon fish ladder was modified prior to the 2003 fish passage season. No longer is the section a serpentine-like ladder, but is now more similar to The Dalles north shore fish ladder exit. The modification has been successful in reducing holding of fish in the fish ladders while still providing a good passage route from the overflow weir section to the exit from the fish ladder. Over the winter of 2009/2010 a similar modification occurred on the north shore fish ladder and included lamprey passage improvements.

Several notable lamprey improvements have been made at John Day Dam.

1. North Fish Ladder - Completed extensive 2-year entrance and lower ladder improvements for salmon and lamprey. Lamprey features include the variable-width weir (with rounded corners to make fishway entry easier), bollards and plating in/around the entrance to slow velocities and provide attachment surfaces, an LPS inside the entrance area (temporarily terminating at a tailrace deck holding tank), new 3/4" diffusers, and diffuser plating for attachment for all diffusers.
2. South Fish Ladder - Installed prototype lamprey trap at the count station to increase tribal collection efficiency and provide a novel means of counting lamprey that bypass the count window.

Eight adult fishway inspections have taken place at John Day Dam:

<b>Date</b>	<b>Inspector(s), Agency</b>
March 21, 2013	Howard Takata (ODFW)
April 25, 2013	Howard Takata (ODFW)
May 22, 2013	Howard Takata (ODFW)
June 19, 2013	Howard Takata (ODFW) and David Benner (FPC)
July 31, 2013	David Benner (FPC)
August 21, 2013	Howard Takata (ODFW)
September 24, 2013	Wayne Van der Naald (ODFW)
October 28, 2013	Howard Takata (ODFW)

Table 3 lists the criteria items and the inspection dates for 2013, with the text below detailing some of the results.

<b>Table 3. Pertinent Data for Fish Facility Inspections in 2013 at JOHN DAY DAM.</b>									
<b>CRITERIA ITEMS</b>									
	<b>DATE OF INSPECTION</b>								
<b>SOUTH SHORE FISHWAY</b>									
<b>South Shore Entrance:</b>									
	<b>21-Mar</b>	<b>25-Apr</b>	<b>22-May</b>	<b>19-Jun</b>	<b>31-Jul</b>	<b>21-Aug</b>	<b>24-Sep</b>	<b>28-Oct</b>	
Depth over entrance weir									
SE-1 (Crit. = 8 ft or >)	ft	9.4	9.8	9.8	10.1	10.4	8.7	9.6	8.6
Head at SE-1 (Crit. = 1-2 ft)	ft	1.6	1.7	1.6	1.6	1.0	1.7	1.4	1.4
Dep. over ladr. weir (Crit.=1.0 +/-0.1) ft [normal] & 1.3 ft shad season)	ft	1.0	1.0	1.2	1.2	1.1	1.1	1.0	1.0
Ladder exit clean (Yes or No)		yes	yes	yes	yes	yes	yes	yes	yes
Staff gages clean (Yes or No)		yes	yes	yes	yes	yes	yes	yes	yes
Picket Leads Clean (Yes or No)		yes	yes	yes	yes	yes	yes	yes	yes
Pumps operating		3	3	3	3	2	3	3	3
Rpm for pumps		57-58	57	57	57	67-68	56	55	55
<b>North Powerhouse Entrance:</b>									
Depth over entrance weir									
NE-1 (Crit. = 8 ft or >)	ft	8.2	8.3	9.6	9.4	8.3	8.4	8.0	8.2
NE-2 (Crit. = 8 ft or >)	ft	7.9	8.5	9.8	9.6	8.4	8.3	7.9	8.2
Head at NE-1&2 (Crit. = 1-2 ft)	ft	1.5	1.3	1.4	1.3	1.0	1.3	1.7	1.5
Staff gages clean (yes or no)		yes	yes	yes	yes	yes	yes	yes	yes
<b>NORTH SHORE FISHWAY</b>									
<b>North Shore Entrance:</b>									
Depth over entrance weir									
N-1 (Crit. = 8 ft or >)	ft	na	fixed	fixed	fixed	fixed	fixed	fixed	fixed
Head at N-1(Crit. = 1-2 ft) Targ - 1.5'	ft	na	1.5	1.6	1.5	1.4	1.4	1.4	1.3
Depth over ldr weir (Crit.=1.0 +/-0.1)	ft	1.2	1.0	1.3	1.3	1.1	1.1	1.1	1.1
Ladder exit clean		yes	yes	yes	yes	yes	yes	yes	yes
Staff gages clean		yes	yes	yes	yes	yes	yes	yes	yes
Picket leads clean		yes	yes	yes	yes	yes	yes	yes	yes
Pumps Operating		0	3	3	3	3	3	3	3
Comment number (if applicable)		1				2			
<b>Comments:</b>									
1. North Fishway at Orifice flow, all north pumps offline.									
2. Some PLC readings and field measurements differed slightly, Fish Pump #2 will return within several days.									

### **South (Oregon Shore) Fishway Inspections**

Gate SE-1 was operated at the South Shore Fishway throughout the season. The gate depth ranged from 8.6 to 10.4 ft over the eight inspections. The head differential ranged from 1.0 ft to 1.7 ft for the season. All SE-1 gate depths and head differentials met criteria during the 2013 fishway inspection season. Overall, entrance conditions at Gate SE-1 should have provided satisfactory fish passage during the 2013 inspections conducted by ODFW/FPC. All inspections reported site readings that were within criteria

(Table 3). It should be noted that fish pump #2 was out of service during the July fishway inspection. Despite being limited to two fish pumps, the south shore fishway was still able to achieve all fishway criteria during this inspection.

The North powerhouse entrance gates, NE-1 and NE-2, operated at head differentials within the range of 1.0 to 1.7 ft with gate depths that ranged from 7.9 ft to 9.8 ft. For the most part, gate depth and head differential criteria at were met at NE-1 and NE-2 throughout the 2013 fishway inspection season. However, during both the March and September inspections NE-2 was slightly below criteria (8.0 feet) at 7.9 feet of depth. Head differentials were within the proper criteria range for all fishway inspections in 2013. Attraction flows from these gates should have provided satisfactory conditions for adult fish approaching those entrance gates over 2013.

**Fish Ladder:** The exit from the fish ladder, staff gauges, and the picketed leads were all reported as clean during all inspections in 2013. The depth of water measured over the ladder weirs was 1.0–1.2 ft for the 2013 season and were within the criteria range during all inspections.

### **North Shore Fishway Inspections**

The north shore fishway entrance (N-1) has been replaced with a variable-width weir that is at a fixed elevation. Therefore, there is no longer an 8-foot depth criterion at the North Shore fishway. There continues to be head differential criteria at the N-1 entrance. In 2013, the head differentials at N-1 were maintained between 1.3 ft and 1.6 ft (targeted 1.5 ft) and met criteria during all inspections when readings were obtained. During the March inspection, all north fish pumps were offline resulting in the fishway being at orifice flow and no readings were obtained.

**Fish Ladder:** The exit from the ladder and the picketed leads at the count station were reported clear of debris on all inspections for the 2013 season. The depth over the North Shore ladder weirs met criteria during all 2013 inspections.

### **Summary and Recommendations**

Overall, the main entrances at the Oregon and the Washington fishways were operated within criteria levels during most of the 2013 fish passage season. It should be noted that fish pump #2 was out of service during the July fishway inspection; however, the south shore fishway was still able to achieve all fishway criteria during this inspection. All north fishway pumps were offline during the March inspection resulting in the fishway being at orifice flow and no readings were obtained.

**MCNARY DAM (photographs on page A-10)**

McNary hydroelectric project is a COE-operated dam completed in 1953. Fourteen main turbine units and 22 spillbays are incorporated in this dam. The Oregon and Washington shore fish ladders incorporate full overflow weirs and have submerged orifices in each weir. On the Oregon fishway, three large electric fish pumps pull water from the tailrace of the project plus about 1,000 cfs of gravity flow from the forebay, and supply water to the main entrance gates located at each end of the powerhouse. Twelve floating orifice gates operate along the powerhouse collection channel with each gate supplying about 60 cfs of water to attract adult fish into the channel. In the mid-1990s, the water supply for the Washington fishway was changed from the pressurized system to a non-pressurized system as Wasco/Klickitat PUDs installed a small turbine on the water supply from the forebay that produces electricity for the PUD and also supplies flow (about 1,500 to 1,700 cfs) to meet gate depth and head differential requirements for the two main entrance gates. With the construction of the new juvenile bypass system, about 400 cfs of water (bleed-off from the bypass flow) is routed to the north end of the powerhouse and enters the fishway via a screened area at the NPEs.

Seven adult fishway inspections took place at McNary Dam:

<b>Date</b>	<b>Inspector(s), Agency</b>
April 26, 2013	Jeff Brown (NOAA)
May 31, 2013	Jeff Brown (NOAA)
June 27, 2013	Jeff Brown (NOAA)
July 24, 2013	Jeff Brown (NOAA)
August 6, 2013	Jeff Brown (NOAA)
September 24, 2013	Jeff Brown (NOAA)
October 16, 2013	David Benner (FPC)

Results of the inspections are discussed below with Table 4 displaying data collected from each inspection.

The project typically can meet criteria standards operating with two of the three pumps at the Oregon fishway. When three pumps operate, the angle opening normally ranges between 20° and 24°. When two pumps operate the blade angle is typically increased up to 28° to 32°. In addition to the pumped and gravity-flow water, about 400 cfs of water from the juvenile bypass system is added to the north end of the powerhouse. Wall screens are present to exclude adult fish from entering this water source.

**South Shore (Oregon) Fishway Inspections**

During 2013, Fish Pump #2 was out of service during the entire inspection season and the Oregon Fishway at McNary Dam was therefore limited to a two pump operation.

The main entrances at the south shore (SFEW-1 & 2) were reported with gate depths that ranged between 8.5 ft and 9.7 ft for the year. The gate depth criteria at SFEW 1 and 2 is now 8.0 feet or greater (2013 change to the Fish Passage Plan: 13MCN004 2.3.2.2. Ladder Depth Criteria). All inspections in 2013 were at or above the 8.0-foot gate depth criteria. The head differentials ranged from 1.1 to 1.9 ft at SFEW-1 & 2, with all inspections having head differentials within criteria.

**Table 4. Pertinent Data for Fish Facility Inspections in 2013 at McNary Dam.**

<b>CRITERIA ITEMS</b>								
		<b><u>DATE OF INSPECTION</u></b>						
<b>SOUTH SHORE FISHWAY</b>								
<b><i>South Shore Entrance:</i></b>		<b><u>26-Apr</u></b>	<b><u>31-May</u></b>	<b><u>27-Jun</u></b>	<b><u>24-Jul</u></b>	<b><u>6-Aug</u></b>	<b><u>24-Sep</u></b>	<b><u>16-Oct</u></b>
Depth over entrance weir (Criteria: 8 ft or > gate depth at SFEW-1,2 & NFEW-1,2)								
SFEW-1	ft	9.3	8.5	8.8	9.7	9.7	9.4	8.9
SFEW-2	ft	9.3	9.5	8.8	9.7	9.7	9.4	8.9
Head at SFEW-1,2 (Crit.= 1-2 ft)	ft	1.4	1.1	1.9	1.4	1.2	1.3	1.3
Dep. over ladr. weir(Crit.= 1-1.3')	ft	1.1	1.0	1.1	1.0	1.0	1.2	1.1
S. Channel velocity (Crit.= 1.5-4.0 fps)	fps	1.1	1.4	1.4	1.3	0.9	0.8	1.4
Ladder exit clean		yes	yes	yes	yes	yes	yes	yes
Picket leads clean		yes	yes	yes	yes	yes	yes	yes
Orifice Gates Operating - 12		10	11	12	10	12	12	12
Pumps Operating & degrees open		2--30	2--30	2--30	2--30	2--30	2--29,30	2--30
<b><i>North Powerhouse Entrance:</i></b>								
Depth over entrance weir								
NFEW-2	ft	8.3	8.6	8.5	8.8	8.6	8.4	8.4
NFEW-3	ft	8.3	8.6	8.7	8.8	8.5	8.4	8.3
Head at NFEW-2&3 (Crit. = 1-2 ft)	ft	1.6	1.5	1.4	1.1	1.2	1.1	1.3
N. Channel velocity (Crit.= 1.5-4.0 fps)	fps	3.3	3.7	3.3	3.1	3.4	3.0	2.2
<b>WA.SHORE FISHWAY</b>								
<b><i>North Shore Entrance:</i></b>								
Depth over entrance weir								
WFE-2 (Crit. = 8 ft or >)	ft	8.8	9.5	8.3	8.7	8.6	9.0	8.9
WFE-3 (Crit. = 8 ft or >)	ft	8.8	8.2	8.9	8.8	8.8	9.0	9.8
Head at WFE-2&3 (Crit. = 1-2 ft)	ft	1.5	1.5	1.4	1.5	1.5	1.5	1.5
Dep. over ladr. weir (Crit. = 1-1.3 ft)	ft	1.1	1.1	1.1	1.4	1.2	1.0	1.0
Ladder exit clean		no	yes	yes	yes	yes	yes	yes
Picket leads clean		yes	yes	yes	yes	yes	yes	yes
Comment number (if applicable)								
<b>Comments:</b>								

The north powerhouse entrances, NFEW 2 and 3, operated over 2013. North powerhouse entrances were both above criteria during all seven inspections recorded in 2013 as gate depths ranged from 8.3 ft to 8.8 ft. The North Powerhouse head differentials ranged from 1.1 ft to 1.6 ft, and were at or above criteria during all inspections in 2013.

