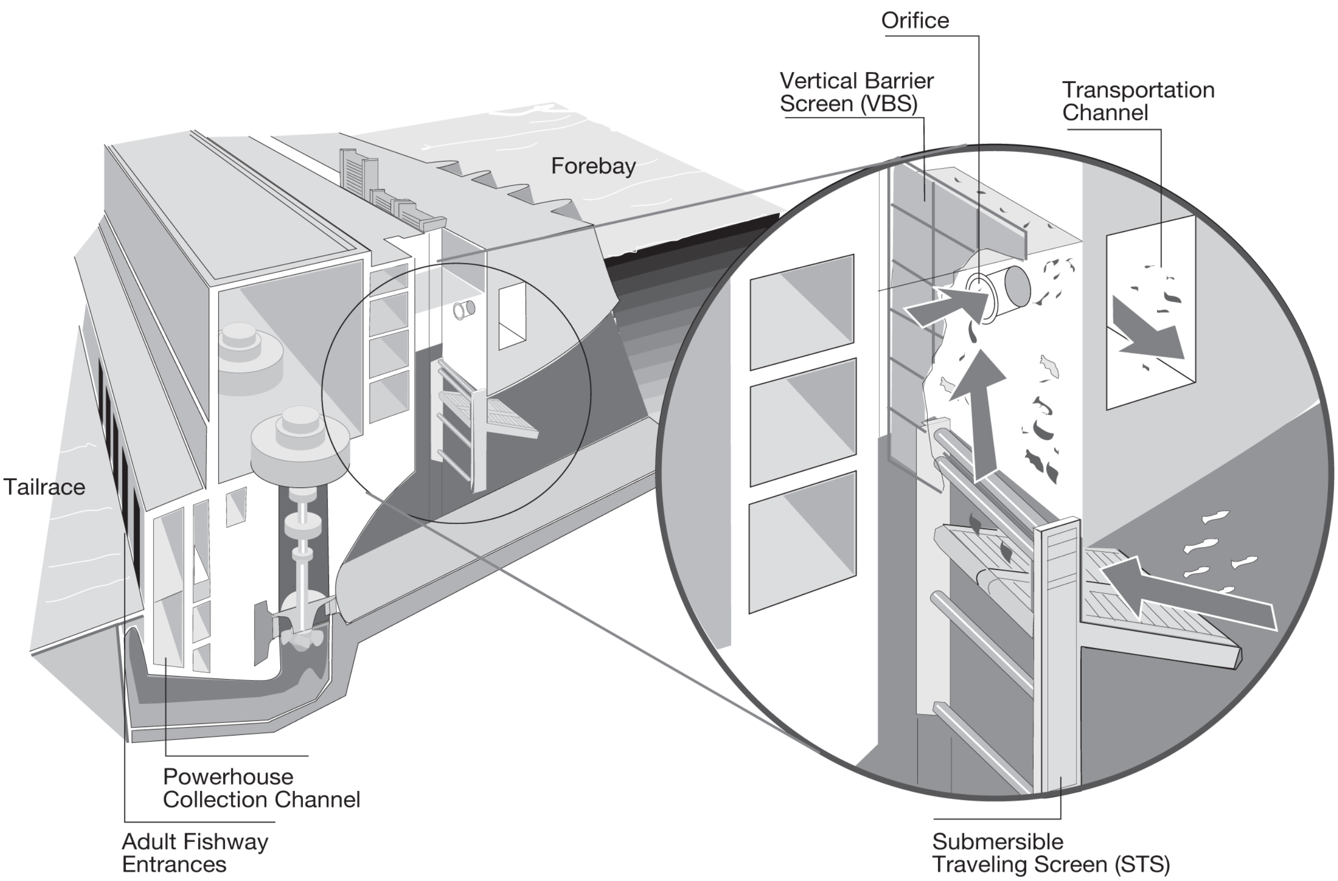
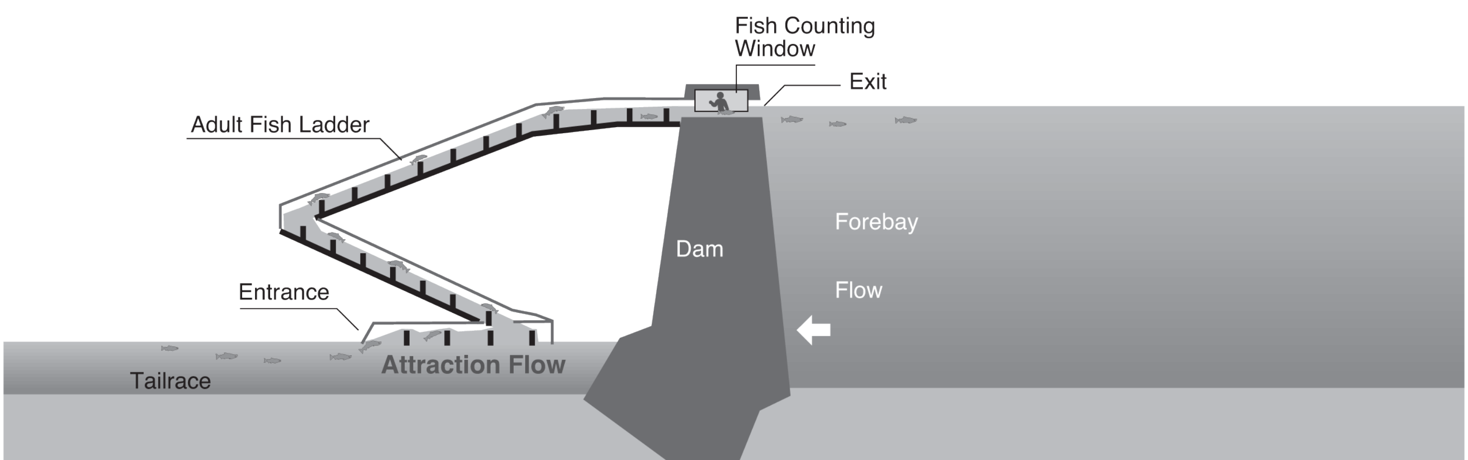
US Army Corps of Engineers®
Northwestern Division

Fish Passage Plan

Corps of Engineers Projects

CENWD-PDW-R





March 2008

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Section 1 Overview

1. Fish Passage Plan

1.1. Overview. The Fish Passage Plan (FPP) is developed by the U.S. Army Corps of Engineers (Corps) in coordination with the region's fish agencies, Indian tribes, Bonneville Power Administration (BPA), and other participants through the Corps' Fish Passage Operations and Maintenance Coordination Team (FPOM). The FPP describes year-round project operations necessary to protect and enhance anadromous and resident fish species listed as endangered or threatened under the Endangered Species Act (ESA), as well as other migratory fish species. The FPP guides Corps actions in regard to providing fish protection and passage at the eight Corps mainstem lower Columbia and Snake River projects, and at Chief Joseph Dam. Other Corps documents and agreements related to fish passage at these projects are consistent with the FPP.

The FPP is revised as necessary to incorporate changes to project operations and maintenance as a result of new facilities or changes in operational procedures. Revisions will incorporate changes adopted through coordination with the National Oceanic and Atmospheric Administration (NOAA) Fisheries and U.S. Fish and Wildlife Service (USFWS) as part of the ESA Section 7 consultation, Recovery Plan, or Section 10 permit processes, and through consideration of other regional input and plans. When revising the FPP, the Corps also considers the amended Northwest Power and Conservation Council's Columbia River Basin Fish and Wildlife Program to the fullest extent practicable. If any revisions to the FPP are necessary, they will be made in accordance with the coordination process for revisions contained in section 1.10.2 of the FPP.

The current FPP revisions reflect provisions contained in the NOAA Fisheries Biological Opinion (BiOp), issued November 30, 2004, and titled "Consultation on Remand for Operation of the Columbia River Power System and 19 Bureau of Reclamation Projects in the Columbia Basin," Updated Proposed Action (UPA) prepared by the Corps, BPA, and the Bureau of Reclamation (Action Agencies)and released November 24, 2004, and USFWS BiOp, issued December 20, 2000, and titled "Effects to Listed Species from Operations of the Federal Columbia River Power System." The Corps prepared a Record of Consultation and Statement of Decision (ROCASOD) relative to the NOAA Fisheries BiOp in January 2005 and also prepared a ROCASOD relative to the USFWS BiOp in May 2001. The two ROCASODs state how the Corps plans to meet its ESA responsibilities to protect multiple ESA-listed fish species.

For 2008, the Corps will operate for fish passage in accordance with the 2008 Fish Operations Plan (FOP) as directed by the court order issued by the U. S. District Court of Oregon on February 25, 2008. The 2008 FOP is included as Appendix E of the FPP.

The 2008 FOP describes actions by the Corps to implement project operations for fish passage at its Federal Columbia River Power System (FCRPS) dams during the April – August 2008 fish migration season. The 2008 FOP was prepared by repeating the 2007 operations, with modifications limited only to those needed to account for new structures that were not in place in 2007 and for continuation or initiation of planned essential research. Consistent with the 2004 Biological Opinion adaptive management strategy, water management and project operations for fish passage not addressed in this FOP will be consistent with the operations considered in the 2004 Biological Opinion and in particular, the 2008 Water Management Plan and 2008 FPP. Additionally, this plan incorporates operational adjustments necessary to perform essential research and to accommodate the installation or adjustment of surface bypass structures subsequent to the 2007 migration season. The structural modifications necessitating changes in operations are: (1) installation of a removable spillway weir (RSW) at Lower Monumental Dam; (2) installation of two prototype temporary spillway weirs (TSWs) at John Day Dam; and, (3) moving one of the two TSWs at McNary Dam to a different spill bay. In addition, the FOP describes operations during low flow periods and load swing hours which occurred in 2007 and were reported to the court.

Comments on the FPP are welcome and may be sent either to the FPOM or the Corps' Northwestern Division, Reservoir Control Center (RCC) Fish Team in Portland, Oregon.

1.2. Emergency Deviations from FPP. River operations emergencies may occur which require projects to deviate temporarily from the FPP. To the extent possible, these operations will be conducted to minimize fish impacts and coordinated with fish agencies and tribes. Normally, coordination occurs prior to an action. However, if an emergency situation requires immediate attention, coordination will be done as soon as possible afterwards. Coordination procedures are detailed in section 1.10.

The phrase "when practicable" appears in the FPP to help describe those project actions for fish that may vary on a case-by-case basis and thus require the exercise of professional judgment by the project for a particular situation. This is due to factors such as real time biological or other environmental conditions, project manpower or mechanical equipment availability, and fish facility or dam structural integrity. In these cases, the project biologist and other project personnel will consider all relevant factors and determine the best way to proceed and implement appropriate action. These actions will be coordinated with fish agencies and tribes when they deviate from the FPP.

1.3. Technical Management Team. In-season decisions on river operations to achieve BiOp biological performance standards for spring and summer outmigrants will be made in coordination with the Regional Forum Technical Management Team (TMT). Coordination of special operations identified in the FPP will occur through TMT and be identified in the Water Management Plan. These may include maintenance or research activities requiring unit outages that affect other river operations, operation of turbines outside of the 1% of best efficiency range, zero nighttime flow, and implementation of the Juvenile Fish Transportation Plan (JFTP - see Appendix B). Coordination procedures are detailed in section 1.10 below.

1.4. Spill at Corps Mainstem Projects. Corps mainstem projects will provide spill for juvenile fish passage in accordance with specifications in Appendix E - Fish Passage Plan to protect ESA-listed salmon species.

1.5. Total Dissolved Gas Monitoring. Total dissolved gas (TDG) saturation levels are monitored at the forebay and tailrace of each mainstem project during the fish passage season. The water quality standard and criterion for TDG developed by the states of Idaho, Montana, Oregon, and Washington, in coordination with EPA, is 110% of saturation at ambient temperature and pressure. The Corps' policy is to operate each mainstem project to meet state standards insofar as physically possible unless other overriding reasons cause temporary deviations. The UPA and NOAA Fisheries 2004 BiOp call for fish spill to be provided at levels that create TDG levels higher than 110% (Appendix D). The UPA states that the FCRPS projects should be operated so that forebays do not exceed 115% and tailwaters do not exceed 120% TDG levels for anadromous fish passage. In response to this recommendation by NOAA Fisheries, the Corps has worked with the states of Oregon and Washington to spill to these higher TDG levels. The State of Oregon provided a modification to the TDG standard on June 22, 2007 which applies through the 2008 and 2009 spill seasons. The State of Washington endorsed the Corps' gas abatement plan and adjusted its TDG criteria on February 8, 2008 to accommodate spill to aid fish passage. Washington's criteria adjustment will be in effect through February 2010.

Spring freshet river flows above the generation capacity of the FCRPS projects has occurred in the past, causing TDG levels to exceed the 115% and 120% levels. Also, implementation of fish spill requests from fish agencies and tribes has resulted in TDG levels of 120% or greater. Therefore, fish spill implementation will be subject to further coordination with appropriate entities through TMT if excessive TDG levels occur or if evidence of gas bubble disease is observed in fish.

The Corps will take those actions necessary to coordinate with the region and provide spill to protect ESA-listed fish. RCC issues a teletype spill priority list which specifies spill discharge levels and the sequence in which projects are to spill at higher TDG levels in order to manage both spill for fish passage and involuntary spill. The sequence is coordinated through TMT while spill levels are evaluated daily by RCC during the spill season and modified as needed in subsequent teletypes. TDG information is provided to TMT and summarized for the year in the Corps' TDG and Water Temperature Annual Report.

The Corps has coordinated with the Bureau of Reclamation on a joint operation of Chief Joseph and Grand Coulee dams to minimize TDG levels. This operation may result in more spill from Chief Joseph Dam (Appendix D). This is a spill management action to reduce TDG below those projects and is not a fish passage operation.

1.6. System Load Shaping. Guidelines coordinated by BPA on system load shaping to consider fish impacts are included in Appendix C. The guidelines describe procedures BPA follows to make hydropower load requests that enable the Corps to operate units consistent with the criterion to operate turbine units within 1% of best efficiency. The time period for this operation is April 1 through October 31 at both the lower Columbia and lower Snake River projects.

1.7. Juvenile Fish Transportation Plan. Juvenile fish will be transported in accordance with the 2008 FOP, the 2008 FPP, and Section 10 permit. Transport criteria are contained in the Juvenile Fish Transportation Plan (JFTP), Appendix B. The JFTP covers collection, holding, and transport of juvenile fish. Other project criteria on operation of the juvenile fish bypass facilities are contained in Sections 2 through 9 of this document (project specific sections). Additional criteria may be developed as part of the ESA Section 10 permit process and/or in coordination with the TMT. Implementation of juvenile fish transportation, including deviation from the plan described in Appendix B, will be coordinated through the TMT and with NOAA Fisheries (ESA).

1.8. Project Fish Passage Facilities Inspection and Reporting Criteria.

1.8.1. General. Sections 2 through 9 of this document include detailed criteria for inspection and reporting for fish passage facilities at the Corps projects on the lower Snake and lower Columbia Rivers. The Corps provides weekly written inspection reports to the NOAA Fisheries Hydropower Program office in Portland, Oregon describing out-of-criteria situations, adjustments made to resolve problems, and a detailed account of how out-of-criteria situations affected project fish passage and survival. The weekly inspection reports also include summaries of equipment calibrations, adult fish collection channel velocity monitoring, and water temperature monitoring. Equipment which does not require calibration will not routinely be included in the weekly report. The Corps also provides an annual report to NOAA Fisheries that summarizes project operations and maintenance, fish passage facility inspections and monitoring, severity of out-of-criteria conditions, and avian predation abatement actions. In addition, the Corps is developing methods to report hourly individual spill bay and turbine unit operations at mainstem projects as called for in the UPA. An acceptable procedure will be coordinated with NOAA Fisheries and other FPOM participants.

1.8.2. Annual Reporting of Excursions Outside the 1% of Best Efficiency Turbine Operating Range. Excursions outside the 1% of best efficiency turbine operating range are tracked by BPA for each project during the fish passage season. The Corps determines the cause of each excursion. This information is compiled approximately bi-weekly. After the fish passage season, the Corps submits an annual report to NOAA Fisheries which describes instances where turbines at lower Columbia and lower Snake River projects operate outside the 1% of best efficiency range for significant periods, as defined under the guidelines in Appendix C. The intent of excursion reporting is to provide a means for quality assurance for project operations.

1.8.3 Reporting of Excursions outside of 1% that are not covered by Appendix C. BPA and the Corps will take all reasonable and practicable steps to provide advance notification through the existing interagency coordinating mechanisms prior to departure from the fish-protection measures set out in the 2008 FOP or the 2004 BiOp. If unforeseen circumstances arise that preclude BPA or the Corps from notifying the court or TMT prior to a variation from required 1% operating criteria and those circumstances are not covered by Appendix C, those variations will be reported to the court as soon as practicable.

1.9. Turbine Dewatering Procedure at Chief Joseph Dam. The Corps has coordinated and adopted a procedure to dewater turbine draft tubes for maintenance at Chief Joseph Dam (Appendix H). While this project does not have fish passage facilities, ESA-listed salmon and steelhead occur in the tailrace. The procedure provides for turbine dewaterings and recovery of any trapped fish in a manner that protects those fish.

1.10. Implementation and Coordination of the Fish Passage Plan. Implementation of the FPP requires information exchange and coordination with NOAA Fisheries, BPA, other Federal and state fish agencies, and tribes. RCC coordinates operations of Corps projects through the TMT that have system-wide effects, such as water management, spill volume, and unit availability. District biologists coordinate through the FPOM on spill patterns, unit priority, adult and juvenile fish facilities, and other project-specific operations that do not have system impacts.

The RCC participates in TMT meetings throughout the year to consider recommendations for river operations to implement the FOP, BiOps, and other recommendations from fish interests. As part of this process, TMT may evaluate research data and advise on whether existing operations are consistent with current study results. These meetings are held in the Corps' Northwestern Division office in Portland, Oregon, and are open to the public. Corps representatives are available at these meetings to discuss the latest weather and runoff forecasts, as well as fish, hydrologic, water quality, and power generation information to assist in planning upcoming operations for fish passage. Fish operation recommendations are evaluated by the Corps to determine impact on overall system operations. TMT coordination procedures are detailed in section 1.10.2.2.

District biologists and an RCC representative attend monthly FPOM meetings dealing with project-specific issues in order to: 1) consider recommendations from affected interests, 2) provide updates on construction, operations and maintenance, research, and other topics, 3) develop criteria for the annual FPP, and 4) coordinate fish passage issues that may require deviation from FPP criteria. FPOM coordination procedures are detailed in section 1.10.2.1.

1.10.1. Agency Responsibilities.

1.10.1.1. U.S. Army Corps of Engineers.

a. Coordinate with NOAA Fisheries and USFWS on operational actions that might impact threatened, endangered, or candidate species.

b. Prepare Water Management Plans and seasonal updates for in-season management, in coordination with TMT members, to implement the Corps' ROCASOD.

c. In cooperation with the fish agencies and tribes, provide fish passage monitoring, surveillance, and reporting at Corps projects throughout the migration period.

d. Provide timely information on all proposed and/or scheduled studies or special operations that may negatively impact or otherwise constrain fish passage or energy production. Discuss unforeseen changes in fish passage operation with fish agencies and tribes.

e. Carry out routine and emergency fish passage operations and maintenance procedures in accordance with criteria in Sections 2 through 9 and Appendix A.

f. Conduct the TDG Monitoring Program as described in Appendix D.

1.10.1.2. Fish Agencies and Indian Tribes.

a. Request spill for fish through TMT to protect ESA-listed species or other species in accordance with the TMT Guidelines.

b. Through TMT, provide RCC with a spill priority list and recommendations for modifications.

c. Provide biological monitoring and surveillance reports throughout the migration period from predetermined locations, such as Smolt Monitoring Program sample sites.

d. Provide status reports on the timing of the downstream migration, including pertinent marked fish release and recovery data, with weekly written reports estimating percentage of runs past key projects.

e. Where biologically and logistically feasible, coordinate hatchery releases to ensure they are protected by regulated fish flows and spills while minimizing impacts on ESA-listed species. Provide and update hatchery release schedules weekly.

f. Provide recommendations to the operating agencies for maintaining acceptable fish passage conditions. This information can be used to maximize other project uses, including power generation.

g. Provide information on all proposed and scheduled studies or special operations designed to improve fish passage operations that may affect energy production or project operation. Discuss unforeseen changes with the Corps.

h. Recommend viable methods and procedures to reduce mortality to migratory and resident fish. This may include such operations as collection and transport of migrants, use of alternate bypass strategies, or other methods to minimize fish mortality.

1.10.1.3. Bonneville Power Administration.

a. Report to RCC on updated load-resource studies during the April-to-September period to supplement the National Weather Service River Forecast Center's runoff volume forecast for fish passage planning assistance.

b. Provide to RCC, NOAA Fisheries, other fish agencies, and tribes, the BPA estimate of power market impacts of requested spill operations.

c. Utilize available flexibility of the Federal Columbia River Power System to shape flow requirements, spill priorities, and plant generation consistent with BPA policies and statutory requirements related to fish protection.

d. Adjust system generation to provide adequate water to meet fish operations requirements in accordance with the FOP and the NOAA Fisheries and USFWS BiOps on hydrosystem operations.

e. Provide project load requests on a real-time, hourly basis that enable the Corps to implement spill priorities.

f. Provide information on unit operation outside the 1% of best efficiency operating range, as indicated in Appendix C.

1.10.1.4. Mid-Columbia Public Utility Districts. Operate projects for spill transfer in accordance with provisions of the FPP with at least one and one-half hours notification to start or stop spill.

1.10.2. Coordination Procedures.

1.10.2.1. FPOM Coordination. The FPP is effective year-round and revisions are coordinated with FPOM, which includes the Corps, NOAA Fisheries, USFWS, BPA, state fish agencies, tribes, and other interested parties. The annual revision process begins in October and the final FPP is issued on/about March 1, although the FPP may be revised at different times by amendment. Suggested revisions should be submitted to FPOM chairs for consideration by the Corps. Draft FPP revisions will be provided to FPOM members by FPOM chairs for a minimum two-week regional review before revision is published and added to the FPP. FPP revisions are provided to TMT for use as part of the overall river operation plan. Sections dealing with special operational requirements also will be included in the Action Agency Water Management Plans.

Project-specific activities under the purview of FPOM that may require deviations from FPP criteria will be fully coordinated in a timely manner. Issues discussed and settled at FPOM meetings will be considered regionally coordinated upon documentation in the final meeting minutes. Outside of the meeting forum, the coordination procedures below should be followed.

For operations and maintenance activities within the District's Operations Division, as a general rule Corps project personnel will communicate their needs to a District biologist. The District biologist will then provide essential information to the fish agencies, tribes, and other affected interests as appropriate, preferably by telephone call with an e-mail follow-up. Information for planned activities should be provided at least two weeks in advance to FPOM representatives for review. For unanticipated but non-emergency activities such as equipment failures, information should be provided at least three workdays in advance. Emergency coordination may be performed immediately prior to or subsequent to the required action (see section 1.2). Information provided to affected interests will include a summary of the problem, location, date and time, analyses of potential impacts to salmon stocks, and potential alternative actions. The affected interests should in turn respond by email, thus providing documentation for the record. A District biologist will forward the decision to project personnel, and in some cases RCC will issue a teletype to the project for approved activities.

For research and construction activities involving both the District's Planning and Operations divisions, Planning Division biologists will generally take the lead in coordination while keeping Operations Division biologists apprised of the proceedings. Research coordination is largely carried out and documented through the Corps' Anadromous Fish Evaluation Program (AFEP). Coordination of new construction or modification of fish facilities is typically carried out and documented through the Fish Facility Design Review Work Group (FFDRWG). If implementation requires assistance from project personnel, temporary equipment installation, temporary facility modification, or operational changes, then Planning and Operations division biologists will work closely with project personnel and others to ensure success.

Following are some of the individuals that are involved with the FPOM coordination process:

- Dan Feil, Scott Boyd (Corps, RCC, Northwestern Division)
- Bernard Klatte*,Tammy Mackey, Robert Stansell (Corps, Operations Division, Portland District)
- Mike Langeslay (Corps, Planning, Programs, and Project Management Division, Portland District)
- Tim Dykstra*, John Bailey, Greg Moody (Corps, Operations Division, Walla Walla District)
- Marvin Shutters (Corps, Planning, Programs, and Project Management Division, Walla Walla District)
- Gary Fredricks, Bill Hevlin, Paul Wagner (NOAA Fisheries, Portland)
- Dave Wills (USFWS, Vancouver)
- Tom Lorz (CRITFC, Portland)
- Rick Kruger (ODFW, Clackamas)
- Russ Kiefer (IDFG, Boise)
- Dave Benner (Fish Passage Center)
- Ann Stephenson (WDFW, Olympia)
- Scott Bettin (BPA, Portland)

*-co-chair

1.10.2.2. TMT Coordination. Actions that may impact fish system wide will be coordinated and documented through the TMT process. Actions that may impact fish at a specific project which are a result of actual operations, implementation of FOP/BiOp actions, incidental take terms and conditions contained in the BiOps, or research projects, will be coordinated through the process outlined below.

The party responsible for the action will prepare, and e-mail, a memorandum to the NOAA Fisheries point of contact responsible for activities at that dam. The memorandum will: describe the action, FOP or BiOp measure addressed; how the action may impact fish; and how the action has been designed to minimize impacts. NOAA Fisheries will provide concurrence or recommended changes in an e-mail response. This coordination process is described in a letter to Brigadier General Carl A. Strock from Brian J. Brown, U.S. Dept. of Commerce, NOAA, National Marine Fisheries Service, dated June 5, 2001. A copy of this letter is available from the District Biologist.

TMT Guidelines are posted at the TMT website at: http://www.nwd-wc.usace.army.mil/tmt/documents/wmp/2007/guidelines.pdf

1.10.2.3. Day-to-day Coordination of River System.

a. Flow Augmentation and Reservoir Operations Recommendations. Procedures described in the Water Management Plan will be used for fish operations. Coordination for system and project operations will occur through TMT. This will include operation of turbine units outside of the 1% best efficiency range, zero nighttime flow in the Snake River, reservoir operation at minimum operating pool (MOP) or some other specific level, and special operations for implementation of approved research projects as identified in Appendix A. During the time when reservoirs are not being operated to provide special protection for fish passage, projects may be operated within the full reservoir operating range.

b. Fish Spill Management. The Corps will implement FOP fish spill provisions described in Appendix E, including special TDG conditions for juvenile fish passage. The TDG and gas bubble trauma signs in fish will be monitored and evaluated during the spill season by the Corps, NOAA Fisheries, other fish agencies, tribes, and water quality agencies. Project spill levels will be adjusted as needed, based on daily physical and biological monitoring results, and coordinated with the TMT and tribes.

c. Special Operations Recommendations (Fish-related and for Project O&M Activities). Recommendations for special fish operations outside the Water Management Plan may be made to RCC. Coordination of these recommendations will be made through the TMT. Recommendations related to project O&M activities requiring special operations will be evaluated for impacts on fish migration and survival. Sufficient lead time will be given for a planned operation, whenever practical, to allow ESA coordination with the TMT, NOAA Fisheries, and USFWS. As much lead time as possible will be provided for activities requiring immediate action. After-action coordination will occur when advance notice is not possible, such as in emergency actions.

d. Other Operational Requests. As with Corps O&M requests, all other operational recommendations will be evaluated for impacts on fish migration and survival and effects on other project O&M requirements. Coordination of special operations with NOAA Fisheries, USFWS, other fish agencies, and tribes will occur through the TMT. Except as necessary for emergency actions, adequate time will be allowed for evaluation of all project and fish impacts prior to implementation. Coordination of emergencies, as identified in the Emergency Protocols adopted by the TMT (Water Management Plan, Appendix 2), will be followed.

1.10.2.4. Activities by Non-Corps Personnel. All non-Corps personnel intending to conduct any activity, such as fish handling or minor facility modifications, at a Corps facility must have prior written approval. This approval must be requested in writing to the Chief, Operations Division, at the Corps District office responsible for a particular project. If the activity could affect ESA-listed fish, proof of consultation with NOAA Fisheries or USFWS (Section 10 permit) must be provided. Appropriate state permits must be provided as well for activities that may impact either ESA-listed or non-listed fish.

Section 2 Bonneville Dam

Bonneville Dam

1. Fish Passage Information. The locations of fish passage facilities are shown on the following general site plans for Bonneville Lock and Dam (**Figures BON-1 through BON-5**). Dates for project operations for fish purposes and special operations are listed in **Table BON-1**.

1.1. Juvenile Fish Passage.

1.1.1. Facilities Description, Powerhouse One (PH1). Juvenile fish passage facilities at the Bonneville Powerhouse One consist of chaingates and an ice and trash sluiceway.

