

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

2006 ANNUAL REPORT

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COLUMBIA BASIN FISH AND WILDLIFE AUTHORITY

DRAFT Report

February 2007

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FISHWAY INSPECTIONS AT COLUMBIA AND SNAKE RIVER DAMS, 2006

INTRODUCTION

This season was the 22nd 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 2006 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 projects. These months encompass the main passage season for adult and juvenile fish at the mainstem dams. In total, the fish facilities are inspected 7 or 8 times during the season by the State or Federal inspector with the FPC coordinator normally accompanying the inspectors twice during the inspection season. The monthly project inspections were coordinated with the salmon managers as well as the operating agencies, i.e., the COE and PUD through periodic updates or forums such as the Fish Passage Operations and Maintenance Committee (FPOM). 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.

Since 2001, security at the COE and PUD projects has increased with check-in at specific security gates the norm for all projects. Identification and check-in procedures are now required at the Projects and unannounced inspections are not completed under present security conditions.

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 PUD 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 Opinion 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, that is 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, 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 fish turbines operating and at what Mw or flow level , number of spill bays operating and quantity of spill, and other measurements,*
- *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 2006 season was a continuation of the long-term inspection program that the State and Federal fish agencies have endorsed since the 1960's. 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 Marine Fisheries Service (NMFS), and the United States Fish and Wildlife Service (USFWS).



Dam	Year in Service	Miles to Mouth	Gross Head (Feet)	Miles of Reservoir	Operator	Adult Fish Passage
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. Other pertinent adult fish passage information was disseminated at FPOM or other FPC reports or memos.

Factors affecting fishway operations at the mainstem dams during the 2006 fish passage season are listed below:

- The Snake and Columbia rivers ended the water year with slightly above normal water supply. The January to July runoff volume at The Dalles Dam was approximately 114.7 million acre-feet or 107 percent of normal and the April to August runoff volume at Lower Granite Dam was approximately 25.6 million acre-feet or 112 percent of normal. There was spill at all projects during the spring and summer months to improve passage conditions for the juvenile fish migrations in the Snake and Columbia rivers.
- The Snake River projects were again operated at Minimum Operating Pool (MOP) plus 1-ft during the spring and summer months to improve juvenile fish passage conditions. The additional 1-ft was required to assist passage of navigation barges up and downstream through the lock channel. During part of the passage season, some fishway entrances at the Snake River dams were operated at reduced weir depths due to the gates resting on sills (no additional depth can be achieved).
- Several fish pumps went down in 2006. Fish pump #2 went down at Priest Rapids beginning on the September inspection. Fish pump #3 was down at Rock Island Dam for the April and May inspections.
- As in previous seasons, large quantities of floating aquatic grasses such as milfoil, elodea, etc., were present in the upper and lower Columbia Rivers, and these grasses caused problems with trashracks, diffuser gratings, and other equipment at the dams. Most projects were affected to some degree by the influx of these grasses at the fish facilities. The heaviest grass problems occur mainly at the upper three Columbia River dams. This may require a fishway be taken out of service for a portion of a day while the grasses are removed from the trash racks or from the wall screens at the various projects (See photos from Rock Island Dam).

SUMMARY BY PROJECT

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

AGENCY	INSPECTOR	DAMS INSPECTED
NOAA	Bryan Nordlund/Susan Novak	Priest Rapids & Wanapum
NOAA	Gary Fredricks	Bonneville
NOAA	Larry Swenson	McNary
ODFW	Wayne van der Naald	The Dalles & John Day
ODFW	Anne Dowdy	Little Goose & Lower Granite
WDFW	Steve Richards	Ice Harbor & Lower Monumental
WDFW	Larry Stillweigh and Crew	Wells
WDFW	Steve Gacek	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 or about 3-days per week basis.

BONNEVILLE DAM

Bonneville Dam has two powerhouses: the old 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. The old powerhouse consists of ten main turbine units while the new powerhouse has eight main turbine units and two smaller fish turbines that supply auxiliary water to the WA shore fishway. Between the two powerhouses is the spillway (part of the old 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 supply about 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 2004, a corner collection system was installed at the South end of the new powerhouse to improve passage for juvenile fish at the project. In addition, an experimental fishway system for passage of adult lamprey was tested at the Bradford Island fish ladder in 2004 and 2005 with excellent passage results. Permanent fish facilities to improve lamprey passage will be ongoing at the Bradford Island fish ladder and the WA fishway entrance.

Seven adult fishway inspections have taken place at Bonneville Dam 1) March 24, 2006 Gary Fredricks (NOAA) 2) April 14, 2006 Gary Fredricks (NOAA) 3) May 26, 2006 Gary Fredricks (NOAA) 4) June 23, 2006 Gary Fredricks (NOAA) 5) August 11, 2006 Gary Fredricks (NOAA) and David Benner (FPC) 6) September 15, 2006 Gary Fredricks (NOAA) and 7) October 13, 2006 Gary Fredricks (NOAA).

Bradford Island (old powerhouse) 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 old powerhouse main entrances are operated in pairs, i.e., Gate 2 and Gate 64, or Gate 1 and Gate 65 depending on tailwater elevation. The orifice/slucice gates were closed for the 2006 season and will remain closed in future years at the Dam.

2006 Inspection Results

The New Powerhouse was again highest priority for turbine operation at Bonneville Dam for the 2006 fish passage season. This resulted in non-operation of the turbine units at the Old Powerhouse or at times 1-3 turbine units might be operating during an inspection. In our inspections, flow from entrance Gate 64 would be very pronounced in the tailwater. Flow from the Ice/Trash Sluiceway partially occludes the flow from Gate 2. The Sluiceway was operated during the entire inspection season whether the powerhouse was operating or not.

Old Powerhouse Inspections

Weir Gate 2, located at the south end of the old powerhouse, had head differentials (site reading) that ranged between 0.7 ft and 1.5 ft. The computer reading and the site reading did not compare favorably for the season with the site and PLC readings sometimes varying by about 0.7-ft. The head differential from the computer during the June inspection read 1.5 ft at the South entrance while the visual reading of the channel minus the tailwater was only 0.8 ft, below the minimum 1-ft requirement. The gate depths ranged from a low of 6.8 ft to a high reading of 13.7 ft for the season. The gate depth was less than 8 ft on one of the seven inspections (October inspection). The criterion on gate depth was changed in recent years to include: minimum depth = 8-ft or > at the entrance with 1.0 ft – 2.0 ft head differential. 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. Because of the system limitation to read tailwater elevation and gate depth at this site, computer readings are

normally used. Gate 2 was on sill during the final inspection and 8-ft or greater weir depth could not be achieved.

Gate 64 was operating during each inspection in 2006. The gate depths at the A-Branch entrance (Gate 64) ranged from 5.9 ft to 8.6 ft, with head differentials through the season ranging from 0.9 ft to 1.6 ft. The gate depth was less than 8 ft on two of the seven inspections (April and October inspections). During the October inspection, tailwater elevation was very low and Gate 64 was submerged only 7.1 ft, during the April inspection flows were over 300 Kcfs and the Depth over gate 64 was only 5.9 ft however, gate 65 was also open 6.6 feet. The head differential at the A-branch entrance was out of criteria (0.9 feet) on the June inspection.

Water velocities along the powerhouse collection channel ranged from 2.0 fps at to 2.8fps over the seven inspections, all within acceptable criteria.

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.

During 2006, the **B-Branch entrances** and the **Cascades Island entrances** were operated continuously throughout the fish passage season. Computer readings with set points and elevations of the tailwater and channel levels were available for part of the season due to problems with sensors, etc., and when in manual control, we were unable to obtain immediate comparison of staff gauge and the computer elevation readings. Lacking suitable locations to measure tailwater with staff gauges, the computer reading normally allows the inspector a better opportunity to obtain an accurate tailwater elevation at both the B-Branch and Cascades Island entrances. For the 2006 inspections, head differentials for the **B-branch** ranged from 1.3 to 2.9 ft. The **Cascades Island** fishway reported head differentials that ranged from 1.2 ft to 4.5 ft during the season. All head differential readings at B-branch and Cascade Island exceeded the minimum 1.0 ft criteria, however somewhat high differentials were recorded during the March inspection at both sites.

Fish Ladder: Depth of water measured over the Bradford Island fish ladder weirs ranged from 0.9 to 1.5 ft. The respective readings normally were in the proper range to achieve about 1.0 ft and 1.3 ft of water down the individual A- and B-branch fish ladders. During the April inspection, the low reading of 0.9 ft resulted in low readings for the year at the A-Branch and B-Branch (0.9 ft). The depth of water measured at A- Branch ranged from 0.9 ft to 1.4 ft during the year, normally within satisfactory range. The depth of water measured at the B-Branch ranged from 0.9 ft to 1.2 ft and readings were usually within satisfactory range. At the Cascades Island fish ladder, water depth over the weirs ranged from 0.8 ft to 1.3 ft; all readings were within normal range through the inspection season. The fish ladder exit at Bradford Island was reported with some level of debris during two of the inspections this year.

Table 1. Pertinent Data for Fish Facility Inspections in 2006 at BONNEVILLE DAM.

CRITERIA ITEMS	DATE OF INSPECTION						
	24-Mar	14-Apr	26-May	23-Jun	11-Aug	15-Sep	13-Oct
<u>Bradford Island Fishway</u>							
<u>Bradford Island Entrances</u>							
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	1.3	1.2	1.6	0.9	1.6	1.6
Depth over Gate 64/65	ft	8.6	5.9/6.6	8.3	8.1	8.4	7.1
Head at South ph entrance	ft	1.3	1.2	1.4	1.5	0.7	1.1
Depth over Gate 1/2	ft	9.2	10.7/13.2	10.4	9.6	13.7	8.2
Channel Velocity	fps	2.5	2.0	2.2	2.1	2.8	2.3
Depth- Bradford Is. ladder weirs	ft	1.0	0.9	1.5	1.3	1.2	1.0
Depth - A-Branch ladder weirs	ft	1.1	0.9	1.4	1.4	1.3	1.0
Exit clean (Yes or No)		yes	yes	no	yes	yes	no
<u>B-Branch Entrance</u>							
Head at B Branch entrance	ft	2.9	1.5	1.4	1.4	1.6	2.3
Staff gages clean		yes	yes	yes	yes	no	yes
Depth over ladder weir	ft	1.0	0.9	1.2	1.2	1.2	1.0
<u>Cascades Island Entrance</u>							
Head at main entrance	ft	4.5	1.5	1.6	na	1.4	2.3
Staff gages clean		yes	yes	yes	yes	no	yes
Depth over ladder weir	ft	1.1	1.1	1.3	1.2	1.2	0.8
<u>Washington Shore Fishway</u>							
<u>WA Shore Entrance:</u>							
Depth over entrance weir (Criteria = 13.0 ft or >)							
NUE	ft	10.5	13.4	13.3	13.4	11.3	14.0
NDE	ft	9.9	13.3	13.3	13.3	11.3	13.5
SUE	ft	10.5	13.4	13.3	13.4	11.3	13.3
SDE	ft	10.5	13.5	13.4	13.5	11.3	13.1
Head at entrance (Criteria = 1.0-2.0 ft)							
NUE	ft	1.5	2.1	1.9	1.9	2.0	2.0
NDE	ft	?	1.9	1.7	1.6	1.7	1.4
SUE	ft	1.2	2.0	1.9	1.6	1.2	1.6
SDE	ft	1.1	1.6	1.7	1.6	1.0	1.6
Depth over ladder weir (67)	ft	1.0	1.1	1.2	1.1	1.0	1.0
Channel Velocity (Elect. Meter)							
Ladder exit clean		yes	yes	yes	yes	yes	yes
Staff gages clean		yes	yes	yes	yes	no	yes
Comment # (if applicable)		1		2	3		4
							5

Comments:

1. Weir 67 staff gauge needed cleaning, inspector could not get NDE tailwater reading
2. Bradford Island Exit not clean had net float stuck to it, inspector notified project
3. Many staff gauges unreadable or nearly unreadable
4. Bottom four inches of Bradford fish count window needs cleaning
5. Bradford Island Exit had a large amount of debris- creating several feet of head across exit trash rack. The floating orifices at B2 were closed although FPOM had recommended opening them several months ago. The B-branch and Cascade Island entrances were above criteria by a few tenths of a foot.