Surface velocity was estimated at the northern and southern end of the collection channel by timing a wood chip or floating object a given distance along the channel. Water velocity was between 2.2 fps and 3.7 fps at the north end of the collection channel (North Powerhouse) and was 0.8 fps to 1.4 fps at the south end of the channel (South Powerhouse).

**Fish Ladder:** The South Shore Fishway picketed leads and the ladder exit were reported clear of debris during all inspections in 2013. The depth of water reported over the south fishway ladder weirs ranged from 1.0 ft to 1.2 ft. and was within criteria on all inspections.

#### **North Shore (Washington) Fishway Inspections**

The Washington shore fishway entrances WFE 2 and 3 were operable over 2013. The Washington shore fishway entrances were submerged from 8.2 ft to 9.8 ft, meeting criteria (8 ft or greater) during all inspections. Head differentials at the Washington shore fishway ranged from 1.4 ft to 1.5 ft. Head differentials were operated within acceptable criteria range throughout all of the 2013 season.

**Fish Ladder:** The fishway exit was reported as clean during six inspections in 2013, however was reported as not clean during the April 26, 2013 fishway inspection. The picketed leads were reported as clean during all inspections in 2013. The depth of water reported over the north fishway ladder weirs ranged from 1.0 ft to 1.4 ft. and were within criteria during all inspections in 2013.

#### **Summary and Recommendations**

Overall, the fishways at McNary Dam operated well considering the limitation to two fish pumps for the entire 2013 fishway season. Some problem areas to note are:

- Fish Pump #2 was out of service during the entire 2013 inspection season.
- The southern collection channel velocity was below the 1.5 fps criteria during all inspections in 2013. In 2012 velocities in the south collection channel were met in five of seven inspections.
- The Washington shore exit was reported as not clean during the April 26, 2013, fishway inspection.

## ICE HARBOR DAM (photographs on page A-15)

Ice Harbor Dam was the initial dam constructed in the lower Snake River and was completed in 1961. The COE-operated project has six main turbine units and ten spillbays to pass water at the dam. A Removable Spillway Weir is now in place at the project and is operated throughout most of the fish passage season.

The adult fish passage facilities consist of a separate water supply system for the south and for the north shore fishway. Attraction flow to the south fishway is supplied by up to eight electric pumps and about 200 cfs bleed-off flow from the juvenile bypass system. The juvenile bypass flow is added into the pumped water supply system. Five to eight fish pumps operate, depending on the tailwater elevation. Under most river flow conditions, the project should have the capability to maintain the south fishway within acceptable criteria for gate depth and head differential. Two electric fish pumps supply attraction water to the north shore fishway with the pumped flow normally able to meet criteria under high to medium flow conditions. The north shore fishway does have three pumps available, but can operate only two at one time due to electrical constraints.

Over the last several years, improvements have been installed in Ice Harbor Dam fishways intended to aid in the passage of adult lamprey. Adult lamprey passage improvements were made to upper fish ladder weirs at Ice Harbor Dam during the winter of 2011/2012. These included cutting horizontal slots in weirs at the fishway floor to allow adult lamprey attachment through a level pathway through the weir. Ramps were installed from the fish ladder floor to the bottom of elevated salmon orifices in the upper ladder weirs to assist lamprey moving through these areas. Additionally, plates were installed on diffuser grating adjacent to orifices in the Ice Harbor north fish ladder to provide attachment surfaces for lamprey in higher-velocity areas.

Six adult fishway inspections have taken place at Ice Harbor Dam:

<b>Date</b>	<b>Inspector(s), Agency</b>
May 30, 2013	A. Dowdy (ODFW), Benner (FPC)
June 14, 2013	A. Dowdy (ODFW)
July 22, 2013	A. Dowdy (ODFW)
August 22, 2013	A. Dowdy (ODFW)
September 26, 2013	A. Dowdy (ODFW)
October 28, 2013	A. Dowdy (ODFW)

Details of the inspections are found in Table 5 and a summary of the inspections reported in the section below.

### **South Shore Fishway Inspections**

At least five fish pumps were operating on all inspections completed this season. Excess flow from the juvenile bypass system and pumped flow water is passed through diffusers to supply water to the main fishway entrances and the orifice gates along the powerhouse collection channel.

The South shore entrance gate (SFEW-1) was submerged from 6.9 ft to 9.0 ft during the 2013 season. Gate SFEW-1 did not meet the 8-foot depth criteria during the last four inspections in 2013 (July, August, September, and October). During these last four inspections, gate SFEW-1 was recorded on sill and could not be lowered further. Head differentials measured at SFEW-1 ranged from 1.3 ft to 2.1 ft for the season. Head differential criteria were met during all inspections.



The north powerhouse entrance gate (NFE-2) was operating with weir depths that ranged between 7.0 ft and 8.3 ft for the season. Gate NFE-2 did not meet the 8-foot depth criteria during the last four inspections in 2013 (July, August, September, and October). During all inspections when criteria were not met, NFE-2 was recorded on sill. Head differentials ranged from 0.8 ft to 1.7 ft over the 2013 inspection season. During the May 30, 2013, inspection, the head differential was below the 1.0 foot criteria (0.8 feet).

Four floating orifice gates operated satisfactorily along the powerhouse collection channel throughout the fish passage season. The water velocity in the collection channel ranged between 1.4 and 2.8 fps over the 2013 inspections season; all channel velocities were within the desired range (1.5–4.0 fps) with the exception of the May inspection. During the May inspection it was noted in the inspection report that a foreign object appeared to be attached to the velocity probe. The velocity recorded during this inspection was 1.4 fps, just below the minimum criteria level.

**Fish Ladder:** The exit from the fish ladder was reported clear of debris on all inspections. The picketed leads located at the counting station were also recorded as clean on all inspections. Depth of water over the ladder weirs was reported between 1.0 and 1.1 ft for the six inspections, all within criteria.

#### **North Shore Fishway Inspections**

Gate NEW-1 was submerged 8.0 ft or more in depth during two of six inspections. Gate depths ranged from 6.5 ft to 8.7 ft. During the last four inspections of 2013 (July, August, September, and October), the NEW-1 gate depth was below criteria; however, the gate was on sill and could not be lowered further. Head differentials were reported in the following range: 1.2 ft to 2.7 ft. Head differentials and North Shore Fishways were within criteria during all inspections in 2013.

**Fish Ladder:** The exit from the north shore fish ladder and also the picketed leads at the counting station were reported clear of debris throughout the inspection season. Depth of water over the ladder weirs was reported to be 1.1–1.2 ft for all inspections. All inspections were within criteria.

#### **Summary and Recommendations**

Fish facilities at Ice Harbor appeared to operate well in 2013 considering entrance weir sill elevations. Overall, multiple gate depths did not meet criteria. However in all cases, gates were operated as low as possible (on sill). During the May 30<sup>th</sup>, 2013, inspection, the head differential at NFE-2 was below criteria (0.8 feet) along with the velocity in the collection channel being slightly below criteria (1.4 fps). However it was noted that an object could have been attached to the velocity meter during this inspection. Multiple staff gauges during the last inspection of the year (October) were reported as not legible.

**Table 5. Pertinent Data for Fish Facility Inspections in 2013 at ICE HARBOR DAM.**

<b>CRITERIA ITEMS</b>							
		<u>30-May</u>	<u>14-Jun</u>	<u>22-Jul</u>	<u>22-Aug</u>	<u>26-Sep</u>	<u>28-Oct</u>
<b>SOUTH SHORE FISHWAY</b>							
<b>South Shore Entrance:</b>							
Depth over entrance weir							
SFEW-1 ( Crit. = 8 ft or >)	ft	9.0	8.5	7.5	6.9	7.4	6.9
Head at SFEW-1 (Criteria = 1-2 ft)	ft	1.3	1.8	1.3	2.1	2.0	1.9
Gate on Sill (yes or no) 332.25		no	no	yes	yes	yes	yes
Dep. over ladr. weir (Cr. = 1-1.3 ft)	ft	1.1	1.1	1.1	1.0	1.1	1.0
Channel velocity (Crit. = 1.5-4 fps)	fps	1.4	1.6	2.2	2.8	2.3	2.8
Ladder exit clean (yes or no)		yes	yes	yes	yes	yes	yes
Staff gages clean (yes or no)		yes	yes	yes	yes	yes	No
Picket leads clean (yes or no)		yes	yes	yes	yes	yes	yes
Pumps Operating (8 available)		6	6	5	6	6	6
<b>North Powerhouse Entrance:</b>							
Depth over entrance weir							
NFE-2 (Criteria = 8 ft or >)	ft	8.3	8.2	7.2	7.8	7.1	7.0
Head at NFE-2 (Criteria = 1-2 ft)	ft	0.8	1.1	1.1	1.7	1.6	1.7
Gate on Sill (yes or no) 332.25		no	no	yes	yes	yes	yes
Staff gages clean	ft	yes	yes	yes	yes	yes	yes
<b>NORTH SHORE FISHWAY</b>							
<b>North Shore Entrance:</b>							
Depth over entrance weir							
NEW-1 (Criteria = 8 ft or >)	ft	8.7	8.6	6.5	7.8	7.8	7.0
Head at NEW-1 (Criteria = 1-2 ft)	ft	1.2	1.6	1.0	2.2	1.5	1.9
Gate on Sill (yes or no) 332.25		no	no	yes	yes	yes	yes
Dep. over ladr. weir (Crit. = 1-1.3 ft)	ft	1.2	1.2	1.1	1.2	1.2	1.2
Ladder exit clean		yes	yes	yes	yes	yes	yes
Staff gages clean		yes	yes	yes	yes	yes	yes
Picket leads clean		yes	yes	yes	yes	yes	yes
Pumps Operating (3 available)		2	2	2	2	2	2
Comment Number (if applicable)		1		2			3
<b>Comments:</b>							
1. Possible foreign object attached to velocity probe (COE will check), NEW-2 in closed position							
2. Staff gauges at SFE and NFE illegible due to intense glare. All entrances at sill.							
3. Many staff gauges illegible, appeared "bleached out".							

## **LOWER MONUMENTAL DAM (photographs on page A-20)**

The COE completed construction and began operation of Lower Monumental Dam in 1969. Six main turbine units and eight spillbays pass flow at the project.

Three turbine-driven pumps pull water from the tailrace and supply water to a conduit that distributes this flow to the diffuser system along the collection channel and the north and south shore collection systems. The south shore fishway has a separate fish ladder, but no separate water supply was added to that side of the dam. After the completion of the new juvenile fish bypass system, about 200 cfs of excess water flow was added to the north shore supply diffusers. Normally the juvenile bypass system operates from March through December. Since that time, and with other changes made to the fish pumps, the project can normally meet gate depth and head differential criteria with two pumps, but standard operating procedure is to operate the three pumps on a continual basis. Floating orifice gates (formerly 4) remain permanently closed at this project.