1.1.2. Facilities Description, Powerhouse Two (PH2). Juvenile fish passage facilities at the Bonneville Powerhouse Two consist of turbine intake extensions (TIEs); streamlined trash racks; submersible traveling screens (STSs); vertical bar screens (VBSs); two 12.5” orifices per gatewell in units 11-14 and fish unit 2; one 12.5” orifice in all other gatewells flowing into a fish bypass channel; an excess water elimination facility; and a 48" fish transport pipe which connects the bypass channel to the tailrace. A 48” and 42” transport pipe at the high and low outfalls respectively, transport fish to the tailrace at the outfall location. A juvenile fish sampling facility is included in the bypass.

1.1.2.1. All eight main turbine units have STSs, VBSs, and streamlined trashracks. Units 15-18 also have TIES.

1.1.2.2. Two smaller turbines that supply adult fishway auxiliary water do not have STSs, TIEs, or streamlined trashracks; however, they have a fine trashrack with a 0.75 inch clear opening.

1.1.2.3. The Powerhouse Two Corner Collector (B2CC) is located on the south side of the powerhouse. The associated flume extends several hundred feet west on the south side of the Powerhouse Two tailrace and empties at the tip of Cascades Island.

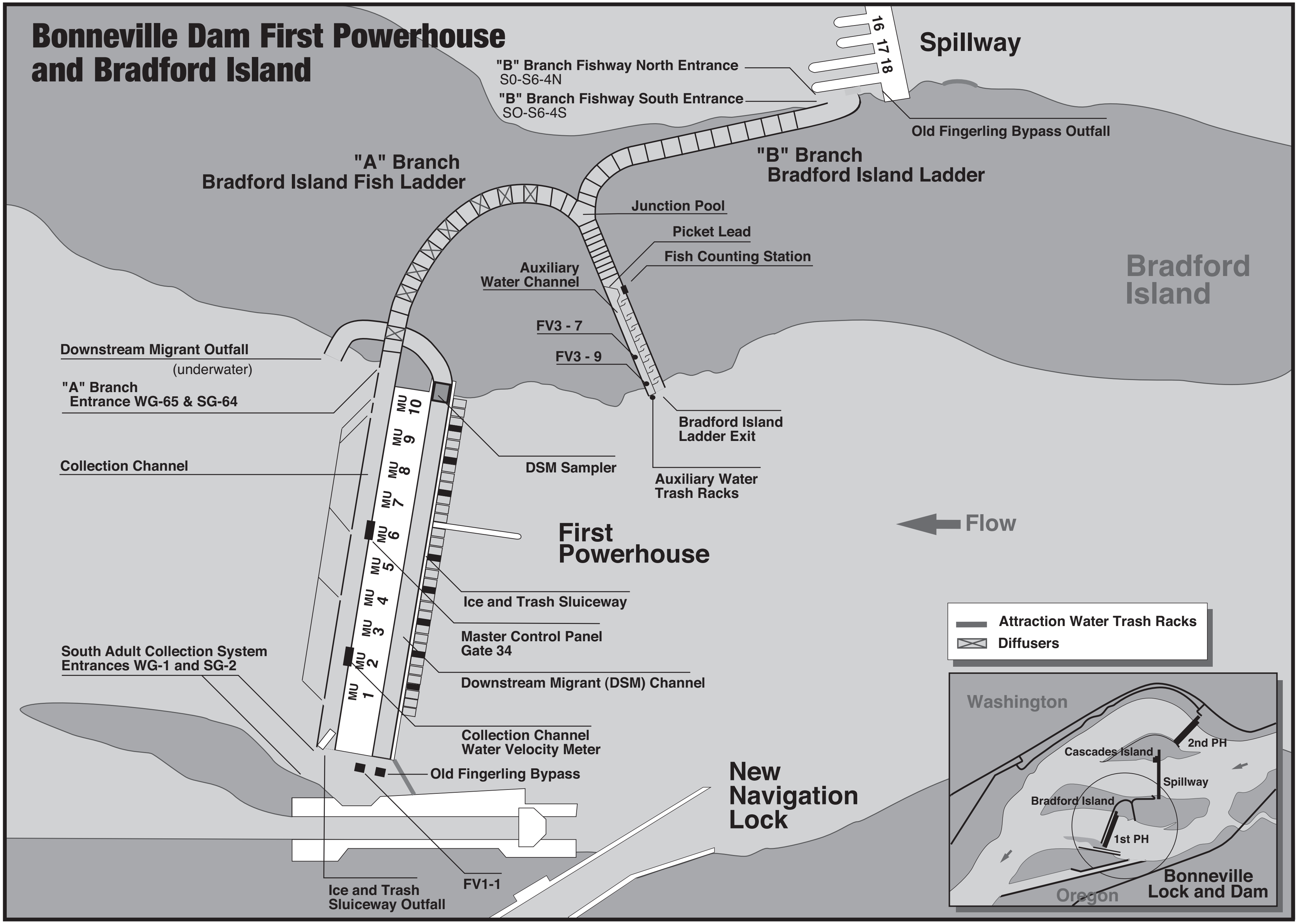


Figure BON-1 Bonneville Dam First Powerhouse and Bradford Island Fish Ladder.

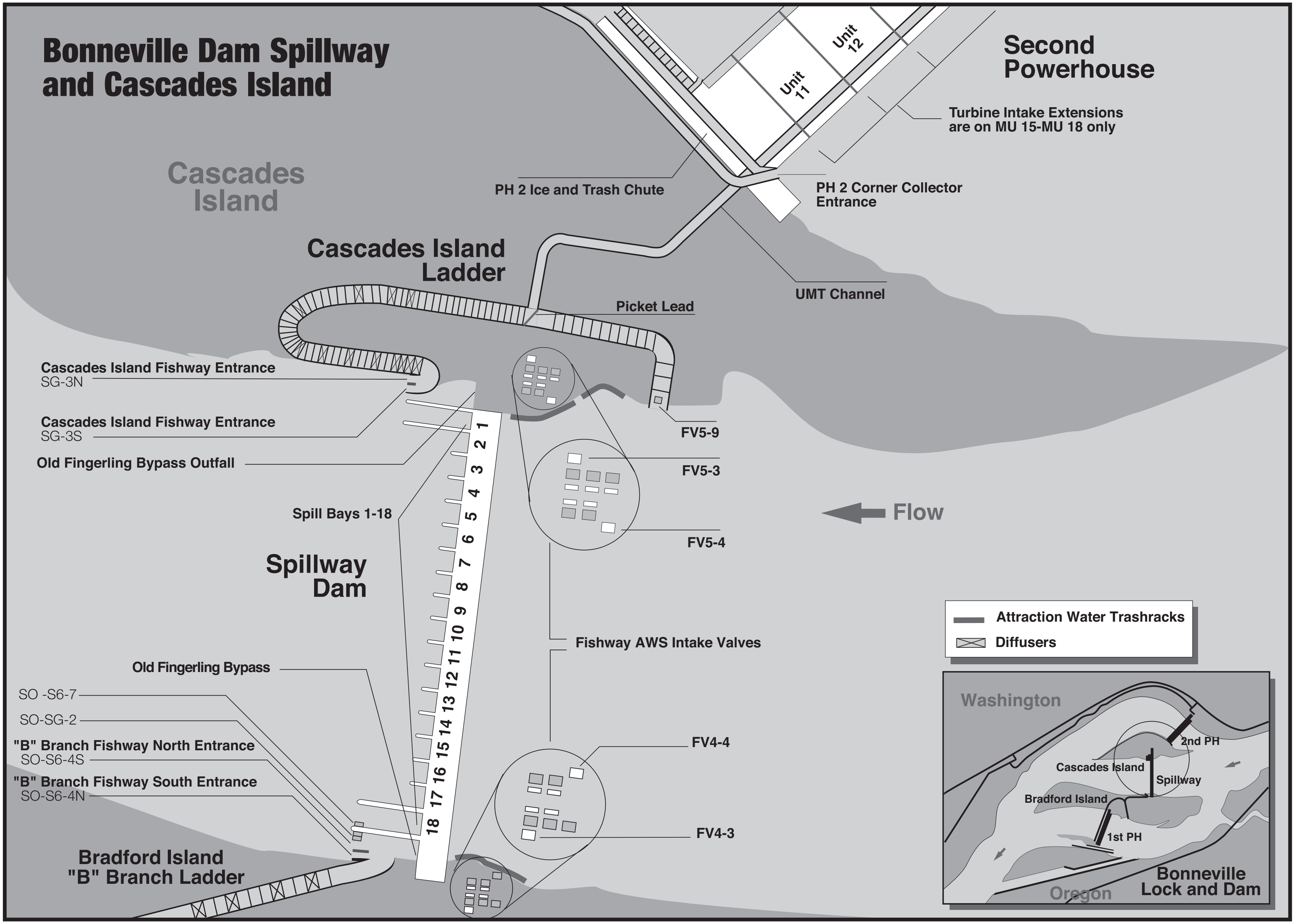


Figure BON-2 Bonneville Dam spillway, Cascades Island Fish Ladder and Upstream Migrant Transportation Channel (UMT).

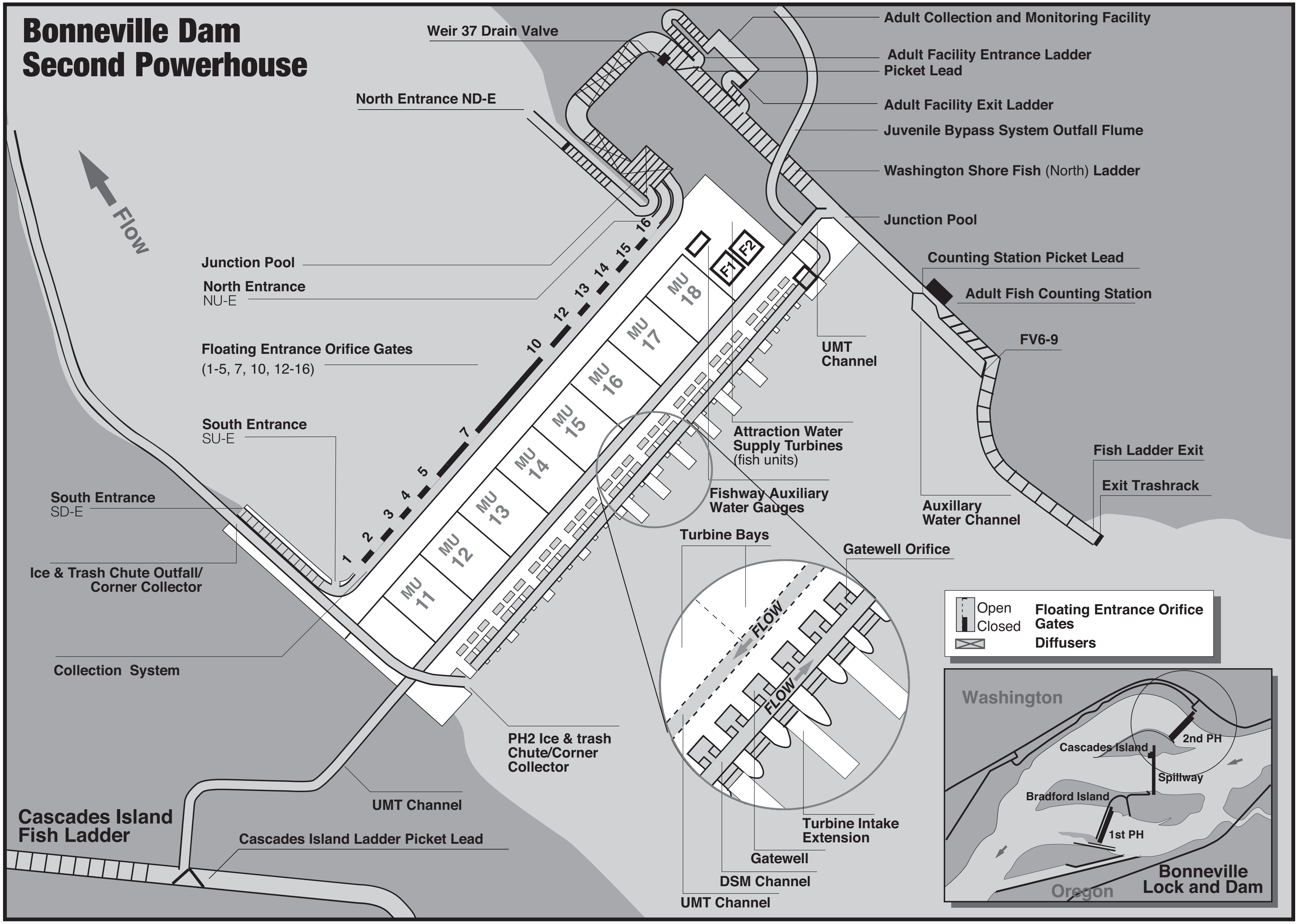


Figure BON-3 Bonneville Dam Second Powerhouse and Washington (North) Fish Ladder.

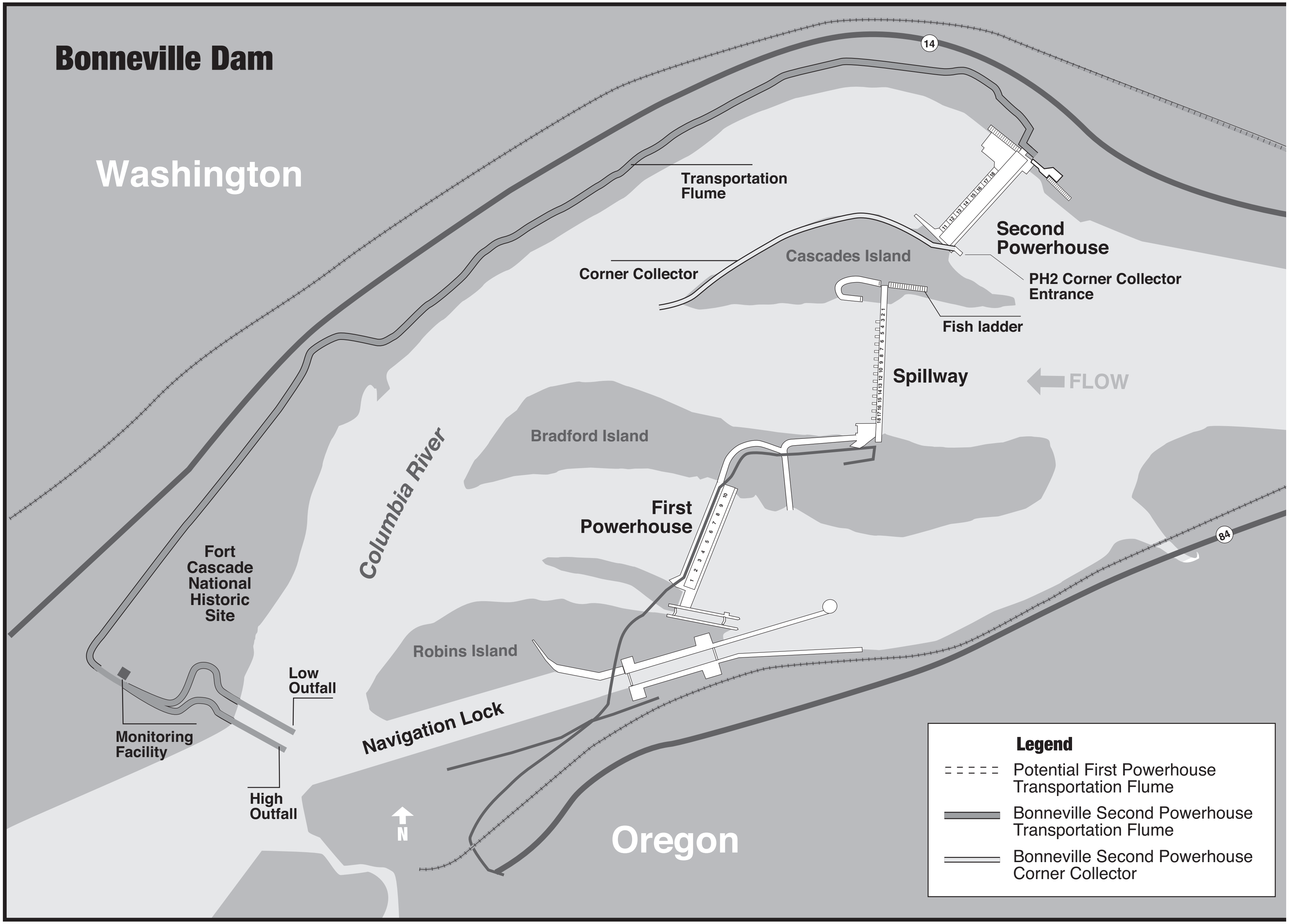


Figure BON-4 Bonneville Juvenile Fish Passage System.

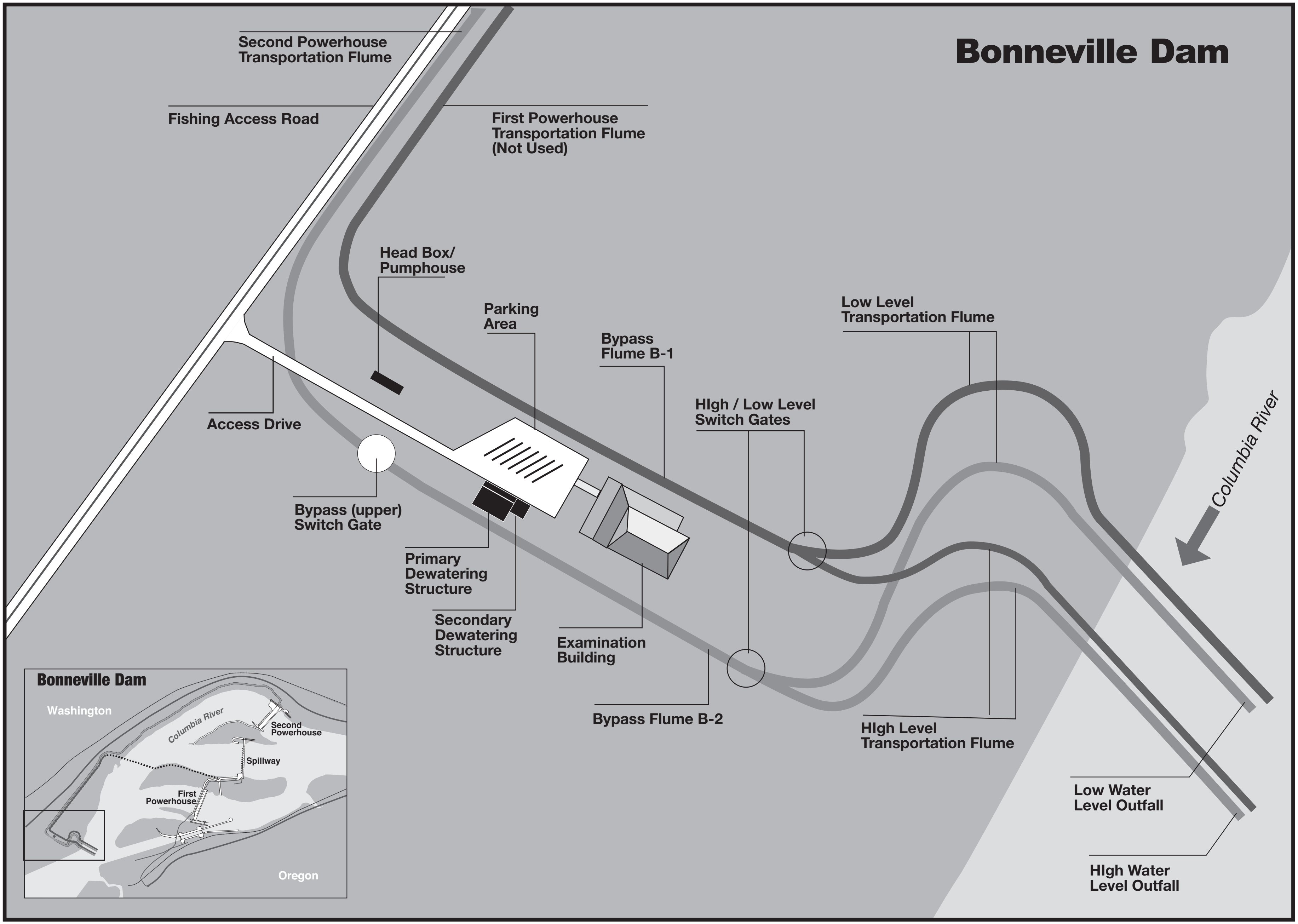
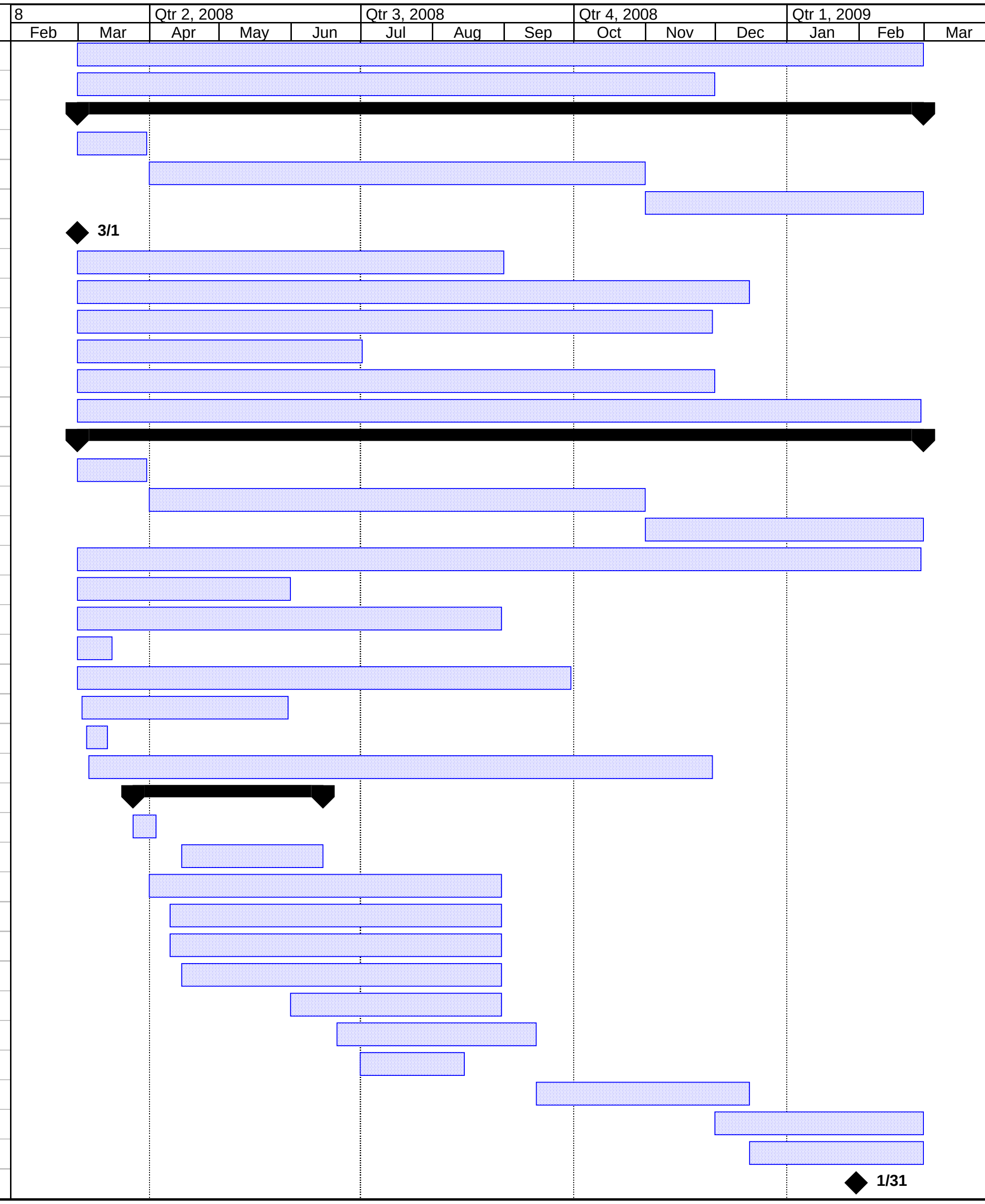


Figure BON-5 Bonnevillle Dam Juvenile Fish Monitoring Facility and Outfall Flumes.

Table BON-1. Dates of project operations for fish purposes at Bonneville, 2008-9 March 2008

Task Name	Start	Finish	FPP Reference
Weekly Reports	3/1/08	2/28/09	Bon 3.3.1
Juvenile Migration Timing	3/1/08	11/30/08	Bon 1.1.3
Adult Fish Counting	**3/1/08**	**2/28/09**	**Bon 1.2.2.1**
Video Count 0400 - 2000 PST	3/1/08	3/31/08	Bon 1.2.2.1
Visual Count 0400 - 2000 PST	4/1/08	10/31/08	Bon 1.2.2.1
Video Count 0400 - 2000 PST	11/1/08	2/28/09	Bon 1.2.2.1
Avian Abatement in Place	3/1/08	3/1/08	Bon 2.4.1.1 f
Operate Avian Cannons	3/1/08	8/31/08	Bon 2.4.2.5.a.5
Screens in Place - PH2	3/1/08	12/15/08	Bon 2.4.2.2.a
Operation of Ice & Trash Chute	3/1/08	11/30/08	Bon 2.4.1.2.d
TIES in place	3/1/08	7/1/08	Bon 2.4.2.1.J & Bon 2.4.2.2.P
Adult Fish Passage Season	3/1/08	11/30/08	Bon 2.5.1.2
Spill Gates 1 and 18 Open 4"	3/1/08	2/28/09	Table Bon-5 & Bon 2.2.3.1
1% limitations	**3/1/08**	**2/28/09**	**Bon 5.3**
1% soft constraint	3/1/08	3/31/08	Bon 5.3
1% hard constraint	4/1/08	10/31/08	Bon 5.3
1% soft constraint	11/1/08	2/28/09	Bon 5.3
PH2 - priority	3/1/08	2/28/09	Table Bon-11
Sea Lion Predation Study	3/1/08	6/1/08	App A Bon 2.7
Operate B2 Corner Collector	3/1/08	8/31/08	Bon 2.4.2.3
Unit 8 Rehabilitation	3/1/08	3/16/08	App A Bon 1.3
Unit 7 Rehabilitation	3/1/08	9/30/08	App A Bon 1.3
PH2 FGE Research	3/3/08	5/31/08	App A Bon 2.3
Spring Creek Hatchery Release Approx.	3/5/08	3/14/08	App A Bon 1.1
Adult Studies Evaluations	3/6/08	11/30/08	App A Bon 2.6
PH2 BGS Evaluation	**3/25/08**	**6/15/08**	**App A Bon 2.2**
Equipment Installation	3/25/08	4/4/08	App A Bon 2.2
Study	4/15/08	6/15/08	App A Bon 2.2
TDG Monitoring	4/1/08	8/31/08	App D Table 4
Spill for Juvenile Fish	4/10/08	8/31/08	App E
Spillway Survival Study	4/10/08	8/31/08	App A Bon 2.1
Bonneville Chum Salmon Study	4/15/08	8/31/08	App A Bon 2.4
Lamprey Passage Evaluations	6/1/08	8/31/08	App A Bon 2.5
Avoid taking PH2 units out of service	6/21/08	9/15/08	Bon 4.2.1.3
Special Spill Time for Sockeye	7/1/08	8/15/08	Bon 2.2.3
2 Screens in Place - PH1	9/15/08	12/15/08	Bon 2.4.1.1.a & Bon 2.5.3.f
Maintenance of Adult Fish Facilities	12/1/08	2/28/09	Bon 1.2.2.2
Maintenance of Juvenile Fish Facilities	12/16/08	2/28/09	Bon 1.1.3
Annual Report	1/31/09	1/31/09	Bon 3.3.4



1.1.3. Juvenile Migration Timing. The juvenile fish migration season occurs from March 1 through November 30. **Tables BON-2a** and **BON-2b** show the primary passage periods for each species. Bull trout, lamprey, juvenile sturgeon, and other listed salmonids shall be recorded in the by-catch of the smolt monitoring facilities. Maintenance of juvenile fish facilities is scheduled for the period December 16 through February to reduce the impact on downstream migrants. These activities will be coordinated to minimize potential impacts on juvenile migrants that may be present at that time.