Powerhouse 2 Fishway

Fish turbines F1 and F2 supply about 5,000 cfs of water to the four main entrances and 12 orifice gates along the powerhouse collection channel. Both Fish turbines operated satisfactorily throughout the fish migration season and remained in service until winter maintenance began.

This was the second year of operation for the corner collector at the WA shore of the new powerhouse. The system was operated successfully from spring season through August 31 to improve collection and passage of juvenile fish at the project. The outfall from the flume is located about 1-mile below the project and appears to have no effect on adult fish approaching the project.

Head differentials measured at the main entrances, North Upstream, North Downstream, South Upstream, and South Downstream ranged between 1.4 ft and 2.1 ft at the North entrance gates with the South entrance gates reporting head between 1.0 ft and 2.0 ft. All readings at the South shore were greater than the 1.0 ft minimum. For the season, the head differentials averaged 1.9, 1.7, 1.8, and 1.4 at the respective NUE, NDE, SUE, and SDE. Gate depths ranged between 8.8 ft and 14.0 ft for the season when both fish turbines were operating.

Along the powerhouse collection channel, all floating orifice gates operated satisfactorily throughout the season. None were submerged such that water was flowing over the top of the orifice gates.

Fish Ladder: The fish ladder exit and the serpentine section of the WA fish ladder was reported clear of debris on all inspections during 2006. Water depth measured over the WA fish ladder weirs was 1.0-1.2 ft at Weir 67 and was within the required range throughout the fish passage season.

Overall, fish passage at Bonneville Dam during 2005:

- Adult fish passage at Bonneville Dam in 2006 should have been satisfactory as equipment and adult facilities were operated at or near criteria levels throughout most of the year with few if any problems at the Bradford Island and WA shore fishways.

Areas that still require improvement are:

- All head differential readings at B-branch and Cascade Island exceeded the minimum 1.0 ft criteria, however somewhat high differentials were recorded during the March inspection at both sites.
- The fish ladder exit at Bradford Island was reported with some level of debris during two of the inspections this year.

THE DALLES DAM

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. The spill basin is shallow with no fliplips installed to dissipate the spilled flow. One change completed prior to the 2004 fish passage season was the addition of a larger training wall near Bay 8 and a smaller extension of the North Shore Entrance to keep flows moving quickly downstream when spilling at the Project (now mainly through Bays 1-8 located on the North End of the Project). It is working satisfactorily for juvenile passage and has not appeared to affect passage of the adult fish at the North (WA) shore entrance.

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 WA shore fishway. This turbine normally supplies about 800 cfs through the diffusers to the operating entrance, usually Gate N-1.

Eight adult fishway inspections have taken place at The Dalles Dam 1) March 30, 2006 Wayne Van der Naald (ODFW) and David Benner (FPC) 2) April 28, 2006 Wayne Van der Naald (ODFW) 3) May 31, 2006 Wayne Van der Naald (ODFW) 4) June 23, 2006 Wayne Van der Naald (ODFW) 5) July 21, 2006 Wayne Van der Naald (ODFW) 6) August 31, 2006 Wayne Van der Naald (ODFW) 7) September 24, 2006 Wayne Van der Naald (ODFW) and 8) October 30, 2006 Wayne Van der Naald (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, with the exception of the August 31st inspection. Head differentials ranged from 1.1 ft to 1.6 ft and averaged 1.4 ft (no reading on March inspection). The East fishway entrances were operating with in established criteria range for gate depths (8 ft or >) in all but one inspection, and head differentials were within the designated criteria range for all inspections completed in 2006. The East entrances pass the majority of the fish at the project with exception of the time frame when spill might cause a larger percentage to use the North Shore entrances.

The channel velocity was taken via a continuous recording unit at the eastern end of the powerhouse collection channel and normally visually estimated by the inspector at the western end of the channel. Water velocity in the collection channel ranged between 1.0 fps and 2.0 fps throughout the season, readings were below criteria on two inspections during the fish passage season (March, October).

The **West** fishway entrances (W-1 and W-2) were submerged 8.0 feet or greater on 8 of 8 inspections during 2006. The gate depths ranged from 8.4 ft to 13.0 ft and averaged 9.5 ft depth with head differential readings that ranged from 0.4 ft to 1.9 ft and averaged 1.5 ft through the season; gate depth readings met the criteria at the West Entrances. The west fishway entrance was below criteria on the first inspection of the year (March-30-06).

Flow to the **South** fishway entrances (S-1 and S-2) is via a separate channel that originates in the Junction Pool and ends near the South end of the Spill basin. This season, S-1 and S-2 were operated with gate

depths that ranged from 8.1 ft to 10.6 ft over the 8 inspections. Head differentials ranged between 0.7 ft and 1.5 ft. The south fishway entrance was below criteria on the first inspection of the year (March-30-06).

Table 2. Pertinent Data for Fish Facility Inspections in 2006 at THE DALLES DAM.									
CRITERIA ITEMS									
SOUTH SHORE FISHWAY		DATE OF INSPECTION							
		30-Mar	28-Apr	31-May	23-Jun	21-Jul	31-Aug	24-Sep	30-Oct
East Entrance:									
Depth over entrance weir									
E-1 (gate set at elev. 83.5 ft)	ft								
E-2 (crit. = 8 ft or >)	ft	11.7	10.8	12.4	13.0	12.1	7.7	13.0	13.2
E-3 (crit. = 8 ft or >)	ft	11.7	11.3	11.9	11.5	11.6	7.7	12.5	12.7
Head at main entrance (crit. = 1-2 ft)	ft	0.0	1.5	1.4	1.1	1.6	1.5	1.4	1.3
Depth over ladr. weir (crit. = 1-1.3 ft)	ft	1.1	1.0	1.2	1.3	1.1	1.2	1.1	1.1
Channel Velocity (crit. = 1.5 - 4.0 fps)	fps	1.0	2.0	2.0	2	2.0	2.0	1.5	1.3
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	no	yes	yes
Picket leads clean (yes or no)		yes	yes	yes	yes	yes	yes	yes	yes
West Entrance:									
Depth over entrance weir									
W-1 (crit. = 8 ft or >)	ft	9.4	9.5	10.2	10.0	9.0	8.9	9.1	8.5
W-2 (crit. = 8 ft or >)	ft	9.4	9.0	10.2	13.0	9.0	9.0	9.1	8.4
Head at main entrance (crit. = 1-2 ft)	ft	0.4	1.8	1.8	1.4	1.6/1.9	1.5	1.5	1.5
South Entrance:									
Depth over entrance weir									
S-1 (Crit. = 8 ft or >)	ft	9.2	9.6	9.6	9.6	8.3		8.1	8.2
S-2 (Crit. = 8 ft or >)	ft	9.2	10.6	9.6	10.2	8.4		8.6	8.1
Head at main entrance (Crit. = 1-2 ft)	ft	0.7	1.5	1.8	1.4	1.5		1.3	1.2
NORTH SHORE FISHWAY									
North Shore Entrance:									
Depth over entrance weir									
N-1 (crit. = 8 ft or >)	ft	8.7	9.3	9.5	9.5	9.4	8.8	9.1	9.0
Head at main entrance (Crit. = 1-2 ft)	ft	1.8	1.5	1.3	1.5	1.3	1.3	1.3	1.4
Depth over ladr. weir (Crit. = 1-1.3 ft)	ft	1.1	1.1	1.3	1.4	1.1	1.1	1.0	1.1
Ladder exit clean	debris		yes	yes	yes	yes	yes	yes	yes
Selsyns operating		yes	yes	yes	yes	yes	yes	yes	yes
Picket leads clean		yes	no	yes	yes	yes	yes	yes	yes
PUD trash rack clean (yes or no)		unknown	unknown	yes	yes	yes	yes	yes	yes
Spill Pattern w/i Criteria (yes or no)		n/sp	yes	yes	yes	yes	yes	yes	yes
Comment Number (if applicable)		1	2	3	4	5			
Comments									
1. Could not gain access to PUD, head diff at South, and West entances out of criteria, Fish units out of order because of E2 wier problem									
2. Could not gain access to PUD, some sticks in north picketed leads									
4. Fish turbine cfs a little high-- at 5210 cfs , 4800 cfs is upper limit									
5. Could not read JP staff gauge, south entrance selsyns and LED not working									

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

North Shore Fishway Inspections

At the WA 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 2006 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 8.7 to 9.5 feet and averaged 9.2 ft for the season. Head differential at N-1 ranged from 1.3 to 1.5 ft. The WA fishway was operated within criteria during all eight inspections in 2006.

Fish Ladder: The ladder exit was reported clear of debris on 7 of 8 inspections and the PUD trash racks were reported clear of debris on six of six inspections (could not access PUD during two inspections). The picketed leads were reported clear of debris during 7 of the 8 inspections during the passage season. The depth of water recorded over the ladder weirs showed the fish ladder in proper criteria on all inspections with a range of 1.1 ft to 1.4 ft. The juvenile passage bypass system was in proper range through the season as well.

Overall, the OR and the WA fishways were operating within or near satisfactory criteria during the fish facility inspections completed in 2006.

Some areas of concern or positive changes made to the Project are listed below.

- The COE should assure that the PUD trashracks continue to be cleaned on a regular basis. The PUD trash racks were cleaner in 2006 at The Dalles, however has been a problem in the past.
- Both south and west fishway entrances were below head differential criteria for the first inspection of the year, the COE should assure that criteria is met 100% of the time.
- The north shore fishway exit was reported as not clean on the first inspection of the year, the COE should assure that exits are always clean.

JOHN DAY DAM

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 fliplips into the spillbays and the addition of a screened juvenile fish bypass system. The fliplips 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 WA 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.

Eight adult fishway inspections have taken place at John Day Dam 1) March 30, 2006 Wayne Van der Naald (ODFW) and David Benner (FPC) 2) April 28, 2006 Wayne Van der Naald (ODFW) 3) May 31, 2006 Wayne Van der Naald (ODFW) 4) June 23, 2006 Wayne Van der Naald (ODFW) 5) July 21, 2006 Wayne Van der Naald (ODFW) and 6) August 31, 2006 Wayne Van der Naald (ODFW) 7) September 24, 2006 Wayne Van der Naald (ODFW) and 8) October 30, 2006 Wayne Van der Naald (ODFW). Table 3 lists the criteria items and the inspection dates for 2006, with the text below detailing some of the results below.

South (Oregon Shore) Fishway Inspections

Gate SE-1 was operated at the South Shore Fishway throughout the season. The gate depth ranged from 7.8 to 9.0 ft over the 8-inspections. The head differential ranged from 1.2 ft to 1.5 ft and averaged 1.4 ft for the season. Overall, entrance conditions at Gate SE-1 should have provided satisfactory fish passage during the 2006 inspections conducted by ODFW. The September inspection gave site reading for the gate depth that that was 0.2 ft below criteria (7.8 feet); however, during this inspection the head differential was 1.5 feet, well within criteria.