Over the last several years, improvements have been installed in Lower Monumental Dam fish ways intended to aid in the passage of adult lamprey. Like those made at Ice Harbor, adult lamprey passage improvements were made to upper fish ladder weirs at Lower Monumental Dam during the winter of 2011/2012. These included cutting horizontal slots in weirs at the floor to allow adult lamprey attachment through a level pathway through the weir. Additionally, ramps were installed from the fish ladder floor to the bottom of elevated salmon orifices in the upper ladder weirs to assist lamprey in maintaining attachment as they move through these areas.

Six adult fishway inspections have taken place at Lower Monumental Dam:

<b>Date</b>	<b>Inspector(s), Agency</b>
June 6, 2013	A. Dowdy (ODFW), Benner (FPC)
June 20, 2013	A. Dowdy (ODFW)
July 22, 2013	A. Dowdy (ODFW)
August 22, 2013	A. Dowdy (ODFW)
September 26, 2013	A. Dowdy (ODFW)
October 28, 2013	A. Dowdy (ODFW)

Data from the inspections are reported in the discussion below as well as in Table 6.

### **North Shore Fishway**

The north shore fishway entrance gates, NSE-1 and NSE-2, were operated with gate depths ranging from 8.0 ft to 8.6 ft during the 2013 inspections. Gate depths at NSE-1 and NSE-2 were within criteria for all inspections in 2013. Head differentials ranged from 1.0 ft to 1.6 ft over the 2013 inspections and were within criteria during all inspections. Discharge and velocity through the NSE-1 and NSE-2 entrance gates should have provided satisfactory passage conditions over the inspections at the north shore entrance gates.

**Table 6. Pertinent Data for Fish Facility Inspections in 2013 at LOWER MONUMENTAL DAM**

<b>CRITERIA ITEMS</b>		<b>DATE OF INSPECTION</b>					
		<b><u>6-Jun</u></b>	<b><u>20-Jun</u></b>	<b><u>22-Jul</u></b>	<b><u>22-Aug</u></b>	<b><u>26-Sep</u></b>	<b><u>28-Oct</u></b>
<b>NORTH SHORE FISHWAY</b>							
<b>North Shore Entrance:</b>							
Depth over entrance weir							
NSE-1 (Criteria = 8 ft or >)	ft	8.5	8.2	8.0	8.2	8.3	8.0
NSE-2 (Criteria = 8 ft or >)	ft	8.5	8.2	8.0	8.1	8.3	8.6
Head at NSE-1 & 2 (Crit. = 1-2 ft)	ft	1.6	1.0	1.6	1.4	1.3	1.4
Gate on Sill (yes or no) 429ft		no	no	yes	yes	no	no
Dep. over ladr. weir (Cr. = 1-1.3 ft)	ft	1.1	1.0	1.0	1.1	1.0	1.1
Channel velocity (Crit. = 1.5 - 4 fps)	fps	2.2	1.5	1.8	1.4	1.6	1.6
Ladder exit clean (yes or no)		yes	yes	yes	yes	yes	yes
Staff gages clean (yes or no)		yes	yes	yes	yes	yes	yes
Picket leads clean (yes or no)		yes	yes	yes	no	yes	no
<b>South Powerhouse Entrance:</b>							
Depth over entrance weir							
SPE-1 (Criteria = 8 ft or >)	ft	6.8	5.6	5.4	5.1	7.0	6.7
SPE-2 (Criteria = 8 ft or >)	ft	6.7	5.6	5.0	5.0	6.9	6.6
Head at SPE-1 & 2 (Crit. = 1-2 ft)	ft	1.3	1.3	1.9	1.6	1.3	1.2
Gate on Sill (Yes or No) 432ft		yes	yes	yes	yes	yes	yes
Staff gages clean/readable (yes or no)		yes	yes	yes	yes	yes	yes
<b>SOUTH SHORE FISHWAY</b>							
<b>South Shore Entrance:</b>							
Depth over entrance weir							
SSE-1 (Criteria = 8 ft or >)	ft	6.7	5.9	5.9	5.5	7.8	7.2
SSE-2 (permanent) 6-feet	ft	6.0	6.0	5.8	closed	6.3	6.3
Head at SSE-1 & 2 (Crit. = 1-2 ft)	ft	1.3	1.3	1.2	1.0	1.2	1.1
Gate on Sill (yes or no) 431ft		yes	yes	yes	yes	yes	yes
Dep. over ladr. weir (Crit. = 1-1.3')	ft	1.0	1.3	1.1	1.0	1.1	1.0
Ladder exit clean		yes	yes	yes	yes	yes	yes
Picket leads clean		yes	yes	yes	yes	yes	yes
Pump speed	rpm		71	75	73	74	73-74
# of Pumps Operating (3 available)			2	2	2	2	2
Comment Number (if applicable)				1	2		3
<b>Comments:</b>							
1. All entrances on sill. Did not observe bubblers at either exit, minor debris build up, exit differentials do not indicate problem							
2. Doble testing underway, project operating to station power only. Head differential at north shore picketed lead slightly above maximum criteria. SSE-2 closed. One adult "jumper" at Nshore picketed leads.							
3. Moderate debris build-up at northshore picketed leads, differential higher than criteria.							

An electronic velocity meter located in the northern end of the collection channel gave water velocity readings that ranged from 1.6 ft/s to 2.2 ft/s and were within criteria during all six inspections (1.5–4.0 fps).

The south powerhouse entrance gates, SPE-1 and SPE-2, were operated with gate depths ranging from 5.0 ft to 7.0 ft. Neither of the SPE entrances met gate depth criteria (8 ft or greater) during any inspection in 2013; however the SPEs were on sill during all inspections in 2013, so no further depth could be obtained. Head differentials recorded at the SPE gates ranged from 1.2 to 1.9 feet. The head differential readings met standard operating criteria during all six inspections in 2013.

**Fish Ladder:** The depth of water over the north shore fish ladder weirs was 1.0–1.1 ft on all inspections and therefore met criteria during all inspections. The north fishway exit was reported clean during all six inspections in 2013; however the picket leads were reported as not clean during both the August and October inspections.

### **South Shore Fishway**

Two south shore entrances are operated (both downstream, no side entrance) to attract fish to the spillway or south fish ladder. All auxiliary water is supplied from the north shore turbine-driven pumps except for the 200 cfs flow that enters from the juvenile bypass system. Gate SSE-2 is a fixed-open gate that remains 6-ft open while Gate SSE-1 is to be submerged 8 ft or more during normal operation. Gate depths at SSE-1 ranged from 5.5 ft to 7.8 ft. SSE-1 was not within gate depth criteria during any of the six inspections in 2013. During all inspections in 2013, SSE-1 was on sill and could not be lowered any further. The head differentials at the south entrances ranged from 1.0 ft to 1.3 ft and were within criteria for all inspections during the 2013 season.

**Fish Ladder:** The south shore exit was recorded as clear of debris during all 2013 inspections. The picketed lead section at the fish counting station was reported clear of debris for all inspections this season. The depth of water over the ladder weir was 1.0–1.3 ft over each inspection in 2013, all within acceptable criteria.

### **Summary and Recommendations**

Overall, fishways at the project were found to be operating within acceptable criteria for the majority of the 2013 inspection season considering entrance weir sill elevations. One issue at Lower Monumental Dam in 2013 was the presence of debris build-up at the north shore picketed leads during both the August and October inspections. It is recommended that all picketed leads be checked for debris, and cleaned, on a more frequent basis.

### **LITTLE GOOSE DAM (photographs on page A-23)**

Little Goose Dam was completed in fall 1970 and is operated by the COE. The project consists of six main turbine units and eight spillbays to pass flow. A Spillway Weir was installed in spill bay 1 in 2009.

The adult fish passage facilities are comprised of one fish ladder located on the south shore, two south shore entrances, a powerhouse collection channel, two entrances at the north end of the powerhouse, and two north shore entrances with a transportation channel underneath the spillway to the powerhouse collection channel. All orifice gates along the powerhouse collection channel were closed in 2001. Three turbine-driven pumps and about 200 cfs excess flow from the juvenile bypass system supply water to the adult fishway. The adult fish facilities can normally operate near acceptable criteria through varying high and low flow conditions.

Over the last several years, improvements have been installed in Little Goose Dam fish ways intended to aid in the passage of adult lamprey. In 2011, picketed leads were modified near the floor of the adult fish ladder at the count station. This was done to enable adult lamprey passage under the picketed leads, providing a low-velocity passage route for lamprey around the adult fish count slot. Over the 2012/2013 winter maintenance period, horizontal slots were cut in weirs at the floor to allow adult lamprey attachment through a level pathway through the weir. Additionally, ramps were installed from the fish ladder floor to the bottom of elevated salmon orifices in the upper ladder weirs to assist lamprey in maintaining attachment as they move through these areas.

Seven adult fishway inspections have taken place in 2013 at Little Goose Dam.

<b>Date</b>	<b>Inspector(s), Agency</b>
April 16, 2013	D. Benner (FPC)
May 21, 2013	A. Dowdy (ODFW)
June 18, 2013	A. Dowdy (ODFW)
July 24, 2013	A. Dowdy (ODFW)
August 21, 2013	A. Dowdy (ODFW)
September 25, 2013	A. Dowdy (ODFW)
October 30, 2013	R. Shearer (ODFW)

During the first four inspections in 2013, only two fish pumps were available for use as Fish Pump #3 was out of service. During the first four inspections, with only two fish pumps available, pumps were operated with rpm levels ranging between 73 and 77 rpm. During the last three inspections, all three pumps were available and operated between 71 and 77 rpm.

#### **Fishway Inspections**

The two South Shore Entrance Gates, SSE-1 and SSE-2, are operated to achieve an 8.0 feet or greater weir submergence with a head differential between 1.0 and 2.0 ft. During the 2013 fish passage season, gate depths at the SSEs ranged from 8.0 to 8.6 ft with head differentials that ranged from 1.1 ft to 1.6 ft. In 2013, all gate depths and head differentials met criteria during all inspections.

The North Powerhouse Entrances, NPE-1 and NPE-2, were operated to meet the depth criteria of 7.0 ft or greater submergence below tailwater and head differential of 1.0 to 2.0 ft. The gate depths ranged from 4.9 ft to 7.3 ft with head differentials that ranged from 1.5 to 2.3 ft. The NPE gates were on sill during all seven inspections in 2013. It should be pointed out that NPE-2 was closed during the first four

inspections of 2013 due to Fish Pump #3 being out of service. All readings were satisfactory as the NPE gates either met criteria or were on sill, so no further depths could be obtained. All head differentials at the north powerhouse entrances were within criteria during each inspection.

The water velocity measured at the south end of the collection channel gave readings that ranged from 1.8 fps to 2.4 fps over the inspections when velocities were recorded (five of seven); all recordings met the minimum criteria of 1.5 fps. During the September 25, 2013, inspection, it was noted that one panel of the fall-out fence appeared to be missing; this was repaired over the 2013/2014 winter overhaul period.

The North Shore Entrances were set to operate at 6.0 ft or more depth below tailwater, with the head differential in the range of 1.0 ft to 2.0 ft. NSE-1 gate depths ranged from 4.9 ft to 7.1 ft and were within criteria during two of seven inspections (September and October inspections). NSE-2 gate depths ranged from 4.9 ft to 7.1 ft and were also within criteria for two of seven inspections. During all inspections in 2013, the gates at the North Shore Fishway weirs were positioned at the fixed elevation of 532 feet due to weir gate operators that failed in 2010. New weir gate operators were installed in January 2014. NSE head differentials ranged from 1.0 to 1.9 ft, meeting differential criteria during each inspection. Despite being fixed at 532 feet, the NSE gates met gate depth criteria during two of seven inspection dates in 2013.