Table BON-2a. PH1 10%, 50%, and 90% passage dates for 1995-1999

Yearling Chinook				
	10 %	50%	90 %	# of Days
1995	Apr 17	May 09	May 26	40
1996	Apr 19	May 02	May 27	39
1997	Apr 20	May 04	May 26	37
1998	Apr 23	May 05	May 23	31
1999	Apr 21	May 09	May 30	40
MEDIAN	Apr 20	May 05	May 26	39
MIN	Apr 17	May 02	May 23	31
MAX	Apr 23	May 09	May 30	40

Subyearling Chinook - "Brights" Only				
	10 %	50%	90 %	# of Days
1995	Jun 06	Jun 23	Jul 15	40
1996	Jun 09	Jun 29	Jul 18	40
1997	Jun 07	Jun 26	Jul 29	53
1998	Jun 03	Jun 16	Jul 20	48
1999	Jun 11	Jun 30	Jul 25	45
MEDIAN	Jun 07	Jun 26	Jul 20	45
MIN	Jun 03	Jun 16	Jul 15	40
MAX	Jun 11	Jun 30	Jul 29	53

Unclipped Steelhead				
	10 %	50%	90 %	# of Days
1995	Apr 28	May 12	May 27	30
1996	Apr 24	May 06	May 26	33
1997	Apr 23	May 08	May 25	33
1998	Apr 27	May 12	May 31	35
1999	Apr 24	May 13	Jun 01	39
MEDIAN	Apr 24	May 12	May 27	33
MIN	Apr 23	May 06	May 25	30
MAX	Apr 28	May 13	Jun 01	39

Clipped Steelhead				
	10 %	50%	90 %	# of Days
1995	May 04	May 17	May 29	26
1996	Apr 27	May 16	May 29	33
1997	Apr 29	May 13	May 28	30
1998	May 02	May 15	Jun 01	31
1999	Apr 27	May 19	Jun 05	40
MEDIAN	Apr 29	May 16	May 29	31
MIN	Apr 27	May 13	May 28	26
MAX	May 04	May 19	Jun 05	40

Coho				
	10 %	50%	90 %	# of Days
1995	Apr 28	May 13	May 29	32
1996	Apr 23	May 14	May 28	36
1997	Apr 29	May 18	Jun 04	37
1998	May 03	May 20	Jun 04	33
1999	Apr 28	May 23	Jun 07	41
MEDIAN	Apr 28	May 18	Jun 04	36
MIN	Apr 23	May 13	May 28	32
MAX	May 03	May 23	Jun 07	41

Sockeye (Wild + Hatchery)				
	10 %	50%	90 %	# of Days
1995	May 10	May 19	May 27	18
1996	May 04	May 18	Jun 02	30
1997	May 06	May 21	Jun 22	48
1998	May 10	May 15	May 29	20
1999	May 10	May 17	Jun 01	23
MEDIAN	May 10	May 18	Jun 01	23
MIN	May 04	May 15	May 27	18
MAX	May 10	May 21	Jun 22	48

Table BON-2b. PH2 10%, 50%, and 90% passage dates for 2000-2007.

Yearling Chinook				
	10 %	50%	90 %	# of Days
2000	Apr 23	May 17	Jun 01	40
2001	Apr 26	May 11	Jun 06	42
2002	Apr 25	May 18	Jun 01	38
2003	Apr 22	May 14	May 31	40
2004	Apr 17	May 04	May 30	44
2005	Apr 19	May 7	May 25	37
2006	Apr 16	May 9	May 21	36
2007	Apr 20	May 11	May 23	34
MEDIAN	Apr 21	May 11	May 30	41
MIN	Apr 16	May 04	May 21	34
MAX	Apr 26	May 18	Jun 06	44

Subyearling Chinook				
	10 %	50%	90 %	# of Days
2000	Jun 06	Jun 22	Jul 19	44
2001	Jun 07	Jul 09	Aug 15	70
2002	Jun 21	Jul 03	Jul 20	30
2003	Jun 15	Jul 01	Jul 19	35
2004	Jun 10	Jun 28	Jul 14	35
2005	Jun 15	Jun 28	Jul 20	36
2006	Jun 16	Jun 29	Jul 15	30
2007	Jun 19	Jul 08	Jul 22	34
MEDIAN	Jun 15	Jun 30	Jul 19	36
MIN	Jun 06	Jun 22	Jul 14	30
MAX	Jun 21	Jul 09	Aug 15	70

Unclipped Steelhead				
	10 %	50%	90 %	# of Days
2000	Apr 23	May 16	Jun 01	40
2001	May 02	May 18	Jun 09	39
2002	May 01	May 27	Jun 09	40
2003	May 03	May 27	Jun 09	38
2004	Apr 17	May 16	May 31	45
2005	Apr 23	May 11	May 29	37
2006	Apr 24	May 07	May 29	36
2007	Apr 29	May 16	Jun 03	36
MEDIAN	Apr 26	May 16	Jun 02	38
MIN	Apr 17	May 07	May 29	36
MAX	May 03	May 27	Jun 09	45

Clipped Steelhead				
	10 %	50%	90 %	# of Days
2000	Apr 28	May 18	Jun 04	38
2001	May 07	May 20	Jun 12	37
2002	May 02	May 27	Jun 11	41
2003	May 07	May 30	Jun 11	36
2004	Apr 30	May 16	May 27	28
2005	Apr 26	May 15	May 30	35
2006	Apr 27	May 08	May 29	33
2007	May 08	May 17	Jun 04	28
MEDIAN	May 01	May 17	Jun 04	35
MIN	Apr 26	May 08	May 27	28
MAX	May 08	May 30	Jun 12	41

Coho				
	10 %	50%	90 %	# of Days
2000	May 06	May 22	Jun 03	29
2001	May 15	May 24	Jun 03	20
2002	May 06	May 19	Jun 06	32
2003	Apr 29	May 16	Jun 09	42
2004	Apr 18	May 05	May 27	40
2005	Apr 22	May 9	May 27	36
2006	Apr 27	May 17	May 27	31
2007	Apr 26	May 13	May 31	36
MEDIAN	Apr 28	May 16	Jun 01	32
MIN	Apr 18	May 05	May 27	20
MAX	May 15	May 24	Jun 09	42

Sockeye (Wild & Hatchery)				
	10 %	50%	90 %	# of Days
2000	May 05	May 25	Jun 07	34
2001	Jun 03	Jun 10	Jun 25	23
2002	May 13	May 23	Jun 09	28
2003	May 12	May 20	Jun 05	25
2004	May 21	Jun 01	Jun 15	26
2005	May 15	May 23	Jun 1	18
2006	May 10	May 19	May 31	22
2007	May 16	May 25	Jun 7	23
MEDIAN	May 14	May 24	Jun 07	25
MIN	May 05	May 19	May 31	18
MAX	Jun 03	Jun 10	Jun 25	34

[1] Includes upriver brights only (excludes influence by Spring Creek NFH Tules).

1.2. Adult Fish Passage.

1.2.1. Facilities Description. Adult fish passage facilities at Bonneville Dam consist of two main fishway segments.

1.2.1.1. The Powerhouse One collection channel and A-branch ladder join the south spillway entrance and B-branch ladder at the junction pool at the Bradford Island ladder to form the Bradford Island fishway. The downstream migration channel (DSM) is also used for adult passage from September 15 through December 15. The system consists of 12" orifices, six STSs and VBSs, and a migration channel that runs south and out the ice and trash sluiceway.

1.2.1.2. The Cascades Island ladder at the north side of the spillway is connected to the Washington shore ladder by the upstream migrant transportation (UMT) channel. The Powerhouse Two collection channel and north and south monoliths join the UMT to form the Washington shore fishway.

1.2.1.3. Bradford Island, Cascades Island and the Washington shore fishways have counting stations. The Washington Shore ladder has an adult fish sampling facility. All four collection systems have auxiliary water supplies for fish attraction.

1.2.2. Adult Migration Timing and Counting. Upstream migrants are present at Bonneville Dam throughout the year and adult passage facilities are operated year round. Adult fish (salmon, steelhead, shad, and lamprey) are normally counted year round (**Table BON-3**), and these data appear daily (or every three days during video counting periods) on the Corps adult count website. Migration timing data for these species, except shad, appear in **Table BON-4**. Sturgeon and bull trout are also counted and recorded on the WDFW fish counters' daily summary sheet comments section, and these data are summarized in the Annual Fish Passage Report, but do not appear on the Corps daily website total due to relative infrequency of passage.

1.2.2.1. The adult fish counting schedule is shown in **Table BON-3**. Because fish passage from November through March is relatively light, fish counting is done by video rather than visual counting, primarily to monitor winter steelhead passage, especially ESA-listed winter steelhead.

1.2.2.2. Annual winter maintenance of adult fish facilities is scheduled from December 1 through February (in-water work period) to minimize the impact on upstream migrants and to minimize adult fall chinook and steelhead fallback.

Table BON-3. Adult fish counting schedule.

Period	Counting Method
January 1 – March 31	Video count 0400–2000 PST
April 1 – October 31	Visual count 0400-2000 PST
November 1 - December 31	Video count 0400–2000 PST

1.2.2.3. Adult fish migration timing has been calculated for Bonneville Dam from count data collected by the Corps since 1938. **Table BON-4** summarizes adult fish passage timing through 2006. The primary passage period and the earliest and latest peaks of migration recorded are listed for each species (except shad). Steelhead are counted by video at Bonneville Dam from November 01 through March 31 as described in **Table BON-3**, but the ESA-listed winter steelhead population passage period is considered to be from November 16 through March as described in **Table BON-4**. Peak winter steelhead migration timing for years 1999-2006 and peak lamprey migration timing for years 2000-2006 appears in this table.

Table BON-4. Adult migration timing from fish counts, 1938-2006.

Species	Passage Period	Earliest Peak	Latest Peak
Spring Chinook	3/15 – 5/31	4/15	5/27
Summer Chinook	6/1 – 7/31	6/3	7/31
Fall Chinook	8/1 – 11/15	8/30	9/17
Sockeye	6/1 – 8/15	6/20	7/13
Steelhead	4/1 – 3/31	7/16	9/22
Winter steelhead	11/16 – 3/31	3/1	3/28
Coho	7/15 – 11/15	8/29	9/22
Lamprey	3/15 – 11/15	6/22	7/13

2. Project Operation.

2.1. General. Yearling chinook and most other juvenile salmonids migrate downstream in the spring, whereas during the summer, after mid-June, sub-yearling chinook dominate. Studies specific to Bonneville Dam indicate that fish survival rates for passage through various routes differ between spring and summer.

2.1.1. Powerhouse Flow Distribution. Bonneville turbine operating priority is established as outlined in **Table BON-5**. If a turbine is out of service, use the next turbine in the priority list.

2.1.2. When adult salmonid counts equal or exceed 30,000 fish/day before August 31, project fisheries will initiate Fish Passage Operations and Maintenance Team (FPOM) coordination to discuss options for powerhouse flow-splitting to provide additional flow attraction areas to help balance adult passage among the project's fishways. When adult salmonid counts equal or exceed 25,000 fish/day after August 31, the Project will operate two priority turbines at PH1 in an attempt to balance adult passage between both powerhouses (assuming there was no prior unit operation at PH1). This operation will continue until Project fish counts fall below 20,000 fish.

2.1.3. Other Activities. Research, non-routine maintenance, other fish-related activities, and construction activities will not be conducted within 100' of any fishway entrance or exit or within 50' of the rest of the fishway, or directly in, above, or adjacent to any fishway, unless coordinated by the Project, Portland District Operations and/or Planning, the Dive operation coordinator, or CEWNP Construction office through FPOM and FFDRWG with the Region. Currently coordinated special operations related to research are described in **Appendix A**.

Alternate actions will be considered by district and project biologists in coordination with the Regional fish agencies on a case-by-case basis. Emergency situations should be dealt with immediately by the project in consultation with the project or district biologist. If unavailable, the biologists will be informed of steps taken to correct the situation immediately following the incident. All activities within boat-restricted zones (BRZ) will be coordinated at least two weeks in advance with the project, unless it is deemed an emergency (see also Overview for coordination guidance).

2.2. Spill Management. See the 2008 Fish Operations Plan (**Appendix E**) for more information.

2.2.1. General. Only one spill schedule will be used at Bonneville Dam (**Table BON-15**).

2.2.1.1. Decisions regarding spill changes will be made through regional agreement at TMT.

2.2.1.2. Nighttime spill is limited as necessary to control total dissolved gas (TDG) supersaturation. Adjustments of the nighttime spill level may be granted on a case-by-case basis by the Reservoir Control Center (RCC), dependent upon TDG monitoring at stations downstream of the dam, biological monitoring, and fish movement.

2.2.1.3. The hours of nighttime spill are the daily complements of the periods of daytime spill (**Table BON-5**). The transition from daytime spill cap to nighttime spill cap and vice versa will normally take 15 to 20 minutes due to the time required to start, synchronize, and load multiple generators. The transition to the daytime spill period should not start until after the nighttime cap period is over.

2.2.1.4. Frequently, a total river discharge change will occur concurrently with these spill transitions. The transition to the nighttime cap should begin early enough to minimize chances of violating the defined nighttime spill maximum.

2.2.2. Juvenile Fish. Spill planning dates for juvenile fish passage have a start date of April 10 and end date of August 31. These are planning dates and are flexible according to specific requirements relating to fish abundance. For current dates, see the Fish Operation Plan in Appendix E. During spring through the end of June, the day and night spill amount is 100 kcfs. From July 1 through August, the daytime spill amount is 75 kcfs, and the nighttime spill amount is a level that entrains gas up to the 120% gas cap without exceeding it. The NMFS 2004 BiOp sets a minimum spill level of 50 kcfs. See Appendix A for changes in spill volumes for research.

2.2.3. Adult Fish. During the primary adult fish passage period (March 01 through November), daytime spill will be limited to 75 kcfs from July 01 through August whenever possible (**see also 2.2.2**.). Normally, this restriction will be from one hour before sunrise to one half hour after sunset (**Table BON-5**). However, during that portion of the sockeye run that occurs between July 01 and August 15, the cap will apply until one hour after sunset.

2.2.3.1. From September 1 through November 30, and from March 1 to the beginning of spill for juvenile fish passage in early April, provide spill from bays 1 and 18 with each spill gate open 6”. From December 1 through February 28, spill only from the bay(s) that are adjacent to an operating fishway entrance with each spill gate open 6”. Spill for these periods will occur during daylight hours, as indicated in **Table BON-5.**

Table BON-5. Daytime spill schedule for Bonneville Project.

Date	**Daytime Spill**	
	Begin	**End**
Jan 01 – Jan 19	0700	1730
Jan 20 – Feb 14	0630	1800
Feb 15 – Mar 01	0600	1830
Mar 02 – Apr 02	0530	1900
Apr 03 – Apr 20	0500	2030
Apr 21 – May 16	0500	2100
May 17 – May 31	0430	2130
Jun 01 – Jun 30	0430	2130
Jul 01 – Jul 31	0430	2200
Aug 01 – Aug 15	0500	2145
Aug 16 – Aug 31	0500	2030
Sep 01 – Sep 16	0530	2000
Sep 17 – Oct 04	0600	1930
Oct 05 – Oct 19	0630	1900
Oct 20 – Oct 29	0630	1830
Oct 30 – Nov 30	0600	1700
Dec 01 – Dec 31	0630	1700

2.3. Total Dissolved Gas (TDG) Management and Control. Total dissolved gas (TDG) levels at Bonneville are monitored in accordance with the Dissolved Gas Monitoring Program, **Appendix D.**

2.3.1. The TDG data will be reported every four hours starting prior to the Spring Creek National Fish Hatchery (NFH) fish release, but not later than March 10 for all stations at Bonneville. Spill volume and total project flow will be reported at the same time.

2.3.2. Excessive TDG levels, which may harm fish, will be controlled to the extent possible, subject to river flow conditions. Control measures will include system spill allocations through the spill priority list issued levels by RCC, nighttime or daytime spill limits, and shaping of spill discharge.

2.4. Juvenile Fish Passage Facilities.

2.4.1. Powerhouse One Operating Criteria

2.4.1.1. December 01 through February 28 (Winter Maintenance Period).

a. Screens (STS, VBS) in place in the two PH1 priority units will remain until December 15 to prevent adult salmonids from falling back through turbine units, thereby shortening some aspects of the winter maintenance period by two weeks.

b. Remove all STSs and VBSs after 15 December.

c. Main unit gatewell drawdown will be measured a minimum of once per week. Remove debris from forebay and trashracks as required to maintain less than 1.5' of total drawdown in gatewells.

d. Remove debris from forebay, trash racks, and gatewell slots such that these areas are free of debris.

e. The ice and trash sluiceway (ITS) operations after November 30 are detailed in section **2.5.3.g**

f. Avian Abatement Measures. Reinstall or repair avian predator control lines as soon as possible following damage or removal. Install and maintain new avian predator control lines in locations determined to be significantly impacted by avian predators. Avian abatement measures shall be in place by March 01 unless this work is delayed because of inclement weather. If this occurs, the work will be completed as soon as the weather permits after that date. However, there will be no avian abatement measures, other than avian lines, performed from September through March each year.

2.4.1.2. March 01 through November 30. (Fish Passage Season).

a. Main unit gatewell drawdown will be measured a minimum of once per week. Remove debris from forebay and trashracks as required to maintain less than 1.5' of total drawdown in gatewells.

b. A slight oily sheen is commonly found in many gatewells. This may come from sources such as lubricated lifting beams, etc. When unusual accumulations of oil (e.g., oil slick) occur in gate slots, they will be removed within 24 hours. Appropriate procedures to remove fish during this situation will be determined in coordination with FPOM. Regardless of unit operating status, oil accumulations will be dealt with promptly.

c. Reinstall or repair avian predator control lines as soon as possible following significant damage or removal. Install and maintain new avian predator control lines in locations determined to be significantly impacted by avian predators. Implement other avian abatement measures as necessary from April through August only.

d. Open ice and trash sluiceway (ITS) chain gates. Open chain gate 1C, 3C and 6C to 71.5' msl. If maintaining 2.5 feet of chain gate submergence with adjustments occurring as often as every four hours is desired by an outside agency prior to completion of the planned gate automation installation, the Project suggests a request of a soft constraint on the forebay level with a System Operational Request (SOR) to RCC, who will subsequently issue a teletype directing this operation to the Project, if approved.

e. This authorization may be terminated at any time if problems arise that negatively impact fish migration or condition.

f. All gatewell orifices should be opened and DSM1 ran south from September 15 through December 15. This is to reduce the number of adults that fall back through the turbine units. Please refer to section **2.5.3.f.**

2.4.2. Powerhouse Two Operating Criteria.

2.4.2.1. December 01 through February 28 (Winter Maintenance Period).

a. Screens (STS) will remain in place until December 15 to prevent adult salmonids from falling back through turbine units, thereby shortening some aspects of the winter maintenance period by two weeks. Unscreened units will be operated on a last-on, first-off basis. Beginning December 16, all STSs may be removed.

b. Video or manually inspect VBSs for damage, holes, debris accumulations, protrusions, and proper seating. Clean and repair, as necessary, such that all VBSs in operable units are functional.

c. Inspect each STS and operate on trial run (dogged off at deck level). Install STS in each intake of operational units by the end of February.

d. DSM2 may be dewatered only when required for maintenance. The maintenance period will be minimized to the extent practicable.

e. Remove debris from forebay, trash racks and gatewell slots such that these areas are free of debris.

f. Inspect and, where necessary, clean and/or repair all gatewell orifices, orifice lighting systems, and flushing systems such that the orifices and associated systems are fully functional.

g. Inspect and, where necessary, clean and/or repair dewatering screens and associated equipment.

h. Inspect and correct any deficiencies in DSM channel, conduit outfall walls and floor.

i. TIES for units 15-18 will be re-installed just prior to the start of the juvenile fish passage season, including, when practicable, prior to early fish releases from Spring Creek NFH.

j. Flume Pipe (from exit of DSM to outfall). Visually inspect outfall flume pipe and associated switch gates once per year from the transition section leaving the powerhouse to the outfall return to the river for obstructions, protrusions, or structural deficiencies that may affect fish passage.

k Avian Predation Lines. Reinstall or repair avian predator control lines as soon as possible following significant damage or removal. Install and maintain new avian predator control lines in locations determined to be significantly impacted by avian predators. Avian abatement measures shall be in place by March 01 unless this work is delayed because of inclement weather. If this occurs, the work will be completed as soon as possible after that date. However, there will be no avian abatement measures, other than avian lines, performed from September through March each year.

2.4.2.2. March 01 through November 30 (Fish Passage Season).

a. Juvenile fish protection devices (STS, etc.) will be in place prior to the juvenile fish passage season. (In the event that juvenile fish are released from Spring Creek NFH prior to March, the screens will be installed before the release occurs. The release for 2008 is currently scheduled for 3 March.) Screens (STSs and VBSs) will remain in operation through December 15 to prevent adult salmonids from falling back through turbine units.

b. Main unit gatewell drawdown will be measured a minimum of once per week.

c. Remove debris from the forebay and trash racks as required to maintain less than 1.5' of drawdown in gatewells, or as indicated by fish condition (e.g., higher than expected descaling), or as determined by the project biologist. The STSs in units being raked will be run continuously during raking operations. Gatewell orifices of the unit being raked must be closed during the procedure.

d. Measure fish unit gatewell drawdown at least once per week. When the head across trash racks exceeds 1.5', the trash racks will be cleaned that day. This may be done by raking late in the workday or by turning the unit off at night and letting the debris float off the racks. However, if the head exceeds 3' or if the adult fishway head is reduced, the unit’s racks will be raked immediately, even if it is early in the day. When debris accumulation is persistent, unit 18 may be operated while the fish unit is off at night to help draw loosened debris away.

e. Operate STSs at angle of 60^o from vertical.

f. Turbines without a full compliment of STSs will not operate except when in compliance with other coordinated fish measures.

g. Observe each STS watt and/or amp gauge at least once each day and record reading once per day. If an STS failure occurs, then follow procedures in Fish Facility Maintenance.

h. Video or manually inspect each STS once per month (or 720 hours run time) and each VBS a minimum of once every two months (or 1440 hours run time). Frequency of monthly inspections may be based on individual turbine unit run time.

> **1.** No STS inspections will be scheduled when they will cause excessive TDG due to increased forced spill.
>
> **2.** VBS inspections will occur immediately prior to peaks in juvenile fish migrations, which begin about May 01, mid-July, and September 01.
>
> **3.** More frequent inspections may be required by the project biologist or under the following conditions: deterioration of fish conditions, increased debris load in bypass system, and other indications of STS or VBS malfunctions or failure.
>
> **4.** If manually inspecting VBSs, prior to pulling VBSs for inspections, shut off units and dip gatewells. It is not necessary to dip gatewells of units that have been off for 48 hours or longer.
>
> **5.** VBSs will be cleaned when drawdowns read 1.1’ on any day (including weekends) and when drawdowns reach .9’ on Thursdays.
>
> **6.** If a screen has reached the cleaning threshold, all three screens in that unit will be cleaned.
>
> **7.** A unit will be shutdown if the VBS drawdown meets or exceeds 1.5’ in a 12 hour period.

i. Rake unit 11 and unit 12 trashracks prior to March 1 and at least once a month throughout fish passage season.

j. If STS or VBS damage or plugging is detected, follow procedures in Fish Facilities Maintenance. Records of inspections or a summary of such records will be made available to FPOM by the February meeting, upon request.

k. All gatewell orifice systems should be operational.

> **1.** Orifices automatically flush 3 times per day, one orifice every 10 minutes. Orifices with less than a clear flow jet will be flushed manually during the inspection.
>
> **2.** Manually flush orifices known to have recurring plugging or other problems.
>
> **3.** Orifice jets will be observed through the light tubes during the inspection. Light tubes and orifice tube lenses shall be replaced and kept clean as required so that visual observations of orifice jets are possible during fishway inspections.

l. Replace all burned out orifice lights within 24 hours. Orifice lights shall remain lighted 24 hours/day.

> **1.** The DSM gallery lights should be left off except when project or other staff is in the gallery.

m. The project will clean gatewells before the water surface becomes one-half covered with debris. If, due to the volume of debris, it is not possible to keep the gatewell surfaces half clear, they will be cleaned at least once daily.

> **1.** Turbines with a gatewell fully covered with debris will not be operated except to be in compliance with other coordinated fish measures, and then only on a last on/first off basis.
>
> **2.** Gatewell orifices will be closed during the cleaning operations. After cleaning a gatewell, inspect and, if necessary, clean the orifice in that gatewell and then check gatewell drawdown.

n. A slight oily sheen is commonly found in many gatewells. When unusual accumulations of oil occur in gate slots, it will be removed within 24 hours. When this is not possible, the gatewell orifice will be closed and the turbine unit will be shut down until cleaning is accomplished. Appropriate procedures to remove fish during this situation will be determined in coordination with FPOM. Regardless of unit operating status, oil accumulations will be dealt with promptly.

> **1.** Coordinate gatewell cleaning with smolt monitoring personnel operating downstream juvenile sampling facilities.

o. Reinstall or repair avian predator control lines in present locations as soon as possible following significant damage or removal. Install and maintain new avian predator control lines in locations determined to be significantly impacted by avian predators. Implement other avian abatement measures as necessary from April through August only.

p. TIES for units 15-18 will be removed following the spring juvenile yearling chinook out-migration period, usually in early July.

2.4.2.3. B2 Corner Collector Operation. Operate the corner collector during spill season. Remove and install the headgate and bulkhead within 12 hours of the start and end of spill season if possible. See **Appendix A** for alterations to this schedule.

2.4.2.4. DSM2 Channel Operation.

a. Screen cleaners. The primary screen cleaner will be the airburst system. The system is currently set to cycle every 60 minutes.

1. In the event that the air system is unable to maintain the desired water elevation at the dewatering area then the duration of the cleaning cycle will be increased as necessary.

2. If the system is still unable to accommodate the debris load, then the mechanical brush system will be activated in conjunction with the airburst system to maintain the desired water elevation. The systems will continue to work in tandem until debris loads lessen and the airburst system can maintain a correct water elevation.

3. Once water elevations can be maintained, the mechanical system will be returned to standby and the airburst system cleaning will be the primary system once again.

4. The Project biologists shall have the discretion to modify the cleaning system program at anytime to maintain FPP criteria.

5. The mechanical screen cleaners will be run once a week to exercise the equipment.

b. Operation. Maintain the channel elevation between 64.2’ and 64.4’ as indicated by the staff gauge in front of the ERG. The system is designed to maintain the channel elevation at 64.3’ in automatic control. If the channel elevation increases or decreases, the PLC system will close or open orifices, respectively.

Table BON-6. DSM2 regulating orifice control (FB is forebay and "X" is open).

Orifice	FB <=71.5	FB <=72.5	FB <=73.5	FB <=74.5	FB <=75.5	FB <=76.5
11A-S	X	X	X	X	X	
11B-S	X	X	X	X		
11C-S	X	X	X	X		
12A-S	X	X	X			
12B-S	X	X	X			
12C-S	X	X				
13A-S	X	X				
13B-S	X	X				
13C-S	X					
14A-S	X					
14B-S	X					
14C-S	X					

2.4.2.5. Juvenile Monitoring Facility

a. Operation.

1. Project Biologists or JMF personnel will operate the upper switchgate as necessary for sampling requirements.

2. The lower switchgate is in automatic control. JMF personnel (PSMFC) will monitor and report to Project biologists any problems with the lower switchgate.

3. On seasonal ascending tailwater elevations, the transition from low to high outfall should be between tailwater elevations at the upper end of 16' to 18' range.

4. On seasonal descending tailwater elevations, the transition from high to low outfall should be between tailwater elevations at the lower end of 18' to 16' range.

5. Operate the outfall avian cannons from March 1 through August 31. During August, avian cannons may be shut off if project observes no predatory birds at the outfall, and coordinates through FPOM. If birds reappear at the outfall, cannon operation will resume and FPOM will be informed. The cannons will be operated 24 hours/day during fish passage season.

6. See also **Appendix J**, "Protocols for Juvenile Monitoring Facility Operations at Bonneville Dam" for specific monitoring facility guidance.

2.4.3. Spillway Operating Criteria.

2.4.3.1. December 01 through February 28 (Winter Maintenance Period).

a. Inspect and, where necessary, repair spill gates and control systems. The spillway, except for coordinated exceptions, must be able to achieve spill patterns on the first day of the juvenile fish passage season.

b. As per the procedures in Bonneville Operating Order 14, each spill gate will be raised and lowered, to test for operability and check calibration, prior to the start of spill season. This will usually occur in March.

c. Refer to **Appendix E** or section **2.2** for spill guidance during winter maintenance periods at Bonneville Project.

2.4.3.2. March 01 through November 30 (Fish Passage Season). Spill will be provided according to the guidance in section **2.2**.

2.5. Adult Fish Passage Facilities.

2.5.1. All Adult Fish Passage Facilities Operating Criteria.

2.5.1.1. December 01 through end of February (Winter Maintenance Period).

a. Operate the adult fish passage facilities according to the fish passage season standards. Systems may be dewatered or operated out of criteria for repair and maintenance.

b. Only one of the ladders servicing the powerhouses and the associated powerhouse collection system (including the auxiliary water supply system) may be out of service or operating out of standard operating criteria at any one time, unless specifically coordinated.

c. Turbines will be operated in the priority outlined in **Table Bon 11** during the winter maintenance period.

d. One of the two ladders servicing the spillway channel will be in full operation at all times unless specially coordinated.

e. Outage periods will be minimized to the extent practicable.

f. Please see section **2.2.3.1.** and **Table Bon-5** to determine spill bays' 1 and 18 operating criteria.

g. Adjust crowders at fish counting stations to full open if videotaping is temporarily discontinued due to unscheduled events or during the winter maintenance (dewatering) period only.

h. Sea Lion Exclusion Devices (SLEDs) will be installed at all 8 main fishway entrances and B2 FOGs on or before February 1 and removed by June 15 each season. SLEDs may be installed earlier or kept in place later if significant numbers of pinnipeds are present at Bonneville outside of these dates.

i. Inspect and calibrate all staff gauges and water level indicators. Repair and/or clean where necessary.

j. Unless specially coordinated, dewater all ladders and inspect all dewatered sections of fish facilities for projections, debris, or plugged orifices that could injure fish or slow their progress up the ladder. Repair deficiencies.

k. Inspect for and clear debris in the ladder exits.

l. Reinstall picket leads at counting stations prior to watering up the ladders during maintenance.

m. Remove STSs and VBSs from PH1 turbine units the week of December 15.

n. At PH1, two adjacent chaingates and gate 7A should remain open from December 01 through the end of February. The two adjacent gates should be located over priority operating units and set to elevation 71.5’ msl. This operation is intended to facilitate steelhead kelt passage.