Table 3. Pertinent Data for Fish Facility Inspections in 2006 at JOHN DAY DAM.									
CRITERIA ITEMS									
		DATE OF INSPECTION							
		30-Mar	28-Apr	31-May	23-Jun	21-Jul	31-Aug	24-Sep	30-Oct
SOUTH SHORE FISHWAY									
South Shore Entrance:									
Depth over entrance weir									
SE-1 (Crit. = 8 ft or >)	ft	9.0	9.0	8.9	8.2	8.2	8.2	7.8	8.1
Head at SE-1 (Crit. = 1-2 ft)	ft	1.2	1.5	1.2	1.5	1.2	1.2	1.5	1.5
Dep. over ladr. weir (Crit.=1.0 +/-0.1)		0.9	1.0	1.3	1.3	1.1	1.0	1.0	1.0
ft [normal] & 1.3 ft shad season)	ft								
Channel Veloc (Crit. = 1.5 - 4.0 fps)	fps	1.5	1.7	1.5	1.5	1.7	1.9	1.8	1.7
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	3	3	3	3
Rpm for pumps		54-59	52-56	51-53	49-56	53-55	49-57	52-55	53-59
North Powerhouse Entrance:									
Depth over entrance weir									
NE-1 (Crit. = 8 ft or >)	ft	8.9	8.9	8.6	8.5	9.8	8.4	8.9	9.1
NE-2 (Crit. = 8 ft or >)	ft	8.7	8.4	8.8	9.3	9.7	8.5	9.0	9.2
Head at NE-1&2 (Crit. = 1-2 ft)	ft	1.5	1.7	1.8	1.7	1.2	1.2	1.2	1.2
Staff gages clean (yes or no)		yes	yes	yes	yes	yes	yes	yes	yes
NORTH SHORE FISHWAY									
North Shore Entrance:									
Depth over entrance weir									
N-1 (Crit. = 8 ft or >)	ft	9.7	9.7	10.6	10.7	9.0	na	8.2	9.0
Head at N-1(Crit. = 1-2 ft) Targ - 1.5'	ft	1.3	1.5	1.4	1.1	1.5	1.0	1.6	1.6
Depth over ldr weir (Crit.=1.0 +/-0.1)	ft	1.0	1.0	1.2	1.2	1.0	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	no	yes	yes
Picket leads clean		yes	yes	yes	yes	yes	yes	yes	yes
Pumps Operating		3	3	3	3	3	3	2	3
Comment number (if applicable)		1				2	3		
Comments:									
1. Orifice lights need cleaning									
2. N-1 entrance weir #1 not in use (gauge not working), weir #2 in use									
2. N-1 entrance weir #1 not in use (gauge not working), weir #2 in use. Entrance weir gauge not readable at N-2.									

The **North powerhouse entrance gates**, NE-1 and NE-2, operated at head differentials within the following range: 1.2 to 1.8 ft with gate depths that ranged from 8.4 ft to 9.8 ft. Gate depth and head differential were within proper criteria range for the 2006 season. Attraction flows from these gates should have provided satisfactory conditions for adult fish approaching those entrance gates for the season.

Water velocity along the powerhouse collection channel ranged from 1.5 to 1.9 fps, all recordings were within criteria (1.5-4.0 fps). The electronic velocity meter appeared to work satisfactorily during the 2006 fish passage season.

Fish Ladder: The exit from the fish ladder was clear of debris through the season, and staff gages were reported as clean during all inspections. The picketed leads were reported clear of debris during all inspections. The depth of water measured over the ladder weirs ranged between 0.9 ft and 1.3 ft for the

season and was within the criteria range of $1.0 \text{ ft} \pm 0.1 \text{ ft}$ during the non-shad period and $1.3 \text{ ft} \pm 0.1 \text{ ft}$ during the shad passage season.

North Shore Fishway Inspections

The criteria settings for the North shore fishway entrances were changed prior to the 2000 season. Only one entrance gate is now operated. In 2006, weir gate N-1 was operated through June and N-2 was used for the rest of the year. Gates N-1 or N-2 should be submerged 8.0 ft or more below tailwater, with the head differential maintained between 1.0 ft and 2.0 ft (targeted 1.5 ft).

The minimum 8.0-ft gate depth criterion was met on all inspections when readings were obtained (no reading was taken on the August 31st inspection); the depths ranged from 8.2 ft to 10.7 ft. Head differentials ranged between 1.0 ft and 1.6 ft. For the season, the gate depth and head differential readings met criteria on all inspections.

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 2006 season. Depth of water over the fish ladder weirs ranged from 1.0 ft to 1.2 ft, all satisfactory readings.

Overall, the main entrances at the Oregon and the Washington fishways were operated very close to criteria levels during the 2006 fish passage season. Areas of concern based on observations from the inspections are listed below.

- The September inspection gave site reading for the SE-1 gate depth that that was 0.2 ft below criteria (7.8 feet). Although this gate depth was very close to criteria, the COE should assure that gate depths are at criteria when possible.

MCNARY DAM (photographs on page __)

McNary hydroelectric project is a COE operated dam completed in 1953. Fourteen main turbine units and 22 spillbays are incorporated in this dam. Until 2002, the two end spillbays per side were split-leaf gates and did not have fliplips installed below them; this design was changed to a 1-piece gate with fliplips now present to reduce dissolved gases below the project. The OR and WA shore fish ladders incorporate full overflow weirs and have submerged orifices in each weir. The fish ladders carry at least double the Q as the newer fish ladders built at other COE dams. On the OR fishway, three large electric fish pumps pulling water from the tailrace of the project plus about 1,000 cfs of gravity flow from the forebay, 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 WA fishway was changed from the pressurized system to a non pressurized one 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 shunted 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 1) April 12, 2006 Larry Swenson (NOAA) and David Benner (FPC) 2) May 18, 2006 Larry Swenson (NOAA) 3) June 30, 2006 Larry Swenson (NOAA) 4) July 28, 2006 Larry Swenson (NOAA) 5) August 22, 2006 Larry Swenson (NOAA) and 6) September 22, 2006 David Benner and Brandon Chockley (FPC) and Brad Eby (COE) 7) October 26, 2006 David Benner (FPC). Results of the inspections are discussed below with Table 4 listing data collected from the inspections. A copy of the computer-generated Status Report of the fishway readings was normally compared with the field data taken at the main entrances. The site readings and the computer-generated report of the fishway readings normally should not vary more than 0.3 ft; if readings varied and were greater, the Project was asked to check calibration.

The project can meet criteria standards operating with two of the three pumps at the OR fishway. When three pumps operate, the angle open normally ranges between 20-24° while the blade angle is increased up to 28 to 32° when two pumps operate. 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 2006, the Project operated with 1, 2 or 3 fish pumps for the entire fish passage season (only one pump was operating during the first inspection of the year, April 12, 2006).

The main entrances at the South shore (SFEW-1 & 2) were reported with gate depths that ranged between 7.3 ft and 10.9 ft for the year. During the first inspection of the year (April 12, 2006) both the SFEW-1 & 2 gates were below criteria, this was likely a result of only one fish pump operating. The head differential ranged from 0.8 to 1.6 ft, with all inspections having head differentials within criteria except the first of inspection of the year. During the first inspection of the year, both gate depths and differentials were out of criteria at the South Entrances.

The North powerhouse entrance NFEW-3 was inoperable for most of 2006 and was scheduled to be repaired over the winter of 2006/2007. The North powerhouse entrance NFEW-2 was operated within the required criteria as gate depths ranged from 8.8 ft to 12.0 ft and head differentials ranged from 1.2 ft to 1.8 ft. The North powerhouse entrances should have provided satisfactory flows during our inspections.

Water velocities were recorded via an electronic meter installed downstream of the junction pool and upstream of ph turbine unit #1. Surface velocity was estimated at the northern end of the channel by timing a wood chip or floating object a given distance along the channel. Basically, water velocity was between 1.5 fps and 3.3 fps at the south end of the collection channel and was 1.5 fps to 3.4 fps at the northern end of the channel. These readings should have allowed for fairly good passage through the collection channel for the 2006 fish passage season.

Fish Ladder: The picketed leads located at the OR fish ladder count station were reported clear of debris this season while the exit from the fish ladder was reported with some amount of debris on 1 of the 7 inspections. The depth of water reported over the OR fish ladder weirs ranged from 1.0 ft to 1.2 ft. PIT tag detection antennas are located on the upstream exit and downstream entrance of the counting window as well as in the orifice sections of weirs in the lower end of the fish ladder. Both sets of PIT tag antennas worked satisfactorily throughout the fish passage season.

North Shore (Washington) Fishway Inspections

The WA shore fishway entrance WFE-2 was inoperable after the first two inspections of the year. The WA shore fishway entrance WFE-3 was submerged from 8.9 ft to 13.5 ft (Average depth = 11.7 ft) with head differentials at the entrances ranging from 1.0 ft to 2.1 ft (Average head = 1.6 ft). The gate depths and head differentials were operated within acceptable criteria range throughout the season, i.e., greater than 8.0 ft gate depth with head differential from 1.0 ft to 2.0 ft.

Fish Ladder: The fishway exit was reported with as clean on all inspections. The picketed lead section located at the counting station in the WA fish ladder was also reported as clean on all inspections. The depth of water recorded over the ladder weirs ranged from 1.0 ft to 1.4 ft during the inspection season. Similar to the Oregon ladder, PIT detectors were placed on a series of submerged orifices in the lower section of the WA fish ladder; no PIT detectors were placed at the counting station, but will be installed during this upcoming winter maintenance season and should be operable by the March 2006 time frame.

Overall, the Oregon and Washington fishways operated within or close to criteria on all inspection dates for the 2006 fish passage season. Some problem areas that exist or should be investigated further are:

- During the first inspection of the year, both gate depths and differentials were out of criteria at the South Entrances a likely result of only one fish pump operating. It is recommended that COE ensure that the proper number of fish pumps are operating to provide conditions that meet criteria at all times.
- The South Shore fishway exit from the fish ladder was reported with some amount of debris on 1 of the 7 inspections in 2006. The COE should assure that exits are always clean.

Table 4. Pertinent Data for Fish Facility Inspections in 2006 at MCNARY DAM.

CRITERIA ITEMS		DATE OF INSPECTION						
		12-Apr	18-May	30-Jun	28-Jul	22-Aug	22-Sep	26-Oct
SOUTH SHORE FISHWAY								
South Shore Entrance:								
Depth over entrance weir (Criteria: 9 ft or > gate depth at SFEW-1,2 & NFEW-1,2)								
SFEW-1	ft	7.3	9.0	9.2	9.1	10.3	10.8	9.9
SFEW-2	ft	7.4	9.1	9.2	9.1	10.3	10.9	9.9
Head at SFEW-1,2 (Crit.= 1-2 ft)	ft	0.8	1.0	1.2	1.6	1.2	1.0	1.4
Dep. over ladr. weir(Crit.= 1-1.3')	ft	1.2	1.1	1.0	1.0	1.0	1.1	1.1
Channel velocity (Crit.= 1.5-4.0 fps)	fps	1.6-1.9	1.7-3.4	1.6-3.3	1.5-2.5	2-2.3	1.5-2.0	2.4
Ladder exit clean		yes	yes	yes	yes	yes	yes	no
Picket leads clean		yes	yes	yes	yes	yes	yes	yes
Orifice Gates Operating - 12		ok	ok	ok	ok	ok	ok	ok
Pumps Operating & degrees open		1	2	2	2	3	2	2
		30deg	29-30deg	29-30deg	30 deg	31 deg	28-30	30
North Powerhouse Entrance:								
Depth over entrance weir								
NFEW-2	ft	8.9	8.9	12.0	8.8	8.9	11.6	10.1
NFEW-3	ft	2.0	9.1	4.6	3.3	2.8	3.6	3.6
Head at NFEW-2&3 (Crit. = 1-2 ft)	ft	1.8	1.6	1.4	1.9	1.5	1.4	1.2
WA.SHORE FISHWAY								
North Shore Entrance:								
Depth over entrance weir								
WFE-2 (Crit. = 8 ft or >)	ft	8.9	11.8	3to4				
WFE-3 (Crit. = 8 ft or >)	ft	8.9	11.8	12.1	11.8	11.1	12.7	13.5
Head at WFE-2&3 (Crit. = 1-2 ft)	ft	1.4	1.5	1.8	1.8	2.1	1.4	1.0
Dep. over ladr. weir (Crit. = 1-1.3 ft)	ft	1.4	1.3	1.3	1.3	1.1	1.0	1.1
Ladder exit clean		yes	yes	yes	yes	yes	yes	yes
Picket leads clean		yes	yes	yes	yes	yes	yes	yes
Comment number (if applicable)		1		2	3	4		5
Comments:								
1. Only one AWS operating on oregon side, the Washington shore tilting weirs out of adjustment								
2. W2 was out of service, top of bulkhead was submerged 3 to 4 feet. WFE1 was in service, no readout available , looked like 7 to 8 feet of submergence.								
3. W1 weir was in manual mode with three chain links showing- about 6-7 feet of submergence. NFEW3 is inoperable and is not scheduled for repair until next winter.								
4. W1 weir was in manual mode . NFEW3 is inoperable and is not scheduled for repair until next winter.								
5. Small raft of debris at oregon shore exit.								