**Fish Ladder:** The fish ladder exit was clean during all inspections in 2013. The picketed lead section of the fish counting facility was reported as clear of debris throughout the 2013 season. The depth of water over the fish ladder weirs was at 1.1–1.2 ft on the individual inspections. All readings were reported within an acceptable range of 1.0 ft to 1.3 ft.

### **Summary and Recommendations**

All in all, the adult fishways at Little Goose Dam were operated satisfactorily considering the limitations of sill elevations at the North Powerhouse Entrances and fixed weirs at the North Shore Fishway.

Several issues were noted during the 2013 fishway inspection season:

Fish Pump #3 was out of service during the first four inspections of 2013. During the September 25, 2013, inspection, it was noted that one panel of the fall-out fence appeared to be missing; this was repaired over the winter outage period.

**Table 7. Pertinent Data for Fish Facility Inspections in 2013 at LITTLE GOOSE DAM.**

<u>CRITERIA ITEMS</u>	<u>DATE OF INSPECTION</u>							
		<u>16-Apr</u>	<u>21-May</u>	<u>18-Jun</u>	<u>24-Jul</u>	<u>21-Aug</u>	<u>25-Sep</u>	<u>30-Oct</u>
<b>SOUTH SHORE FISHWAY</b>								
<b><i>South Shore Entrance:</i></b>								
<u>Depth over entrance weir</u>								
SSE-1 (Criteria = 8 ft or >)	ft	8.3	8.6	8.3	8.2	8.2	8.4	8.3
SSE-2 (Criteria = 8 ft or >)	ft	8.1	8.6	8.3	8.0	8.1	8.4	8.3
Head at SSE-1 & 2 (Criteria = 1-2 ft)	ft	1.1	1.2	1.4	1.4	1.5	1.6	1.6
Dep. over ladr. weir (Crit. = 1-1.3 ft)	ft	1.2	1.1	1.1	1.1	1.1	1.1	1.1
Channel velocity (Criteria = 1.5-4 fps)	fps	na	na	1.9	2.4	2.3	1.8	2.4
Channel velocity (North Shore)	fps	na	na	na	na	na	na	na
Ladder exit clean (yes or no)		yes	yes	yes	yes	yes	yes	yes
Staff gages clean (yes or no)		yes	yes	yes	yes	yes	yes	yes
Picket leads clean (Criteria = 0.3' max)		yes	yes	yes	yes	yes	yes	yes
<b><i>North Powerhouse Entrance:</i></b>								
<u>Depth over entrance weir</u>								
NPE-1 (Criteria = 7 ft or >)	ft	5.2	5.5	5.2	4.9	5.1	7.2	7.1
NPE-2 (Criteria = 7 ft or >)	ft	closed	closed	closed	closed	5.2	7.3	7.2
Head at NPE-1 & 2 (Criteria = 1-2 ft)	ft	1.7	2.3	1.8	2.0	1.7	1.5	1.5
Gate on Sill (Yes or No)		yes	yes	yes	yes	yes	yes	yes
Staff gages clean		yes	yes	yes	yes	yes	yes	yes
Pump speed	rpm	73-74	77	75-76	75	72-73	72-77	71-75
Pumps Operating (3 available)		2	2	2	2	3	3	3
<b><i>North Shore Entrance:</i></b>								
<u>Depth over entrance weir</u>								
NSE-1 (Criteria = 6 ft or >)	ft	5.2	5.6	5.2	5.1	4.9	7.1	6.9
NSE-2 (Criteria = 6 ft or >)	ft	5.2	5.6	5.2	5.1	4.9	7.1	6.9
Head at NSE-1 & 2 (Criteria = 1-2 ft)	ft	1.8	1.9	1.8	1.5	1.3	1.0	1.2
Staff gages clean		yes	yes	yes	yes	yes	yes	yes
Comment number (if applicable)		1	1	1	1	2	3	
<b>Comments:</b>								
1. Velocity no longer measured at SSE due to erratic diffuser upwelling. Fish pump #3 OOS, NPE-2 closed, northshore weirs inoperable and fixed at 532 ft.								
2. Fish Pump #3 back in service as of 8-20-13, NPE-2 back open- velocities appear better than previous.								
3. Missing panel on fallout fence- reported to COE.								



### **LOWER GRANITE DAM (photographs on page A-25)**

Lower Granite Dam was the final lower Snake River project constructed by the COE; the project began operation in 1975. The powerhouse consists of six main turbine units and eight spillbays that are equipped with spillway deflectors. A removable spillway weir was incorporated into the south spillbay to pass juvenile fish at the project in 2002.

In the fish ladder, an adult fish sampling/trapping facility was incorporated in the original construction of the project. Since that date, major modifications to the facility have occurred. Presently, the site includes modern detection equipment, both CWT and PIT-tag automated detectors that have the ability to shunt adult fish to the holding facility or, in the case of the PIT-tag system, the fish can be separated by its PIT-tag code if desired. A new set of PIT-tag detectors was installed during winter 2003 in the upper exit section of the fish ladder and also worked satisfactorily through 2013. This system provides adult detection capabilities without handling the fish or shunting the fish to the adjacent fish ladder where the trapping facility is located.

Three electric fish pumps supply water to the fishway; however, only two pumps can be operated at one time. Attraction flows are directed to two south shore entrances, two north powerhouse entrances, four operating orifice gates along the powerhouse collection channel, and two north shore entrances. No excess juvenile bypass water is incorporated into the adult attraction flow system at Lower Granite as occurs at the other three Snake River projects.

Over the last several years, improvements have been installed in Lower Granite Dam fishways intended to aid in the passage of adult lamprey. In 2011, picketed leads were raised and secured 1.5" off of the floor of the adult fish ladder at the count station. This was done to enable adult lamprey passage under the picketed leads, providing a low-velocity passage route for lamprey around the adult fish count slot. Over the 2012/2013 winter maintenance period, horizontal slots were cut in weirs at the floor to allow adult lamprey attachment through a level pathway through the weir. Additionally, ramps were installed from the fish ladder floor to the bottom of elevated salmon orifices in the upper ladder weirs to assist lamprey in maintaining attachment as they move through these areas.

Seven adult fishway inspections have taken place at Lower Granite Dam in 2013:

<b>Date</b>	<b>Inspector(s), Agency</b>
April 16, 2013	D. Benner (FPC)
May 20, 2013	A. Dowdy (ODFW)
June 17, 2013	A. Dowdy (ODFW)
July 29, 2013	A. Dowdy (ODFW)
August 30, 2013	A. Dowdy (ODFW)
September 27, 2013	A. Dowdy (ODFW)
October 31, 2013	A. Dowdy (ODFW)

Details of the inspections can be found in Table 8 and text that follows.

**Table 8. Pertinent Data for Fish Facility Inspections in 2013 at LOWER GRANITE DAM.**

<b>CRITERIA ITEMS</b>	<b>DATE OF INSPECTION</b>							
	<b>16-Apr</b>	<b>20-May</b>	<b>17-Jun</b>	<b>29-Jul</b>	<b>30-Aug</b>	<b>27-Sep</b>	<b>31-Oct</b>	
<b>SOUTH SHORE FISHWAY</b>								
<b><i>South Shore Entrance</i></b>								
<u>Depth over entrance weirs</u>								
SSE-1 (Criteria = 8 ft or >)	ft	8.2	8.2	7.8	8.1	9.1	8.1	8.2
SSE-2 (Criteria = 8 ft or >)	ft	8.2	8.2	7.9	8.1	9.1	8.2	8.2
Head at SSE-1 & 2 (Crit. = 1 - 2 ft)	ft	1.5	1.5	1.7	1.1	1.0	1.2	1.1
Depth over ladr. Weir (Crit.= 1-1.3 ft)	ft	1.2	1.2	1.3	1.3	1.2	1.3	1.3
Channel velocity (Crit. = 1.5-4 fps)	fps	>2.0	2.4	2.3	2.4	2.8	2.2	1.9
Channel velocity (n shore)	na		1.5	2.0	1.7	1.4	1.6	1.5
Ladder exit clean (yes or no)		yes	yes	yes	yes	yes	yes	yes
Staff gages clean (yes or no)		yes	yes	yes	no	yes	yes	yes
Picket leads clean (yes or no)		yes	yes	yes	yes	yes	yes	yes
<b><i>North Powerhouse Entrance:</i></b>								
<u>Depth over entrance weir</u>								
NPE-1 (Criteria = 8 ft or >)		5.7	6.7	5.1	5.1	5.7	8.3	8.2
NPE-2 (Criteria = 8 ft or >)		5.7	6.7	5.1	5.1	5.8	8.2	8.2
Head at NPE-1&2 (Criteria = 1-2 ft)		1.5	1.2	1.1	0.9	1.2	0.8	0.7
Gate on sill (Yes or No)		yes	yes	yes	yes	yes	no	yes
Staff gages clean		yes	yes	yes	yes	yes	yes	yes
<b><i>North Shore Entrance:</i></b>								
<u>Depth over entrance weir</u>								
NSE-1 (Criteria = 7 ft or >)		6.0	7.1	4.8	6.0	5.1	5.1	5.1
NSE-2 (Criteria = 7 ft or >)		5.1	5.1	2.9	3.2	3.4	7.0	6.5
Head at NSE-1&2 (Criteria = 1-2 ft)		1.4	1.0	1.4	0.6	0.9	0.8	0.2
Staff gages clean		yes	yes	yes	yes	yes	yes	yes
Comment number (if applicable)			1	2	3	4	5	6
<b><u>Comments:</u></b>								
1. No attraction lighting visible at NPE entrance, NSE manually positioned at 630 feet. Decreased flow from floating orifice gate #1.								
2. NSE2 manually positioned at 630 ft.								
3. Staff gauge at SSE channel above water, NSE-2 fixed at 630 ft, discharge at FOG-1 appeared less forceful than ordinary, moderate sized eddy near SSE, project operating two additional pumps for high ladder temps.								
4. Cracked mirror at NPE replaced attraction lighting still not visible, ladder exit obscured by established shrubbery, exit differential did not indicate problem, adult trap remains OOS.								
5. Head differentials at NPE and NSE did not meet criteria, NSE-1 did not meet gate depth criteria, NSE-2 fixed at elevation 630 ft, ladder exit had vegetation but exit differential within criteria.								
6. Head differentials at NPE and NSE did not meet criteria, COE Biologist reported to operators. Did not see attraction lighting in channel under spillway via the mirror.								

**Fishway Inspections**

Two fishway entrances, SSE-1 and SSE-2, are operated on the south shore of the project. The location of the entrances is fairly unique in that SSE-1 is downstream of the SSE-2 Gate by about 150 ft. These two entrance gates are narrow (4-foot wide) compared to most gates at other COE projects.

In 2013, gates SSE-1 and SSE-2 operated with depths that ranged from 7.8 ft to 9.1 ft and head differentials that ranged from 1.0 ft to 1.7 ft. During the passage season, head differentials were operating within criteria at the SSE's during all seven inspection dates. Both SSE-1 and SSE-2 gates were slightly below the 8.0 ft criteria during the June 17, 2013, inspection, however met criteria during the other six inspections in 2013.

Water velocities at the southern end of the collection channel ranged between 1.9 fps to 2.8 fps. Velocity readings were within criteria in the southern end of the collection channel during all inspections.

The North Powerhouse Entrances, NPE-1 and NPE-2, were operated with the gates on sill for six of seven inspections. During all but one of the inspections that the NPE's were on sill, the project was unable to meet the 8.0 ft criteria for gate depth. During the one inspection where the gates were not on sill, the NPE gates met or exceeded the 8.0 ft criteria. Gate depths for the season ranged from 5.1 ft to 8.3 ft. Head differentials ranged from 0.7 ft to 1.5 ft for the season; four of seven inspections recorded differential readings within criteria. For the most part, inspections showed the NPE gates operating satisfactorily and within criteria (given the sill elevations); however head differentials were below criteria during three of seven inspections.