2.5.1.2. March 01 through November 30 (Fish Passage Season).

a. Maintain the water depth over fish ladder weirs at 1' +/- 0.1' during the non-shad passage season (August 16 through May 14) and 1.3' +/- 0.1' during the shad passage season (May 15 through August 15). Water depths will be measured at the A and B-branch staff gages in the Bradford Island fishway, at weirs 37 and 38 in the Washington shore fishway, and at the UMT staff gage in the Cascades Island fishway.

b. Water temperature will be measured in an adult fishway at each powerhouse. When water temperature reaches 70^{o} F, all fish handling activities will be coordinated through FPOM prior to any action to verify protocols that will be followed. Fish handling activities in the Adult Fish Facility (AFF) will implement protocols in **Appendix G**.

c. Head on all entrances should be: 1' to 2' (1.5' preferred). Head at the NUE is calculated differently because the collection channel staff gage is in the junction pool. A head of approximately 1' to 2' at the NUE entrance is indicated by a 1.2' to 2.2' (1.7' preferred) entrance head calculated using the fishway and tailwater staff gages closest to NUE. Refer to **Table BON-10** when unable to achieve head criterion.

d. A water velocity of 1.5 to 4 fps (2 fps preferred) shall be maintained for the full length of the powerhouse collection channel, and the lower ends of the fish ladders that are below the tailwater. Water velocities will be measured directly, and monitored during fishway inspections to verify channels are operating between 1.5 and 4 fps.

e. A maximum of 0.5' head will be allowed on the Powerhouse One attraction water intakes and trash racks at all the ladder exits, with 4" maximum head on all picket leads. Debris shall be removed when significant amounts accumulate.

f. Staff gages and water level indicators will be readable at all water levels encountered during the fish passage period. These include the; PH1 south collection channel, PH1 north collection channel, PH1 north tailwater, PH1 south forebay, BI, A and B branch ladders, BI weir, B branch entrance, CI entrance, CI ladder below the UMT entrance, NUE/NDE/SUE/SDE collection channel, NUE/SUE tailwater, and PH2 north forebay.

g. Stillwells used in lieu of staff gages will be checked for calibration once per week.

h. The current fish counting program is conducted 16 hours per day, year around (see **Table BON-3**). Count station crowders shall remain in the operating position while visual counting and/or videotaping is being conducted.

> **1.** The crowder shall be closed to allow the count slot width to be no less than 18 inches. This will usually occur during high turbidity conditions to allow count accuracy criteria to be achieved.
>
> **2.** If passage is impaired by this condition, the count slot may be widened until proper passage conditions are achieved, even though count accuracy may be compromised to some degree.
>
> **3.** Project biologists, FFU, and the WDFW fish count supervisor shall coordinate to achieve optimum count slot passage and/or count accuracy conditions.
>
> **4.** If counting is temporarily discontinued due to unscheduled events, the crowder shall be fully opened.
>
> **5.** The crowder may remain in operating position during the counters' hourly ten-minute break period.
>
> **6.** Leave the fish passage slot lighted overnight.

i. Upstream light banks in both count stations shall remain off to facilitate fish passage through the count slot and help reduce the number of fish impacting the count window framework, unless other passage problems result, or count accuracy is compromised as determined by the fish count supervisor and coordinated through the FPOM.

j. Inspect and ensure that optimum passage conditions are maintained at fishway entrances, exits, and in the count slots.

2.5.2. Main Dam Ladders.

a. When spilling exclusively for adult attraction, spill only during the daylight hours (see **Table BON-5**). Spill Bays 1 and/or 18 shall be open 6” only if adjacent to operating fishway entrances. (see section **2.2.3.1**).

b. Side entrances SW-SG-5 and SO-SG-7 shall remain closed. Downstream entrances SW-SG-1 and SO-SG-2 shall operate as continuously open free-flowing vertical slots. Downstream entrances SW-SG-3 and SO-SG-4 (adjacent to shore) consist of pairs of sluice gates. When the tailwater is below 9', sluice gates SW-SG-3N, SW-SG-3S, SO-SG-4N, and SO-SG-4S shall be open. When the tailwater is between 9' and 17', sluice gates SO-SG-4S and SW-SG-3N shall close. When the tailwater exceeds 17', sluice gates SW-SG-3N, SW-SG-3S, SO-SG-4N, and SO-SG-4S shall be closed.

2.5.3. Powerhouse One.

a. Weir Gates. The Powerhouse One weir gates will be operated as shown in **Table BON-7.**

1. Gate Pairing. The four weir gates will be operated in two pairs. Only one gate pair will be allowed to operate at any given time. Gates 1 and 65 will operate together as the active pair for tailwater elevations greater than 23' msl, while gates 2 and 64 will operate together as the active pair for tailwater elevations less than 26' msl. For tailwater elevations between 23' and 26', the designated active pair will depend on whether the tailwater elevation has been rising or falling with a "dead band" of 1.5'.

2. Transition Positioning. During a transition, the former active pair is closed and the new active pair is positioned according to tailwater.

Table BON-7. Bonneville Dam first powerhouse weir gate requirements.

Weir Gate	Submergence Requirement	Differential Requirement	Sill Elevation
1	>8'	1'-2'	8.5'
2	>8'*	1'-2'	2'
64	8'-8.4'	1'-2'	2'
65	8'-8.4'	1'-2'	8.5'

* When tailwater is <13.5’, the 8’ submergence requirement can not be satisfied.

b. Control of Fish Valve FV1-1.

1. Emergency Closure. If the collection channel/tailwater differential is greater than 2.5' or if the pressure differential between the auxiliary water supply conduit and the collection channel becomes excessive, as determined by operators, close FV1-1.

2. Differential. Low: if the collection channel/tailwater differential is less than 1'. High: if the collection channel/tailwater differential is more than 2.0'.

c. Control of Fish Valve FV3-7. Maintain the opening concurrent with the charts for valve opening, as set by the forebay and tailwater elevations.

d. Control of A-Branch Diffusion Gates FG3-3 through FG3-9. First powerhouse A-branch diffusers are open according to the pattern in **Table BON-9**.

Table BON-8. Bonneville Dam A-branch diffuser operating ranges.

Diffusers	Operating Range (TW Elevation)	Dead Bands
FG3-3	8.2' – 13.3'	7.8' – 8.2'
FG3-4	13.7' – 16.3'	13.3' – 13.7'
FG3-5	16.7' – 19.3'	16.3' – 16.7'
FG3-6	19.7' – 24.8'	19.3' – 19.7'
FG3-7	25.2' – 27.8'	24.8' – 25.2'
FG3-8	28.2' – 30.8'	27.8' – 28.2'
FG3-9	> 31.2'	30,8' - 31.2'

e. Powerhouse One Collection Channel Diffusers. Diffuser valves are operated according to the pattern in **Table BON-9**.

Table BON-9. Bonneville Dam Powerhouse One adult fish collection channel diffuser valves that are open. (Any diffusers not listed should be closed)

Valve	Setting	Valve	Setting
FG2-4	Open	FG2-20	Open
FG2-8	Open	FG2-21	Open
FG2-12	Open	FG2-22A	Open
FG2-19	Open	FG2-22B	Open

f. STSs and VBSs will be installed in two PH1 priority units on September 15. This is to prevent adult fallbacks from going through the turbines. The two priority units will be screened through December 15, with a spare STS and VBS available.

1. The Powerhouse One DSM will be watered up on September 15, with water flow to the south. The DSM will remain heading south until STSs and VBSs are removed mid-December.

2. All orifices will be opened to provide appropriate water flow.

3. All units with fish screens will have operating orifice lights. All non-screened units should have the orifice lights off.

4. Spare screens may be stored below the deck even with the orifices open.

2.5.4. Second Powerhouse Two.

a. Operate all north (NUE and NDE) and south (SUE and SDE) entrances. Operate weir crests at elevation 1' (fully lowered) for tailwater elevations up to 14'. For tailwater elevations greater than 14', operate weir crest 13' or greater below tailwater.

b. Operate all 12 active powerhouse floating gate fishway entrances.

3. Facility Monitoring and Reporting.

3.1. Inspections.

3.1.1. The results of all inspections and the readiness of the facilities for operation will be reported to the FPOM at the meeting immediately prior to the fish passage season.

3.1.2. During fish passage season, fish passage facilities will be inspected at least three times per day/seven days a week to assure operation according to established criteria.

3.1.3. During winter maintenance season, fish passage facilities will be inspected three times per day/at least three days a week.

3.1.4. More frequent inspections will occur as noted throughout the text.

3.1.5. The project fish biologists and fish biological staff will conduct at least three inspections per week though additional fishway inspections may be performed by FFU and fish agencies.

3.2. Zebra Mussel Monitoring. A zebra mussel monitoring program will continue. These organisms have become a serious problem elsewhere in the country and may become introduced into the Columbia River basin. Inspections should also be made when dewatering all project facilities.

3.3. Reporting.

3.3.1. Project biologists shall prepare weekly reports throughout the year summarizing project operations. The weekly reports will provide an overview of how the project and the fish passage facilities operated during the week and an evaluation of resulting fish passage conditions. The reports shall include:

a. **A**ny out-of-criteria situations observed and subsequent corrective actions taken.

b. **A**ny equipment malfunctions, breakdowns, or damage along with a summary of resulting repair activities.

c. **A**dult fishway control calibrations.

d. STS and VBS inspections.

e. AWS closures (i.e. cleaning times).

f. **W**hen trapping is occurring in the AFF.

g. **A**ny unusual activities which occurred at the project which may affect fish passage.

3.3.2. The weekly reports shall cover a Sunday through Saturday period and they shall be e-mailed to CENWP-OD and other interested parties as soon as possible the following week, with a copy to CENWD-PDW-R (RCC).

3.3.3. The project biologists shall prepare a memo for the record for any negative impact to fish or fishways. This memo will be sent to FPOM by the next working day. Items that shall be included in the memo are:

a. Time and date.

b. Nature of activity that leads to fish impact.

c. Agency responsible for the impact, or the reportee if no responsible party can be identified.

d. Fish numbers, species, origin, discernible external injuries, tags, etc.

e. Future actions to avoid a similar impact.

f. Any relevant photos.

3.3.4. The project biologists shall prepare an annual report by January 31, summarizing the operation of the project fish passage facilities for the previous year.

a. The report will cover from the beginning of one adult fish facility winter maintenance period to the beginning of the next.

b. The annual report also will include a description of all actions taken to discourage avian predation at the project, with an overview of the effectiveness of the activities in discouraging avian predation.

c. The annual report will be provided to CENWP-OD in time for distribution to FPOM members at the February meeting.

4. Fish Facilities Maintenance.

4.1. General.

4.1.1. Routine Maintenance.

4.1.1.1. Staff gages and other water-level sensors will be installed, cleaned, and/or repaired as required.

4.1.1.2. Scheduled fishway maintenance, to the extent practicable, will be conducted during periods when passage has been documented to be at its lowest during the regular scheduled workday, to minimize impacts to migrating salmonids.

4.1.1.3. Maintenance activities that occur during the fish passage period and that may affect fish passage will be reported in the weekly reports.

4.2. Juvenile Fish Passage Facilities.

4.2.1. Routine Maintenance.

4.2.1.1. Submersible Traveling Screens. The STS system will receive preventive maintenance or repair at all times of the year, including the winter maintenance period. Whenever a generator malfunctions or is scheduled for maintenance, the three STSs in that turbine may be maintained, repaired, or exchanged for other STSs needing maintenance or repair. One third of the STSs at Bonneville are scheduled for complete overhaul each year resulting in a three-year maintenance cycle unless future developments indicate that longer life expectancy is possible.

4.2.1.2. Juvenile Bypass System. The juvenile bypass facilities will receive preventive maintenance throughout the year. During the juvenile fish passage season, this will normally be above-water work such as maintenance of automatic systems, air lines, electrical systems, and monitoring equipment. During the winter maintenance period, the systems may be dewatered downstream of the gatewell orifices. The systems will then be visually inspected in all accessible areas for damaged equipment and in areas that may cause problems to the juvenile fish. Any problem areas identified are to be repaired if the project is able. In extreme cases, the work will be contracted as soon as possible or repaired during the next winter maintenance period. Channel modifications and general maintenance also should be completed at this time.

a. The trash racks are to be raked just prior to the juvenile fish passage season and whenever trash accumulations are suspected because of increased head across the trash racks (>1.5') or increased juvenile fish descaling. Additional trash rack raking may be necessary when a storm brings large quantities of debris down river to the project. Gatewell orifices in the unit being raked will be closed during the procedure.

4.2.1.3. Turbines and Spillways. Maintenance and routine repair of project turbines and spillways is a regular and recurring process which requires units to be shut down for extended periods of time

a. The maintenance schedules for turbines and spillways will reflect equal weighting given to fish, power, and water management and will be coordinated with the appropriate fish and resource agencies through FPOM.

b. Certain turbine and spillway discharges at the projects are secondarily used to attract adult fish to fishway entrances, to keep predator fish from accumulating near juvenile release sites, and to move juveniles downstream away from the project. During the fish passage season, do not take units F1, F2, 1, 2, 11, 17, and 18 out of service, when practicable.

c. When practicable, do not take any other Powerhouse Two units out of service during June 21 through September 15, to minimize Powerhouse One operation.

d. Fish units may be taken out of service to facilitate cleaning of the fish unit brush rigging. Through trial and error, it has been determined that the rigging should be cleaned twice during the passage season. One cleaning operation is performed in conjunction with the mid-year collection channel diffuser grating inspection, and the second stands alone on the outage schedule

e. Some types of turbine maintenance will require testing the turbine throughout its full operating range before returning it to normal service. These operations will be coordinated with the appropriate resource agencies.

4.2.2. Non-Routine Maintenance. Maintenance of facilities such as fish screens, which sometimes break down during the fish passage season, will be carried out as described below.

a. Unscheduled maintenance that will have a significant impact on juvenile fish passage shall be coordinated with the Regional fish agencies through FPOM and with RCC on a case-by-case basis by CENWP-OD biologists. The CENWP-OD biologists will be notified by the project as soon as possible after it becomes apparent that maintenance repairs are required. The Project Operations Manager has the authority to initiate work prior to notifying CENWP-OD when delay of the work will result in an unsafe situation for people, property, or fish. Information required by CENWP-OD includes: (see also **Overview** for coordination procedures).

1. Description of the problem.
2. Type of outage required.
3. Impact on facility operation.
4. Length of time for repairs.
5. Expected impacts on fish passage.

4.2.2.1. Submersible Traveling Screens. If an STS or VBS is found to be damaged or inoperative in an operating unit, the unit will be regarded as an unscreened unit. The screen will be repaired or replaced before returning the unit to normal service.

4.2.2.3 Juvenile Bypass System.

a. Juvenile bypass systems are controlled automatically (PLC). When an automatic system fails, it can usually be operated manually. This allows either facility to operate according to criteria while repair of the automatic system is completed.

b. Orifices allow fish out of the gatewells into a bypass channel. If an orifice valve system becomes inoperative, it will be repaired expeditiously. When the orifices become plugged with debris they are pneumatically flushed.

c. If the automatic systems fail and the system is operated manually, facility inspections should be increased to a frequency that assures these systems continue to operate within criteria.

d. All STS Gatewells will be inspected daily and the project will clean them before they become half covered with debris. If, due to volume of debris, it is not possible to keep the gatewell surfaces at least half clear, they will be cleaned at least once daily. Turbines with a gatewell fully covered with debris will not be operated, except on a last on/first off basis, if required to be in compliance with other coordinated fish measures. This is to maintain clean orifices and minimize fish injury. The gatewell orifices will be closed during the cleaning operation. Check gatewell drawdown and clean trashracks if necessary.

e. Powerhouse One. PH1 juvenile passage facilities will not be in service in 2008.

f. Powerhouse Two. If the bypass system fails in the dewatering section or release pipe, fish may be released through the emergency relief conduit. This operation will continue until repairs are accomplished or until the end of the fish passage season. Any decision on whether or not to shut this system down for dewatering and repairs will be made in coordination with the FPOM. During this emergency operating mode, power generation will be minimized at the Powerhouse Two. Repairs will receive high priority.

g. During fishway inspections the VBSs may be found plugged, damaged, or not properly seated. In these cases, the associated unit will be taken out of service as if unscreened and repairs will be made before returning the unit to normal service. If screens are pulled and replaced, the underwater video inspection camera will be deployed to check the screens for proper seating.

4.2.2.4. Turbines and Spillways. If a spill gate becomes inoperable, the operator will make the changes necessary to accommodate the spill and then immediately notify the operations supervisor and project biologist to determine the best pattern to follow until repairs are completed. This interim operation shall be coordinated with the FPOM through the district biologist who will provide additional guidance to the project.

4.3. Adult Fish Passage Facilities.

4.3.1. Routine Maintenance. Maintenance activities that occur during the fish passage period and that may affect fish passage will be reported in the weekly reports.

4.3.1.1. Fishway Auxiliary Water Systems. Bonneville Project auxiliary water systems consist of gravity flow and hydroelectric generating systems. Preventive maintenance and normal repair are carried out as needed throughout the year. Trash racks for the AWS intakes will be raked when drawdown exceeds criteria. When practicable, rake trash racks during the time of day when fish passage is least affected.

4.3.1.2. Powerhouse and Spillway Adult Fish Collection Systems. Preventive maintenance and repair occurs throughout the year. During the primary adult fish passage season this maintenance will not involve any operations which will cause failure to comply with the adult fishway criteria except as specially coordinated or as needed for semi-annual maintenance. Inspection of those parts of the adult collection channel systems which require dewatering, such as diffusion gratings, leads, and entrance gates, will be scheduled once per year during the winter maintenance season while the system is dewatered, with one additional inspection during the fish passage season, unless a channel must be dewatered for fishway modifications or to correct observed problems.

a. An underwater video system or diver may be used for the underwater inspections. This scheduled inspection and any associated maintenance will occur during the winter maintenance period and once during fish passage season unless specially coordinated. Any non-routine maintenance and fishway modifications will be handled on an individual basis.

b. A project biologist will attend all dewatering activities potentially involving fish, as well as inspections, to provide fish related input.

4.3.1.3. Diffuser Gratings: Diffuser chambers for adding auxiliary water to fish ladders and collection channels are covered by gratings attached by several different methods. Diffuser gratings are normally checked during the winter maintenance period to make sure they are in place. These inspections are done by either dewatering the fish passage way and physically inspecting the diffuser gratings, or by using other methods to inspect the gratings. Diffuser gratings may come loose during the fish passage season.

a. Daily inspections of fish ladders and collection systems should include looking for any flow changes that may indicate problems with diffuser gratings.

b. If a diffuser grating is known to or suspected of having moved, creating an opening into a diffuser chamber, efforts must immediately be taken to correct the situation and minimize impacts on adult fish in the fishway.

c. If possible, a video inspection should be made as soon as possible to determine the extent of the problem. If diffusers gratings are found to be missing or displaced, creating openings into the diffuser chambers, a method of repair shall be developed and coordinated with the fish agencies and tribes through the established FPOM coordination procedure.

d. Repairs shall be made as quickly as possible unless coordinated differently.

4.3.1.4. Adult Fish Ladders and Counting Stations. (Also see Appendix G for Adult Fish Trapping Protocols.) The adult fish ladders will be dewatered once each year during the winter maintenance period. During this time, the ladders will be inspected for blocked orifices, projections into the fishway that may injure fish, stability of the weirs, damaged picket leads, exit gate problems, loose diffusion gratings, unreadable or damaged staff gauges, defective diffusion valves, and malfunctioning operating equipment at the counting stations, as well as other potential problems. Problems identified throughout the passage year that do not affect fish passage, as well as those identified during the dewatered period, may then be repaired. Trash racks at the ladder exits will be raked when criteria is approached or exceeded. When practicable, rake trash racks during the time of day when fish passage is least affected, usually late morning fish count station windows, light panels, and crowder panels will be cleaned as needed to achieve accurate counts and, when practicable, during the time of day when fish passage is least affected, usually late morning.

4.3.2. Non-routine Maintenance. Maintenance activities that occur during the fish passage period and that may affect fish passage will be reported in the weekly reports. Non-routine maintenance that will significantly affect the operation of a facility, such as repair of displaced diffuser gratings, will be coordinated with the Regional fish agencies through FPOM and with RCC. Coordination procedures for non-routine maintenance of adult facilities are the same as for juvenile facilities. Any non-routine maintenance and fishway modifications will be handled on an individual basis.

4.3.2.1. Fishway Auxiliary Water Systems. Most fishway auxiliary water systems are operated automatically. If the automatic system fails, then the system will be manually operated by project personnel to maintain criteria while repair of the automatic system is carried out. When this operation becomes necessary, project personnel will increase the surveillance of the adult system to ensure that criteria are being met. In the event of AWS failure, FPOM will be used in an advisory capacity to assist the project as needed.

a. Powerhouse One. If any of the valves or any other part of the system fails, then the project is to attempt to maintain criteria by adjusting those valves which continue to function. Conduit pressure must be monitored and not allowed to exceed the established limits.

b. Spillway. Two separate fishway auxiliary water valves add water to each spillway ladder (Cascades Island and B-branch ladders). If one of these valves or any other part of the system malfunctions, the functioning parts of the system are to be adjusted to compensate. If repairs cannot be made in 24 hours, close the sluice gate entrance, if open. This will divert the reduced available water to the entrance slots. If a head of 1' is still not achieved, stop logs are to be added to the entrance slots until the desired head or a weir depth of not less than 6' below the tailwater surface is reached. At this point maintain the gate positions until the auxiliary water system is repaired.

c. Powerhouse Two.

1. If either of the fishway auxiliary water turbines is unable to provide water sufficient to meet full criteria, the adult facilities will be operated according to **Table Bon-10**, Emergency Operations for Bonneville Powerhouse Two AWS Systems Operations or until a fishway head of 1’ is achieved.

2. Table Bon-10 is a guide for configuring turbine flows, floating orifices, diffuser gates, and main gates during emergency situations when one of the fish turbines has failed or been taken out of service.

3. If both of the fish unit turbines fail between September 01 and March 31, and repairs cannot be made within 8 hours, coordination with FPOM will occur to develop operational guidelines that may include alternative powerhouse priority operations.

4. Table BON-10 guidance should be followed to the extent practicable, and shore entrance weirs should be raised in increments or closed as needed to maintain the proper fishway head.

5. If all auxiliary water systems fail or malfunction, close the NUE, SUE, and SDE and raise the NDE weir crest to 6’ below tailwater with the floating orifice gates open. Maintain this configuration until the system is repaired. While under this configuration, power generation at Powerhouse Two will be minimized to the extent practicable to reduce fish attraction into this area unless Powerhouse One facilities are dewatered.

6. Powerhouse Two adult fishway diffusion system valves A3 and A4 were found damaged and have been removed. These valves were designed to be closed when tailwater drops below 11' and 9', respectively. Even though the valves cannot be closed, velocity in the channel has remained in criteria.

Table Bon-10. Emergency Operations Table for Bonneville Powerhouse Two AWS.

TW (ft)	Turbine MW	Turbine Q (cfs)	Floating Orifices Closed	South "B" Diffusers Closed	PH "C" Diffusers Closed	Main Entrances Closed
8	13.90	2950	All	B3-8	C1-5	None
9	13.95	3010	All	B3-8	C1-5	None
10	14.05	3090	All	B3-8	C1-5	None
11	14.15	3165	All	B3-8	C1-5	None
12	14.20	3230	All	B3-8	C1-5	None
13	14.40	3340	All	B3-8	C1-5	None
14	14.40	3400	All	B3-8	C1-5	None
15	14.60	3520	All	B3-8	C1-5	None
16	14.30	3515	All	B3-8	C1-5	None
17	14.20	3560	All	B3-8	C1-5	None
18	14.00	3575	All	B5-8	None	NU-E
19	13.60	3535	All	B5-8	None	NU-E
20	13.30	3520	All	B4-8	None	NU-E
21	13.00	3510	All	B4-8	None	NU-E
22	12.70	3505	All	B4-8	None	NU-E
23	12.40	3505	All	B4-8	None	NU-E
24	12.20	3535	All	B4-8	None	NU-E
25	11.60	3535	All	B4-8	None	NU-E
26	11.10	3365	All	B4-8	None	NU-E
27	10.60	3285	All	B4-8	None	NU-E
28	10.00	3160	All	B3-8	None	NU-E

4.3.2.2. Powerhouse and Spillway Adult Fish Collection Systems. Bonneville Project contains several types of fishway entrances. In most cases, if failures occur, the entrance can and will be operated manually by project personnel until repairs are made. If this operation becomes necessary, project personnel will increase the surveillance of the adult system to ensure that criteria are being met. In those cases in which the failure will not allow the entrance to be operated manually, the gate will be maintained, to the extent possible, in an operational position. If this is not possible, the entrance will be repaired expediently and returned to manual or automatic control at the earliest possible date.

4.3.2.3. Adult Fish Ladders and Counting Stations. The components of the ladders include picket leads, counting stations, fishway exits, and overflow weirs with orifices. Pickets with excessive spacing (greater than 1"), concrete erosion around the leads, or missing pickets can allow fish into areas where escape is difficult. In some instances of picket lead failure, spare leads and spare installation slots are available. In these cases the spare leads are installed and the damaged leads are removed and repaired. In the remaining instances of picket lead failure or concrete erosion, the timing and method of repair will depend upon the severity of the problem. The decision of whether or not to dewater the fishway and repair any problems will be made in coordination with the Regional fish agencies through FPOM.

4.3.2.4. Diffuser Gratings. Diffuser chambers for adding auxiliary water to fish ladders and collection channels are covered by gratings attached by several different methods. Diffuser gratings are normally checked during the winter maintenance period to make sure they are in place. These inspections are done by either dewatering the fish passage way and physically inspecting the diffuser gratings, or by using other methods to inspect the gratings. Diffuser gratings may come loose during the fish passage season.

a. Daily inspections of fish ladders and collection systems should include looking for any flow changes that may indicate problems with diffuser gratings.

b. If a diffuser grating is known to or suspected of having moved, creating an opening into a diffuser chamber, efforts must immediately be taken to correct the situation and minimize impacts on adult fish in the fishway.

c. If possible, a video inspection should be made as soon as possible to determine the extent of the problem. If diffuser gratings are found to be missing or displaced, creating openings into the diffuser chambers, a method of repair shall be developed and coordinated with the Regional fish agencies through FPOM.

d. Repairs shall be made as quickly as possible unless coordinated differently.

5. Turbine Unit Operation and Maintenance.

Table BON-11. Turbine unit operating priorities, Bonneville Powerhouses One and Two.

PERIOD	PRIORITY
Year-round; adult fish ladders are in service	**11,18,15,12,17,14,13,16, 1,3,6,2,4,5,8,10,7,9**
First Powerhouse Adult Fish Ladder out of service	**11,18,15,12,17,14,13,16, 1,3,6,2,4,5,8,10,7,9**
Second Powerhouse Adult Fish Ladder out of service	**1,3,6,2,4,5,8,10,7,9 11,18,15,12,17,14,13,16**

See **Appendix A**, BON section, para. 3.0 for unit priorities during FGE and survival tests. Additional changes in unit priorities may occur and will be authorized in RCC teletypes as needed.

5.1. Unit operating priority throughout the year is shown in section **2.1.1**, Powerhouse Flow Distribution.

5.2. Turbine units will operate within 1% of best efficiency and within cavitation limits at various head ranges as shown in **Tables BON-12 through BON-14** for both powerhouses. Powerhouse One units 1 through 6, 8 and 10 have different MW output requirements because they are minimum gap runner units and have a different MW versus discharge relationship.

5.3. To the extent technically feasible, turbines will be operated within +/-1% of best turbine efficiency from April 1 through October 31 (as specified in the BPA load shaping guidelines) to avoid excess daytime spill (during the time of year when the 75 kcfs spill cap applies), or to comply with other coordinated fish measures. However, during the rest of the year, the project will continue to operate units within the 1% turbine efficiency range, except as specifically requested by BPA to do otherwise as provided in **Appendix C**. New, separate 1% operating criteria are provided for MGR units 1 through 6 in **Table BON-13**).

5.4. The project turbine unit maintenance schedules will be reviewed by Project and Operations Division biologists for fish impacts. If possible, maintenance of priority units will be scheduled for winter maintenance periods, or when there are low numbers of fish passing the project.