ICE HARBOR DAM (*photographs on page ___*)

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 recent change at the project has been the addition of fliplips in the spillbays and a training wall (completed in 1999) to “straighten” flow on the south end of the spillway. A Removable Spillway Weir is now in place at the project 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 8 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. Three 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.

Seven adult fishway inspections have taken place at Ice Harbor Dam 1) April 14, 2006 Steve Richards (WDFW) and David Benner (FPC) 2) May 23, 2006 Steve Richards (WDFW) 3) June 22, 2006 Steve Richards (WDFW) 4) July 24, 2006 Steve Richards (WDFW) 5) August 17, 2006 Steve Richards (WDFW) 6) September 26, 2006 Steve Richards (WDFW) 7) October 31, 2006 Steve Richards (WDFW). Details of the inspections are found in Table 5 and a summary of the inspections reported in the section below.

South Shore Fishway Inspections

Eight fish pumps were operating on all 7 inspections completed this season, maximum capacity. 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 5.0 ft to 9.5 ft during the season. Gate SFEW-1 was not recorded on sill during any inspections this season. Head differential measured at SFEW-1 ranged from 0.9 ft to 2.7 ft for the season with the head differentials between 1.5 and 2.0 ft on 5 of the 7 inspections. Only twice did the Project meet actual gate depth criteria of 8.0 ft or greater in 2006. Minimum head differential was not met during the last inspection.

The North powerhouse entrance gate (NFEW-2) was operating with weir depths that ranged between 5.8 ft and 11.8 ft for the season. Head differential ranged from 0.4 ft to 2.2 ft. Gate NFEW-1 was not recorded on sill during any inspections this season. Head differential was not within proper criteria on two inspections, September and October of 2006. Gate depth was less than the required 8.0 ft on 5 of 7 inspections.

Seven floating orifice gates operated satisfactorily along the powerhouse collection channel throughout the fish passage season. The water velocity in the collection channel was reported from >2.0 to >3.1 fps during the season; all reports were within the desired range.

Fish Ladder: The exit from the fish ladder was reported clear of debris on all inspections as were the picketed leads located at the counting station. Depth of water over the ladder weirs was reported at 1.1 ft for the seven inspections.

North Shore Fishway Inspections

Gate NEW-1 was submerged 8.0 ft or more in depth on two of seven inspections. Gate depths ranged from 5.1 ft to 10.7 ft. Head differentials were reported in the following range: 1.5 ft to 2.3 ft. The Gate was not on sill during the inspections and it appeared that gate depths could have been increased during most inspections.

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 ft for all inspections.

Overall, fish facility inspections completed during 2006 were lacking on some of the following items.

- It appeared from the inspection reports that sufficient water was available to meet criteria, but that the control system was not functioning properly or else the set points were not allowing gate depth to be within the proper range. The Project should improve the control system for the fishways and make it workable prior to the fish passage season. The 2006 season appeared to have very similar results as in 1997-2005 when the system was not balanced properly between head differential and gate depth.
- The above comment has been in at least the last several annual fishway reports. The COE needs to do a better job of meeting head differential and gate depth criteria at Ice Harbor Dam.

Table 5. Pertinent Data for Fish Facility Inspections in 2006 at ICE HARBOR DAM.

CRITERIA ITEMS		DATE OF INSPECTION						
		14-Apr	23-May	22-Jun	24-Jul	17-Aug	26-Sep	31-Oct
SOUTH SHORE FISHWAY								
South Shore Entrance:								
Depth over entrance weir								
SFEW-1 (Crit. = 8 ft or >)	ft	8.4	9.5	5.0	7.3	6.5	7.2	7.0
Head at SFEW-1 (Criteria = 1-2 ft)	ft	1.4	1.3	2.7	1.5	2.0	1.0	0.9
Gate on Sill (yes or no)		no	no	no	no	no	no	no
Dep. over ladr. weir (Cr. = 1-1.3 ft)	ft	1.1	1.1	1.1	1.1	1.1	1.1	1.1
Channel velocity (Crit. = 1.5-4 fps)	fps	> 2	1.8-2.0	> 2.5	> 2.5	> 3.0	> 3.1	2-3.1
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 (yes or no)		yes	yes	yes	yes	yes	yes	yes
Pumps Operating (8 available)		8	8	8	8	8	8	8
North Powerhouse Entrance:								
Depth over entrance weir								
NFE-2 (Criteria = 8 ft or >)	ft	11.8	9.5	5.8	7.7	6.7	6.4	6.4
Head at NFE-2 (Criteria = 1-2 ft)	ft	1.5	no reading	2.2	1.0	1.5	0.6	0.4
Gate on Sill (yes or no)		no	no	no	no	no	no	no
Staff gages clean	ft	yes	yes	yes	yes	yes	yes	yes
NORTH SHORE FISHWAY								
North Shore Entrance:								
Depth over entrance weir								
NEW-1 (Criteria = 8 ft or >)	ft	10.2	10.7	6.8	6.2	5.1	6.5	5.9
Head at NEW-1 (Criteria = 1-2 ft)	ft	1.5	no reading	1.8	2.0	2.3	1.7	1.8
Gate on Sill (yes or no)		no	no	no	no	no	no	no
Dep. over ladr. weir (Crit. = 1-1.3 ft)	ft	1.1	1.1	1.1	1.1	1.1	1.1	1.1
Ladder exit clean		yes	yes	yes	yes	yes	yes	yes
Staff gages clean		yes	yes	yes	yes	yes	yes	yes
Picket leads clean		yes	yes	yes	yes	yes	yes	yes
Pumps Operating (3 available)		2	3	2	2	3	2	2
Comment Number (if applicable)								
Comments:								

LOWER MONUMENTAL DAM

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. Fliplips were originally installed on six bays with completion of fliplips on the two end bays during winter 2002-03.

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) will remain permanently closed at this project.

Seven adult fishway inspections have taken place at Lower Monumental Dam 1) April 14, 2006 Steve Richards (WDFW) and David Benner (FPC) 2) May 23, 2006 Steve Richards (WDFW) 3) June 14, 2006 Steve Richards (WDFW) 4) July 24, 2006 Steve Richards (WDFW) 5) August 17, 2006 Steve Richards (WDFW) 6) September 18, 2006 Steve Richards (WDFW) 7) October 31, 2006 Steve Richards (WDFW). 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 5.1 ft to 8.4 ft during the inspections with the average depth of 7.9 ft. On the July 24th inspection, the gate depth at NSE-1 was 5.1 feet, on this inspection the NSE-1 gate was at a depth of 432.1 feet, and could have lowered to elevation 429 feet (its sill elevation); NSE-1 would have been within criteria had it dropped to its sill elevation. With the exception of the August 17th, 2006 inspection when NSE-2 was at 7.9 feet, all other inspections contained gate depths that were within the 8.0-foot or greater criteria. Head differentials ranged from 1.3 ft to 1.8 ft with the seasonal average for the 7-inspections of 1.6 ft. Discharge and velocity through the NSE-1 and NSE-2 entrance gates should have provided satisfactory passage conditions for the seven inspections at the North shore entrance gates, with the one exception of NSE-1 on July 24th, 2006.

Table 6. Pertinent Data for Fish Facility Inspections in 2006 at LOWER MONUMENTAL DAM

CRITERIA ITEMS								
		DATE OF INSPECTION						
		14-Apr	23-May	14-Jun	24-Jul	17-Aug	18-Sep	31-Oct
NORTH SHORE FISHWAY								
North Shore Entrance:								
Depth over entrance weir								
NSE-1 (Criteria = 8 ft or >)	ft	8.0	8.4	8.2	5.1	8.1	8.1	8.2
NSE-2 (Criteria = 8 ft or >)	ft	8.0	8.2	8.0	8.3	7.9	8.1	8.1
Head at NSE-1 & 2 (Crit. = 1-2 ft)	ft	1.7	1.4	1.7	1.8	1.7	1.3	1.5
Gate on Sill (yes or no)		no	no	no	no	no	no	no
Dep. over ladr. weir (Cr. = 1-1.3 ft)	ft	1.0	1.1	1.1	1.1	1.1	1.1	1.1
Channel velocity (Crit. = 1.5 - 4 fps)	fps	> 2	> 2	> 2	> 2	> 2	> 3	1.7-3.2
Ladder exit clean (yes or no)		yes	yes	no	no	yes	no	no
Staff gages clean (yes or no)		yes	yes	yes	yes	yes	yes	yes
Picket leads clean (yes or no)		yes	yes	yes	yes	yes	yes	yes
South Powerhouse Entrance:								
Depth over entrance weir								
SPE-1 (Criteria = 8 ft or >)	ft	8.3	8.7	7.0	4.9	5.7	7.6	7.5
SPE-2 (Criteria = 8 ft or >)	ft	8.3	8.8	7.2	4.9	5.7	7.6	7.5
Head at SPE-1 & 2 (Crit. = 1-2 ft)	ft	1.2	0.7	1.3	1.6	1.1	1.1	1.1
Gate on Sill (Yes or No)		no	no	yes	yes	yes	yes	yes
Staff gages clean/readable (yes or no)		yes	yes	yes	yes	yes	yes	yes
SOUTH SHORE FISHWAY								
South Shore Entrance:								
Depth over entrance weir								
SSE-1 (Criteria = 8 ft or >)	ft	7.7	8.1	7.3	5.6	7.7	8.4	7.5
SSE-2 (permanent) 6-feet	ft	normal	normal	normal	normal	normal	normal	normal
Head at SSE-1 & 2 (Crit. = 1-2 ft)	ft	1.1	1.7	2.0	1.3	1.3	2.4	2.2
Gate on Sill (yes or no)		no	no	yes	yes	yes	no	no
Dep. over ladr. weir (Crit. = 1-1.3')	ft	1.1	1.1	1.1	1.1	1.0	1.0	1.1
Ladder exit clean		yes	yes	yes	yes	yes	yes	yes
Picket leads clean		yes	yes	yes	yes	yes	yes	yes
Pump speed	rpm	69-70	67-69	71-72	70-71	77-79	78-80	79-80
# of Pumps Operating (3 available)		3	3	3	3	2	2	2
Comment Number (if applicable)				1	2	3	4	
Comments:								
1. Lots of small debris in front of the northshore exit								
2. North shore exit had lots of floating debris in front of it and the south shore backerboard and count slots needed cleaning.								
3. North shore exit had a lot of large and small woody debris around it								
4. North shore exit had a lot of large and debris around it, north shore picketed leads need to be cleaned (diff > 0.1 ft)								

An electronic velocity meter located in the northern end of the collection channel gave water velocity readings that ranged from about >2 fps to 3.2 fps and were within the criteria bounds for water velocity in the channel.