The North Shore Entrances, NSE-1 and NSE-2, reported gate depths that ranged from 2.9 ft to 7.1 ft and head differentials that ranged 0.2 ft to 1.4 ft. The project met head differential criteria during three of seven inspections at North Shore Entrances over 2013. Head differentials were below criteria during the July, August, September, and October inspections. The project failed to meet gate depth of 7.0 ft or greater on most inspections for the 2013 fish passage season, with the exception of the May inspection when NSE-1 was operated within criteria. It should be pointed out that NSE-2 was manually positioned at 630 feet beginning in May and continuing through the end of the inspection season in October. The project has three fish pumps, but only two can be operated due to hydraulic limitations of the system. As a result, the north shore entrance gates cannot operate to meet both gate depth and head differential criteria under most conditions, even though the gates could be lowered further in the gate slot (i.e., the gates are normally not operated on sill at the NSEs).

**Fish Ladder:** The ladder exit was reported as clean during all seven inspections; however during several inspections the inspector did note that the ladder exit was obscured by established shrubbery. The picketed leads (count station) were reported clear of debris during all seven inspections during the fish passage season. The depth of water over the fish ladder weirs ranged between 1.2 and 1.3 ft, and was within criteria during all inspections.

Over the summer of 2013, adult passage at Lower Granite Dam was impeded by excessive temperatures in the ladder. The upper fishway at Lower Granite reported water temperatures between 72° and 76° F, while the tailrace at the dam was reporting temperatures below 68° F. The thermal gradient within the ladder had caused minimal adult passage for all species. Of particular importance were the very low daily passage number of sockeye and the discrepancy between the counts of sockeye reported at Little Goose Dam as compared to those reported at Lower Granite Dam.

Concerning this issue, three Technical Management Team calls were initiated between July 22<sup>nd</sup>, 2013, and July 24<sup>th</sup>, 2013. After the initial call on July 22<sup>nd</sup>, the action agencies implemented an operation that prioritized Unit #1, effectively moving more water through the powerhouse and less water over the spillway, with all spilled water moving over the RSW. Adult fish counts did not show a response to this operation.

On July 23<sup>rd</sup>, 2013, the Fish Passage Advisory Committee (FPAC) submitted SOR 2013-4 which asked the Action Agencies to immediately take actions that may increase adult passage and decrease the water

temperature in the adult ladder. After the submission of SOR 2013-4 to the Action Agencies, a TMT call was convened to discuss the options presented in the SOR. At the TMT meeting the COE agreed to implement the modified project operations outlined in the last bullet of the FPAC suggestions for a period of 2 days. Each day of the modified operations resulted in two test periods: (1) Daytime (0600–1800) Unit One Priority with RSW spill, and (2) Nighttime (1800–0600) Operate to Powerhouse Station Service (5 Kcfs) and maximize spill. The COE also agreed to investigate upper ladder options that would potentially aid in the reduction of warmest water contributions to the ladder.

At a subsequent TMT meeting on July 24, 2013, the COE suggested utilizing the emergency pumping system to attempt to change the temperature differential between the adult fish ladder and tailrace. The emergency pumps drew water from deeper in the forebay (cooler water) as compared to the other sources of water contributing to the upper ladder.

Shortly after 7:00 AM on July 25<sup>th</sup>, 2013, Emergency Pump #2 was turned on, which provided cooler water to enter Diffuser 14 to mix with the warmer water entering through the fishway exit. The COE reported that the initiation of this pump gradually began changing water temperatures below Diffuser #14 by several degrees Fahrenheit. At 3:30 PM on July 25<sup>th</sup>, 2013, Emergency Pump #1 was turned on to initiate cooling in the control section of the ladder. Water from Emergency Pump #1 entered into the control section (vertical slot weirs) adjacent to the exit into the forebay.

Adults passing through the ladder did respond to the initiation of the emergency pumps and resulting cooler ladder water on July 25<sup>th</sup>, 2013. Twenty-six sockeye passed at Lower Granite on July 25<sup>th</sup>, 2013, as compared to daily counts between 1 and 6 the previous six days. Additionally, on July 25<sup>th</sup>, 204 adult Chinook and 170 jack Chinook passed as compared to -4 to 23 adults and 6 to 22 jacks over the prior 6 days.

## **Summary and Recommendations**

The following are recommendations for adult fish facilities at Lower Granite Dam:

- Multiple entrance head differentials at Lower Granite Dam were below criteria; to the extent of their ability, operators should ensure all fishway criteria are met.
- The ladder exit was reported as clean during all seven inspections; however during several inspections the inspector did note that the ladder exit was obscured by established shrubbery. Vegetation is beginning to establish itself on the exit debris containment structure. This structure itself is in poor condition and should be considered for replacement.
- Considering the potential for another thermal barrier in the fish ladder, all options should continue to be investigated that could help alleviate this problem. The COE has stated that the emergency pumping system used in 2013 would be available in 2014 to attempt to alleviate the temperature differential between the adult fish ladder and tailrace. Other options being considered are extending the intake to Diffuser #14 deeper into the forebay.

## **PUBLIC UTILITY DISTRICT PROJECTS**

The Public Utility District Projects are comprised of five mainstem Columbia River dams from Priest Rapids Dam located above the free-flowing Hanford Reach section of the Columbia River to Wells Dam located about 45 miles upstream from Wenatchee, Washington. Grant County PUD owns and operates the lower two dams, Priest Rapids and Wanapum dams; Chelan County PUD – Rock Island and Rocky Reach dams; and Douglas County PUD – Wells Dam. These dams use a variety of pump systems or gravity-flow water to supply AWS channels that feed this water through diffusion systems into the main collection chambers. At Priest Rapids and Wanapum dams, orifice gates along the powerhouse collection were sealed off in 2002, and these gates will remain closed in future years. Adult fish will be attracted to and passed only through the main entrance gates. Rocky Reach still operates with six orifice gates along its powerhouse collection channel. Wells and Rock Island dams do not have orifice gates along their powerhouses; main entrance gates are located at each end of the powerhouse channel to attract fish to the fish ladder. In addition to the adult fish facilities, spill has been the main passage route that juvenile fish are bypassed to below an individual project. Spill schedules have been developed to assist juvenile fish passage but not impact adult fish passage. In 2003, a permanent surface bypass collector to pass juvenile salmonids was completed at Rocky Reach Dam and will continue to operate in future years.

Inspections of adult fish facilities are summarized for the individual projects in the sections below.

### **PRIEST RAPIDS DAM (photographs on page A-29)**

Construction of Priest Rapids Dam was completed in 1959. The hydropower plant contains ten main turbine units and 22 spillbays. The project is owned and operated by Grant County Public Utility District (GPUD). The adult fish facilities consist of two fishways, one located on the left bank and the other on the right bank of the Columbia River. Make-up water for the lower end of the fish ladder is stored in Auxiliary Water Supply (AWS) pools at each bank. The AWS pools are filled by five electric pumps that pull water from the tailrace and a Gravity Intake Gate (GIG) that pulls water from the forebay of the project. AWS pool water is channeled through a diffusion system (mostly floor diffusers) into the collection channel (left bank only) and lower end of the fish ladder at both shores of the project. The main slotted entrance on the Left Bank fishway is located at the eastern end (shore entrance) and the western end of the powerhouse. All orifice gates were closed along the powerhouse collection channel in late summer 2001. One main slotted entrance is operated at the right bank fishway. Adult PIT-tag detectors were added to the right and left bank fish ladders prior to the 2003 fish passage season.

Seven adult fishway inspections have taken place at Priest Rapids Dam in 2013:

<b>Date</b>	<b>Inspector(s), Agency</b>
April 23, 2013	Beavers (NOAA)
May 14, 2013	Beavers (NOAA)
June 25, 2013	Benner (FPC)
July 24, 2013	Beavers (NOAA)
August 22, 2013	Beavers (NOAA)
September 18, 2013	Beavers (NOAA)
October 23, 2013	Benner (FPC)

An operator, a fish biologist or fish technician, and an engineer from Grant County PUD normally accompanied inspectors during the inspections. The adult fishways are computer controlled and computer printouts identifying set points and actual readings can be generated as needed. The computer-generated readings are normally compared to the site readings to assess whether calibration of the equipment was necessary, or if tailwater elevations or project operations were changed during the inspection.

### **Left Bank Fishway**

Slotted entrance LSE-2 is located at the western end of the powerhouse and it was open continually throughout the fish migration season. The head differential target is 1.2 feet at LSE-2, with an acceptable range of 1 to 2 feet. Head differentials ranged from 1.1 ft to 1.6 ft over the seven inspections. The project was operating at acceptable criteria during the 2013 inspection season as the head differential was within the 1- to 2-foot range and always equal or greater than the 1.2 ft target for the six of the seven inspections.

Slotted entrance LSE-4 is located on the eastern end of the powerhouse and operated continually throughout the fish migration season. The head differential target is 1.5 feet at LSE-4, with an acceptable range of 1 to 2 feet. Head differentials ranged from 1.3 ft to 1.6 ft over the six inspections. During the 2013 inspection season all the head differentials were within the 1- to 2-foot criteria range and four inspections were equal or greater than the target of 1.5 feet.

Water velocity in the collection channel was measured using a deployable velocity meter and ranged from 1.2 fps to 2.5 fps. Water velocities in the collection channel were equal or above the 1.5 fps criteria on all but one inspection over the 2013 season. The August inspection (8-22-13) contained the lowest recorded velocity in the collection channel (1.2 fps).

**Fish Ladder:** At the left bank fish ladder, the depth of water over the ladder weirs ranged between 1.0 and 1.1 ft during all six inspections. All depth over left bank ladder weir readings were within the acceptable range of 1–1.2 feet. The exit from the fish ladder was clear of debris for the season and the staff gauges were reported clean during all inspections on the left bank fishway.

### **Right Bank Fishway**

In 2013, auxiliary water from the left bank was transported via a large conduit to the right fishway; however, beginning in 2014 the right bank fishway will have its own source of water fed directly from the forebay. Slotted Entrance RSE-1 operated during the 2013 fish passage season. RSE-1 is required to operate within the following range: 1.0 to 2.0 ft for head differential with the target being 1.5 ft.

RSE-1 had head differentials ranging from 0.9 to 1.5 ft for the season. RSE-1 was operated within the acceptable criteria range of 1.0 to 2.0 ft during each fishway inspection with exception of the May 14, 2013, inspection (head differential slightly below 1.0 ft). RSE-1 met the target differential during five of seven inspections in 2013.

**Fish Ladder:** The depth of water reported over the fish ladder weirs was at 1.0–1.1 ft on all inspections. The depth over the right bank ladder weir was within criteria for each inspection in 2013. The ladder exit was reported clear of debris on all inspections and the right bank staff gauges were reported clean during all inspections in 2013.

**Table 9. Pertinent Data for Fish Facility Inspections in 2013 at PRIEST RAPIDS DAM.**

<b>CRITERIA ITEMS</b>		<b>DATE OF INSPECTION</b>						
		<b>23-Apr</b>	<b>14-May</b>	<b>25-Jun</b>	<b>24-Jul</b>	<b>22-Aug</b>	<b>18-Sep</b>	<b>23-Oct</b>
<b>LEFT BANK FISHWAY</b>								
<i>Left Bank Entrance:</i>								
<b>Head at main entrances (Criteria = 1-2 ft)</b>								
LSE-2 (1.2 ft target)	ft	1.5	1.5	1.2	1.6	1.5	1.6	1.1
LSE-4 (1.5 ft target)	ft	1.5	1.4	1.6	1.6	1.5	1.4	1.3
Depth over ladr. weir (Crit. = 1-1.2 ft)	ft	1.1	1.1	1.1	1.1	1.1	1.0	1.1
Water velocity (Crit. = 1.5-4 fps)	fps	2.5	1.8	1.5	1.9	1.2	1.6	2.0
Ladder exit clean (Crit. = yes or no)		yes	yes	yes	yes	yes	yes	yes
Staff gages clean (Crit. = yes or no)		yes	yes	yes	yes	yes	yes	yes
<b>RIGHT BANK FISHWAY</b>								
<i>Right Bank Entrance:</i>								
<b>Head at Entrance (Criteria = 1-2 ft)</b>								
RSE-1 (1.5 ft target)	ft	1.5	0.9	1.5	1.5	1.5	1.4	1.5
Depth over ladr. weir (Crit. = 1-1.2 ft)	ft	1.1	1.1	1.0	1.0	1.1	1.0	1.1
Ladder exit clean (Crit. = yes or no)		yes	yes	yes	yes	yes	yes	yes
Staff gages clean (Crit. = yes or no)		yes	yes	yes	yes	yes	yes	yes
Comment number (if applicable)		1						
<b>Comments:</b>								
1. No access to right bank fishway, data obtained from control room.								