5.4.1. Unit 1 provides important attraction flow for adult fish, and it helps move juvenile fish downstream. Long-term outages will be avoided after the beginning of the juvenile fish passage season, until after the adult fall chinook and coho runs at the end of October.

5.4.2. In the event of long-term outages at Bonneville powerhouses, affected units will be exercised periodically. Each unit will be operated 4-8 hours every two weeks to exercise governor components and clean wetted surfaces of corrosion, so that if needed, fish injury will be minimized and the units will be in good operating condition. Actual runtime will be the minimum amount needed to keep the unit in good working condition. This may be performed at night, daytime, or whenever unit cycling will have the least effect on fish passage as determined by the project biologist.

5.5. The headgates at units 11 through 18 have been dogged off and the system has been depressurized. Oil leaks develop frequently when the system operates with normal pressure. Further related instructions are described in a memorandum from the project operations superintendent. (Memorandum for All Operations, from BON Chief of Operations, dated September 23, 1993. Subject: Powerhouse 2 Hydraulic Head Gate Operation).

6. Dewatering Plans.

6.1. Guidelines for any dewatering. Guidelines for Dewatering and Fish Handling Plans (**Appendix F**) have been developed and are followed for most project facilities dewaterings. These plans include consideration for fish safety and are consistent with the following general guidance. The appropriate plans are reviewed by participants before each salvage operation.

6.1.2. Whether pumps or drain valves are used, automatic pump shut off devices will be utilized to prevent stranding fish. If automatic pump shut off devices and low water alarms are not used, the dewatering process must be continuously monitored to prevent stranding.

6.1.3. A project biologist and/or alternate Corps fish personnel will attend all project activities involving fish handling.

6.1.4. The fish agencies and tribes will be invited to assist in any dewatering and, at a minimum, are invited to participate in all ladder dewaterings.

6.1.5. Adult fish will be released into the forebay and juvenile fish will be released into the tailrace. If a ladder is dewatered in the spring or summer, steelhead kelts will be released into the tailrace.

6.2. Juvenile bypass systems. See Guidelines for Dewatering and Fish Handling Plans (**Appendix F**) and the Fish Recovery Plans in the Project Fisheries office.

6.3. Adult Fish Ladder.

6.3.1. Routine Maintenance.

6.3.1.1. When possible operate the ladder to be dewatered at a reduced flow for at least 24 hours, and up to 96 hours, prior to dewatering. Reduced flow is defined as less than criterion operation, but more than orifice flow. This operation shall not be initiated prior to 1800 hours on November 30 if a ladder outage is scheduled for December 1.

6.3.1.2. Discontinue all fishway auxiliary water supplies at least 24 hours, but no more than 96 hours, prior to dewatering. This operation shall not be initiated until 1800 hours on November 30 if a ladder outage is scheduled for December 1.

6.3.1.3. A project biologist will assure that fish rescue equipment is available and will coordinate to assure adequate numbers of personnel will be available to move fish out of the dewatered ladder.

6.3.1.4. Project personnel will install head gates to shut down ladder flow. Where possible, a minimum flow depth of 1" - 2" will be maintained in the ladder until fish are rescued.

6.3.1.5. Orifice blocking devices that are placed in the lower-most weirs to prevent fish from re-ascending the dewatered portion of the adult fishway shall have ropes placed on them to be tied to fishway railings. The orifice blocks shall be removed just before the fishway is returned to service. The ropes will help identify and prevent the orifice blocks from being accidentally left in place after fishway water-up. The orifice blocking devices will appear on the pre-water-up checklist maintained by the project biologist.

6.3.2. Non-Routine Maintenance.

6.3.2.1. When possible discontinue fishway auxiliary water and operate the ladder at orifice flow as long as possible (prefer 3-24 hours) prior to dewatering.

6.3.2.2. Follow **6.3.1.3.** through **6.3.1.5.** above.

6.4. Powerhouse Fish Collection System.

6.4.1. Routine Maintenance.

6.4.1.1. During the pumping or draining operation to dewater a portion or the entire collection channel, the water level will not be allowed to drop to a level which strands fish. Personnel shall remain onsite during pumping operations to ensure stranding does not occur, or a water-level sensor that deactivates the dewatering process will be used.

6.4.1.2. A project biologist will assist directly in fish rescue operations, provide technical guidance to assure fish safety, and assure that rescue equipment and personnel are available if needed.

6.5. Turbines.

6.5.1. Immediately before setting the head gates, remove juvenile fish from the gatewell(s) that will be drained. This is done by use of a special dipping basket. Typically, at least one gatewell is drained to allow ventilation into the draft tube.

6.5.2. When possible place head gates and tail logs immediately after a turbine unit is shut down if the draft tube is to be dewatered. This is necessary for both scheduled and unscheduled outages.

6.5.3. If a turbine unit draft tube is to be dewatered and the turbine unit has been idle, it will be operated when possible at speed/no load and stop logs will then be placed immediately.

6.5.4. Water levels in the draft tube will not be allowed to drop to a level that strands fish. Adequate inspections will be conducted to ensure that stranding does not occur.

6.5.5. Fish rescue personnel will inspect dewatered turbine draft tubes, scroll cases, and intakes as soon as the water levels reach a depth permitting visual inspection and the hatch cover is opened.

6.5.6. A project biologist and/or alternate Corps fish personnel will provide technical guidance for fish safety and will directly participate in fish salvage.

6.5.7. A project biologist will invite FPOM members to participate in the dewatering, and will assure that rescue equipment is available if needed.

6.5.8. If the unit is planned to be out of service and partially drained for less than 4 days and low numbers of fish are trapped, then it will not be necessary to remove fish from draft tubes as long as an adequate safety pool is maintained. Adequate inspections will be conducted to ensure the safety pool is maintained and fish are in good condition.

7. Forebay Debris Removal. Debris can impact fish passage conditions in several ways. It can plug or block trash racks, VBSs, gatewell orifices, dewatering screens, and facility piping, resulting in impingement, injuries, and descaling of fish.

7.1. Debris is removed by operating the ice and trash sluiceway at Powerhouse One, the corner collector at Powerhouse Two, or passing it through the spillway with special spill gate operation.

7.2. Special spill operations that don't follow the normal spill schedule or volume limits will be coordinated prior to their execution. Normally, the project shall contact CENWP-OD at least two workdays prior to the day the special operation is required. Using information provided by the project, CENWP-OD will coordinate with FPOM and with RCC, as necessary. Once the coordination is complete, RCC will issue a Teletype detailing the special operations.

8. Response to Hazardous Materials Spills. Bonneville Project's guidance for responding to hazardous substance spills is contained in its Emergency Spill Response Plan. This guidance will be followed in case of a spill.

8.1. Project Fisheries will be contacted as soon as possible after a hazardous material release and prior to any modification to fishway operations. The project biologist will in turn contact the CENWP-OD biologist and FPOM. Attempts should be made to first contact the project biologist on duty. During fish passage season there is a project biologist on duty seven days a week. If a project biologist cannot be reached by radio or in the office, attempts to contact Project Fisheries will occur in the following order:

1. Ben Hausmann- home and mobile numbers are available in the Control Room.
2. Jon Rerecich- home and mobile numbers are available in the Control Room.
3. Tammy Mackey- 503-808-4305 (Portland Office), mobile phone number is available in the Control Room.
4. Kasey Welch- mobile number available in the Control Room.

9. Endnotes. (Not applicable to this Project)

Table BON-12. Turbine operating ranges within the 1% turbine efficiency range for Bonneville Powerhouse One, unit 9.

Head (feet)	With STS				Without STS			
	Lower Limit (MW)	Lower Limit (cfs)	Upper Limit (MW)	Upper Limit (cfs)	Lower Limit (MW)	Lower Limit (cfs)	Upper Limit (MW)	Upper Limit (cfs)
35	12.7	5,192	29.2	11,894	13.2	5,272	31.0	12,355
36	13.3	5,251	30.3	11,999	13.7	5,296	32.3	12,449
37	13.8	5,307	31.5	12,096	14.2	5,317	33.5	12,536
38	14.4	5,358	32.7	12,186	14.7	5,336	34.8	12,614
39	14.9	5,406	33.8	12,269	15.2	5,353	36.0	12,686
40	15.1	5,284	35.1	12,270	15.7	5,368	37.3	12,751
41	15.6	5,329	36.2	12,341	16.3	5,414	38.5	12,825
42	16.2	5,371	37.4	12,407	16.8	5,456	39.8	12,895
43	16.7	5,410	38.6	12,469	17.4	5,496	41.0	12,959
44	17.3	5,447	39.7	12,526	18.0	5,534	42.3	13,019
45	17.8	5,481	40.9	12,579	18.5	5,569	43.5	13,075
46	18.4	5,537	41.8	12,553	19.2	5,626	44.4	13,048
47	19.1	5,590	42.7	12,527	19.8	5,680	45.4	13,021
48	19.7	5,641	43.6	12,501	20.4	5,732	46.3	12,995
49	20.3	5,688	44.5	12,476	21.1	5,781	47.3	12,969
50	20.9	5,734	45.4	12,451	21.7	5,827	48.2	12,944
51	21.7	5,824	46.1	12,375	22.5	5,919	49.0	12,866
52	22.5	5,910	46.8	12,302	23.3	6,006	49.8	12,811
53	23.2	5,992	47.4	12,232	24.2	6,090	50.6	12,757
54	24.0	6,071	48.1	12,163	25.0	6,170	51.4	12,705
55	24.8	6,146	48.8	12,097	25.8	6,247	51.9	12,578
56	25.3	6,157	50.1	12,193	26.3	6,258	53.3	12,677
57	25.8	6,168	51.3	12,286	26.8	6,269	54.6	12,774
58	26.3	6,179	52.6	12,376	27.3	6,280	55.9	12,867
59	26.7	6,189	53.8	12,463	27.8	6,290	57.2	12,958
60	27.2	6,199	55.1	12,548	28.3	6,300	58.6	13,046
61	27.6	6,192	56.2	12,595	28.7	6,293	59.7	13,095
62	28.0	6,186	57.2	12,641	29.1	6,287	60.0	12,961
63	28.4	6,180	58.3	12,685	29.5	6,281	59.8	12,696
64	28.8	6,175	59.4	12,729	29.9	6,275	59.5	12,425
65	29.2	6,170	59.2	12,495	30.4	6,270	59.2	12,148
66	29.9	6,221	59.7	12,418	31.0	6,322	59.7	12,076
67	30.5	6,271	60.1	12,337	31.7	6,372	60.1	12,000
68	31.2	6,320	60.5	12,253	32.4	6,422	60.5	11,921
69	31.8	6,368	60.9	12,165	33.1	6,471	60.9	11,838
70	32.5	6,415	61.3	12,073	33.8	6,519	61.3	11,751

Note: Table is based on information provided by HDC in 2000 and 2001 (Table BON-12 revised, 2005)

Table BON-13. Turbine operating ranges within 1% turbine efficiency range for Bonneville Powerhouse One (rehabbed) MGR, Units 1-8, 10.

Head (feet)	First Powerhouse (units 1-8, 10)							
	With STS				Without STS			
	Lower Limit (MW)	Lower Limit (cfs)	Upper Limit (MW)	Upper Limit (cfs)	Lower Limit (MW)	Lower Limit (cfs)	Upper Limit (MW)	Upper Limit (cfs)
38	19.3	6,794	26.0	9,145	20.7	7,204	25.6	8,918
39	19.8	6,804	26.6	9,128	21.3	7,202	26.3	8,886
40	20.4	6,753	27.3	9,031	21.9	7,199	26.9	8,854
41	21.0	6,754	28.4	9,148	22.5	7,201	28.0	8,969
42	21.5	6,755	29.5	9,259	23.1	7,202	29.1	9,077
43	22.0	6,756	30.5	9,363	23.6	7,203	30.1	9,180
44	22.6	6,756	31.6	9,463	24.2	7,203	31.2	9,278
45	23.1	6,756	32.7	9,557	24.8	7,203	32.3	9,370
46	23.7	6,763	33.6	9,603	25.4	7,210	33.2	9,416
47	24.3	6,769	34.6	9,648	26.0	7,217	34.1	9,459
48	24.8	6,775	35.5	9,689	26.6	7,223	35.0	9,500
49	25.4	6,780	36.5	9,729	27.3	7,229	36.0	9,539
50	26.0	6,785	37.4	9,766	27.9	7,234	36.9	9,575
51	26.5	6,792	38.3	9,809	28.5	7,241	37.8	9,618
52	27.1	6,798	39.3	9,850	29.1	7,248	38.4	9,577
53	27.7	6,804	40.2	9,889	29.7	7,254	39.0	9,537
54	28.3	6,810	41.2	9,927	30.3	7,260	39.7	9,499
55	28.8	6,815	42.1	9,962	30.9	7,266	41.6	9,768
56	29.4	6,817	43.1	10,003	31.5	7,269	42.5	9,808
57	29.9	6,820	44.0	10,042	32.1	7,272	43.4	9,846
58	30.4	6,823	45.0	10,079	32.7	7,274	44.4	9,883
59	31.0	6,825	45.9	10,115	33.3	7,277	45.3	9,918
60	31.5	6,827	46.9	10,150	33.8	7,279	46.3	9,952
61	32.1	6,842	47.6	10,128	34.5	7,296	46.9	9,930
62	32.8	6,857	48.3	10,106	35.1	7,311	47.6	9,909
63	33.4	6,871	49.0	10,085	35.8	7,326	48.3	9,889
64	34.0	6,884	49.7	10,064	36.5	7,340	49.0	9,868
65	34.6	6,897	50.4	10,044	37.1	7,354	49.7	9,849
66	35.0	6,885	51.2	10,072	37.6	7,341	50.6	9,876
67	35.5	6,873	52.1	10,099	38.1	7,329	51.4	9,902
68	35.9	6,862	53.0	10,126	38.6	7,317	52.3	9,928
69	36.4	6,851	53.9	10,152	39.0	7,305	53.2	9,954
70	36.8	6,841	54.8	10,177	39.5	7,294	54.1	9,979

Note: Table is based on information provide by HDC in June 2000 (Table BON-13 revised-captions only, 2005).

Table BON-14. Turbine operating ranges within the 1% efficiency range for Bonneville Powerhouse Two (Units 11-18), with/without STSs.

Head (feet)	Second Powerhouse (units 11-18)							
	With STS				Without STS			
	Lower Limit (MW)	Lower Limit (cfs)	Upper Limit (MW)	Upper Limit (cfs)	Lower Limit (MW)	Lower Limit (cfs)	Upper Limit (MW)	Upper Limit (cfs)
35	27.6	11,259	44.3	18,068	28.2	11,444	45.1	18,277
36	28.5	11,271	45.8	18,097	29.2	11,455	46.6	18,306
37	29.4	11,279	47.3	18,121	30.1	11,464	48.1	18,331
38	30.3	11,284	48.8	18,139	31.0	11,470	49.7	18,350
39	31.3	11,287	50.3	18,153	32.0	11,473	51.2	18,364
40	32.2	11,288	51.8	18,162	32.9	11,474	52.7	18,374
41	33.0	11,259	53.3	18,197	33.7	11,445	54.3	18,409
42	33.8	11,230	54.9	18,228	34.6	11,415	55.8	18,441
43	34.6	11,201	56.4	18,255	35.4	11,386	57.4	18,468
44	35.4	11,172	57.9	18,278	36.2	11,357	58.9	18,493
45	36.2	11,144	59.4	18,299	37.0	11,328	60.5	18,514
46	37.0	11,139	61.0	18,366	37.9	11,324	62.1	18,581
47	37.8	11,135	61.9	18,200	38.7	11,319	63.0	18,415
48	38.7	11,129	62.7	18,040	39.6	11,314	63.8	18,255
49	39.5	11,124	63.5	17,887	40.4	11,308	64.7	18,101
50	40.3	11,118	67.5	18,598	41.3	11,303	68.7	18,817
51	41.3	11,154	69.8	18,850	42.2	11,339	71.1	19,072
52	42.3	11,187	72.1	19,091	43.2	11,373	73.4	19,316
53	43.2	11,219	74.5	19,323	44.2	11,405	75.8	19,551
54	44.2	11,249	76.5	19,536	45.2	11,436	76.5	19,431
55	45.2	11,278	76.5	19,115	46.2	11,466	76.5	18,975
56	46.4	11,343	76.5	18,718	47.4	11,531	76.5	18,581
57	47.6	11,404	76.5	18,336	48.6	11,593	76.5	18,202
58	48.8	11,461	76.5	17,967	49.9	11,652	76.5	17,836
59	50.0	11,515	76.5	17,611	51.1	11,707	76.5	17,483
60	51.2	11,567	76.5	17,267	52.3	11,760	76.5	17,142
61	51.8	11,532	76.5	16,978	53.0	11,724	76.5	16,857
62	52.5	11,498	76.5	16,699	53.7	11,690	76.5	16,582
63	53.1	11,466	76.5	16,428	54.3	11,657	76.5	16,315
64	53.7	11,434	76.5	16,166	55.0	11,625	76.5	16,056
65	54.4	11,405	76.5	15,912	55.6	11,595	76.5	15,806
66	55.4	11,448	76.5	15,671	56.7	11,639	76.5	15,570
67	56.5	11,490	76.5	15,437	57.8	11,682	76.5	15,341
68	57.5	11,532	76.5	15,210	58.9	11,724	76.5	15,119
69	58.6	11,571	76.5	14,990	59.9	11,764	76.5	14,903
70	59.6	11,610	76.5	14,775	61.0	11,803	76.5	14,693

Note: Table is based on information provided by HDC in January 2001 (Table BON-14 revised, 2006).

Table BON-15. Spill patterns for Bonneville Dam. Flows calculations updated 3/21/2005

Spillway Bay Number																		Stops	FB=74.0
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	ft.	Kcfs
vertical gate opening (ft.)																			
0.5																	0.5	2	2.3
0.5	0.5																0.5	3	3.4
0.5	0.5															0.5	0.5	4	4.6
0.5	0.5														0.5	0.5	0.5	5	5.7
0.5	0.5		0.5												0.5	0.5	0.5	6	6.9
0.5	0.5		0.5	0.5											0.5	0.5	0.5	7	8.0
0.5	0.5		0.5	0.5									0.5		0.5	0.5	0.5	8	9.2
0.5	0.5		0.5	0.5							0.5		0.5		0.5	0.5	0.5	9	10.3
0.5	0.5		0.5	0.5					0.5		0.5		0.5		0.5	0.5	0.5	10	11.5
0.5	0.5		0.5	0.5			0.5		0.5		0.5		0.5		0.5	0.5	0.5	11	12.6
0.5	0.5	0.5	0.5	0.5			0.5		0.5		0.5		0.5		0.5	0.5	0.5	12	13.8
0.5	0.5	0.5	0.5	0.5			0.5		0.5		0.5		0.5		0.5	1	0.5	13	14.9
0.5	1	0.5	0.5	0.5			0.5		0.5		0.5		0.5		0.5	1	0.5	14	16.0
0.5	1	0.5	0.5	0.5	0.5		0.5		0.5		0.5		0.5		0.5	1	0.5	15	17.2
0.5	1	0.5	0.5	0.5	0.5		0.5		0.5		0.5		0.5	0.5	0.5	1	0.5	16	18.3
0.5	1	0.5	0.5	0.5	0.5	0.5	0.5		0.5		0.5		0.5	0.5	0.5	1	0.5	17	19.5
0.5	1	0.5	0.5	0.5	0.5	0.5	0.5		0.5		0.5	0.5	0.5	0.5	0.5	1	0.5	18	20.6
0.5	1	0.5	0.5	0.5	0.5	0.5	0.5		0.5	0.5	0.5	0.5	0.5	0.5	0.5	1	0.5	19	21.8
0.5	1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	1	0.5	20	22.9
0.5	1	1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	1	0.5	21	24.1
0.5	1	1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	1	1	22	25.2
1	1	1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	1	1	23	26.3
1	1	1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	1	1	1	24	27.4
1	1	1	1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	1	1	1	25	28.6
1	1	1	1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	1	1	1	1	26	29.7
1	1	1	1	0.5	0.5	0.5	0.5	1	0.5	0.5	0.5	0.5	0.5	1	1	1	1	27	30.8
1	1	1	1	0.5	0.5	1	0.5	1	0.5	0.5	0.5	0.5	0.5	1	1	1	1	28	31.9
1	1	1	1	0.5	0.5	1	0.5	1	0.5	0.5	1	0.5	0.5	1	1	1	1	29	33.1
1	1	1	1	0.5	1	1	0.5	1	0.5	0.5	1	0.5	0.5	1	1	1	1	30	34.2
1	1	1	1	0.5	1	1	0.5	1	0.5	0.5	1	1	0.5	1	1	1	1	31	35.3
1	1	1	1	0.5	1	1	0.5	1	1	0.5	1	1	0.5	1	1	1	1	32	36.4
1	1	1	1	1	1	1	0.5	1	1	0.5	1	1	0.5	1	1	1	1	33	37.6
1	1	1	1	1	1	1	1	1	1	0.5	1	1	0.5	1	1	1	1	34	38.7
1	1	1	1	1	1	1	1	1	1	0.5	1	1	1	1	1	1	1	35	39.8
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	36	40.9
1	1.5	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	37	42.0
1	1.5	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1.5	1	38	43.2
1	1.5	1	1	1	1	1	1	1	1	1	1	1	1	1	1.5	1.5	1	39	44.3
1	1.5	1.5	1	1	1	1	1	1	1	1	1	1	1	1	1.5	1.5	1	40	45.4
1.5	1.5	1.5	1	1	1	1	1	1	1	1	1	1	1	1	1.5	1.5	1	41	46.5
1.5	1.5	1.5	1	1	1	1	1	1	1	1	1	1	1	1	1.5	1.5	1.5	42	47.6
1.5	1.5	1.5	1	1	1	1	1	1	1	1	1	1	1	1	1.5	2	1.5	43	48.6
1.5	2	1.5	1	1	1	1	1	1	1	1	1	1	1	1	1.5	2	1.5	44	49.7
1.5	2	1.5	1	1	1	1	1	1	1	1	1	1	1	1	2	2	1.5	45	50.8
1.5	2	1.5	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	46	51.9
2	2	1.5	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	47	53.0
2	2	1.5	1	1	1	1	1	1.5	1	1	1	1	1	1	2	2	2	48	54.1

Table BON-15 (cont). Spill patterns for Bonneville Dam. Flows calculations updated 3/21/2005

Spillway Bay Number																		Stops	FB=74.0
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	ft.	Kcfs
vertical gate opening (ft.)																			
2	2	2	1	1	1	1	1	1.5	1	1	1	1	1	1	2	2	2	49	55.1
2	2	2	1	1.5	1	1	1	1.5	1	1	1	1	1	1	2	2	2	50	56.2
2	2	2	1.5	1.5	1	1	1	1.5	1	1	1	1	1	1	2	2	2	51	57.3
2	2	2	1.5	1.5	1	1	1	1.5	1	1	1.5	1	1	1	2	2	2	52	58.4
2	2	2	1.5	1.5	1	1	1	1.5	1	1	1.5	1	1.5	1	2	2	2	53	59.5
2	2	2	1.5	1.5	1	1.5	1	1.5	1	1	1.5	1	1.5	1	2	2	2	54	60.6
2	2	2	1.5	1.5	1	1.5	1	1.5	1	1	1.5	1	1.5	1	2	2.5	2	55	61.7
2	2.5	2	1.5	1.5	1	1.5	1	1.5	1	1	1.5	1	1.5	1	2	2.5	2	56	62.8
2	2.5	2	1.5	1.5	1.5	1.5	1	1.5	1	1	1.5	1	1.5	1	2	2.5	2	57	63.9
2	2.5	2	1.5	1.5	1.5	1.5	1	1.5	1	1	1.5	1	1.5	1.5	2	2.5	2	58	65.0
2	2.5	2	1.5	1.5	1.5	1.5	1	1.5	1.5	1	1.5	1	1.5	1.5	2	2.5	2	59	66.1
2	2.5	2	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1	1.5	1	1.5	1.5	2	2.5	2	60	67.2
2	2.5	2	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1	1.5	1.5	1.5	1.5	2	2.5	2	61	68.3
2	2.5	2	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	2	2.5	2	62	69.4
2	2.5	2	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	2.5	2.5	2	63	70.4
2	2.5	2	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	2.5	3	2	64	71.5
2	2.5	2	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	2.5	3	2.5	65	72.5
2	3	2	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	2.5	3	2.5	66	73.6
2	3	2	1.5	2	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	2.5	3	2.5	67	74.6
2	3	2	1.5	2	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	2	2.5	3	2.5	68	75.7
2	3	2	2	2	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	2	2.5	3	2.5	69	76.8
2	3	2	2	2	1.5	1.5	1.5	1.5	1.5	1.5	1.5	2	1.5	2	2.5	3	2.5	70	77.9
2	3	2	2	2	1.5	1.5	2	1.5	1.5	1.5	1.5	2	1.5	2	2.5	3	2.5	71	79.0
2.5	3	2	2	2	1.5	1.5	2	1.5	1.5	1.5	1.5	2	1.5	2	2.5	3	2.5	72	80.0
2.5	3	2	2	2	1.5	1.5	2	1.5	2	1.5	1.5	2	1.5	2	2.5	3	2.5	73	81.1
2.5	3	2	2	2	1.5	1.5	2	1.5	2	1.5	1.5	2	1.5	2	3	3	2.5	74	82.1
2.5	3	2	2	2	2	1.5	2	1.5	2	1.5	1.5	2	1.5	2	3	3	2.5	75	83.2
2.5	3	2	2	2	2	1.5	2	1.5	2	1.5	1.5	2	2	2	3	3	2.5	76	84.3
2.5	3	2	2	2	2	1.5	2	1.5	2	1.5	1.5	2	2	2	3	3	3	77	85.3
2.5	3	2	2	2	2	1.5	2	1.5	2	1.5	2	2	2	2	3	3	3	78	86.4
3	3	2	2	2	2	1.5	2	1.5	2	1.5	2	2	2	2	3	3	3	79	87.4
3	3	2.5	2	2	2	1.5	2	1.5	2	1.5	2	2	2	2	3	3	3	80	88.5
3	3	2.5	2	2	2	2	2	1.5	2	1.5	2	2	2	2	3	3	3	81	89.6
3	3	2.5	2	2	2	2	2	2	2	1.5	2	2	2	2	3	3	3	82	90.7
3	3	2.5	2	2	2	2	2	2	2	2	2	2	2	2	3	3	3	83	91.7
3	3	2.5	2	2.5	2	2	2	2	2	2	2	2	2	2	3	3	3	84	92.8
3	3	2.5	2.5	2.5	2	2	2	2	2	2	2	2	2	2	3	3	3	85	93.9
3	3	2.5	2.5	2.5	2	2	2	2	2	2	2	2	2.5	2	3	3	3	86	94.9
3	3	2.5	2.5	2.5	2	2	2	2	2	2	2	2	2.5	2.5	3	3	3	87	96.0
3	3.5	2.5	2.5	2.5	2	2	2	2	2	2	2	2	2.5	2.5	3	3	3	88	97.0
3	3.5	3	2.5	2.5	2	2	2	2	2	2	2	2	2.5	2.5	3	3	3	89	98.0
3	3.5	3	2.5	2.5	2	2	2	2	2	2	2	2	2.5	2.5	3	3.5	3	90	99.0
3	3.5	3	2.5	2.5	2.5	2	2	2	2	2	2	2	2.5	2.5	3	3.5	3	91	100.1
3	3.5	3	2.5	2.5	2.5	2	2	2	2	2	2	2	2.5	2.5	3.5	3.5	3	92	101.1
3	3.5	3	2.5	2.5	2.5	2.5	2	2	2	2	2	2	2.5	2.5	3.5	3.5	3	93	102.2
3	3.5	3	2.5	2.5	2.5	2.5	2	2	2	2	2	2	2.5	3	3.5	3.5	3	94	103.2
3	3.5	3	2.5	3	2.5	2.5	2	2	2	2	2	2	2.5	3	3.5	3.5	3	95	104.2

Table BON-15 (cont). Spill patterns for Bonneville Dam. Flows calculations updated 3/21/2005