The South powerhouse entrance gates, SPE-1 and SPE-2, were operated with gate depths ranging from 4.9 ft to 8.8 ft. The SPEs were on sill during all but the first two inspections, so no further depth could be attained. During the first two inspections, both SPE gates were above the 8-foot criteria. Head differentials recorded at these the SPE gates ranged from 0.7 ft to a high of 1.6 feet. The head differential readings met standard operating criteria with exception of the May inspection when 0.7 ft was recorded. On the May inspection, 8.7 ft (SPE-1) and 8.8 ft (SPE-2) gate depths were reported with the 0.7 ft head

differential; flow from the two entrance gates should have produced satisfactory passage conditions for adult fish.

Fish Ladder: The depth of water over the North shore fish ladder weirs was 1.1 ft on 6 of 7 inspections and 1.0 ft on the remaining inspection. All readings were acceptable. On four of seven inspections, the north fishway exit had excessive debris; however the picket leads were clean on all 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 80 cfs flow that enters from the fish ladder. 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 5.6 ft to 8.4 ft, with the gate on sill 3 of 7 inspections completed this season. During all inspections when the SSE-1 gate was on sill, all gate depths were below criteria. The SSE-1 gate was also below criteria on the first and last inspections when the visual reading for SSE-1 gate depth was not on sill. On the last two inspections, it was noted by the inspector that the visual gate reading for SSE-1 was one foot different than the digital reading for SSE-1 gate depth. The head differentials at the South entrances ranged from 1.1 ft to 2.4 ft and were within or near acceptable criteria for the season. Again, there were fairly large discrepancies between visual on digital elevations at SSE-1 on the last two inspections. Overall, the volume of flow and velocities should have been satisfactory at the South fishway entrance for most of the season.

Fish Ladder: The South shore exit and the picketed lead section at the fish counting station was reported clear of debris this season. The depth of water over the ladder weirs was 1.1 ft on 5 of 7 inspections and 1.0 ft on the other two inspections, all within acceptable criteria.

Overall, fishways at the project were found operating within acceptable criteria for most of the 2005 inspection season with minor problems noted. The computer-controlled fishway appeared to perform very well again this season and readings from the computer were normally close to the site readings obtained by the inspector.

- The readings from the computer varied from the visual readings at SSE-1 over the last two inspections, it is recommended that the visual and digital readings be investigated before the start of the 2007 season.
- It is recommended that all gate depth criteria be met when gates are not on sill.
- On four of seven inspections, the north fishway exit had excessive debris. It is recommended that all exits be checked for debris on a more frequent basis.

LITTLE GOOSE DAM (photographs on page ___)

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. Only six of the eight spillbays are equipped with flippers, and at present, Spillbays 1 and 8 do not operate to pass normal spill at the project.

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.

Seven adult fishway inspections have taken place at Little Goose Dam 1) April 13, 2006- Fromm (ODFW) and David Benner (FPC) 2) May 16, 2006- Fromm (ODFW) 3) June 15, 2006- A. Dowdy (ODFW) 4) July 13, 2006- A. Dowdy (ODFW) 5) August 17, 2006- A. Dowdy (ODFW) 6) September 14, 2006- A. Dowdy (ODFW) 7) October 19, 2006- A. Dowdy (ODFW).

During 2006, all 3 fish pumps operated with rpm levels ranging between 71 and 77 rpm (normal operation for the pumps) with no outages during the season.

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 ft to 2.0 ft. During the 2006 fish passage season, gate depths at the SSEs ranged from 8.1 to 8.4 ft with head differentials that ranged from 1.0 ft to 1.6 ft. In 2006, 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 5.6 ft to 7.2 ft with head differentials that ranged from 1.4 to 1.7 ft. The NPE gates were on sill for four of the seven inspections in 2006. The NPE gates generally met criteria during the three inspection dates where the gates were off sill, with the one exception being that NPE-1 was at a depth of 6.7 feet on the last inspection. All readings were satisfactory as the gates were on sill for 4-inspections so no further depths could be attained. 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 2.5 fps to 2.8 fps over the seven inspections, all within criteria. Water velocity in the North Shore collection channel ranged from 1.7 to 2.4 fps over the seven inspections, all within criteria.

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. The gate depths ranged from 5.9 ft to 6.0 ft with head differentials that ranged from 1.0 to 1.3 ft. The NSE gates were not on sill for any of the inspections in 2006. The NSE gates generally met criteria during all inspection dates, with the two inspections containing gate depth recordings that were only 0.1 ft from the 6.0 ft criteria. The head differentials were satisfactory during all inspections.

Fish Ladder: The fish ladder exit was not clean during one inspection (June 15th, 2006). The picketed lead section of the fish counting facility was reported as clear of debris throughout the 2006 season,

however during the September inspection the fishway inspector noticed a rattling metal plate on the upstream end of the viewing window. The fishway inspector thought this rattling plate might be a deterrent to adult fish passage. The depth of water over the fish ladder weirs was at 1.1 ft or 1.3 ft on the individual inspections. All readings were reported within an acceptable range of 1.0 ft to 1.3 ft.

Table 7. Pertinent Data for Fish Facility Inspections in 2006 at LITTLE GOOSE DAM.

CRITERIA ITEMS	DATE OF INSPECTION						
	13-Apr	16-May	15-Jun	13-Jul	17-Aug	14 Sept	19-Oct
SOUTH SHORE FISHWAY							
South Shore Entrance:							
<u>Depth over entrance weir</u>							
SSE-1 (Criteria = 8 ft or >)	ft	8.3	8.3	8.3	8.1	8.2	8.2
SSE-2 (Criteria = 8 ft or >)	ft	8.3	8.2	8.4	8.1	8.2	8.1
Head at SSE-1 & 2 (Criteria = 1-2 ft)	ft	1.4	1.0	1.4	1.1	1.0	1.6
Dep. over ladr. weir (Crit. = 1-1.3 ft)	ft	1.1	1.0	1.0	1.0	1.2	1.3
Channel velocity (Criteria = 1.5-4 fps)	fps	2.7	2.8	2.7	2.6	2.6	2.5
Channel velocity (North Shore)	fps	2.0	2.1	2.4	1.9	1.8	1.7
Ladder exit clean (yes or no)		yes	yes	no	yes	yes	yes
Staff gages clean (yes or no)		yes	no	yes	yes	yes	yes
Picket leads clean (Criteria = 0.3' max)		yes	yes	yes	yes	yes	yes
North Powerhouse Entrance:							
<u>Depth over entrance weir</u>							
NPE-1 (Criteria = 7 ft or >)	ft	7.2	6.7	6.1	5.7	5.6	7.1
NPE-2 (Criteria = 7 ft or >)	ft	7.2	6.7	6.1	5.7	5.6	7.1
Head at NPE-1 & 2 (Criteria = 1-2 ft)	ft	1.6	1.7	1.4	1.4	1.4	1.5
Gate on Sill (Yes or No)		no	yes	yes	yes	yes	no
Staff gages clean		yes	no	yes	yes	yes	yes
Pump speed	rpm	71-73	73-75	73-74	71-75	69-72	73-77
Pumps Operating (3 available)		3	3	3	3	3	3
North Shore Entrance:							
<u>Depth over entrance weir</u>							
NSE-1 (Criteria = 6 ft or >)	ft	6.0	6.1	6.0	5.9	5.9	6.1
NSE-2 (Criteria = 6 ft or >)	ft	6.0	6.1	6.1	6.1	5.9	6.1
Head at NSE-1 & 2 (Criteria = 1-2 ft)	ft	1.3	1.2	1.3	1.0	1.1	1.3
Staff gages clean		yes	no	yes	yes	yes	yes
Comment number (if applicable)			1	2	3	4	5
							6
Comments:							
1. Forebay staff gauges dirty, NSE tailwater gauge also dirty							
2. Forebay exit partially blocked with debris, NPE 1 and 2 out of criteria but on sill.							
3. NSE-1 and NPE 1 and 2 out of criteria but on sill.							
4. NPE 1 and 2 out of criteria but on sill, NSE 1 and 2 slightly out of criteria - may have been due to fluctuating readings.							
5. Fishway inspector noticed a metal plate rattling at upstream end of viewing window and though it could be a possible deterrent to adult fish passage.							
6. Fishway inspector noticed oil coming from spillbay #2- operator notified.							

Overall, the project operated the main SSE and NPE fishway entrances close to acceptable limits during the 2006 fish passage season. Areas that should be considered or improved follow:

- During the first inspection, staff gauges were not clean.
- The fish ladder exit was not clean during one inspection (June 15th, 2006).
- During the September inspection the fishway inspector noticed a rattling metal plate on the upstream end of the viewing window. The fishway inspector thought this rattling plate might be a deterrent to adult fish passage.
- It is recommended that all exits, picketed leads and staff gauges be checked more frequently.

LOWER GRANITE DAM (photographs on page __)

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 flippers. A removable spillway weir was incorporated into the South spillbay to pass juvenile fish at the project in 2002. It was successfully deployed and worked satisfactorily through the 2005 spring and early summer season with research tests still being conducted at the Project.

In the fish ladder, an adult fish sampling/trapping facility was incorporated in the original construction of the project. Since that date, major modification of the facility has 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 2006. 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.

Seven adult fishway inspections have taken place at Lower Granite Dam 1) April 13, 2006- A. Dowdy (ODFW) and David Benner (FPC) 2) May 31, 2006- A. Dowdy (ODFW) 3) June 16, 2006- A. Dowdy (ODFW) and K. Blevins (COE) 4) July 16, 2006- A. Dowdy (ODFW) and K. Blevins (COE) 5) August 17, 2006- A. Dowdy (ODFW) and Mike Halter (COE) 6) September 16, 2006- A. Dowdy (ODFW) and K. Blevins (COE) 7) October 20, 2006- A. Dowdy (ODFW) and K. Blevins (COE). Details of the inspections can be found in Table 8 and text that follows.

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 about 150 ft. It was originally thought that this downstream gate would be an effective attractor for the adult fish traveling along the shoreline. This has not proven to be the case, but it still operates at full criteria. These two entrance gates are narrow (4-foot) compared to most gates at other COE projects.

In 2006, Gates SSE-1 and SSE-2 operated with depths that ranged from 7.9 ft to 8.2 ft and head differentials that ranged from 1.4 ft to 1.7 ft. The gate depths averaged 8.1 ft submerged below tailwater elevation for the season with the head differential averaging 1.6 ft. During the passage season, head differentials were operating within criteria at the SSEs during all seven inspection dates. The SSE-1 gate was submerged less than 8.0 ft on two occasions (July 13th, 2006 and October 19th, 2006) when it was at 7.9 ft, within 0.1 foot of the criteria. The SSE-2 gate was submerged less than 8.0 ft on one occasion (July 13th, 2006) when it was also at 7.9 ft, within 0.1 foot of the criteria.