### Summary and Recommendations

- Overall, Priest Rapids Fishways were found to be in good condition in 2013. It is recommended that the water velocity in the collection channel at Priest Rapids Dam be between 1.5 and 4.0 fps during all inspections; also the head differential at RSE-1 was slightly below criteria during one inspection in 2013.

### WANAPUM DAM (photographs on page A-31)

Wanapum Dam hydro project was completed in 1963 with ten main turbine units for power production and 12 spill gates to pass excess flow. The project is owned and operated by Grant County PUD. Two turbine-operated pumps that pull water from the tailwater of the dam and are driven by gravity flow water from the forebay of the dam supply make-up water to the left bank Auxiliary Water Supply (AWS) pool. Two 10-foot diameter butterfly valves provide a backup system for the turbine-driven pumps. Fishway water flows through the two main slotted fishway entrances: LSE-2 at the eastern end of the powerhouse (shore), and LSE-3 at the western end of the powerhouse. In late 2001, the ten operating orifice gates along the powerhouse collection channel were permanently closed. Auxiliary water for the right bank fishway is a gravity-flow system that pulls water from the forebay of the dam. This water normally supplies sufficient flow to the diffusers located in the lower end of the fish ladder to meet head differential criteria established for slotted entrance, RSE-2.

Seven adult fishway inspections have taken place at Wanapum Dam:

<b>Date</b>	<b>Inspector(s), Agency</b>
April 23, 2013	Beavers (NOAA)
May 14, 2013	Beavers (NOAA)
June 25, 2013	Benner (FPC)
July 24, 2013	Beavers (NOAA)
August 22, 2013	Beavers (NOAA)
September 18, 2013	Beavers (NOAA)
October 23, 2013	Benner (FPC)

A summary of the inspections is listed in Table 10 and in the text below.

#### **Left Bank Fishway**

The east slotted entrance LSE-2 operates as the primary entrance with a head differential criterion of 1.0 ft to 2.0 ft and a target of 1.5 ft. Slotted entrance LSE-2 operated within a range of 1.4 ft to 1.7 ft over the seven inspections in 2013. Head differentials at LSE-2 were within the acceptable criteria range over the entire season (1–2 feet) and at or above the target head differential for five of the seven inspections. Passage conditions for adult fish at LSE-2 should have been satisfactory throughout the 2013 migration season.

The operational criterion for LSE-3 head differential is from 1.0 ft to 2.0 ft with the targeted head differential of 1.2 ft. LSE-3 operated within the following range: 1.4 ft to 1.8 ft for the fish passage season. The head differential target at LSE-3 was equaled or exceeded on all inspections in 2013. LSE-3 should have provided excellent entrance conditions for adult fish throughout the 2013 passage season.

Water velocity was estimated at the upstream end of the powerhouse channel and readings ranged between 1.8 and 2.5 fps. All readings exceeded the minimum criteria of 1.5 fps during the 2013 inspection season.

**Fish Ladder:** The depth of water over the left bank fish ladder weirs was 1.0 ft during each inspection in 2013; all readings were satisfactory for the season. The ladder exit was clear of debris on all inspections.



**Table 10. Pertinent Data for Fish Facility Inspections in 2013 at WANAPUM DAM.**

<b>CRITERIA</b>								
<b>LEFT BANK FISHWAY</b>		<b>DATE OF INSPECTION</b>						
		<b><u>23-Apr</u></b>	<b><u>14-May</u></b>	<b><u>25-Jun</u></b>	<b><u>24-Jul</u></b>	<b><u>22-Aug</u></b>	<b><u>18-Sep</u></b>	<b><u>23-Oct</u></b>
<b><i>Left Bank Entrance:</i></b>								
<b><u>Head at entrances (Criteria = 1-2 ft)</u></b>								
LSE-2 (target head = 1.5 ft)	ft	1.4	1.4	1.6	1.5	1.7	1.5	1.5
LSE-3 (target head = 1.2 ft)	ft	1.4	1.4	1.8	1.5	1.6	1.5	1.5
Dep. over ladder weir (Crit. = 1.0-1.2ft)	ft	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Channel velocity (Crit. = 1.5-4.0 fps)	fps	2.2	2.0	2.5	2.1	2.5	2.0	1.8
Staff gages clean (Crit. = yes or no)		yes	yes	yes	yes	yes	yes	yes
Auxiliary H2O Pumps	rpm	130/140	141/143	125/126	125/137	127/137		106/129
Ladder exit clean (Crit. = yes or no)		yes	yes	yes	yes	yes	yes	yes
<b>RIGHT BANK FISHWAY</b>								
<b><i>Right Bank Entrance:</i></b>								
<b><u>Head at Entrance (Criteria = 1-2 ft)</u></b>								
RSE-2 (target head = 1.2 ft)	ft	1.6	1.6	1.7	1.7	1.3	1.6	1.6
Depth over ladder weir	ft	1.0	1.1	1.0	1.1	1.0	1.0	1.1
Ladder exit clean		yes	yes	yes	yes	yes	yes	yes
Staff gages clean		yes	yes	yes	yes	yes	yes	yes
Comment number (if applicable)								1
<b>Comments:</b>								
1. South Channel staff gauge broken, been out about one month.								

**Right Bank Fishway**

The right bank slotted entrance RSE-2 is targeted to operate with a head differential of 1.2 ft and within the range of 1.0 ft to 2.0 ft. RSE-2 was operated with head differentials that ranged from 1.3 ft to 1.7 ft during the 2013 season. All inspections met the head differential target and criteria in 2013.

**Fish Ladder:** The right bank fish ladder operated with a depth of water over the weir crests ranging between 1.0 ft and 1.1 ft for the season. All readings were satisfactory for the season. The fish ladder exit was clear of debris and staff gauges were clean on all inspections.

## **Summary and Recommendations**

Overall, the Wanapum Dam fish facilities were well maintained throughout the 2013 fish passage season. Head differential criteria and depth over ladder weir criteria were met or exceeded during each fishway inspection in 2013.

## **ROCK ISLAND DAM (photographs on page A-34)**

The Rock Island hydro-project is owned and operated by Chelan County PUD. The dam is comprised of two powerhouses: an old powerhouse with ten main turbine units that was constructed in 1933, with a major upgrade of the turbine units in 1953. A new powerhouse with eight main turbine units and located on the right bank of the Columbia River was completed in 1979. The spillway, consisting of 32 spillbays, is located between the two powerhouses. Several spill gates have been notched to provide “surface flow” for the juvenile fish to pass downstream of the project.

The old powerhouse adult fish facilities consist of the left bank fishway and the middle or spillway fishway, with the right bank fishway located at the new powerhouse. Gravity-fed water is used to supply attraction flows to the fishways at the old powerhouse with a combination of pumped and gravity-fed water at the new powerhouse. Each fishway has a fish counting station located near the top of the fish ladder and new PIT-tag systems located in the exit section of each ladder. The final installation of the adult PIT-tag system was completed prior to the 2004 adult fish passage season.

Seven adult fishway inspections have taken place at Rock Island Dam in 2013:

<b>Date</b>	<b>Inspector(s), Agency</b>
April 25, 2013	Solorio (WDFW)
May 16, 2013	Solorio (WDFW)
June 26, 2013	Solorio (WDFW), Benner (FPC)
July 24, 2013	Solorio (WDFW)
August 15, 2013	Solorio (WDFW)
September 18, 2013	Solorio (WDFW)
October 23, 2013	Solorio (WDFW)

Results and discussion of the inspections follow in the text below and in Table 11.

### **Left Bank Fishway**

Gravity-fed water is supplied from the forebay to the lower end of the left bank fish ladder through diffuser gratings. This auxiliary water supplies sufficient flow to allow Gates LO5 and LO6 to operate at 6.0 ft or greater depth with a corresponding head differential of 1.0 ft minimum at all tailwater elevations.

Gates LO5 and LO6 were submerged a similar depth during the 2013 season. Gate depths ranged from 7.0 ft to 8.2 ft. Left bank fishway head differentials ranged between 1.2 ft and 1.4 ft. The gate depth and head differential readings were all found within acceptable criteria range through the 2013 inspection season.

Fish Ladder: Depth of water measured over the left bank fish ladder weirs was 1.1 ft during all inspections of the 2013 passage season. The trash racks located at the exit from the fish ladder and the picketed leads at the counting station were clear of debris during all the inspections.

### **Middle Fishway**

Gravity-fed water from the forebay of the dam supplies water to the lower end of the fish ladder through floor diffusers. The end gate and a fixed-open side gate operate to attract adult fish from the spillway section of the dam. The end gate, MO3, is required to operate at 8.5 ft or greater depth below tailwater, while the side gate is continually open and depends on head differential to be within acceptable criteria. The head differential required for both gates is the standard 1.0-ft to 2.0-ft range.

Gate MO3 depths recorded at the Middle Ladder during the inspections ranged from 8.6 ft to 9.1 ft with head differentials that ranged from 1.1 ft to 1.4 ft. Middle fishway gate depths and head differentials at the entrances met criteria during all inspections.

**Fish Ladder:** The depth of water over the fish ladder weirs was reported as 1.1 ft during all seven inspections in 2013. The picketed leads and the ladder exit were clear of debris during the inspections.

<b>Table 11. Pertinent Data for Fish Facility Inspections in 2013 at ROCK ISLAND DAM</b>								
<b>CRITERIA ITEMS</b>								
		<b>DATE OF INSPECTION</b>						
		<b><u>25-Apr</u></b>	<b><u>16-May</u></b>	<b><u>26-Jun</u></b>	<b><u>24-Jul</u></b>	<b><u>15-Aug</u></b>	<b><u>18-Sep</u></b>	<b><u>23-Oct</u></b>
<b>LEFT BANK FISHWAY</b>								
<b><i>Left Bank Entrance:</i></b>								
Depth over entrance weir								
LO5 (Criteria = 6.0 ft or >)	ft	7.7	7.9	7.3	7.3	7.5	7.4	7.4
LO6 (Criteria = 6.0 ft or >)	ft	8.2	7.5	7.0	7.2	7.3	7.7	7.6
Head at LO5 & 6 (Crit. = 1-2 ft)	ft	1.4	1.2	1.4	1.3	1.3	1.4	1.3
Depth over ladder weir	ft	1.1	1.1	1.1	1.1	1.1	1.1	1.1
(Criteria = 1.0-1.2 ft)								
Staff gages clean (yes or no)		yes	yes	yes	yes	yes	yes	yes
Ladder exit clean (yes or no)		yes	yes	yes	yes	yes	yes	yes
Picket leads clean (yes or no)		yes	yes	yes	yes	yes	yes	yes
<b>CENTER FISHWAY</b>								
<b><i>Center Entrance:</i></b>								
Depth over entrance weir								
MO3 (Criteria = 8.5 ft or >)	ft	9.1	8.6	8.8	9.0	9.0	8.8	8.8
Head at MO3 (Criteria = 1-2 ft)	ft	1.2	1.1	1.4	1.2	1.2	1.2	1.3
Depth over ladder weir	ft	1.1	1.1	1.1	1.1	1.1	1.1	1.1
(Criteria = 1.0-1.2 ft)								
Ladder exit clean (yes or no)		yes	yes	yes	yes	yes	yes	yes
Picket leads clean (yes or no)		yes	yes	yes	yes	yes	yes	yes
<b>RIGHT BANK FISHWAY</b>								
<b><i>Right Bank Entrance:</i></b>								
Head Differential (Crit. = 1-2 ft)								
LPE-1	ft	1.1	1.1	1.2	1.1	0.9	1.1	1.2
RPE-1 and RPE-2	ft	1.5	1.5	1.5	1.4	0.9	1.4	1.4
TPE	ft	1.1	1.1	1.2	1.1	0.9	1.1	1.4
Depth over ladder weir	ft	1.0	1.1	1.1	1.1	1.1	1.1	1.1
(Criteria = 1.0-1.2 ft)								
Channel veloc(Cr. = 1.5-4 fps)	fps	3.7	3.5	3.9	3.9	3.9	3.8	3.7
Ladder exit clean (yes or no)		yes	yes	yes	yes	yes	yes	yes
Picket leads clean (yes or no)		yes	yes	yes	yes	yes	yes	yes
Pumps operating		3	3	3	3	3	3	3
Pump Gate Openings	%	38-93	38-96	73-96	80-99	93-96	91	89-96
Comment number (if applicable)		1	1	1	2			
<b>Comments:</b>								
1. One 6ft stop log in RPE-1 and RPE-2 due to high tailwater.								
2. 6 ft stop log removed from RPE-1, 6 ft stop log was left in RPE-2.								