Spillway Bay Number																		stops	FB=74.0
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	ft.	Kcfs
vertical gate opening (ft.)																			
3	3.5	3	3	3	2.5	2.5	2	2	2	2	2	2	2.5	3	3.5	3.5	3	96	105.3
3	3.5	3	3	3	2.5	2.5	2.5	2	2	2	2	2	2.5	3	3.5	3.5	3	97	106.3
3	3.5	3	3	3	2.5	2.5	2.5	2	2	2	2	2.5	2.5	3	3.5	3.5	3	98	107.4
3	3.5	3	3	3	2.5	2.5	2.5	2	2	2	2.5	2.5	2.5	3	3.5	3.5	3	99	108.5
3	3.5	3	3	3	2.5	2.5	2.5	2	2.5	2	2.5	2.5	2.5	3	3.5	3.5	3	100	109.5
3	3.5	3.5	3	3	2.5	2.5	2.5	2	2.5	2	2.5	2.5	2.5	3	3.5	3.5	3	101	110.5
3	3.5	3.5	3	3	2.5	2.5	2.5	2	2.5	2.5	2.5	2.5	2.5	3	3.5	3.5	3	102	111.6
3	3.5	3.5	3	3	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	3	3.5	3.5	3	103	112.6
3	3.5	3.5	3	3	3	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	3	3.5	3.5	3	104	113.7
3	3.5	3.5	3	3	3	3	2.5	2.5	2.5	2.5	2.5	2.5	2.5	3	3.5	3.5	3	105	114.7
3	3.5	3.5	3	3	3	3	2.5	2.5	2.5	2.5	2.5	2.5	2.5	3	3.5	3.5	3.5	106	115.7
3	3.5	3.5	3	3	3	3	2.5	2.5	2.5	2.5	2.5	2.5	2.5	3	3.5	4	3.5	107	116.7
3	3.5	3.5	3	3	3	3	3	2.5	2.5	2.5	2.5	2.5	2.5	3	3.5	4	3.5	108	117.8
3	3.5	3.5	3	3	3	3	3	2.5	2.5	2.5	2.5	2.5	3	3	3.5	4	3.5	109	118.8
3	3.5	3.5	3	3	3	3	3	2.5	2.5	2.5	2.5	3	3	3	3.5	4	3.5	110	119.8
3	3.5	3.5	3	3	3	3	3	2.5	2.5	3	2.5	3	3	3	3.5	4	3.5	111	120.9
3	3.5	3.5	3	3	3	3	3	2.5	2.5	3	3	3	3	3	3.5	4	3.5	112	121.9
3.5	3.5	3.5	3	3	3	3	3	2.5	2.5	3	3	3	3	3	3.5	4	3.5	113	122.9
3.5	3.5	3.5	3.5	3	3	3	3	2.5	2.5	3	3	3	3	3	3.5	4	3.5	114	124.0
3.5	3.5	3.5	3.5	3	3	3	3	2.5	2.5	3	3	3	3	3	3.5	4	4	115	124.9
3.5	3.5	3.5	3.5	3	3	3	3	2.5	2.5	3	3	3	3	3.5	3.5	4	4	116	126.0
3.5	3.5	3.5	3.5	3	3	3	3	2.5	2.5	3	3	3	3	3.5	4	4	4	117	127.0
3.5	3.5	3.5	3.5	3	3	3	3	2.5	3	3	3	3	3	3.5	4	4	4	118	128.0
3.5	3.5	3.5	3.5	3	3	3	3	3	3	3	3	3	3	3.5	4	4	4	119	129.0
3.5	4	3.5	3.5	3	3	3	3	3	3	3	3	3	3	3.5	4	4	4	120	130.0
3.5	4	4	3.5	3	3	3	3	3	3	3	3	3	3	3.5	4	4	4	121	131.0
4	4	4	3.5	3	3	3	3	3	3	3	3	3	3	3.5	4	4	4	122	132.0
4	4	4	4	3	3	3	3	3	3	3	3	3	3	3.5	4	4	4	123	133.0
4	4	4	4	3	3	3	3	3	3	3	3	3	3	4	4	4	4	124	134.0
4	4	4	4	3	3.5	3	3	3	3	3	3	3	3	4	4	4	4	125	135.0
4	4	4	4	3.5	3.5	3	3	3	3	3	3	3	3	4	4	4	4	126	136.1
4	4	4	4	3.5	3.5	3	3	3	3	3	3	3.5	3	4	4	4	4	127	137.1
4	4	4	4	3.5	3.5	3	3	3	3	3	3	3.5	3.5	4	4	4	4	128	138.1
4	4	4	4	3.5	3.5	3	3	3	3	3	3	3.5	3.5	4	4	4.5	4	129	139.1
4	4	4	4	3.5	3.5	3.5	3	3	3	3	3	3.5	3.5	4	4	4.5	4	130	140.1
4	4	4	4	3.5	3.5	3.5	3	3	3	3	3.5	3.5	3.5	4	4	4.5	4	131	141.1
4	4	4	4	3.5	3.5	3.5	3	3	3	3	3.5	3.5	3.5	4	4.5	4.5	4	132	142.1
4	4.5	4	4	3.5	3.5	3.5	3	3	3	3	3.5	3.5	3.5	4	4.5	4.5	4	133	143.1
4	4.5	4.5	4	3.5	3.5	3.5	3	3	3	3	3.5	3.5	3.5	4	4.5	4.5	4	134	144.0
4	4.5	4.5	4	3.5	3.5	3.5	3	3	3.5	3	3.5	3.5	3.5	4	4.5	4.5	4	135	145.1
4	4.5	4.5	4	3.5	3.5	3.5	3.5	3	3.5	3	3.5	3.5	3.5	4	4.5	4.5	4	136	146.1
4	4.5	4.5	4	3.5	3.5	3.5	3.5	3	3.5	3.5	3.5	3.5	3.5	4	4.5	4.5	4	137	147.1
4	4.5	4.5	4	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	4	4.5	4.5	4	138	148.1
4	4.5	4.5	4	4	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	4	4.5	4.5	4	139	149.1
4	4.5	4.5	4	4	4	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	4	4.5	4.5	4	140	150.1
4	4.5	4.5	4	4	4	3.5	3.5	3.5	3.5	3.5	3.5	3.5	4	4	4.5	4.5	4	141	151.1
4	4.5	4.5	4	4	4	4	3.5	3.5	3.5	3.5	3.5	3.5	4	4	4.5	4.5	4	142	152.1

Table BON-15 (cont). Spill patterns for Bonneville Dam. Flows calculations updated 3/21/2005

Spillway Bay Number																		stops	FB=74.0
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	ft.	Kcfs
vertical gate opening (ft.)																			
4	4.5	4.5	4	4	4	4	3.5	3.5	3.5	3.5	3.5	4	4	4	4.5	4.5	4	143	153.1
4	4.5	4.5	4	4	4	4	3.5	3.5	3.5	3.5	4	4	4	4	4.5	4.5	4	144	154.1
4	4.5	4.5	4	4	4	4	4	3.5	3.5	3.5	4	4	4	4	4.5	4.5	4	145	155.1
4	4.5	4.5	4	4	4	4	4	3.5	3.5	4	4	4	4	4	4.5	4.5	4	146	156.1
4	4.5	4.5	4	4	4	4	4	4	3.5	4	4	4	4	4	4.5	4.5	4	147	157.1
4	4.5	4.5	4	4	4	4	4	4	4	4	4	4	4	4	4.5	4.5	4	148	158.1
4	4.5	4.5	4.5	4	4	4	4	4	4	4	4	4	4	4	4.5	4.5	4	149	159.1
4	4.5	4.5	4.5	4	4	4	4	4	4	4	4	4	4	4.5	4.5	4.5	4	150	160.0
4	4.5	4.5	4.5	4.5	4	4	4	4	4	4	4	4	4	4.5	4.5	4.5	4	151	161.0
4	4.5	4.5	4.5	4.5	4	4	4	4	4	4	4	4	4.5	4.5	4.5	4.5	4	152	162.0
4	4.5	4.5	4.5	4.5	4.5	4	4	4	4	4	4	4	4.5	4.5	4.5	4.5	4	153	163.0
4	4.5	4.5	4.5	4.5	4.5	4	4	4	4	4	4	4.5	4.5	4.5	4.5	4.5	4	154	163.9
4	4.5	4.5	4.5	4.5	4.5	4	4	4	4	4	4	4.5	4.5	4.5	4.5	5	4	155	164.9
4	5	4.5	4.5	4.5	4.5	4	4	4	4	4	4	4.5	4.5	4.5	4.5	5	4	156	165.9
4	5	4.5	4.5	4.5	4.5	4	4	4	4	4	4.5	4.5	4.5	4.5	4.5	5	4	157	166.8
4	5	4.5	4.5	4.5	4.5	4.5	4	4	4	4	4.5	4.5	4.5	4.5	4.5	5	4	158	167.8
4	5	4.5	4.5	4.5	4.5	4.5	4	4	4	4	4.5	4.5	4.5	4.5	5	5	4	159	168.8
4	5	4.5	4.5	4.5	4.5	4.5	4	4	4	4.5	4.5	4.5	4.5	4.5	5	5	4	160	169.8
4	5	5	4.5	4.5	4.5	4.5	4	4	4	4.5	4.5	4.5	4.5	4.5	5	5	4	161	170.7
4	5	5	4.5	4.5	4.5	4.5	4	4	4	4.5	4.5	4.5	4.5	5	5	5	4	162	171.7
4	5	5	5	4.5	4.5	4.5	4	4	4	4.5	4.5	4.5	4.5	5	5	5	4	163	172.6
4	5	5	5	4.5	4.5	4.5	4	4.5	4	4.5	4.5	4.5	4.5	5	5	5	4	164	173.6
4	5	5	5	4.5	4.5	4.5	4	4.5	4	4.5	4.5	4.5	5	5	5	5	4	165	174.6
4	5	5	5	4.5	4.5	4.5	4.5	4.5	4	4.5	4.5	4.5	5	5	5	5	4	166	175.6
4	5	5	5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	5	5	5	5	4	167	176.5
4	5	5	5	4.5	5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	5	5	5	5	4	168	177.5
4	5	5	5	4.5	5	4.5	4.5	4.5	4.5	4.5	5	4.5	5	5	5	5	4	169	178.5
4	5	5	5	4.5	5	4.5	4.5	4.5	4.5	4.5	5	5	5	5	5	5	4	170	179.4
4	5	5	5	5	5	4.5	4.5	4.5	4.5	4.5	5	5	5	5	5	5	4	171	180.4
4	5	5	5	5	5	4.5	5	4.5	4.5	4.5	5	5	5	5	5	5	4	172	181.3
4	5	5	5	5	5	4.5	5	4.5	5	4.5	5	5	5	5	5	5	4	173	182.3
4	5	5	5	5	5	4.5	5	5	5	4.5	5	5	5	5	5	5	4	174	183.3
4	5	5	5	5	5	5	5	5	5	4.5	5	5	5	5	5	5	4	175	184.2
4	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	4	176	185.2
4	5.5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	4	177	186.1
4	5.5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5.5	4	178	187.1
4	5.5	5	5	5	5	5	5	5	5	5	5	5	5	5	5.5	5.5	4	179	188.0
4	5.5	5.5	5	5	5	5	5	5	5	5	5	5	5	5	5.5	5.5	4	180	189.0
4	5.5	5.5	5	5.5	5	5	5	5	5	5	5	5	5	5	5.5	5.5	4	181	189.9
4	5.5	5.5	5	5.5	5	5	5	5	5	5	5	5	5	5.5	5.5	5.5	4	182	190.8
4	5.5	5.5	5.5	5.5	5	5	5	5	5	5	5	5	5	5.5	5.5	5.5	4	183	191.8
4	5.5	5.5	5.5	5.5	5	5	5	5	5.5	5	5	5	5	5.5	5.5	5.5	4	184	192.7
4	5.5	5.5	5.5	5.5	5	5	5.5	5	5.5	5	5	5	5	5.5	5.5	5.5	4	185	193.7
4	5.5	5.5	5.5	5.5	5	5	5.5	5	5.5	5	5	5.5	5	5.5	5.5	5.5	4	186	194.6
4	5.5	5.5	5.5	5.5	5	5	5.5	5.5	5.5	5	5	5.5	5	5.5	5.5	5.5	4	187	195.6
4	5.5	5.5	5.5	5.5	5.5	5	5.5	5.5	5.5	5	5	5.5	5	5.5	5.5	5.5	4	188	196.5
4	5.5	5.5	5.5	5.5	5.5	5	5.5	5.5	5.5	5	5.5	5.5	5	5.5	5.5	5.5	4	189	197.5

Table BON-15 (cont). Spill patterns for Bonneville Dam. Flows calculations updated 3/21/2005

Spillway Bay Number																		stops	FB=74.0
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	ft.	Kcfs
vertical gate opening (ft.)																			
4	5.5	5.5	5.5	5.5	5.5	5	5.5	5.5	5.5	5	5.5	5.5	5.5	5.5	5.5	5.5	4	190	198.4
4	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5	5.5	5.5	5.5	5.5	5.5	5.5	4	191	199.3
4	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	4	192	200.3
4	5.5	5.5	5.5	6	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	4	193	201.2
4	5.5	5.5	5.5	6	5.5	5.5	5.5	5.5	5.5	5.5	5.5	6	5.5	5.5	5.5	5.5	4	194	202.1
4	5.5	5.5	5.5	6	5.5	5.5	5.5	5.5	5.5	5.5	6	6	5.5	5.5	5.5	5.5	4	195	203.1
4	5.5	5.5	5.5	6	6	5.5	5.5	5.5	5.5	5.5	6	6	5.5	5.5	5.5	5.5	4	196	204.0
4	5.5	5.5	5.5	6	6	5.5	6	5.5	5.5	5.5	6	6	5.5	5.5	5.5	5.5	4	197	204.9
4	5.5	5.5	5.5	6	6	5.5	6	5.5	6	5.5	6	6	5.5	5.5	5.5	5.5	4	198	205.9
4	6	5.5	5.5	6	6	5.5	6	5.5	6	5.5	6	6	5.5	5.5	5.5	5.5	4	199	206.8
4	6	5.5	5.5	6	6	5.5	6	5.5	6	5.5	6	6	5.5	5.5	5.5	6	4	200	207.7
4	6	5.5	5.5	6	6	5.5	6	5.5	6	5.5	6	6	5.5	5.5	6	6	4	201	208.6
4	6	6	5.5	6	6	5.5	6	5.5	6	5.5	6	6	5.5	5.5	6	6	4	202	209.6
4	6	6	5.5	6	6	5.5	6	5.5	6	5.5	6	6	6	5.5	6	6	4	203	210.5
4	6	6	5.5	6	6	5.5	6	5.5	6	5.5	6	6	6	5.5	6	6	4.5	204	211.5
4.5	6	6	5.5	6	6	5.5	6	5.5	6	5.5	6	6	6	5.5	6	6	4.5	205	212.4
4.5	6	6	6	6	6	5.5	6	5.5	6	5.5	6	6	6	5.5	6	6	4.5	206	213.4
4.5	6	6	6	6	6	5.5	6	5.5	6	5.5	6	6	6	6	6	6	4.5	207	214.3
4.5	6	6	6	6	6	5.5	6	6	6	5.5	6	6	6	6	6	6	4.5	208	215.2
4.5	6	6	6	6	6	6	6	6	6	5.5	6	6	6	6	6	6	4.5	209	216.2
4.5	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	4.5	210	217.1
4.5	6	6	6	6.5	6	6	6	6	6	6	6	6	6	6	6	6	4.5	211	218.0
4.5	6	6	6	6.5	6	6	6	6	6	6	6	6.5	6	6	6	6	4.5	212	218.9
4.5	6	6	6	6.5	6	6	6	6	6	6	6.5	6.5	6	6	6	6	4.5	213	219.8
4.5	6	6	6	6.5	6.5	6	6	6	6	6	6.5	6.5	6	6	6	6	4.5	214	220.7
4.5	6	6	6	6.5	6.5	6	6.5	6	6	6	6.5	6.5	6	6	6	6	4.5	215	221.6
4.5	6	6	6	6.5	6.5	6	6.5	6	6	6	6.5	6.5	6	6	6	6.5	4.5	216	222.6
4.5	6.5	6	6	6.5	6.5	6	6.5	6	6	6	6.5	6.5	6	6	6	6.5	4.5	217	223.5
4.5	6.5	6	6	6.5	6.5	6	6.5	6	6	6	6.5	6.5	6	6	6.5	6.5	4.5	218	224.4
4.5	6.5	6.5	6	6.5	6.5	6	6.5	6	6	6	6.5	6.5	6	6	6.5	6.5	4.5	219	225.3
4.5	6.5	6.5	6	6.5	6.5	6	6.5	6	6.5	6	6.5	6.5	6	6	6.5	6.5	4.5	220	226.2
4.5	6.5	6.5	6	6.5	6.5	6	6.5	6	6.5	6	6.5	6.5	6	6.5	6.5	6.5	4.5	221	227.1
4.5	6.5	6.5	6.5	6.5	6.5	6	6.5	6	6.5	6	6.5	6.5	6	6.5	6.5	6.5	4.5	222	228.0
4.5	6.5	6.5	6.5	6.5	6.5	6	6.5	6	6.5	6	6.5	6.5	6.5	6.5	6.5	6.5	4.5	223	228.9
4.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6	6.5	6	6.5	6.5	6.5	6.5	6.5	6.5	4.5	224	229.9
4.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	4.5	225	230.8
4.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	4.5	226	231.7
4.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	5	227	232.6
5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	5	228	233.6
5	6.5	6.5	6.5	7	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	5	229	234.5
5	6.5	6.5	6.5	7	6.5	6.5	6.5	6.5	6.5	6.5	6.5	7	6.5	6.5	6.5	6.5	5	230	235.4
5	6.5	6.5	6.5	7	6.5	6.5	6.5	6.5	6.5	6.5	7	7	6.5	6.5	6.5	6.5	5	231	236.3
5	6.5	6.5	6.5	7	7	6.5	6.5	6.5	6.5	6.5	7	7	6.5	6.5	6.5	6.5	5	232	237.2
5	6.5	6.5	6.5	7	7	6.5	7	6.5	6.5	6.5	7	7	6.5	6.5	6.5	6.5	5	233	238.1
5	6.5	6.5	6.5	7	7	6.5	7	6.5	6.5	6.5	7	7	6.5	6.5	6.5	7	5	234	239.0
5	7	6.5	6.5	7	7	6.5	7	6.5	6.5	6.5	7	7	6.5	6.5	6.5	7	5	235	239.9
5	7	6.5	6.5	7	7	6.5	7	6.5	6.5	6.5	7	7	6.5	6.5	7	7	5	236	240.8

Table BON-15 (cont). Spill patterns for Bonneville Dam. Flows calculations updated 3/21/2005

Spillway Bay Number																		stops	FB=74.0
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	ft.	Kcfs
vertical gate opening (ft.)																			
5	7	7	6.5	7	7	6.5	7	6.5	6.5	6.5	7	7	6.5	6.5	7	7	5	237	241.7
5	7	7	6.5	7	7	6.5	7	6.5	7	6.5	7	7	6.5	6.5	7	7	5	238	242.6
5	7	7	6.5	7	7	6.5	7	6.5	7	6.5	7	7	6.5	7	7	7	5	239	243.5
5	7	7	7	7	7	6.5	7	6.5	7	6.5	7	7	6.5	7	7	7	5	240	244.4
5	7	7	7	7	7	6.5	7	6.5	7	6.5	7	7	7	7	7	7	5	241	245.3
5	7	7	7	7	7	7	7	6.5	7	6.5	7	7	7	7	7	7	5	242	246.2
5	7	7	7	7	7	7	7	6.5	7	7	7	7	7	7	7	7	5	243	247.1
5	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	5	244	248.0
5	7	7	7	7.5	7	7	7	7	7	7	7	7	7	7	7	7	5	245	248.8
5	7	7	7	7.5	7	7	7	7	7	7	7	7.5	7	7	7	7	5	246	249.7
5	7	7	7	7.5	7	7	7	7	7	7	7.5	7.5	7	7	7	7	5	247	250.6
5	7	7	7	7.5	7.5	7	7	7	7	7	7.5	7.5	7	7	7	7	5	248	251.5
5	7	7	7	7.5	7.5	7	7.5	7	7	7	7.5	7.5	7	7	7	7	5	249	252.4
5	7	7	7	7.5	7.5	7	7.5	7	7	7	7.5	7.5	7	7	7.5	7	5	250	253.3
5	7	7.5	7	7.5	7.5	7	7.5	7	7	7	7.5	7.5	7	7	7.5	7	5	251	254.1
5	7	7.5	7	7.5	7.5	7	7.5	7	7.5	7	7.5	7.5	7	7	7.5	7	5	252	255.0
5	7	7.5	7	7.5	7.5	7	7.5	7	7.5	7	7.5	7.5	7	7.5	7.5	7	5	253	255.9
5	7	7.5	7.5	7.5	7.5	7	7.5	7	7.5	7	7.5	7.5	7	7.5	7.5	7	5	254	256.8
5	7	7.5	7.5	7.5	7.5	7	7.5	7	7.5	7	7.5	7.5	7.5	7.5	7.5	7	5	255	257.7
5	7	7.5	7.5	7.5	7.5	7.5	7.5	7	7.5	7	7.5	7.5	7.5	7.5	7.5	7	5	256	258.6
5	7	7.5	7.5	7.5	7.5	7.5	7.5	7	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7	5	257	259.5
5	7	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7	5	258	260.3
5	7	7.5	7.5	8	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7	5	259	261.2
5	7	7.5	7.5	8	7.5	7.5	7.5	7.5	7.5	7.5	7.5	8	7.5	7.5	7.5	7	5	260	262.1
5	7	7.5	7.5	8	7.5	7.5	7.5	7.5	7.5	7.5	8	8	7.5	7.5	7.5	7	5	261	262.9
5	7	7.5	7.5	8	8	7.5	7.5	7.5	7.5	7.5	8	8	7.5	7.5	7.5	7	5	262	263.8
5	7	7.5	7.5	8	8	7.5	8	7.5	7.5	7.5	8	8	7.5	7.5	7.5	7	5	263	264.7
5	7	7.5	7.5	8	8	7.5	8	7.5	7.5	7.5	8	8	7.5	7.5	7.5	7.5	5	264	265.6
5	7.5	7.5	7.5	8	8	7.5	8	7.5	7.5	7.5	8	8	7.5	7.5	7.5	7.5	5	265	266.5
5	7.5	7.5	7.5	8	8	7.5	8	7.5	7.5	7.5	8	8	7.5	7.5	8	7.5	5	266	267.3
5	7.5	8	7.5	8	8	7.5	8	7.5	7.5	7.5	8	8	7.5	7.5	8	7.5	5	267	268.2
5	7.5	8	7.5	8	8	7.5	8	7.5	8	7.5	8	8	7.5	7.5	8	7.5	5	268	269.1
5	7.5	8	7.5	8	8	7.5	8	7.5	8	7.5	8	8	7.5	8	8	7.5	5	269	269.9
5	7.5	8	8	8	8	7.5	8	7.5	8	7.5	8	8	7.5	8	8	7.5	5	270	270.8
5	7.5	8	8	8	8	7.5	8	7.5	8	7.5	8	8	8	8	8	7.5	5	271	271.7
5	7.5	8	8	8	8	8	8	7.5	8	7.5	8	8	8	8	8	7.5	5	272	272.5
5	7.5	8	8	8	8	8	8	7.5	8	8	8	8	8	8	8	7.5	5	273	273.4
5	7.5	8	8	8	8	8	8	8	8	8	8	8	8	8	8	7.5	5	274	274.3
5	7.5	8	8	8.5	8	8	8	8	8	8	8	8	8	8	8	7.5	5	275	275.1
5	7.5	8	8	8.5	8	8	8	8	8	8	8	8.5	8	8	8	7.5	5	276	276.0
5	7.5	8	8	8.5	8	8	8	8	8	8	8.5	8.5	8	8	8	7.5	5	277	276.9
5	7.5	8	8	8.5	8.5	8	8	8	8	8	8.5	8.5	8	8	8	7.5	5	278	277.7
5	7.5	8	8	8.5	8.5	8	8.5	8	8	8	8.5	8.5	8	8	8	7.5	5	279	278.6
5	7.5	8	8	8.5	8.5	8	8.5	8	8	8	8.5	8.5	8	8	8	8	5	280	279.5
5	8	8	8	8.5	8.5	8	8.5	8	8	8	8.5	8.5	8	8	8	8	5	281	280.3
5	8	8	8	8.5	8.5	8	8.5	8	8	8	8.5	8.5	8	8	8.5	8	5	282	281.2
5	8	8.5	8	8.5	8.5	8	8.5	8	8	8	8.5	8.5	8	8	8.5	8	5	283	282.0

Table BON-15 (cont). Spill patterns for Bonneville Dam. Flows calculations updated 3/21/2005

Spillway Bay Number																		stops	FB=74.0
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	ft.	Kcfs
vertical gate opening (ft.)																			
5	8	8.5	8	8.5	8.5	8	8.5	8	8.5	8	8.5	8.5	8	8	8.5	8	5	284	282.9
5	8	8.5	8	8.5	8.5	8	8.5	8	8.5	8	8.5	8.5	8	8.5	8.5	8	5	285	283.8
5	8	8.5	8.5	8.5	8.5	8	8.5	8	8.5	8	8.5	8.5	8	8.5	8.5	8	5	286	284.6
5	8	8.5	8.5	8.5	8.5	8	8.5	8	8.5	8	8.5	8.5	8.5	8.5	8.5	8	5	287	285.5
5	8	8.5	8.5	8.5	8.5	8.5	8.5	8	8.5	8	8.5	8.5	8.5	8.5	8.5	8	5	288	286.3
5	8	8.5	8.5	8.5	8.5	8.5	8.5	8	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8	5	289	287.2
5	8	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8	5	290	288.1
5	8	8.5	8.5	9	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8	5	291	288.9
5	8	8.5	8.5	9	8.5	8.5	8.5	8.5	8.5	8.5	8.5	9	8.5	8.5	8.5	8	5	292	289.7
5	8	8.5	8.5	9	8.5	8.5	8.5	8.5	8.5	8.5	9	9	8.5	8.5	8.5	8	5	293	290.6
5	8	8.5	8.5	9	9	8.5	8.5	8.5	8.5	8.5	9	9	8.5	8.5	8.5	8	5	294	291.4
5	8	8.5	8.5	9	9	8.5	9	8.5	8.5	8.5	9	9	8.5	8.5	8.5	8	5	295	292.3
5	8	8.5	8.5	9	9	8.5	9	8.5	8.5	8.5	9	9	8.5	8.5	8.5	8.5	5	296	293.1
5	8	8.5	8.5	9	9	8.5	9	8.5	8.5	8.5	9	9	8.5	8.5	9	8.5	5	297	294.0
5	8	9	8.5	9	9	8.5	9	8.5	8.5	8.5	9	9	8.5	8.5	9	8.5	5	298	294.8
5	8	9	8.5	9	9	8.5	9	8.5	9	8.5	9	9	8.5	8.5	9	8.5	5	299	295.7
5	8	9	8.5	9	9	8.5	9	8.5	9	8.5	9	9	8.5	9	9	8.5	5	300	296.5

Section 3 The Dalles Dam

The Dalles Dam

1. Fish Passage Information.

The locations of fish passage facilities at The Dalles Dam are shown on **Figures TDA-1 through TDA-3**. Dates for project operations for fish purposes and special operations are listed in **Table TDA-2**.

1.1. Juvenile Fish Passage.

1.1.1. Facilities Description. Turbine units at The Dalles Dam are not screened. Juvenile fish passage consists of the ice and trash sluiceway and one 6”-orifice in each gatewell. All 6” orifices will be closed as units are dewatered. Currently unit 1 orifice is closed. The ice and trash sluiceway is a rectangular channel extending along the total length of the 22-unit powerhouse and is located in the forebay side of the powerhouse. Gatewell orifices allow flow into the sluiceway, providing a potential means of passing fish from the gatewells to the sluiceway. When any of the sluiceway gates (located in the forebay side of the sluiceway) are opened, water and juvenile migrants are skimmed from the forebay into the sluiceway and deposited in the tailrace downstream of the project.

1.1.2. Juvenile Migration Timing. The primary juvenile fish passage period at The Dalles Dam is April through November. Currently juvenile migration timing is monitored by PSMFC at John Day Dam. **Table JDA-2** in section 4 of the FPP reports data from 1994 to 2006. Since no juvenile monitoring is done at The Dalles Dam, refer to this table, and add approximately 1 day to the dates reported for each species to estimate juvenile fish arrival at The Dalles.

1.1.2.1. Diel passage at The Dalles sluiceway is affected by spill and flow conditions. In years of consistently high flow and spill, fish may be distributed higher in the water column and daytime passage may increase.

1.2. Adult Fish Passage.

1.2.1. Facilities Description. Adult fish passage facilities at The Dalles Dam are composed of a north shore fish ladder, which passes fish collected at the north end of the spillway, and an east fish ladder that passes those fish collected at the south end of the spillway and across the downstream face of the powerhouse.

1.2.1.1. A small hydropower facility, utilizing the north fishway ladder auxiliary water supply, was constructed in 1991 and is operated by the North Wasco PUD. Adult fishway criteria associated with this facility are monitored and maintained during the daily fishway inspections. A backup auxiliary water supply system, unscreened for juveniles has been upgraded to facilitate its use if required.

1.2.2. Adult Migration Timing and Counting. Upstream migrants are present at The Dalles Dam throughout the year and adult passage facilities are operated year round. Adult fish (salmon, steelhead, shad, and lamprey) are normally counted from February 20 through December 7 (**Table TDA-2**), and these data appear daily (or every three days during video counting periods) on the Corps adult count website. Migration timing data for these species, except shad, appear in **Table TDA-3**. Sturgeon and bull trout are also counted and recorded on the WDFW fish counters' daily summary sheet comments section, and these data are summarized in the Annual Fish Passage Report, but do not appear on the Corps daily website total due to relative infrequency of passage.