Table 8. Pertinent Data for Fish Facility Inspections in 2006 at LOWER GRANITE DAM.								
CRITERIA ITEMS	DATE OF INSPECTION							
	13-Apr	31-May	16-Jun	16-Jul	17-Aug	16-Sep	19-Oct	
SOUTH SHORE FISHWAY								
South Shore Entrance								
<u>Depth over entrance weirs</u>								
SSE-1 (Criteria = 8 ft or >)	ft	8.1	8.1	8.1	7.9	8.1	8.2	7.9
SSE-2 (Criteria = 8 ft or >)	ft	8.1	8.1	8.1	7.9	8.2	8.2	8.1
Head at SSE-1 & 2 (Crit. = 1 - 2 ft)	ft	1.5	1.6	1.7	1.7	1.4	1.7	1.3
Depth over ladr. Weir (Crit.= 1-1.3 f	ft	0.9	0.8	0.9	0.9	1.1	0.8	1.2
Channel velocity (Crit. = 1.5-4 fps)	fps	0.9	2.4	2.5	2.0	2.5	1.9	1.5
Channel velocity (n shore)	na		1.5	1.5	2.0	2.0	1.3	1.3
Ladder exit clean (yes or no)		no	yes	yes	yes	yes	no	yes
Staff gages clean (yes or no)		yes	yes	yes	yes	yes	yes	yes
Picket leads clean (yes or no)		yes	yes	yes	yes	yes	yes	yes
North Powerhouse Entrance:								
<u>Depth over entrance weir</u>								
NPE-1 (Criteria = 8 ft or >)		8.0	7.4	7.2	5.2	6.0	8.2	8.0
NPE-2 (Criteria = 8 ft or >)		8.0	7.3	7.2	5.2	6.0	8.1	7.8
Head at NPE-1&2 (Criteria = 1-2 ft)		1.1	1.3	1.5	1.5	1.6	1.3	1.2
Gate on sill (Yes or No)		yes	yes	yes	yes	yes	no	no
Staff gages clean		yes	yes	yes	yes	yes	yes	yes
North Shore Entrance:								
<u>Depth over entrance weir</u>								
NSE-1 (Criteria = 7 ft or >)	na		4.5	4.5	5.6	4.6	4.8	4.8
NSE-2 (Criteria = 7 ft or >)	na		5.2	5.2	4.8	5.4	5.5	5.5
Head at NSE-1&2 (Criteria = 1-2 ft)	na		1.1	1.2	1.1	1.2	1.0	1.0
Staff gages clean	na		yes	yes	yes	yes	yes	yes
Comment number (if applicable)		1	2	3	4	5	6	
Comments:								
1. Debris at ladder exit, northshore inaccessible elevator broken.								
2. NSE out of criteria.								
3. NPE 1 and 2 out of criteria due to gates being on sill, NSE 1 and 2 out of criteria due to MOP operations per Corps Biologist								
4. NPE 1 and 2 out of criteria due to gates being on sill, NSE 1 and 2 out of criteria due to MOP								
5. NPE 1 and 2 out of criteria due to gates being on sill, NSE 1 and 2 out of criteria due to MOP								
6. Plastic debris spanning the width of the exit along with a bucket were found impinged across the exit, the Corps Biologist will remove.								

Water velocities at the southern end of the collection channel ranged between 0.9 fps to 2.5 fps. Velocity readings were within criteria in the southern end of the collection channel in six of seven inspections. Water velocities recorded at the North Shore channel ranged from 1.3 fps to 2.0 fps. Water velocities were not obtained on the first inspection at the North Shore channel, however were with criteria on four of six of the remaining inspections.

The North Powerhouse entrances, NPE-1 and NPE-2, were operated with the Gates on sill for five of seven inspections. During most of the inspection that the NPEs were on sill, the project was unable to meet the 8.0 ft criteria for gate depth. During one (October 19th, 2006) of the two inspections were the gates were not on sill, the NPE-2 gate was at a 7.8 ft depth, 0.2 feet below criteria. Gate depths for the

season ranged from 5.2 ft to 8.2 ft. Head differentials ranged from 1.0 ft to 1.6 ft for the season. For the most part, inspections showed the NPE gates operating satisfactorily and within criteria (given the water elevations) during this season's fishway inspections.

The North Shore entrances, NSE-1 and NSE-2, reported gate depths that ranged from 4.5 ft to 5.6 ft and head differentials that ranged 1.0 ft to 1.2 ft. Although the project met head differential criteria during all inspections, it failed to meet gate depth of 7.0 ft or greater on all inspections for the 2006 fish passage season. 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 not clean on two of seven inspections, the picketed leads (count station) were reported clear of debris on all inspections during the fish passage season. The depth of water over the fish ladder weirs ranged between 0.8-1.2 ft, and were below criteria on 5 of 7 inspections, the minimum criteria is 1.0 ft. According to the fishway inspector, the adult trap pulls excess water from the ladder and when coupled with MOP operations, this causes the depth over the ladder weir to not meet criteria. However, the depth of water over the fish ladder weirs was 1.1 ft during each inspection in both 2004 and 2005, years when the Snake River was also operated at MOP.

Overall, the adult fish facilities operated with the fish pumps working throughout the year, no known failures. Several limitations of the fish facilities still exist.

- 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. It is recommended that the COE explore the possibility/feasibility of increasing the hydraulic capacity of the system to include the use of a third pump when needed to meet gate depth criteria at the North Shore Entrances. This would also help North Shore channel velocities, which were out of criteria on two of six inspections.
- The ladder exit was reported as not clean on two of seven inspections, it is recommended that all exits be checked more frequently.
- The depth of water over the fish ladder weirs ranged between 0.8-1.2 ft, and were below criteria on 5 of 7 inspections, the minimum criteria is 1.0 ft. According to the fishway inspector, the adult trap pulls excess water from the ladder and when coupled with MOP operations, this causes the depth over the ladder weir to not meet criteria. However, the depth of water over the fish ladder weirs was 1.1 ft during each inspection in both 2004 and 2005, years when the Snake River was also operated at MOP. It is recommended that the COE explore what has changed this year relative to the past two years that has prevented the meeting of criteria over the ladder weir on most inspections.

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, WA. 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 also 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 ___*)

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. Makeup 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 (right bank only) and lower end of the fish ladder at both shores of the project. Main entrance gates on the Left Bank fishway are 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 entrance gate is operated at the Right Bank fishway. All main entrance gates are slotted. 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 1) April 27, 2006- Nordland and Novak (NOAA) and David Benner (FPC) 2) May 17, 2006- Novak and Jundt (NOAA) 3) June 21, 2006- Novak and Jundt (NOAA) 4) July 13, 2006- Novak (NOAA) 5) August 15, 2006- Novak (NOAA) and David Benner and Pete McHugh (FPC) 6) September 13, 2006- Novak (NOAA) 7) October 18, 2006- Novak (NOAA). 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

Gate 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 1.2 ft to 1.7 ft over the seven inspections. The project was operating at acceptable criteria during the 2006 inspection season as the head differential was within the 1 to 2 foot range and always was equal to or greater than the 1.2 ft target for the seven inspections.

Gate 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 seven inspections. Although the project was operating within acceptable criteria during the 2006 inspection season as all the head differentials were within the 1 to 2 foot range, three of the seven inspections had head differentials at LSE-4 that were below the target of 1.5 feet.

Water velocity in the collection channel was visually estimated and ranged from 1.0 fps to 2.5 fps. Water velocities in the collection channel were below the 1.5 fps criteria on two of seven inspections (last two inspections of the year). The low velocities were a likely result of fish pump #2 being down (September inspection) and LV-5 stuck open at the end of the channel, which caused the channel flow to be impeded (per inspectors notes).

Since 2004, Grant PUD has operated the sluice gate/new juvenile bypass system during the late summer and through November 15 to provide a route for the adult fish to fallback at the dam. Priest Rapids Dam normally has a substantial number of adult fish that overshoot the project and then must fallback to the area below the dam where they are destined, such as Ringold or Priest Rapid hatcheries or the Hanford Reach section of the Mid-Columbia River. This should continue to provide positive benefits to those adult fish that overshoot the dam.

Fish Ladder: At the Left Bank fish ladder, the depth of water over the ladder weirs ranged between 1.0 ft and 1.1 ft for the season. 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. The picketed leads were reported clear of debris in all inspections as were the staff gauges on the left bank fishway.

Right Bank Fishway

Auxiliary water from the Left Bank is transported via a large conduit to the Right Fishway. This water flows through diffuser gratings into the lower end of the right bank fish ladder. Slotted Entrance Weir, RSE-1, operated during the 2006 fish passage season. The main gate is required to operate within the following range: 1.0 to 2.0 ft for head differential with the target "head" being 1.5 ft.

Gate RSE-1 had head differentials ranging from 1.4 to 1.5 ft for the season. The Gate was operated within the acceptable criteria range of 1.0 to 2.0 ft, but was less than the target of 1.5 ft on 6 of 7 inspections. Although passage conditions should have been satisfactory through the Right Bank fishway in 2006, some improvements could be made in keeping differentials at or above the 1.5 ft target.

Fish Ladder: The depth of water reported over the fish ladder weirs was at 0.9-1.1 ft on all inspections. The reading of 0.9 feet on August 15th was not within the acceptable range of 1-1.2 feet. All other readings were satisfactory. The ladder exit was reported clear of debris on all inspections, with only. The picketed were reported clear of debris in all inspections as were the staff gauges on the right bank fishway.

Table 9. Pertinent Data for Fish Facility Inspections in 2006 at PRIEST RAPIDS DAM.

<u>CRITERIA ITEMS</u>	<u>DATE OF INSPECTION</u>							
	<u>27-Apr</u>	<u>17-May</u>	<u>21-Jun</u>	<u>13-Jul</u>	<u>15-Aug</u>	<u>13-Sep</u>	<u>18-Oct</u>	
LEFT BANK FISHWAY								
<i>Left Bank Entrance:</i>								
Head at main entrances (Criteria = 1-2 ft)								
LSE-2 (1.2 ft target)	ft	1.6	1.6	1.6	1.5	1.7	1.2	1.3
LSE-4 (1.5 ft target)	ft	1.4	1.3	1.6	1.5	1.5	1.4	1.5
Depth over ladr. weir (Crit. = 1-1.2 ft)	ft	1.1	1.1	1.1	1.0	1.0	1.0	1.0
Water velocity (Crit. = 1.5-4 fps)	fps	1.8	1.9	2.5	2.0	2.2	1.1	1.0
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
Picket leads clean (Crit. = yes or no)		yes	yes	yes	yes	yes	yes	yes
RIGHT BANK FISHWAY								
<i>Right Bank Entrance:</i>								
Head at Entrance (Criteria = 1-2 ft)								
RSE-1 (1.5 ft target)	ft	1.4	1.4	1.4	1.4	1.5	1.4	1.4
Depth over ladr. weir (Crit. = 1-1.2 ft)	ft	1.0	1.0	1.0	1.1	0.9	1.0	1.0
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
Picket leads clean (Crit. = yes or no)		yes	yes	yes	yes	yes	yes	yes
Comment number (if applicable)		1	2			3	4	5

Comments:

1. Depth over rightbank ladder weirs were too low, requested that project reset check pts. for RSW-3, collection channel water surface elevation differential was too low (should be 0.3 ft).
2. LSE-4 was below the target of 1.5 feet
3. Depth over right bank weir was 0.1 feet out of criteria
4. Fish pump #2 down until winter maintenance, collection channel velocities low averaged 1.1 ft/s at 10:30 AM, 1.4 ft/s at 11:30 AM and 2.1 ft/s at 3:00 PM
5. Collection channel velocity was low, GCPUD increased auxiliary water supply differential from 6.5 feet to 6.8 feet, another reading was taken later in the day and was 1.4 ft/s- all reading taken by "bubble" timing as velocity meter was not working- GCPUD followed up later that LV-5 is stuck open at the end of the channel- this puts too much water at the end of the channel during low tailwater - and reduces the hydraulic gradient through the channel.

Overall, Priest Rapids fishways were found to be in good condition. Several limitations of the fish facilities still exist.