### **Right Bank Fishway**

Auxiliary water is supplied to the right bank fishway from three fish pumps that pull water from the tailwater and gravity-fed water from the forebay of the dam. Most of this flow enters the fishway in the lower end of the fish ladder through sidewall diffusers. This attraction water is distributed to an entrance at the downstream end of the project, one main entrance at the left end of the powerhouse, and through two entrances at the right end of the powerhouse. Each entrance has a 3-foot wide opening, but its depth will increase as flow and tailwater elevation increases. The entrances are operated to meet head differential criteria of 1.0 to 2.0 ft. In addition to the entrance flow, a high velocity flow of water is discharged below the water surface near the right powerhouse entrances. The purpose of this high velocity flow is to attract fish to the right powerhouse entrances from across the face of the dam. The three pumps are normally operated at 60%–100% open with the gravity water valve operated at 35%-100% open.

In 2013, the decision was made to add one 6-foot stop log in RPE-1 and RPE-2 during periods when tailwater was relatively high. In past years, the right fishway has struggled to meet head differential criteria at all four entrances when the tailwater was above 574.5 feet. In 2013, 6-foot stop logs were added to RPE-1 and RPE-2 during the April, May, and June inspections.

The entrance gates, TPE, LPE, and the RPEs were reported with head differentials that ranged from 0.9 ft to 1.5 ft throughout the season. Head differentials at the right fishway were met during all inspections in 2013 except the August inspection. During the August 15th, 2013, inspection, all right bank entrances recorded head differentials just below 1.0 foot (all measuring 0.9 feet).

Water velocity recorded in the powerhouse transportation channel was measured using a portable flow meter; velocities ranged between 3.5 to 3.9 fps during the inspections. Even with these higher-measured water velocities in the Rock Island transport channels, adult fish pass through both channel sections with little or no delay based on radio telemetry studies.

**Fish Ladder:** Depth of water measured over the ladder weirs was 1.0–1.1 ft for all seven inspections at the right ladder and met criteria in all inspections in 2013. The exit from the fish ladder was clear of debris during all inspections, as were the picketed lead section at the fish counting station.

### **Summary and Recommendations**

Overall, fishway attendants at Rock Island Dam have done a good job of maintaining adult fishway criteria. The only fishway issue at Rock Island Dam occurred during the August 15<sup>th</sup>, 2013, inspection when all right bank entrances recorded head differentials just below 1.0 foot (0.9 feet).

**ROCKY REACH DAM (photographs on page A-37)**

Rocky Reach Dam was completed in 1961 and is owned and operated by Chelan County PUD. The project is comprised of 11 main turbine units and 12 spillbays to pass water through the dam. Originally, four turbines were fixed-blade units (8–11); however, these units have been modified and were adjustable blade turbines over the 2013 fish passage season. Flow from the turbine units is at right angle to the river and spillway flow.

The adult fish facilities are comprised of three turbine-driven propeller-type fish pumps that supply water from the tailwater of the project for the powerhouse fishway entrances, most of the spillway entrance flow, and the six orifice gates along the powerhouse collection channel. The fish pumps operated satisfactorily during the 2013 fish passage season. Additional gravity-flow water can be supplied at the main spillway entrance to maintain the agreed upon criteria for that entrance. The powerhouse collection, left powerhouse, and spillway channels merge in the junction pool area to form the transportation channel that guides fish to the lower end of the fish ladder. The fish ladder exit is located on the right bank of the Columbia River.

A prototype juvenile fish passage facility was tested for several years at the project with the new Corner Surface Collector completed prior to the 2003 fish passage season. The system has operated satisfactorily since that time with the juvenile bypass season that lasts from about April 1 to late August. When the bypass system operates, the south powerhouse turbines (1–5) are normally prioritized to attract juvenile fish to the area of the juvenile collector’s entrances.

Seven adult fishway inspections have taken place at Rocky Reach Dam in 2013:

<b>Date</b>	<b>Inspector(s), Agency</b>
April 25, 2013	Solorio (WDFW)
May 16, 2013	Solorio (WDFW)
June 26, 2013	Solorio (WDFW), Benner (FPC)
July 24, 2013	Solorio (WDFW)
August 15, 2013	Solorio (WDFW)
September 18, 2013	Solorio (WDFW)
October 23, 2013	Solorio (WDFW)

Table 12 lists inspections and pertinent data with the text filling in details of the activities for this season.

**Powerhouse Entrances**

The Right Powerhouse Entrances, RPE-1 and RPE-2, are rotary wing gates that operate with a 3-ft opening, and require head differential of 1.0 ft to 2.0 ft. The head differentials at RPE-1 and RPE-2 ranged from 1.0 ft to 1.3 ft for the season, all within criteria.

Six orifice gates operated along the channel (1, 2, 3, 16, 18, and 20) from April through November. All gates operated satisfactorily.

The Left Powerhouse Entrances, LPE-1 and LPE-3, are located at the left end of the powerhouse nearest to Main Turbine #11. Flow from one entrance discharges back toward the powerhouse with flow from the other entrance moving toward the retaining wall that separates the spillway flow from the powerhouse flow.

Gate depths at LPE-1 and LPE-3 ranged from 10.5 ft to 12.5 ft, with head differentials that ranged from 1.0 ft to 1.3 ft. Head differential were within the required ranged of 1.0 to 2.0 ft on all inspections and gate depths were above 10 ft on all inspections. The LPEs were operated within criteria through the 2013 inspection season.

The water velocity meter is installed about 150 ft upstream from the junction pool and centered in the transportation channel. In 2013, the transportation channel velocities ranged from 1.6 to 1.9 fps, all above the minimum criteria of 1.5 fps.

### **Spillway Entrance**

The spillway entrance was operated from May through October inspection dates. The spillway gate (MSE) is to be submerged 10 ft or greater unless the gate is on sill. During the year, weir depths ranged between 8.8 and 12.2 feet and were 10 feet or greater during all inspections, with the exception of the September inspection when the tailwater was very low. Head differentials were reported from 1.0 ft to 1.3 ft during the 2013 inspection dates. All inspections had satisfactory head differential readings and most inspections had satisfactory gate depth readings.

**Fish Ladder:** The exit from the fish ladder was clear of debris during the 2013 inspection season. The depth of water over the fish ladder weirs was 1.2 ft during all inspections and was within the criterion range of 1.0 and 1.3 ft.

### **Summary and Recommendations**

Overall, fishway attendants at Rocky Reach have done an excellent job of maintaining adult fishway criteria.

**Table 12. Pertinent Data for Fish Facility Inspections in 2013 at ROCKY REACH DAM.**

<u>CRITERIA ITEMS</u>	<u>DATE OF INSPECTION</u>							
	<u>25-Apr</u>	<u>16-May</u>	<u>26-Jun</u>	<u>24-Jul</u>	<u>15-Aug</u>	<u>18-Sep</u>	<u>23-Oct</u>	
<b>ADULT FISHWAY</b>								
<b><i>Left Powerhouse Entrance:</i></b>								
Depth over entrance weirs								
LPE-1 & 3 (Depend. On Tw Elev)	ft	12.5	10.8	10.9	11.4	11.7	10.5	12.2
Head at LPE-1 & 3 (Crit. = 1-2 ft)	ft	1.1	1.0	1.1	1.1	1.1	1.3	1.0
Depth over Ladr Weir (Crit = 1-1.3 ft)	ft	1.2	1.2	1.2	1.2	1.2	1.2	1.2
Channel velocity (Crit. = 1.5-4 fps)	fps	1.8	1.7	1.6	1.8	1.9	1.9	1.8
Ladder exit clean (yes or no)		yes	yes	yes	yes	yes	yes	yes
Picket leads clean (yes or no)		yes	yes	yes	yes	yes	yes	yes
Turbine 11 Operating (yes or no)		yes	yes	yes	yes	yes	yes	no
<b><i>Right Powerhouse Entrance:</i></b>								
Wing gate opening (Criteria = 3.0 ft)								
RPE-1 and RPE-2	ft	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Head at RPE-1&2 (Crit. = 1-2 ft)	ft	1.3	1.2	1.2	1.1	1.2	1.0	1.0
Orif. Gates Oper - (1,2,3,16,18, 20)	y/n	yes	yes	yes	yes	yes	yes	yes
Pumps operating		3	3	3	3	3	3	3
Pump Gate Openings	%	58	65	75	59	64	65	59
<b><i>Spillway Entrance:</i></b>								
Depth over entrance weir								
MSE (Dependent on Tailwtr Elev.)	ft	closed	12.2	11.7	11.3	11.4	8.8	11.3
Head at MSE (Criteria = 1-2 ft)	ft	closed	1.1	1.3	1.1	1.3	1.3	1.0
Comment number (if applicable)		1	2	2	2	3	4	5
<b>Comments:</b>								
1. Plan to open spillway entrance on May 1.								
2. Unit #10 down all of May/June/July.								
3. Units 6 and 10 down month of August.								
4. Spillway entrance unable to achieve 10 ft criteria due to low Tailwater.								
5. Units 8,9,10,11 temporarily offline due to suspected design issues.								



### **WELLS DAM (photographs on page A-39)**

Wells Dam was completed in 1967 with 10 main turbine units and the spillbays placed directly above them. The hydropower project is owned and operated by Douglas County PUD.

The adult fish passage facilities were built and incorporated into the project during the construction phase. The west and east bank fishway entrances are similar in design and in past years normally operated with an end gate and a side gate open. Two fish turbine pumps are operated per bank and supply attraction flows through floor and wall diffuser gratings into the main channel that leads to the downstream gate at each fishway. Only the downstream entrance gate is now operated per fishway and is open the maximum width of 8 ft. The depth of water passing through the entrance gates extends from near floor level of the fishway to the water surface elevation in the entrance pool. High velocity water discharge pipes originally operated near the side entrances but were also closed when the side entrance gates were permanently closed.

Six adult fishway inspections have taken place at Wells Dam in 2013.

<b>Date</b>	<b>Inspector(s), Agency</b>
May 15, 2013	Ryan Flynn (WDFW)
June 12, 2013	Martin Coin (WDFW)
July 10, 2013	Martin Coin (WDFW)
August 14, 2013	Martin Coin (WDFW)
September 5, 2013	Martin Coin (WDFW)
October 10, 2013	Martin Coin (WDFW)

Results of the inspections are summarized in Table 13 with discussion relating to overall inspections for the year in the text below.

The fish pumps operated satisfactorily throughout the 2013 fish passage season with no reported out-of-service time. The Wells project can meet head differential criterion at the main downstream entrances through all tailwater and flow conditions.

#### **East and West Fishways**

The head differentials reported at the East entrances for the 2013 season ranged between 1.2 ft and 1.8 ft. At the east entrances, minimum head differential criteria were met on all six inspections. The head differential readings at the west fishway entrances ranged between 1.4 ft and 2.2 ft, meeting the minimum criteria during all inspections.