1.2.2.1. The adult fish counting schedule is shown in Table TDA-1.

Table TDA-1. Adult fish counting schedule at The Dalles Dam.

Period	Counting Method
April 1 – October 31	Visual count 0400 - 2000 PST

1.2.2.2. Annual winter maintenance of adult fish facilities is scheduled from December 1 through February (in-water work period) to minimize impacts on upstream migrants.

1.2.2.3. Adult fish migration timing has been calculated for The Dalles Dam from count data collected by the Corps since 1957. Table TDA-2 summarizes adult fish passage timing through 2006. The primary passage period and the earliest and latest peaks of migration recorded are listed for each species (except shad). Peak lamprey migration timing for only the years 2000-2006 appears in this table.

Table TDA-2. The Dalles Dam adult migration timing, 1957-2007.

Species	Count Period	Earliest Peak	Latest Peak
Spring Chinook	4/1 - 6/3	4/13	5/13
Summer Chinook	6/4 - 8/3	6/6	8/1
Fall Chinook	8/4 – 10/31	9/2	9/23
Sockeye	4/1 – 10/31	6/20	7/10
Steelhead	4/1 – 10/31	7/9	9/23
Coho	4/1 – 10/31	9/3	10/25
Lamprey	4/1 – 10/31	7/14	8/1

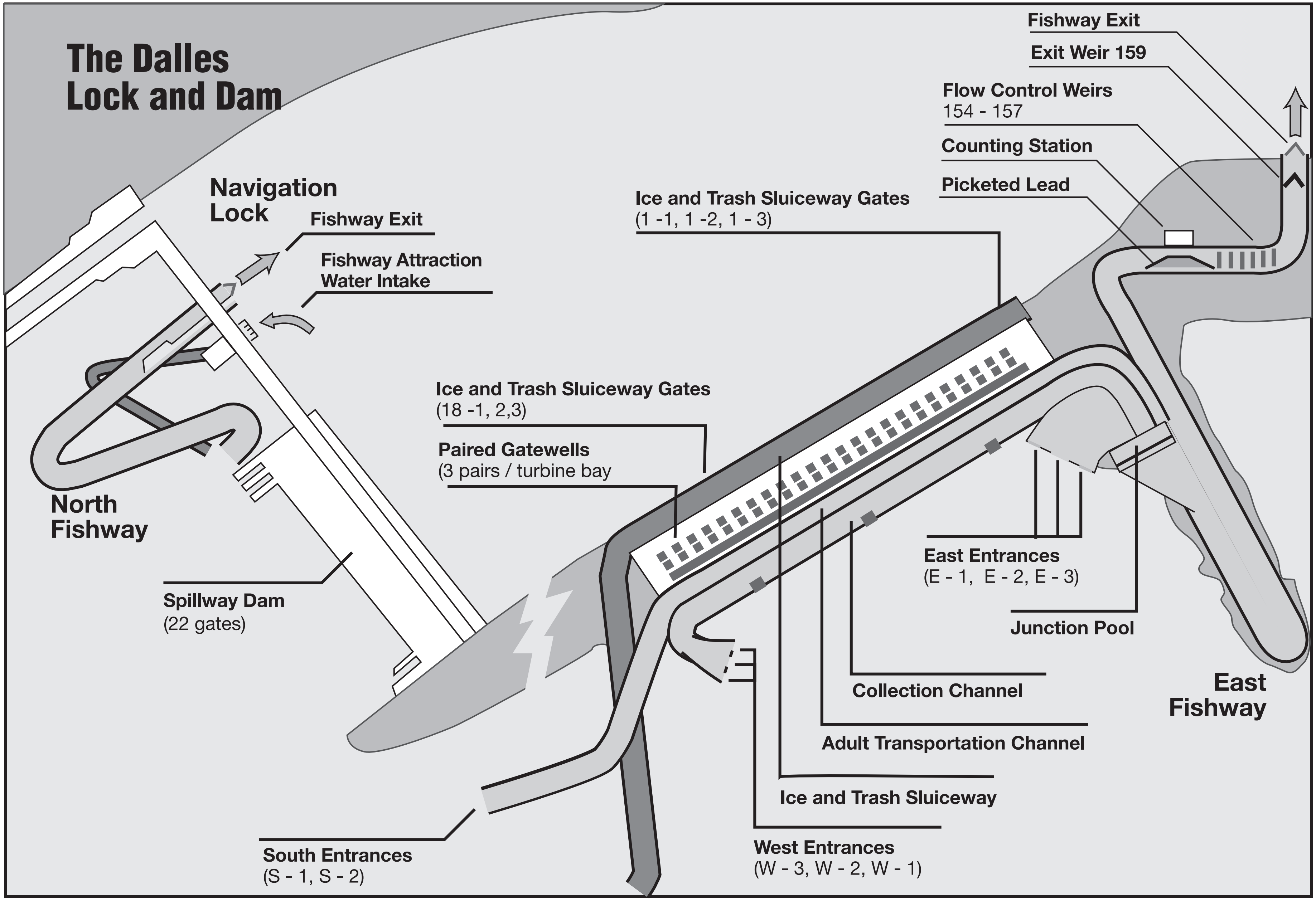


Figure TDA-1 The Dalles Dam.

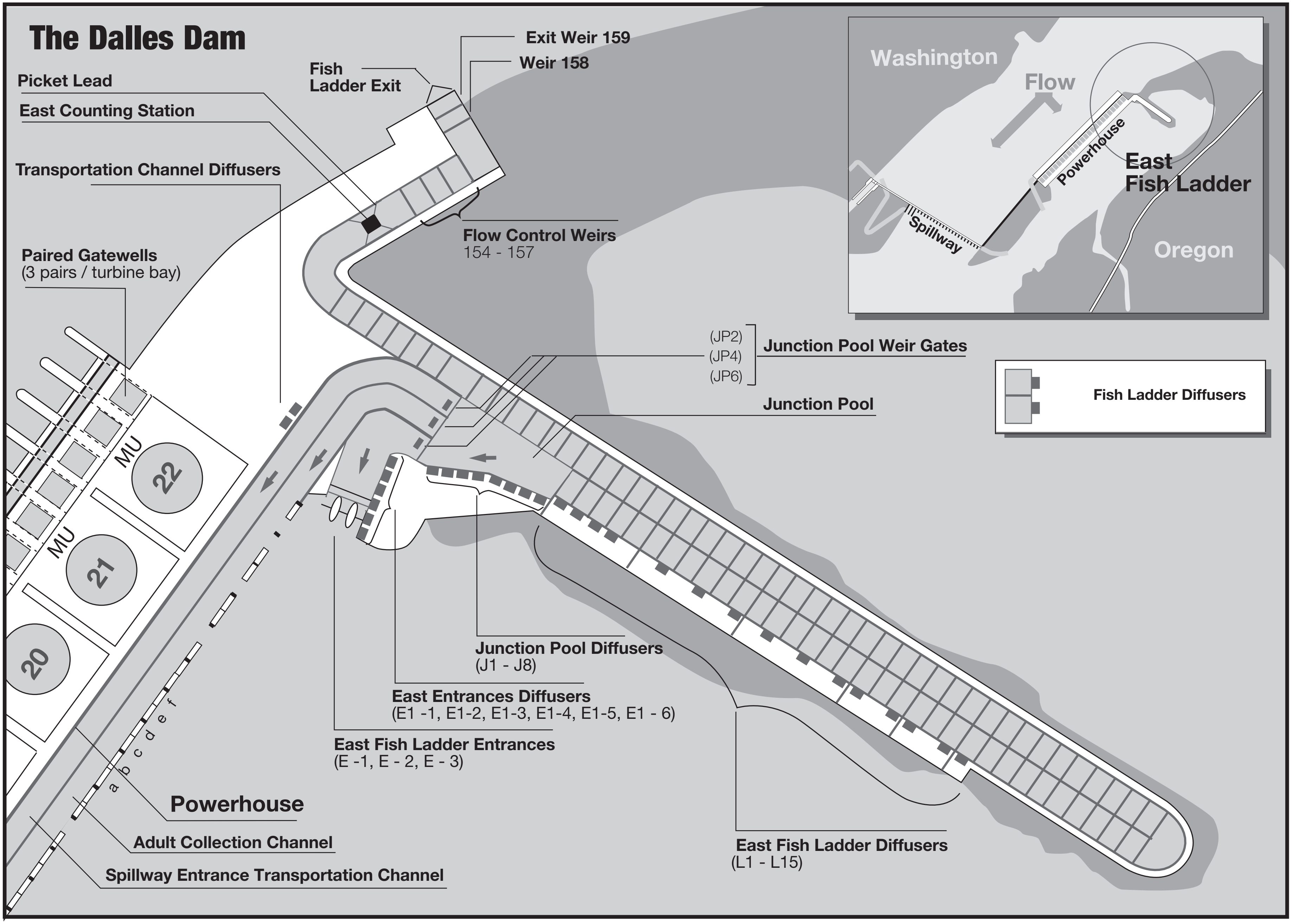


Figure TDA-2 The Dalles Dam East Fish Ladder.

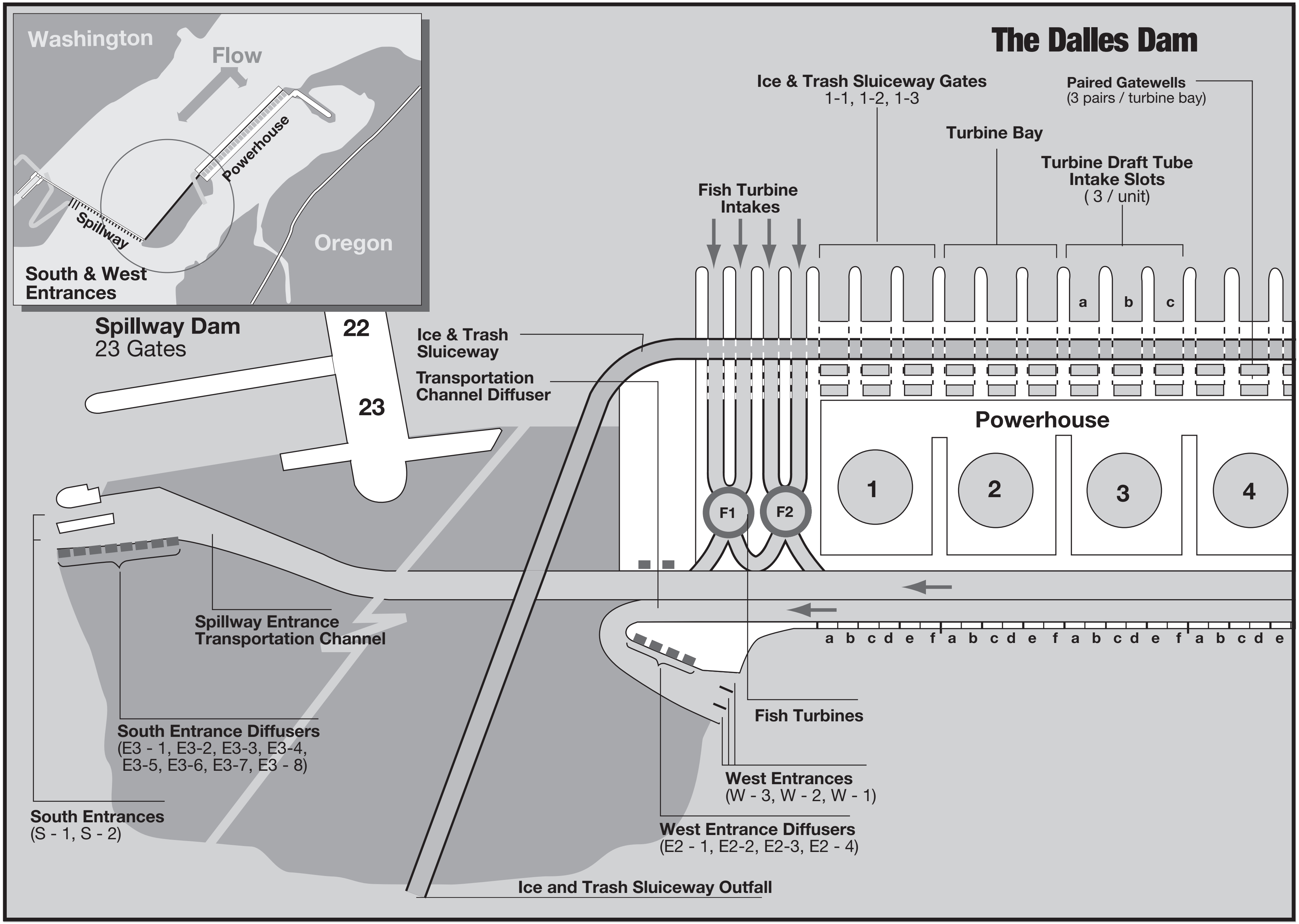


Figure TDA-3 The Dalles Dam South and West Fish Ladder Entrances.

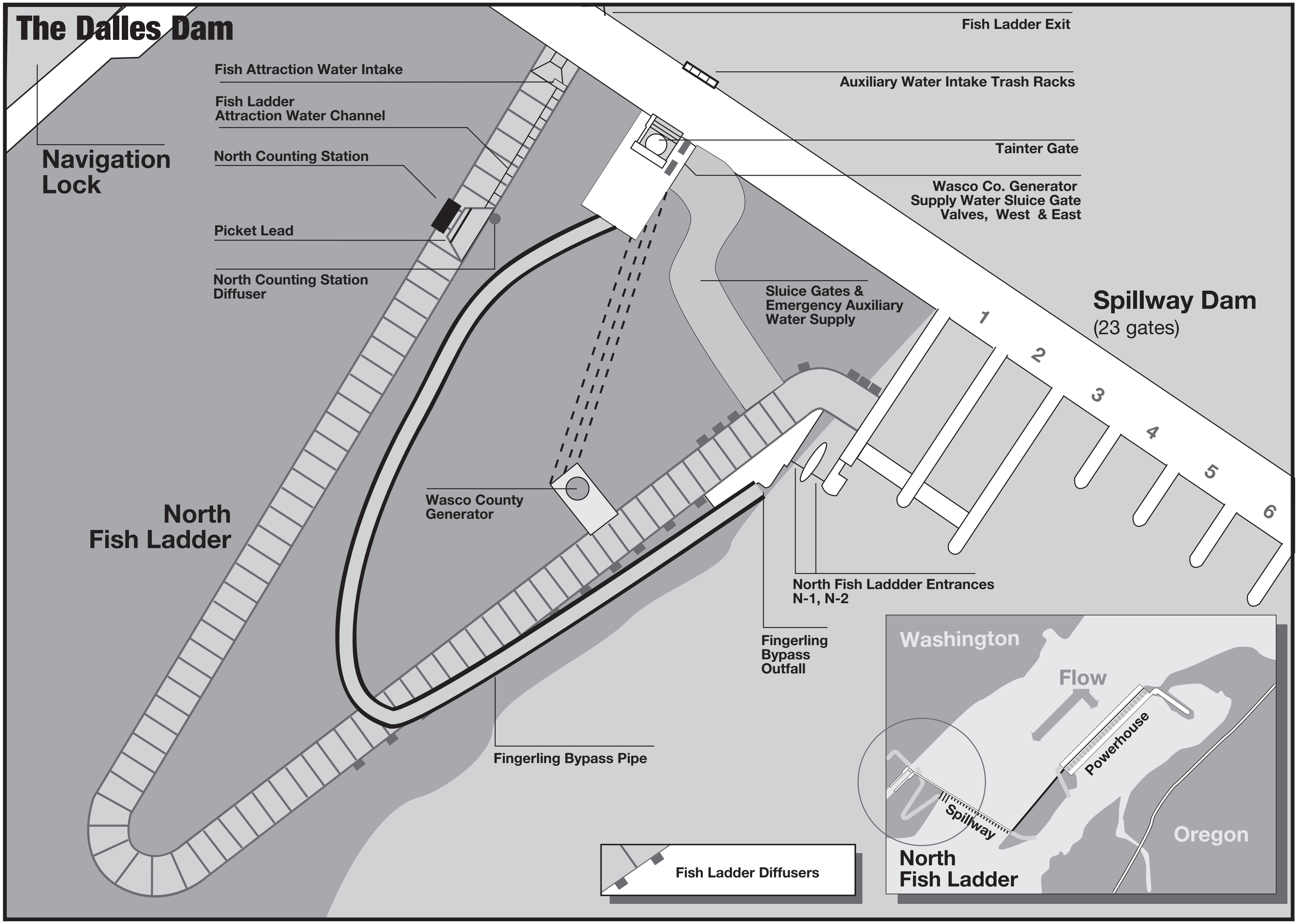
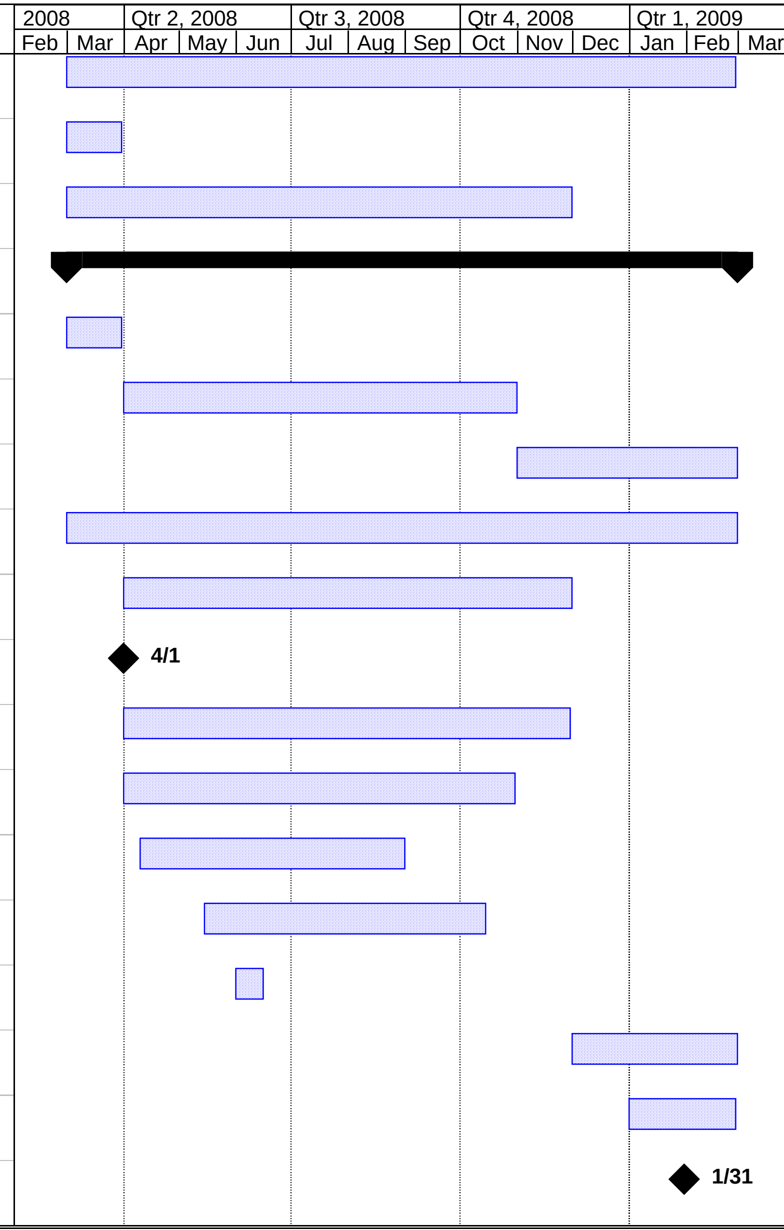


Figure TDA-4 The Dalles Dam North Fish Ladder and Spillway.

Table TDA-3. Dates of project operations for fish purposes at The Dalles, 2008-9

March 2008

Task Name	Start	Finish	FPP Reference
TDG Monitoring	3/1/08	2/28/09	App D Table 4
Juvenile Fish Maintenance Season	3/1/08	3/31/08	Tda 2.4.1.1
Adult Fish Passage Period	3/1/08	11/30/08	Tda 2.5.1.2
1% limitations	**3/1/08**	**2/28/09**	**Tda 5.4**
1% soft	3/1/08	3/31/08	Tda 5.4
1% hard	4/1/08	10/31/08	Tda 5.4
1% soft	11/1/08	2/28/09	Tda 5.4
Weekly Reports	3/1/08	2/28/09	Tda 3.3.1
Juvenile Passage Period	4/1/08	11/30/08	Tda 1.1.2
Avian Abatement in Place	4/1/08	4/1/08	Tda 2.4.1.1 e
Operate Ice and Trash Chute	4/1/08	11/30/08	Tda 2.4.1.2 e
Adult Fish Counting Visual 0400 -2000 PST	4/1/08	10/31/08	Tda 1.2.2.1
Spill for Fish	4/10/08	8/31/08	App E
Adult Lamprey Study	5/15/08	10/15/08	App A Tda 2.1
Rake Trash Racks Again	6/1/08	6/15/08	Tda 2.4.1.2 a
Winter Maintenance Adult Facilities	12/1/08	2/28/09	Tda 1.2.2.2
Juvenile Fish Maintenance Season	1/1/09	2/28/09	Tda 2.4.1.1
Annual Report	1/31/09	1/31/09	Tda 3.3.4



2. Project Operation.

2.1. General.

2.1.1. Research, non-routine maintenance, other fish related activities, and construction activities will not be conducted within 100' of any fishway entrance or exit, or within 50' of any other part of the adult fishway, or directly in, above, or adjacent to any fishway, unless coordinated by the project, Portland District Operations and/or Planning, or CENWP Construction office through Fish Passage Operation and Maintenance Team (FPOM) and Fish Facility Design and Review Work Group (FFDRWG). Currently coordinated special operations related to research are described in Appendix A. Alternate actions will be considered by district and project biologists in conjunction with the Regional fish agencies on a case by case basis.

2.1.2. Emergency situations should be dealt with immediately by the project in coordination with the project or district biologist. If unavailable, the biologists will be informed of steps taken to correct the situation immediately following the incident. All activities within the boat-restricted zone (BRZ) will be coordinated at least 2 weeks in advance with the project, unless it is deemed an emergency (see also Overview for coordination guidance.)

2.1.3. All fish passage related equipment and operation will be inspected twice daily.

2.2. Spill Management. See the 2008 Fish Operations Plan (Appendix E) for more information. The spill schedules contained in the spreadsheet titled "TDASpillPatterns04.xls" will be utilized to provide spill for juvenile fish passage in 2008. Spill during 2008 will only be provided through operating bays 1-9, with priority given to bays 1-6 to protect juvenile migrants from piscivorous and avian predation. Bays 10-13 will be put on seal. A summary of the spill patterns is provided in Table TDA-5.

2.3. Total Dissolved Gas Management and Control. Total dissolved gas (TDG) levels at The Dalles are monitored in accordance with the Dissolved Gas Monitoring Program, Appendix D.

2.3.1. Excessive TDG levels, which may harm fish, will be controlled to the extent possible, subject to river flow conditions. Control measures will include system spill allocations through the spill priority list issued by Reservoir Control Center (RCC), nighttime or daytime spill limits, and shaping of spill discharge.

2.4. Juvenile Fish Passage Facilities.

2.4.1. Operating Criteria.

2.4.1.1. December 1 through March 31 (Winter Maintenance Period)

a. With the use of an ROV, inspect trashracks and main unit intakes, and if necessary, remove debris from forebay, trashracks, gatewell slots, and gatewell orifices such that these areas are free of debris on April 1.

b. Inspect, lubricate, and test hoist-operated chain gates, end gates, and hoists for operation as needed.

c. Inspect and correct any epoxy or concrete deficiencies on the ice and trash sluiceway walls and floors, where accessible.

d. Inspect and, where necessary, repair spill gates and control systems. The spillway, except for coordinated changes, must be able to achieve spill patterns on April 1.

e. Reinstall or repair avian predator control lines as soon as possible following damage or removal. Install and maintain new avian predator control lines in locations determined to be significantly impacted by avian predators. Avian abatement measures shall be in place by April 1 unless this work is delayed because of inclement weather. If this occurs, the work will be completed as soon as the weather permits after that date. Hazing will be implemented 4/1-9/30. However, there will be no avian abatement measures, other than avian lines, performed from September through March each year.

f. December 1 through February (per January 2004 FPOM agreement), discontinue operation of the Ice-Trash Sluiceway on a 24 hour basis. Close endgate, and open sluice gates 1-1 and 17-3 to allow fish egress from the ITS that has equalized with the forebay.

g During March, set top of bottom endgate at elevation 142' to create an orifice plunge pool. Maintain orifices clear of debris.

2.4.1.2. April 1 through November 30 (Fish Passage Season).

a. Measure gatewell drawdown a minimum of once per week, and more frequently, three times per week or more, as needed during high debris periods. Clean trashracks as flow conditions dictate, or when drawdown in gatewell slots exceeds 1.5''. Rake trashracks in front of turbine units FU-1 through at least main unit 5 again between June 1 and June 15. All trashracks can be raked using the Hammerhead crane.

b. Remove debris from the forebay as needed by operating sluiceway.

c. Inspect all gatewells daily. The project will clean gatewells before the gatewell water surface becomes half covered with debris. If, due to the volume of debris, it is not possible to keep the gatewell surfaces at least clear, they will be cleaned at least once daily. Turbines with a gatewell fully covered with debris will not be operated except to be in compliance with other coordinated fish measures, and then only on a last on/first off basis.

d. Project maintenance will permanently close the gate slot orifices as the unit intakes are serviced over the next few years, utilizing orifice plates as covers.

e. Open ice and trash sluiceway (ITS) gates 1-1, 1-2, and 1-3 over operating Main Unit-1, and sluiceway gates 5-3, 18-2, and 18-3 over operating Main Unit 18. If either of these main units is out of service, operate the next available main unit and associated gates adjacent to these units, (i.e. operate MU-2 w/gates if MU-1 is OOS, and operate MU-17 w/gates **or** MU-19 w/gates if MU-18 is OOS). The ice and trash sluiceway will be operated on a 24-hour basis April 1 through November. From December 1 through the end of February, put the ITS on seal (do not operate). During periods when gates do not operate, set the top of the bottom end gate at elevation 142' to create an orifice plunge pool.

f. When units are being dewatered, set top of bottom end gate at an elevation to create an orifice plunge pool, and install orifice blocker. After orifice-sealing devices are installed, end gate should be returned to the open position during the juvenile passage season.

g. Efforts should be made to keep all petroleum out of gatewells. Project environmental section will determine cleanup efforts if needed. Regardless of unit operating status, oil accumulations will be dealt with promptly.

h. Reinstall or repair avian predator control lines as soon as possible following damage or removal. Install and maintain new avian predator control lines in locations determined to be significantly impacted by avian predators. Implement avian hazing measures as necessary from April through September only.

i. Follow the schedule in **Table TDA-5** for spill. This schedule was developed for juvenile fish passage.

2.5. Adult Fish Passage Facilities.

2.5.1. Operating Criteria.

2.5.1.1. December 1 through February (Winter Maintenance Period).

a. Inspect and calibrate all staff gages and water level indicators. Repair and/or clean where necessary.

b. Dewater all ladders and inspect for projections, debris, or plugged orifices that could injure fish or slow their progress up the ladder. Make necessary repairs and complete preventative maintenance.

c. Pull exit trashracks and inspect and clear debris from the ladder exits.

d. Inspect count station equipment and assure operational. Reinstall picket leads at counting stations prior to watering up the ladders. Ensure the leads are properly seated.

2.5.1.2. March 1 through November 30 (Fish Passage Season).

a. All Adult Facilities.

1. Water depth over fish ladder weirs: 1.0’ +/- 0.1'. During the shad passage season (> 5000 shad/count station/day): 1.3’ +/- 0.1’. (See **2.5.1.2.b.2**. and **3**. for an exception).

2. Water temperatures will be measured in count station of each adult fishway and station service penstock. Temperatures will be recorded in the fishway status report. When water temperature reaches 70^{o} F, all fish handling activities will be coordinated through FPOM prior to any action to verify protocols that will be followed.

3. Head on all entrances: 1' to 2' (1.5’ optimum). Refer to paragraph **3.3.1**., Routine Maintenance, when unable to achieve head criteria.

4. A water velocity of 1.5 to 4 fps (2 fps optimum) shall be maintained for the full length of the powerhouse collection channel and the lower ends of the fish ladders that are below the tailwater. Water velocities will be measured at one location directly and monitored during fishway inspections to verify channels are operating within velocity criteria.

5. Remove debris as required to maintain head below 0.5' on attraction water intakes and trash racks at all the ladder exits, with a 0.3' maximum head on all picket leads. Debris shall be removed when significant amounts accumulate.

6. Necessary staff gauges and water level indicators will be readable at all water levels encountered during the fish passage period and accuracy checked weekly. Instruments will be recalibrated when necessary, and ASAP.

7. Main entrance weir depths: 8' or greater below tailwater. Maintain a minimum tailwater at 70' msl to remain in entrance weir criteria operating range, which is regulated by RCC.