- The Project could improve head differentials at LSE-4 and RSE-1 to be closer to the 1.5 ft target. In 2006, only four of seven inspections recorded head differentials equal or greater than 1.5 feet at LSE-4 and only one of seven inspections recorded head differentials equal or greater than 1.5 feet at RSE-1. It should be pointed out that all head differentials at these locations were within criteria in 2006.
- Water velocities in the collection channel were below the 1.5 fps criteria on two of seven inspections (last two inspections of the year). The low velocities were a likely result of fish pump #2 being down (beginning on the September inspection). On the last inspection of the year, the channel velocity was 1.0 fps, by increasing the auxiliary water supply pool differential

from 6.5 feet to 6.8 feet, operators increased velocity in the channel to 1.4 fps. Adjustments to LEW-5 also have increased channel velocities. When a pump is down all avenues should be explored that will increase velocities to criteria levels. In 2006, it was hypothesized that LV-5 being stuck open limited velocities somewhat, this should be repaired (if not already) before the 2007 season.

WANAPUM DAM (photographs on page ___)

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 makeup 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 Q to the diffusers located in the lower end of the fish ladder to meet head differential criteria established for main entrance gate, REW-2.

Seven adult fishway inspections have taken place at Wanapum Dam 1) April 27, 2006 Nordland and Novak (NOAA) and David Benner (FPC) 2) May 17, 2006 Novak and Jundt (NOAA) 3) June 21, 2006 Novak and Jundt (NOAA) 4) July 13, 2006 Novak (NOAA) 5) August 15, 2006 Novak (NOAA) and David Benner and Pete McHugh (FPC) 6) September 13, 2006 Novak (NOAA) 7) October 18, 2006 Novak (NOAA). 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 weir with a head differential criterion of 1.0 ft to 2.0 ft and a target of 1.5 ft. Gate LSE-2 operated within a range of 1.3 ft to 2.3 ft over the seven inspections in 2006. Head differentials at LSE-2 were within the acceptable range over the entire season (1-2 feet), however three inspections recorded a head differential less than the target and one inspection contained a head differential above two feet (the inspector noted that the differential was high but falling rapidly due to changing tailwater). Passage conditions for adult fish at the LSE-2 should have been satisfactory throughout the 2006 migration season.

Prior to the fish passage season, LSE-3 was relocated to the front of the powerhouse due to the start of construction of the cofferdam for bypass construction. The operational criterion for head differential is from 1.0 ft to 2.0 ft with the targeted head differential of 1.25 ft (1.2-1.3 ft). Gate LSE-3 operated within the following range: 1.4 ft to 2.1 ft for the fish passage season. The target head differential of 1.25 ft was exceeded on all seven inspections in 2006, one inspection contained a head differential above two feet (the inspector noted that the differential was high but falling rapidly due to changing tailwater). Gate LSE-3 should have provided satisfactory entrance conditions for adult fish throughout the 2006 passage season.

Water velocity was estimated at the upstream end of the powerhouse channel and readings ranged between 2.1 and 3.3 fps. All readings exceeded the minimum criteria of 1.5 fps during the 2006 inspection season. Orifice gates along the channel are sealed since summer 2001 and this action has contributed to excellent water velocity readings.

Fish Ladder: The depths of water over the fish ladder weirs ranged from 1.1 ft to 1.2 ft for the season and all readings were satisfactory for the season. The ladder exit was clear of debris around the exit and staff gauges were clean on all inspections.

Right Bank Fishway

The right bank slotted entrance weir, RSE-2, is targeted to operate with a head differential of 1.25 ft and within the range of 1.0 ft to 2.0 ft. Gate RSE-2 is the operating entrance weir at the Right Bank Fishway

and operated with head differentials that ranged from 1.4 ft to 1.6 ft. All inspections met or exceeded the targeted head differential of 1.25 ft in 2006.

Fish Ladder: The right fish ladder operated with depth of water over the weir crests ranging between 1.0 ft and 1.2 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.

Overall, the Wanapum fish facilities were operated satisfactorily throughout the fish passage season. Table 10 shows the only deviations from criteria were slightly high entrance differentials at LSE 2 & 3 during the last inspection, which were due to rapidly changing tailwater elevations. Head differentials at LSE-2 were within the acceptable range over the entire season (1-2 feet), however three inspections recorded a head differential less than the target (1.5 feet). Our only recommendation would be that LSE-2 be operated to the target differential or above 100% of the time, keeping in mind that its current operation is within criteria and is satisfactory.

Table10. Pertinent Data for Fish Facility Inspections in 2006 at WANAPUM DAM.

CRITERIA								
		<u>DATE OF INSPECTION</u>						
LEFT BANK FISHWAY								
<i>Left Bank Entrance:</i>								
<u>Head at entrances (Criteria = 1-2 ft)</u>								
		<u>27-Apr</u>	<u>17-May</u>	<u>21-Jun</u>	<u>13-Jul</u>	<u>15-Aug</u>	<u>13-Sep</u>	<u>18-Oct</u>
LSE-2 (target head = 1.5 ft)	ft	1.3	1.3	1.6	1.5	1.3	1.6	2.3
LSE-3 (target head = 1.25 ft)	ft	1.4	1.4	1.9	1.5	1.4	1.4	2.1
Dep. over ladr. weir (Crit. = 1.0-1.2ft)	ft	1.1	1.1	1.1	1.2	1.1	1.1	1.1
Channel velocity (Crit. = 1.5-4.0 fps)	fps	2.8	3.3	2.3	2.4	2.5	2.1	2.2
Staff gages clean (Crit. = yes or no)		yes	yes	yes	yes	yes	yes	yes
Auxiliary H2O Pumps	rpm	133/133	140/133	144/143	119/131	121-137	115-136	117-123
Ladder exit clean (Crit. = yes or no)		yes	yes	yes	yes	yes	yes	yes
RIGHT BANK FISHWAY								
<i>Right Bank Entrance:</i>								
<u>Head at Entrance (Criteria = 1-2 ft)</u>								
RSE-2 (target head = 1.25 ft)	ft	1.4	1.4	1.5	1.4	1.4	1.6	1.5
Depth over ladder weir	ft	1.1	1.1	1.1	1.0	1.2	1.2	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	2	3		4		5
Comments:								
1. LSE-2 differential was too low, collection channel water surface elevation was too low (should be 0.3 feet) 2. LSE-2 differential was slightly below target 3. Turbines 4 and 5 were down, LSE-3 could not be accessed so control room printout was used- can be considered an estimate 4. LSE-2 was below target but within criteria- it was recommended that differential be adjusted to be within target 5. LSE-2 differential was high but was falling due to changing tailwater . Readings mfrom later in the day were within target range.								

ROCK ISLAND DAM (photographs on page __)

The Rock Island hydro-project is owned and operated by Chelan County PUD. The Dam is comprised of two powerhouses; an old powerhouse with 10 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. In recent years several spillgates 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 system was completed prior to the 2004 adult fish passage season.

Seven adult fishway inspections have taken place at Rock Island Dam 1) April 26, 2006- Gacek (WDFW), David Benner (FPC), Kline, Mosey and McMahon CHPUD 2) May 22, 2006- Gacek (WDFW) and McMahon CHPUD 3) June 28, 2006- Kline, Solorio and McMahon CHPUD 4) July 25, 2006- Gacek (WDFW) and McMahon CHPUD 5) August 31, 2006- Gacek (WDFW) and Kline CHPUD 6) September 27, 2006- Gacek (WDFW) and Kline CHPUD 7) October 25, 2006- Gacek (WDFW) and Kline CHPUD. 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 through all tailwater elevations.

Gates LO5 and LO6 were normally submerged the same depth during the 2006 season. Gate depths ranged from 6.5 ft to 7.0 ft. Head differentials ranged between 1.1 ft and 1.3 ft. The gate depth and head differential readings were found within acceptable criteria range through the 2006 inspection season.

Fish Ladder: Depth of water measured over the Left Bank fish ladder weirs ranged between 1.0 and 1.1 ft during the 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 depths recorded at the Middle Ladder during the inspections ranged from 8.4 ft to 8.8 ft with head differentials that ranged from 1.2 ft to 1.4 ft. With the exception of being below the gate depth criteria by

0.1 ft on August 31st, 2006, the gate depths and corresponding head differentials at the entrances were within criteria for the entire inspection season and should have provided satisfactory attraction flows for adult fish at the Middle Ladder for 2006.

Fish Ladder: The depth of water over the fish ladder weirs was reported at 1.0 to 1.1 ft for all seven inspections. The picketed leads and the ladder exit were clear of debris during the inspections.

Table 11. Pertinent Data for Fish Facility Inspections in 2006 at ROCK ISLAND DAM								
CRITERIA ITEMS		DATE OF INSPECTION						
		26-Apr	22-May	28-Jun	25-Jul	31-Aug	27-Sep	25-Oct
LEFT BANK FISHWAY								
Left Bank Entrance:								
Depth over entrance weir								
LO5 (Criteria = 6.0 ft or >)	ft	7.0	6.5	6.9	6.7	6.7	6.8	6.5
LO6 (Criteria = 6.0 ft or >)	ft	7.0	6.5	6.9	6.7	6.7	6.8	6.5
Head at LO5 & 6 (Crit. = 1-2 ft)	ft	1.1	1.2	1.2	1.3	1.1	1.1	1.3
Depth over ladder weir (Criteria = 1.0-1.2 ft)	ft	1.0	1.0	1.0	1.0	1	1.0	1.0
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
CENTER FISHWAY								
Center Entrance:								
Depth over entrance weir								
MO3 (Criteria = 8.5 ft or >)	ft	8.6	8.5	8.8	8.8	8.4	8.7	8.8
Head at MO3 (Criteria = 1-2 ft)	ft	1.3	1.2	1.3	1.4	1.3	1.2	1.2
Depth over ladder weir (Criteria = 1.0-1.2 ft)	ft	1.0	1.1	1.0	1.0	1	1.0	1.0
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
RIGHT BANK FISHWAY								
Right Bank Entrance:								
Head Differential (Crit. = 1-2 ft)								
LPE-1	ft	0.2	1.1	0.6	0.8	1.2	1.2	1.3
RPE-1 and RPE-2	ft	0.6	0.7	0.7	0.9	1.4	1.4	1.5
TRE	ft	0.4	0.5	0.5	0.7	1.3	1.3	1.5
Depth over ladder weir (Criteria = 1.0-1.2 ft)	ft	1.0	1.0	1.0	1.1	1.0	1.0	1.0
Channel veloc(Cr. = 1.5-4 fps)	fps	na	na	4.0	4.2	4.3	4.1	4.2
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		2	2	3	3	3	3	3
Pump Gate Openings	%	97.2-99.5	94.5-96.2	100	98-99	26-99	95-98	91-98
Comment number (if applicable)		1	2		3	4		
Comments:								
1. Attraction pump number three down due to heat exchanger as result right fishway out of criteria								
2. Attraction pump number three still down								
3. Rightbank out of criteria								
4. Depth over MO3 entrance weir was slightly below criteria								

Spillway: Specific spillbays at the project have been modified (notched) to improve passage for juvenile salmonids. Nine spillbays were affected for the year: 1, 16, 18, 24, 26, and 29 through 32. Normally the Project spills 20% of inflow during the spring migration with a higher percentage 30% during the summer migration season.

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 gate at the downstream end of the project, one main gate at the left end of the powerhouse, and through two gates at the right end of the powerhouse. Each entrance gate is opened 3-ft, but its depth (outflow) will increase as flow and tailwater elevation increases. The gates 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 entrance gates. 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 100% open with the gravity water valve also operated at 100% open. In 2006, fish pump number three went down for a period that included the April and May fishway inspections.