**Fish Ladder:** At both fishways, the exits from the fish ladder were monitored for differential between the last fish ladder pool and the forebay elevation. In 2013, differentials at the exits ranged from 0.4 ft to 1.1 ft. The exits from the fish ladders appeared clear of debris throughout the year. The picketed leads at the counting stations were clear of debris during all inspection dates. The depth of water over the ladder weirs ranged from 1.1 ft to 1.2 ft at the west and east ladders. Criterion for depth of water over ladder weir is 1.0 to 1.2 ft. The depth of water over both the east and west ladder weirs met minimum criteria during all inspections in 2013.

## Summary and Recommendations

Overall, the adult fishways at Wells Dam were well operated. During the last inspection of the year (October), several staff gauges were reported as not clean or readable.

<b>Table 13. Pertinent Data for Fish Facility Inspections in 2013 at WELLS DAM.</b>							
<b>CRITERIA ITEMS</b>		<b><u>15-May</u></b>	<b><u>12-Jun</u></b>	<b><u>10-Jul</u></b>	<b><u>14-Aug</u></b>	<b><u>5-Sep</u></b>	<b><u>10-Oct</u></b>
<b><i>EAST FISHWAY:</i></b>							
Head at main entrance (Target = 1.5ft)	ft	1.6	1.8	1.8	1.6	1.2	1.5
D/Stream entrance open (Criteria = 8-ft)	ft	8 ft	8 ft	8 ft	8ft	8ft	8ft
Depth over ladder weir (Crit.= 1-1.2 ft)	ft	1.1	1.2	1.2	1.2	1.1	1.2
Ladder exit differential (Crit = 0.8-1.1ft)	ft	0.7	0.9	0.4	0.9	0.4	0.8
Staff gages clean/readable (yes or no)		yes	yes	yes	yes	yes	no
Picket leads clean (yes or no)		yes	yes	yes	yes	yes	yes
Auxiliary Fish Pump Speed (rpm)		56/54	61/60	58/57	56/57	52/52	46/46
<b><i>WEST FISHWAY: (Criteria same as East)</i></b>							
Head at main entrance	ft	1.4	1.5	2.2	1.5	1.4	1.5
Downstream entrance open	ft	8 ft	8 ft	8 ft	8ft	8ft	8ft
Depth over ladder weir	ft	1.1	1.2	1.2	1.2	1.2	1.2
Ladder exit differential	ft	0.8	1.1	1.0	1.0	0.8	1.0
Staff gages clean/readable		yes	yes	yes	yes	yes	no
Picket leads clean		yes	yes	yes	yes	yes	yes
Auxiliary Fish Pump Speed (rpm)		50/51	48/49	56/57	48/48	50/53	50/45
Comment Number (if applicable)							
<b>Comments:</b>							

## **GENERAL PROJECT RECOMMENDATIONS**

Most recommendations relating to adult fish passage and improvements to fish facilities are normally discussed at the FPOM committee meetings for COE projects or in MCOL committee meetings both prior to and during a year. Main issues relating to passage of adult fish have been addressed in a broad way via the Biological Opinion that was completed by NOAA Fisheries. Some general recommendations to improve fish passage conditions follow.

- Projects should assure that water-measuring devices are easy to read at all water elevations during the year. Preferred conditions would be those where staff gauges can be cleaned easily and/or have benchmarks available so sensor readings can be taken.
- Projects should evaluate back-up water supply sources to assure that adequate water is available to attract adult fish should the main water supply fail.
- Projects should monitor ladder temperatures during warm water periods of the year. At projects such Lower Granite where adult passage has been impacted by water temperature differentials between the ladder and tailrace, plans should continue to be developed that attempt to alleviate this issue.
- Projects should assure that diffuser gratings are intact and clear of debris before the main fish passage season begins and at some point during the season. Videotape, divers, or other acceptable means should accomplish this task.
- All projects should have a plan of action on how to deal with removal of debris from the forebay of each dam. This would help assure that fish turbines/pumps, exits from the dams, picketed leads, or other areas would have less chance of plugging or causing damage to mechanical systems of the fishways or to the adult or juvenile fish passing the dams.
- Sharp projections or other obstacles located in the fish ladders, collection or transportation channels, should be removed.
- Based on past performance of the fishway equipment, the projects should purchase spare parts of critical operating equipment that would allow “quick” fixes during the fish passage season should the equipment fail.
- Dewatering plans or other fish handling tasks should be reviewed and annually updated where necessary.

## SUMMARY OF FISHWAY CRITERIA

### **Summary of fishway criteria for mainstem dams on the Columbia and Snake River**

Detailed criteria for COE dams can be found in the COE's Fish Passage Plan, or at PUD projects in Fishery Operating Plans (adult criteria) for each District. This Appendix summarizes the general standards for the fishways at each project.

**Entrance Head Differentials:** 1.0 to 2.0 feet standard at all projects.

Wells, Wanapum, Priest Rapids, and Bonneville dams target 1.5 ft at some entrances, Priest Rapids and Wanapum target 1.25 ft.

### **Entrance Weir Gate Depths:**

**Bonneville** - At the old powerhouse, maintain 8.0 ft or more depth at Gate 1/2 and 64/65; at the new powerhouse maintain 13' or > depth when tailwater elevation is above elevation 14 (sill = elev 1.0').

**The Dalles, John Day (OR fishway), McNary (OR fishway and north shore), Ice Harbor (south, north ph) Lower Monumental, Little Goose (south), and Lower Granite (south, north ph)** - 8 ft or > depth at Entrance Gates.

**Rock Island (spillway entrance)** - 8.5 ft or > gate depth.

**Rock Island left bank, Little Goose north shore** - 6.0 ft or > gate depth.

**Lower Granite north shore, Little Goose north powerhouse** - 7.0 ft or > gate depth.

**Rocky Reach left powerhouse & spillway** - 10' or > gate depth.

### **Entrance Wing Gate Openings:**

**Wells** - 8.0 ft open end gate.

**Rock Island** - 2.0 ft open on center fishway side gate; 3.0 ft open on the new powerhouse entrance gates.

**Rocky Reach** - 3.0 ft open on right powerhouse gates.

**Entrance (fixed-open) Gates:** Maintain head differential of 1.0-2.0 ft

**Bonneville** (spillway entrances)

**Wanapum** (all entrances)

**Priest Rapids** (all entrances)

**John Day North**

**Lower Monumental** (south shore, SSE-2 is a permanent fix 6-ft open gate).

**Turbine Unit Operating Priority:** Specific to each dam (See year 2013 FPP for COE projects).

**Spillway Operation:** Specific to each dam (See 2013 FPP for COE projects and DFOP/LSOP and HCPs for PUD projects).

**Collection or Transportation Channel Velocities:** 1.5 to 4.0 fps at all projects.

**Staff Gauges or other Elevation Gauges:** At all projects, gauges must be maintained throughout the fish passage season and readable at all elevations.

### **Fish Ladder**

**Depth of Water over Fish Ladder Weirs:** 1.0 ft ± 0.1 ft; most projects use a 1.0 ft to 1.2 ft or 1.3 ft.

**Head on Picketed Leads:** Maximum of four inches at most projects (0.3 ft); 6.0 inches is required at Chelan PUD projects.

**Head on Exit Trash Racks:** Maximum of 0.5 ft greater than reading with a clean trash rack. Debris should be removed when significant amounts accumulate.

## SUMMARY OF 2013–2014 COLUMBIA/SNAKE RIVER FISHWAY OUTAGES

<b>Bonneville Dam</b>	<ul style="list-style-type: none"> <li>• Bradford Island Fishway: December 1, 2013 - February 28, 2014</li> </ul>
<b>The Dalles Dam</b>	<ul style="list-style-type: none"> <li>• East Fish Fishway: December 3, 2013 - January 15, 2014</li> <li>• North Fish Fishway: January 28, 2014 - February 28, 2014</li> </ul>
<b>John Day Dam</b>	<ul style="list-style-type: none"> <li>• North Fish Fishway: December 2, 2013 - December 16, 2013</li> <li>• South Fish Fishway: January 7, 2014 - February 28, 2014</li> </ul>
<b>McNary Dam</b>	<ul style="list-style-type: none"> <li>• Washington Shore Fishway: January 6, 2014 - January 24, 2014</li> <li>• Oregon Shore Fishway: February 3, 2014 - February 28, 2014</li> </ul>
<b>Ice Harbor Dam</b>	<ul style="list-style-type: none"> <li>• North Shore Fishway: February 1 - 27, 2014</li> <li>• South Shore Fishway: January 6 - January 30, 2014</li> </ul>
<b>Lower Monumental Dam</b>	<ul style="list-style-type: none"> <li>• North Shore Fishway: January 2 - 17, 2014</li> <li>• South Shore Fishway: January 20 - February 28, 2014</li> </ul>
<b>Little Goose Dam</b>	<ul style="list-style-type: none"> <li>• January 6, 2014 - February 28, 2014</li> </ul>
<b>Lower Granite Dam</b>	<ul style="list-style-type: none"> <li>• January 6, 2014 - February 27, 2014</li> </ul>
<b>Priest Rapids Dam</b>	<ul style="list-style-type: none"> <li>• Left Bank Fishway: November 26, 2013 - January 13, 2014</li> <li>• Right Bank Fishway: January 22, 2014 - February 24, 2014</li> </ul>
<b>Wanapum Dam</b>	<ul style="list-style-type: none"> <li>• Right Bank Fishway: November 29, 2013 - January 15, 2014</li> <li>• Left Bank Fishway: January 23, 2014 - March 6, 2014</li> </ul>
<b>Rock Island Dam</b>	<ul style="list-style-type: none"> <li>• Right Bank Fishway: December 2nd, 2013 to January 31st, 2014</li> <li>• Left Bank Fishway: January 2nd, 2014 to January 14th, 2014</li> <li>• Middle Fishway: January 15th, 2014 to January 31st, 2014</li> </ul>
<b>Rocky Reach Dam</b>	<ul style="list-style-type: none"> <li>• January 2nd, 2014 to March 1, 2014</li> </ul>
<b>Wells Dam</b>	<ul style="list-style-type: none"> <li>• West Ladder: December 12th, 2013 to January 23rd, 2014</li> <li>• East Ladder: January 29th, 2014- February 15th, 2014</li> </ul>

## **ACKNOWLEDGMENTS**

Oregon Department of Fish and Wildlife, Washington Department of Fish and Wildlife, and NOAA Fisheries provided personnel to inspect adult fishways during the 2013 fish passage season. The Fish Passage Center appreciated the time and commitment from the individual inspectors and from the Agencies who assured that fishery personnel were available to complete inspections at the mainstem dams each month. During the 2013 Fish Passage season, the ODFW crew of Annie Dowdy and Ruth Sheerer deserve the added appreciation of assuming the fishway inspection duties at Ice Harbor and Lower Monumental Dams as well their regular inspections at Little Goose and Lower Granite dams. Fishery agency personnel who participated in the inspection program during 2013 are listed below.

<b>AGENCY</b>	<b>INSPECTOR</b>	<b>DAMS INSPECTED</b>
NOAA	Aaron Beavers	Priest Rapids & Wanapum
NOAA	Gary Fredricks	Bonneville
NOAA	Jeff Brown	McNary
ODFW	Howard Takata	The Dalles & John Day
ODFW	Anne Dowdy/Ruth Shearer	Little Goose & Lower Granite
ODFW	Anne Dowdy/Ruth Shearer	Ice Harbor & Lower Monumental
WDFW	Ryan Flynn and crew	Wells
WDFW	Solorio and Crew	Rock Island & Rocky Reach

Project operations personnel and biologists from Portland and Walla District Corps of Engineers provided on-site assistance whenever necessary to assure that the agency inspector could thoroughly inspect the adult and juvenile fishways. The inspectors were appreciative of assistance provided by project personnel at Corps of Engineers dams.

Grant, Chelan, and Douglas Public Utility Districts provided access and assistance for the State and Federal fishway inspectors at their projects. This continued cooperation and assistance was greatly appreciated by the NOAA and WDFW inspectors.

Funding for the FPC staff coordination of the inspections was provided by the following fishery agencies: ODFW, IDFG, WDFW, USFWS, and NOAA.