The entrance gates, TPE, LPE, and the RPEs were reported with head differentials that ranged from 0.2 ft to 1.5 ft throughout the season. Head differentials were well below criteria during the first and second inspections of the year as fish pump number was down. Over the June and July inspections, with all three pumps operating, head differentials were still below criteria. The June and July inspections occurred during high tailwater elevations, when tailwater elevations exceed or are close to elevation 574.5 ft, the head differentials can drop below the minimum 1.0 ft as was noted in the 2005 and 2006 inspections. As the river flow dropped during the summer, the head differentials were reported from 1.2 to 1.5 ft for the remaining August through October inspections for the three entrance gates.

Water velocity recorded in the powerhouse transportation channel was measured using a portable flow meter; velocities ranged between 4.1 to 4.3 fps during the inspections (velocities were not recorded during the two inspections when fish pump three was down). 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 to 1.1 ft for the seven inspections at the Right ladder. The exit from the fish ladder was clear of debris, as was the picketed lead section at the fish counting station.

Overall, the fish passage facilities operated 2006 fairly well during the adult fish passage season. Areas of concern are listed below.

- The Right Bank Fishway cannot meet head differential criteria at the main entrances when tailwater elevations increase to near or above elevation 574.5 ft.
- Chelan PUD should investigate installing back up fish pumps or alternative methods of supplying attraction water, or at least have all parts stored so if a pump goes down it can be fixed within several days.

ROCKY REACH DAM *(photographs on page)*

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 are now adjustable blade turbines. 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 2005 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 facilities 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 – 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 1) April 26, 2006- Gacek (WDFW), Rainey (CHPUD) and David Benner (FPC) 2) May 22, 2006- Gacek (WDFW) and Rainey (CHPUD) 3) June 28, 2006- Nystrom and Solorio (CHPUD) 4) July 25, 2006- Rainey (CHPUD) and Gacek (WDFW) 5) August 30, 2006- Rainey, Smith and Nystrom (CHPUD) and Gacek (WDFW) 6) September 27, 2006- Rainey, Smith and Nystrom (CHPUD) and Gacek (WDFW) 7) October 25, 2006- Smith and Nystrom (CHPUD) and Gacek (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 1.1 ft for the season, all within criteria.

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

The **Left Powerhouse Entrances, LPE-1 and LPE-2**, 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-2 ranged from 11.2 ft to 12.0 ft, with head differentials that ranged from 1.1 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 in criteria through the 2006 inspection season.

The water velocity meter is installed about 150 ft upstream from the junction pool and centered in the transportation channel. In 2006, the meter ranged from 1.6 to 2.0 fps, all above the criteria range of 1.5 to 4.0 fps.

Spillway Entrance

The Spillway Entrance was operated from May 1 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, depths were 10 feet or greater on 5 of the 6 inspections with the gate at 9.8 ft during the September inspection. Head differentials were reported from 1.0 ft – 1.5 ft during the 2006 inspection dates. All inspections had satisfactory readings for the year.

Fish Ladder: The exit from the fish ladder was clear of debris during the 2006 inspection season. The depth of water over the fish ladder weirs was 1.0 ft during all inspections and was within the criterion range of 1.0 and 1.2 ft.

Overall, the Rocky Reach fish facilities were operated satisfactorily throughout the 2006 fish passage season. Table 12 shows the only deviations from criteria were slightly below criteria depth over the spillway weir on the September inspection. Our only recommendation would be that MSE be operated to the criteria 100% of the time.

Table 12. Pertinent Data for Fish Facility Inspections in 2006 at ROCKY REACH DAM.

CRITERIA ITEMS	DATE OF INSPECTION							
	26-Apr	22-May	28-Jun	25-Jul	30-Aug	27-Sep	25-Oct	
ADULT FISHWAY								
Left Powerhouse Entrance:								
Depth over entrance weirs								
LPE-1 & 3 (Depend. On Tw Elev)	ft	11.5	11.3	11.4	11.5	11.5	11.2	12.0
Head at LPE-1 & 3 (Crit. = 1-2 ft)	ft	1.3	1.1	1.3	1.3	1.2	1.3	1.1
Depth over Ladr Weir (Crit = 1-1.3 ft)	ft	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Channel velocity (Crit. = 1.5-4 fps)	fps	1.8	1.7	1.6	2.0	1.8	1.7	1.7
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
Turbine 11 Operating (yes or no)		yes	no	yes	no	no	no	yes
Right Powerhouse Entrance:								
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	1.1	1.0	1.0	1.0	1.0	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
Fish Pump Speed	rpm	60	75-90	58.1-72.9	52-58	51	53-58	65
Spillway Entrance:								
Depth over entrance weir								
MSE (Dependent on Tailwtr Elev.)	ft	na	12.3	10.3	11.5	11.5	9.8	12.1
Head at MSE (Criteria = 1-2 ft)	ft	na	1.0	1.5	1.4	1.2	1.3	1.1
Comment number (if applicable)		1						
Comments:								
1. Spillway entrance closed								

WELLS DAM (photographs on page 59)

Wells Dam was completed in 1967 with 10 main turbine units and the spillbays placed directly above them. The turbine units are termed hydrocombines. 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.

Seven adult fishway inspections have taken place at Wells Dam 1) April 25, 2006- Stillweigh (WDFW) and David Benner (FPC) 2) June 12, 2006- Stewart and Gonzales (WDFW) 3) July 12, 2006- Gonzales and Evans (WDFW) 4) August 8, 2006- Gonzales and Evans (WDFW) and 5) September 14, 2006- Evans and Schott (WDFW) 6) October 24, 2006- Gonzales (WDFW) 7) Evans (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 2006 fish passage season with no reported out of service time. The project can meet head differential criterion at the main downstream entrance through all tailwater and flow conditions.

Inspection procedures follow a given pattern, i.e., the inspector obtains the computer readings for plant operations from the Control Room. The inspector and operator then make a site visit to the fishway entrance and take readings from the staff gauges and deck gauges located at the entrances. The operator then contacts the Control Room operator to obtain the computer readings. The computer reads are then compared to the site readings. If the gauges vary by more than 0.3 ft, then the project would calibrate the deck gauge or Control Room sensors. This protocol works well as long as the tailwater and entrance staff gauges can be easily read or the tailwater elevation was somewhat flat.

East and West Fishways

The head differentials reported at the **East** entrances for the 2006 season ranged between 1.4 ft and 1.9 ft based on the staff gage readings. The head differential readings at the **West** fishway entrances ranged between 1.4 ft and 1.8 ft. At each fishway entrance, the head differential fell within the criteria of 1.0 – 2.0 ft for the season. The head differential target of 1.5 ft \pm 0.1 ft was met on six of seven inspections at the East and six of seven at the West fishway entrance. The staff gauges were readable on all inspections this year.

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 past years, the differential ranged from 0.5 ft to 0.8 ft, depending on the forebay elevation. Prior to the 2004 season, the exit gates were altered and the racks refitted with 28” spacing rather than the 32” spacing as in previous years. This modification of the spacing has definitely changed the head differentials measured across the racks from the first pool to the tailwater. In 2006, differentials at the exits ranged from 0.1 ft to 1.2 ft. The exit from the fish ladder appeared clear of debris throughout most of the year, even when head differentials approached and the 1.2 ft difference. The picketed leads at the counting stations were clear of debris during the inspection dates.

The depth of water over the ladder weirs ranged from 1.1 ft to 1.6 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 the east fishway weir was above criteria on the June inspection (1.6 feet), the west fishway depth over ladder weir was above criteria on the June inspection (1.6 feet) and on October inspection (1.3 feet).

Overall, the fishway entrances at Wells Dam were operated satisfactorily. The only recommendation that can be made was that Chelan PUD achieve 1.0-1.2 ft of depth over each ladder weir 100% of the time.

Table 13. Pertinent Data for Fish Facility Inspections in 2006 at WELLS DAM.

CRITERIA ITEMS		DATE OF INSPECTION						
		25-Apr	12-Jun	12-Jul	8-Aug	14-Sep	24-Oct	15-Nov
EAST FISHWAY:								
Head at main entrance (Target = 1.5ft)	ft	1.5	1.5	1.4	1.4	1.6	1.9	1.5
D/Stream entrance open (Criteria = 8-ft)	ft	8.0	8.0	8.0	8.0	8.0	8.0	8.0
Depth over ladder weir (Crit.= 1-1.2 ft)	ft	1.1	1.6	1.1	1.1	1.2	1.2	1.2
Ladder exit differential (Crit = 0.8-1.1ft)	ft	0.6	1.2	1.0	0.9	0.1	0.3	0.8
Staff gages clean/readable (yes or no)		yes	yes	yes	yes	yes	yes	yes
Picket leads clean (yes or no)		yes	yes	yes	yes	yes	yes	yes
Auxiliary Fish Pump Speed (rpm)		47/55	47/55	19/81	21/80	28/57	28/47	21/74
Fishway entrance jets		closed	closed	closed	closed	closed	closed	closed
WEST FISHWAY: (Criteria same as East)								
Head at main entrance	ft	1.4	1.6	1.5	1.8	1.5	1.5	1.5
Downstream entrance open	ft	8.0	8.0	8.0	8.0	8.0	8.0	8.0
Depth over ladder weir	ft	1.1	1.6	1.1	1.2	1.2	1.3	1.2
Ladder exit differential	ft	1.2	1.0	0.9	0.9	0.7	0.1	0.8
Staff gages clean/readable		yes	yes	yes	yes	yes	no	yes
Picket leads clean		yes	yes	yes	yes	yes	yes	yes
Auxiliary Fish Pump Speed (rpm)		53/53	47/55	55/52	54/53	50/49	53/52	52/50
Fishway entrance jets		closed	closed	closed	closed	closed	closed	closed
Comment Number (if applicable)							1	

Comments:

1. The west fishway differential was calculated from the control room readings, the channel staff gauge could not be accessed. The depth over the west ladder weir was slightly high.

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, and that includes at all water elevations during the year. Preferred staff gages would be those that can be cleaned easily or have benchmarks available so sensor readings can be taken.
- Projects should evaluate backup water supply sources to assure that adequate water is available to attract adult fish should the main water supply fail.
- Prior to the adult/juvenile fish passage season, a pre-season meeting should be held to discuss previous year's inspections and assess readiness for operation during the upcoming season. Issues at COE projects should continue to be discussed at the FPOM monthly meetings and individual meetings set with Douglas, Chelan, and Grant County PUDs.
- 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.
- Where known sharp projections or other obstacles are located in the fish ladders, collection or transportation channels, they 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" fix during the fish passage season should 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 (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.

McNary (OR fishway) - 9.0 ft or > gate depths.

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)

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

Turbine Unit Operating Priority: Specific to each dam (See year 2005 FPP for COE projects).

Spillway Operation: Specific to each dam (See 2005 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 Gages: At all projects, gages 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.

ACKNOWLEDGMENTS

Oregon Department of Fish and Wildlife, Washington Department of Fish and Wildlife, and NOAA Fisheries provided personnel to inspect adult fishways during the 2006 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. Fishery agency personnel who participated in the inspection program during 2006 are listed below.

AGENCY	INSPECTOR	DAMS INSPECTED
NOAA	Bryan Nordlund/Susan Novak	Priest Rapids & Wanapum
NOAA	Gary Fredricks	Bonneville
NOAA	Larry Swenson	McNary
ODFW	Wayne van der Naald	The Dalles & John Day
ODFW	Anne Dowdy	Little Goose & Lower Granite
WDFW	Steve Richards	Ice Harbor & Lower Monumental
WDFW	Larry Stillweigh and Crew	Wells
WDFW	Steve Gacek	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