8. Count station crowders shall remain in the maximum width while visual counting and/or video-taping is being conducted. The crowder shall not be closed to less than 18" width. If passage is impaired by this condition, the count slot may be widened until proper passage conditions are achieved, even though count accuracy may be compromised to some degree. Project biologists, FFU, and fish counters shall coordinate to achieve optimum count slot passage and/or count accuracy conditions. The crowder shall remain fully open during hours when no fish counting is performed.

b. East Fishway.

1. Removable weirs #154 -#157 will drop into the ladder at a differential (water surface at respective weir location relative to the forebay) of 2.5' +/- 0.1'.

2. Telescoping weir #159 will adjust to maintain 1.1 +/- 0.1' depth over the weirs, measured below the counting station.

3. Telescoping weir #158 will track 1' +/- 0.1' below weir #159 at all times during fishway operation.

c. North Fishway Entrance. Operate one entrance weir, N1 or N2. Project biologists and Wasco Co. will work in conjunction to maintain fishway entrances within established criteria.

d. Powerhouse.

1. West Powerhouse Entrance: Operate entrance weirs W1 and W2. W3 will be closed at 81'msl, but remain operational as backup to W1 and W2.

2. East Powerhouse Entrance: Operate entrance weirs E2 and E3 to maintain gate crest > 8'below tailwater, currently operated at 13'below tailwater. Weir E1 to be closed at 81' msl, but remain operational. At lower range of tailwater elevation, E1 may be operated manually at any depth to provide criteria entrance differential.

3. Operate east ladder junction pool weirs at the following minimum depths in relation to east entrance tailwater surface elevation:

JP6.........................>7'

4. South Spillway Entrance: Operate entrance weirs S1 and S2 to maintain gate crest at 8' or greater below tailwater.

5. Discharge from the two operating fish units will be adjusted to maintain criteria at all associated fishway entrances. Discharge volume will be dependent on criteria levels at entrances.

2.5.1.3. December 1 through February (Winter Maintenance Period).

a. Operate the powerhouse and north and south spillway adult fish passage facilities according to the fish passage period standards above. The system may be dewatered or operated out of criteria for repair and maintenance. Adjust the counting station fish crowder to full open and rotate picket leads to the open position at the counting station at the end of the counting season.

b. Only one of the two adult fish facilities may be out of service at any one time unless coordinated through FPOM. The operating facility shall be operated at full fish passage season criteria unless specially coordinated. Outage periods will be minimized to the extent practicable.

3. Facility Monitoring and Reporting.

3.1. Inspections.

3.1.1. The results of all inspections and the readiness of the facilities for operation will be reported to the FPOM at the meeting immediately prior to the fish passage season.

3.1.2. During fish passage season, fish passage facilities will be inspected at least twice per day/seven days a week to assure operation according to established criteria.

3.1.3. During winter maintenance season, fish passage facilities will be inspected once per day/at seven days a week.

3.1.4. More frequent inspections of some facility components will occur as noted throughout the text.

3.1.5. Additional fishway inspections may be performed by FFU and fish agencies.

3.2. Zebra Mussel Monitoring. A zebra mussel monitoring program will continue. These organisms have become a serious problem elsewhere in the country and may become introduced into the Columbia River basin. Inspections should also be made when dewatering all project facilities.

3.3. Reporting.

3.3.1. Project biologists shall prepare weekly reports throughout the year summarizing project operations. The weekly reports will provide an overview of how the project and the fish passage facilities operated during the week and an evaluation of resulting fish passage conditions. The reports shall include:

a. **A**ny out-of-criteria situations observed and subsequent corrective actions taken;

b. Any equipment malfunctions, breakdowns, or damage along with a summary of resulting repair activities;

c. **A**dult fishway control calibrations;

d. STS and VBS inspections;

e. AWS closures (i.e. cleaning times);

f. **A**ny unusual activities which occurred at the project which may affect fish passage.

3.3.2. The weekly reports shall cover a Sunday through Saturday period and they shall be e-mailed to CENWP-OD and other interested parties as soon as possible the following week, with a copy to CENWD-PDW-R (RCC).

3.3.3. The project biologists shall prepare a memo for the record for any negative impact to fish or fishways. This memo will be sent to FPOM by the next working day. Items that shall be included in the memo are:

a. Time and date.

b. Nature of activity that lead to fish impact.

c. Agency responsible for the impact, or the reportee if no responsible party can be identified.

d. Fish numbers, species, origin, discernible external injuries, tags, etc.

e. Future actions to avoid a similar impact.

f. Any relevant photos.

3.3.4. The project biologists shall prepare an annual report by January 31, summarizing the operation of the project fish passage facilities for the previous year.

a. The report will cover from the beginning of one adult fish facility winter maintenance period to the beginning of the next.

b. The annual report also will include a description of all actions taken to discourage avian predation at the project, with an overview of the effectiveness of the activities in discouraging avian predation.

c. The annual report will be provided to CENWP-OD in time for distribution to FPOM members at the February meeting.

4. Fish Facilities Maintenance.

4.1. General.

4.1.1. Routine Maintenance.

4.1.1.1. Staff gages will be installed, cleaned, and/or repaired as required.

4.1.1.2. A zebra mussel monitoring program will continue. This includes veliger (free-swimming juvenile life-stage) sampling, colonization sample units, and dewatering inspections. These organisms have become a serious problem elsewhere in the country and may become introduced into the Columbia River basin.

4.1.1.3. Routine fishway maintenance, to the extent practicable, will be conducted during periods when passage has been documented to be at its lowest to minimize impacts to migrating salmonids. Maintenance activities that occur during the fish passage period and that may affect fish passage will be reported in the weekly reports (paragraph **2.6**).

4.2. Juvenile Fish Passage Facilities.

4.2.1. Routine Maintenance.

4.2.1.1. Collection and Transportation Systems. The Dalles Dam ice and trash sluiceway will receive preventive maintenance throughout the year. During the juvenile fish passage season, this will normally be above-water work, such as maintenance of automatic systems, air lines, electrical systems, and monitoring equipment. The system is then visually inspected in all accessible areas for damaged equipment and areas that may cause problems to the juvenile fish. Any problem areas identified are repaired and modifications to the channel and general maintenance are completed. The trash racks are raked if necessary as determined by ROV inspection just prior to the juvenile fish passage season (April 1), between June 1 and June 15, and whenever trash accumulations are suspected because of increased head across the trash racks.

4.2.1.2. **Turbines and Spillways.** Maintenance and routine repair of project turbines and spillways are a regular and recurring process which require that units be shut down for extended periods (see **section 6. Dewatering Plans**.) The schedule for this maintenance is reviewed by the project and district biologists and coordinated within NWP, NWD, BPA, and among fish agencies and tribes through the FPOM. Certain turbine and spillway discharges at the projects are secondarily used to attract adult fish to the fishway entrance areas. The maintenance schedules for these turbines and spillways will reflect equal weighting given to fish, power, and water management, and will be coordinated with the appropriate resource agencies. No other fish related restrictions regarding maintenance will be placed on any units at this project, except to coordinate research activities. Some types of turbine maintenance will require testing operation of the turbine throughout its full range before returning it to normal service. Units which should receive low priority for scheduling maintenance during the fish passage season are F1, F2, 1, 2, 3, 4 5, and 18 (during ice and trash sluiceway operation).

4.2.2. Non-Routine Maintenance. Maintenance of all fish related facilities will be carried out as described below. Unscheduled maintenance that will have a significant impact on juvenile fish passage shall be coordinated through FPOM on a case-by-case basis by project and CENWP-OD biologists. The CENWP-OD biologists will be notified as soon as possible after it becomes apparent that maintenance repairs are required. The Project Operations Manager has the authority to initiate work prior to notifying CENWP-OD when delay of the work will result in an unsafe situation for people, property, or fish. (See also **Overview** section for coordination guidance.) Information required by CENWP-OD includes:

a. Description of the problem.

b. Type of outage required.

c. Impact on facility operation.

d. Length of time for repairs.

e. Expected impacts on fish passage.

4.2.2.1. **Collection and Transportation Systems.** The ice and trash sluiceway is now being used as a juvenile bypass system.

a. The chain/hoist gates are fully opened during normal operation. If a chain gate fails, an adjacent gate can be operated until repairs can be made.

b. Inspect all gatewells daily. The project will clean gatewells before the gatewell water surface becomes half covered with debris. If due, to the volume of debris, it is not possible to keep the gatewell surfaces at least half clear, they will be cleaned at least once daily. Turbines with a gatewell fully covered with debris will not be operated except on a last on/first off basis, if required to be in compliance with other coordinated fish measures. This is to maintain clean orifices and minimize fish injury.

c. If a gate hoist fails, it will be repaired promptly. The gate will be removed when there are problems with the seal and the difficulty cannot be repaired promptly. If the epoxy-lined section of the sluiceway is damaged, it will be repaired.

d. To prepare a turbine for dewatering, the ice/trash sluiceway can be temporarily closed to install a gatewell orifice plug.

4.2.2.2. Turbines and Spillways- Spill Gate Failure. If a spill gate becomes inoperable, the operators will make the changes necessary to accommodate the spill and then immediately notify the Project Operations supervisor and the project biologist to determine the best pattern to follow until repairs can be made. This interim operation shall be coordinated with FPOM and FFDRWG through the CENWP-OD biologist, who will, depending on coordination, provide additional guidance to the project (see also **2.2**. **Spill Management**).

4.3. Adult Fish Passage Facilities.

4.3.1. Routine Maintenance. Maintenance activities that occur during the fish passage period and that may affect fish passage will be reported in the weekly reports (paragraph 2.6).

4.3.1.1. Fishway Auxiliary Water Systems. The Dalles Project fishway auxiliary water is provided by discharge from hydroelectric turbine systems. Preventive maintenance and normal repair occur throughout the year. Trashracks for the AWS intakes will be raked when drawdown exceeds criteria. When practicable, rake trashracks during the time of day when fish passage is least affected.

4.3.1.2. Powerhouse and Spillway Adult Collection Systems. Preventive maintenance and repair occurs throughout the year. During the adult fish passage season the maintenance will not involve any operations that will cause a failure to comply with the fishway criteria, unless specially coordinated. Inspection of those parts of the adult collection channel systems, such as diffusion gratings, picket leads, and entrance gates, will be scheduled once per year during the winter maintenance season while the system is dewatered. An inspection during first week of August with the system watered up will also be conducted (see section 5. Dewatering Plans.). A diver or underwater video system may be used for underwater inspections. Any non-routine maintenance and fishway modification will be handled on a case-by-case basis.

4.3.1.2.1. The project fish biologist or alternate Corps fish personnel will attend all dewatering activities potentially involving fish, as well as inspections to provide fish input (see **section 5**.).

4.3.1.3. Adult Fish Ladders and Counting Stations. The adult fish ladders will be dewatered once each year during the winter maintenance period. Unless specially coordinated, only one ladder will be dewatered at a time, with the other ladder capable of operating within criteria. During this time, the ladders are inspected for blocked orifices, projections into the fishway that may injure fish, stability of the weirs, damaged picket leads, exit gate problems, loose diffuser valves, ladder orifice reduction plates, malfunctioning equipment at the counting stations, and other potential problems. Problems identified throughout the passage year that do not affect fish passage, as well as those identified during the dewatered period are then repaired. Trashracks at the ladder exits and the north AWS intake will be raked when criteria are exceeded. Rake trashracks between 1100 and one hour prior to sunset. Fish count station windows will be cleaned when necessary, and when practicable.

4.3.2. Non-Routine Maintenance. Maintenance activities that occur during the fish passage period and that may affect fish passage will be reported in the weekly reports (section 2.6). Non-routine maintenance that will significantly affect the operation of a facility, such as repair of displaced diffuser gratings, will be coordinated with the Region, through FPOM. Coordination procedures for non-routine maintenance of adult facilities are the same as for juvenile facilities (paragraph **3.2.2**, and **Overview** section).

4.3.2.1. Fishway Auxiliary Water Systems. Most fishway auxiliary water systems operate automatically. If the automatic system fails, the system will be manually operated by the project personnel until the system is repaired. When this operation becomes necessary, project personnel will increase surveillance on the adult system to ensure that criteria are being met. In the event of AWS failure, FPOM will work with the project to determine the best operating procedure.

a. Powerhouse**.** If one of the two fishway auxiliary water turbines fails or malfunctions for eight hours or longer, use the following sequential procedure until a fishway entrance head of 1' is achieved:

1. Increase discharge of remaining operating fish unit to maximum operating capacity.

2. Raise entrance weir E2 and E3 to 8’ depth.

3. Close entrance weir S1.

4. Close entrance weir S2 in 1’ increments.

5. Close entrance weir W2 in 1’ increments.

6. Close entrance weir W1 in 1’ increments.

7. Differentials for open entrances should be checked between each of the above steps.

b. If both of the fishway auxiliary water turbines fail or malfunction, regardless of fish passage season, the adult fish passage facility will be operated as follows:

1. Raise the south entrance weirs to elevation 81’msl (closed position).

2. Close west entrance.

3. Close entrance weir E1 and E2 and keep E3 at 6’ depth

c. **North Ladder.** If the North Wasco County power unit auxiliary water system fails, the backup auxiliary water system will be started and the system operated at criteria. If the backup auxiliary water system fails, N1 will remain open with a weir depth of 6' below the tailwater surface.

4.3.2.2. Powerhouse and Spillway Adult Fish Collection Systems. The Dalles Dam contains several types of fishway entrances. In most cases, if failures occur, the entrance will be operated manually by project personnel until repairs are made. If this operation becomes necessary, project personnel will increase surveillance on the adult system to ensure criteria are being met. In those cases in which the failure will not allow the entrance to be operated manually, the gate will be maintained, to the extent possible, in an operational position. If this is not possible, the entrance will be repaired expediently, and it will be returned to manual or automatic control at the earliest possible date.

4.3.2.3. Adult Fish Ladders and Counting Stations. The ladder structures include picket leads, counting stations, fishway exits, and overflow weirs with orifices. Picket leads with excessive spacing (greater than 1"), erosion of concrete around the picket leads, or missing pickets can allow fish into areas where escape is not likely. If picket lead failure or concrete erosion occurs, then the timing and method of repair will depend upon the severity of the problem. The decision of whether or not to dewater the fishway and repair any problem will be made in coordination with the fish agencies and tribes through the FPOM.

4.3.2.4. Diffuser Gratings. Diffuser chambers for adding auxiliary water to fish ladders and collection channels are covered by gratings attached by several different methods. Diffuser gratings are normally checked during the winter maintenance period to make sure they are in place. These inspections are done by either dewatering the fish passage system and physically inspecting the diffuser gratings, or using underwater video cameras and divers or other methods to inspect the gratings. Diffuser gratings may come loose during the fish passage season due to a variety of reasons. If a diffuser grating is known to or suspected of having moved, creating an opening into a diffuser chamber, close associated diffuser valve ASAP. Efforts must immediately be taken to correct the situation and minimize impacts on adult fish in the fishway. If possible, a video inspection should be made as soon as possible to determine the extent of the problem. If diffuser gratings are found to be missing or displaced, creating openings into the diffuser chambers, a method of repair shall be developed and coordinated with the fish agencies and tribes through the established FPOM coordination procedure. Repairs shall be made as quickly as possible unless coordinated differently.

5. Turbine Unit Operation and Maintenance.

5.1. Throughout the juvenile fish passage season, either turbine unit 1 or unit 2 or both units will operate during daylight hours unless specially coordinated with FPOM. In order to provide favorable fish passage conditions while meeting transmission line needs, the main powerhouse turbine units will operate in the following priority order: Unit 1 then Unit 2 at the west end of the powerhouse, then place every other available unit on line until the east end of the powerhouse is reached. Then go back to the west end of the powerhouse and place the remaining available units on line, from west to east, until all the available units are on line. Reverse the order when reducing load.

5.2. The project turbine unit maintenance schedules will be reviewed by project and district biologists for fish impacts and be coordinated with FPOM.

5.3. Guidelines for operation of the turbine units within 1% of best efficiency at various head ranges are shown in Table TDA-4.

5.4. To the extent technically feasible, turbines will be operated within +/- 1% of best turbine efficiency from April 1 through October 31 (as specified in the BPA load shaping guidelines). However, during the rest of the year, the project will continue to operate units within the turbine efficiency range, except as specifically requested by BPA to do otherwise as power requirements demand.

5.5. When it is necessary to operate turbines outside of the 1% efficiency range, the units will be selected according to the following guidance: Units 7 through 14 will be selected first, spacing by at least one unit. For example, assuming they are available to operate, the following sequence might be used: 7, 9, 11, 13, 15, 5, 2, 1, 8, etc. Since each successive unit in this list is thought to pass more fish, this outage priority sequence is intended to have a lower negative impact on fish during turbine unit passage, if units are taken out of service in this order.

6. Dewatering Plans.

6.1. Guidelines for Dewatering and Fish Handling Plans have been developed by the projects and approved by FPOM, and are followed for most project facilities dewaterings. These plans include consideration for fish safety and are consistent with the following general guidance. The appropriate plans are reviewed by participants before each salvage operation.

6.1.2. The project fish biologist and/or alternate Corps fish personnel will attend all project activities involving fish handling.

6.1.3. The fish agencies and tribes are encouraged to participate in all ladder dewaterings. Agency fish count supervisor required, per contract, to attend.

6.2. Juvenile Bypass Systems. (Not applicable for this Project)

6.3. Adult Fish Ladder.

6.3.1. Routine maintenance.

6.3.1.1. When possible, operate the ladder to be dewatered at orifice flow with the AWS off for at least 24 hours, but not more than 96 hours prior to dewatering.

6.3.1.2. A project biologist will assure that fish rescue equipment is available, and will coordinate to ensure adequate numbers of personnel will be available to move fish out of the dewatered ladder.

6.3.1.3. Project personnel will install exit bulkheads to shut down ladder flow. Where possible, a minimum flow of 1"-2" will be maintained in the ladder until fish are rescued.

6.3.1.4. The project biologist or alternate Corps fish personnel will oversee fish rescue when the ladders are dewatered. The fish are then transported to the forebay or tailwater, depending on the fish life stage (adults to forebay, juveniles to tailrace), for release. If a ladder is dewatered in the spring or summer, identifiable steelhead kelts should be released into the tailrace.

6.3.1.5. Orifice blocking devices, with attachment ropes tied to handrails may be placed in the lower-most weirs to prevent fish from re-ascending the dewatered portion of the adult fishway. Use of orifice blocking devices will be at the discretion of the project biologist. The fishway return-to-service checklist is as follows:

- **a.** Remove orifice blocking devices if used.
- **b.** Activate automation for systems.
- **c.** Assure all count station lighting is operational.
- **d.** Open count station crowder
- **e.** Close picket leads.
- **f.** Remove all tools, equipment, and debris from inside ladder.

6.3.2. Non-Routine Maintenance.

6.3.2.1. When possible, discontinue fishway auxiliary water and operate ladder at reduced flow as long as possible (prefer 3-24 hours) prior to dewatering.

6.3.2.2. Follow steps **6.3.1.3**. through **6.3.1.5**. above.

6.4. Powerhouse Collection System Routine Maintenance.

6.4.1. During the pumping or draining operation to dewater a portion or the entire collection channel, the water level will not be allowed to drop so low it strands fish. Personnel shall remain present onsite during pumping operations to ensure stranding does not occur or a water level sensor that de-activates the dewatering process will be used.

6.4.2. The project biologist will ensure that rescue equipment is available if needed.

6.4.3. The project biologist or alternate Corps fish personnel will provide technical guidance on fish safety and will assist directly in rescue operations.

6.5. Turbines.

6.5.1. Gatewells need not be dipped as is required at other projects due to the lack of VBSs. Immediately before draining it will be operated at speed/no load briefly to flush fish out of the draft tube.

6.5.2. When possible, place head gates and tail logs immediately after the turbine unit is shut down if the draft tube is to be dewatered. Operate at speed/no load just prior to shut down. Install bottom two tail logs side-by-side first before stacking the remainder to minimize sturgeon from entering the draft tube before dewatering. This is necessary for both scheduled and unscheduled outages.

6.5.3. If a turbine unit is idle and partially dewatered, and tail logs are put into place, an adequate safety pool may be maintained for up to 4 days to accommodate fish trapped in the draft tube (If longer timeframes are needed for the safety pool, project fisheries will coordinate with FPOM on a case-by-case basis). The safety pool will be maintained at an appropriate level which will be determined by the project biologist.

6.5.4. Fish rescue personnel will inspect dewatered turbine draft tubes and intakes as soon as the water levels reach a depth permitting visual inspection and the hatch cover is opened. The project biologist or alternate Corps fish personnel will provide technical guidance on fish safety, will assure that rescue equipment is available if needed, and will directly participate in fish salvage.

7. Forebay Debris Removal.

7.1. Debris at projects can impact fish passage conditions. It can plug or block trashracks, gatewell orifices, dewatering screens, separators, and facility piping resulting in impingement, injuries, and descaling of fish. The preferred option is to remove debris at each project when possible to avoid passing a debris problem on to the next project downstream. This is not always possible at each project as some projects do not have forebay debris removal capability. In this case, the only viable alternative is to spill to pass the debris.

7.2. Special spill operations that don't follow the normal spill schedule or volume limits will be coordinated prior to their execution. Normally, the project shall contact CENWP-OD at least two workdays prior to the day the special operation is required. Using information provided by the project, CENWP-OD will coordinate with FPOM and with RCC, as necessary. Once the coordination is complete, RCC will issue a teletype detailing the special operations.

8. Response to Hazardous Materials Spills. The Dalles Project's guidance for responding to hazardous substance spills is contained in its Emergency Spill Response Plan. This guidance will be followed in case of a spill.

8.1. Project Fisheries will be contacted as soon as possible after a hazardous material release and prior to any modification to fishway operations. The project biologist will in turn contact the CENWP-OD biologist and FPOM. Attempts should be made to first contact the project biologist on duty. During fish passage season there is a project biologist on duty seven days a week. If a project biologist cannot be reached by radio or in the office, attempts to contact Project Fisheries will occur in the following order:

1. Bob Cordie- home and mobile numbers are available in the Control Room.
2. Miro Zyndol- home and mobile numbers are available in the Control Room.
3. Bern Klatte (503-808-4318) or Tammy Mackey (503-808-4305).

9. Endnotes. (Not applicable to this Project)

Table TDA-4. Ranges for turbine operation within 1% of best efficiency at The Dalles Dam.

Head Ft	Units 1-14				Units 15-22			
	Lower Limit MW	Lower Limit cfs	Upper Limit MW	Upper Limit cfs	Lower Limit MW	Lower Limit cfs	Upper Limit MW	Upper Limit cfs
55	35.1	8,854	44.1	11,108	38.5	9,643	49.3	12,346
56	35.9	8,875	45.1	11,147	39.0	9,554	50.6	12,402
57	36.7	8,894	46.2	11,184	39.4	9,468	51.9	12,454
58	37.5	8,912	47.2	11,219	39.9	9,384	53.2	12,503
59	38.3	8,929	48.3	11,252	40.4	9,302	54.4	12,548
60	39.1	8,945	49.4	11,282	40.8	9,223	55.7	12,590
61	39.5	8,870	50.8	11,415	41.6	9,219	56.8	12,599
62	39.9	8,798	52.3	11,543	42.3	9,215	57.9	12,607
63	40.3	8,728	53.8	11,665	43.0	9,211	58.9	12,613
64	40.7	8,660	55.3	11,783	43.8	9,207	60.0	12,619
65	41.0	8,593	56.8	11,896	44.5	9,202	61.1	12,624
66	41.8	8,614	58.0	11,939	45.1	9,164	62.5	12,719
67	42.6	8,633	59.2	11,980	45.6	9,127	64.0	12,810
68	43.4	8,652	60.3	12,019	46.1	9,091	65.5	12,899
69	44.2	8,670	61.5	12,056	46.7	9,056	66.9	12,984
70	45.0	8,686	62.7	12,092	47.2	9,021	68.4	13,066
71	45.8	8,693	63.7	12,111	47.9	9,019	70.0	13,168
72	46.5	8,700	64.5	12,067	48.6	9,016	70.6	13,105
73	47.2	8,706	65.2	12,024	49.3	9,014	71.3	13,043
74	47.9	8,712	65.9	11,982	50.0	9,011	72.0	12,983
75	48.6	8,717	68.0	12,179	50.7	9,008	76.2	13,542
76	49.1	8,673	69.2	12,226	51.3	8,984	77.8	13,638
77	49.5	8,629	70.4	12,270	51.8	8,960	79.4	13,731
78	49.9	8,587	71.6	12,314	52.4	8,936	81.0	13,821
79	50.4	8,545	72.8	12,356	53.0	8,913	82.6	13,908
80	50.8	8,505	74.0	12,396	53.5	8,891	84.3	13,993
81	51.4	8,493	75.4	12,471	54.2	8,896	85.9	14,092
82	52.0	8,482	76.8	12,543	54.9	8,902	87.5	14,188
83	52.5	8,471	78.2	12,613	55.6	8,908	89.2	14,283
84	53.1	8,460	79.6	12,681	56.3	8,914	90.8	14,375
85	53.7	8,449	81.0	12,748	57.0	8,919	92.4	14,465
86	54.3	8,441	82.5	12,833	57.5	8,898	94.1	14,564
87	54.9	8,433	84.0	12,916	58.0	8,877	95.8	14,660
88	55.5	8,425	85.6	12,997	58.5	8,856	97.4	14,755
89	56.0	8,417	87.1	13,076	59.0	8,836	98.7	14,786
90	56.6	8,409	88.6	13,154	59.5	8,817	98.7	14,602
91	57.3	8,411	89.7	13,236	60.1	8,815	98.7	14,429
92	57.9	8,414	89.7	13,080	60.8	8,813	98.7	14,260
93	58.6	8,416	89.7	12,928	61.4	8,811	98.7	14,094
94	59.2	8,418	89.7	12,779	62.1	8,809	98.7	13,932
95	59.8	8,420	89.7	12,634	62.7	8,808	98.7	13,773

Note: Tables is based on information provided by HDC in 2001 and 2002(Table TDA-4 revised, 2006).

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Table TDA-5. Examples of spill patterns for juvenile fish passage at The Dalles Dam. The full spill patterns are contained in the spreadsheet titled "TDA Spill Pattern May 2006.xls". Patterns vary as a function of total river flow, forebay elevation, and tailwater elevation at the spillway stilling basin.

Spillway Bay Number																							Total	Total
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Feet	Spill
vertical gate opening (ft.)																							(ft)	(cfs)
4																							4	6,000
4	4																						8	12,000
6	6																						12	18,000
		4	4	4	4																		16	24,000
	4	4	4	4	4																		20	30,000
4	4	4	4	4	4																		24	36,000
4.5	4.5	4.5	4.5	4.5	4.5																		27	40,500
5	5	5	5	5	5																		30	45,000
5.5	5.5	5.5	5.5	5.5	5.5																		33	49,500
6	6	6	6	6	6																		36	54,000
6.5	6.5	6.5	6.5	6.5	6.5																		39	58,500
7	7	7	7	7	7																		42	63,000
7.5	7.5	7.5	7.5	7.5	7.5																		45	67,500
8	8	8	8	8	8																		48	72,000
8.5	8.5	8.5	8.5	8.5	8.5																		51	76,500
9	9	9	9	9	9																		54	81,000
9.5	9.5	9.5	9.5	9.5	9.5																		57	85,500
10	10	10	10	10	10																		60	90,000
10.5	10.5	10.5	10.5	10.5	10.5																		63	94,500
11	11	11	11	11	11																		66	99,000
11.5	11.5	11.5	11.5	11.5	11.5																		69	103,500
12	12	12	12	12	12																		72	108,000

Table TDA-5 continued

Spillway Bay Number																							Total	Total
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Feet	Spill
vertical gate opening (ft.)																							(ft)	(cfs)
12.5	12.5	12.5	12.5	12.5	12.5																		75	112,500
13	13	13	13	13	13																		78	117,000
13.5	13.5	13.5	13.5	13.5	13.5																		81	121,500
14	14	14	14	14	14																		84	126,000
14	14	14	14	14	14	3																	87	130,500
13	13	13	13	13	13	10																	88	132,000
13	13	13	13	13	13	11																	89	133,500
13	13	13	13	13	13	12																	90	135,000
14	14	14	14	14	14	12																	96	144,000
14	14	14	14	14	14	12	3																99	148,500
13	13	13	13	13	13	12	10																100	150,000
13	13	13	13	13	13	12	11																101	151,500
13	13	13	13	13	13	12	12																102	153,000
14	14	14	14	14	14	12	12																108	162,000
14	14	14	14	14	14	12	12	3															111	166,500
13	13	13	13	13	13	12	12	10															112	168,000
13	13	13	13	13	13	12	12	11															113	169,500
13	13	13	13	13	13	12	12	12															114	171,000
14	14	14	14	14	14	12	12	12															120	180,000
14	14	14	14	14	14	12	12	12	0	0	0	0	1										121	181,500
14	14	14	14	14	14	12	12	12	0	0	0	0	1	1									122	183,000
14	14	14	14	14	14	12	12	12	0	0	0	0	1	1	1								123	184,500
14	14	14	14	14	14	12	12	12	0	0	0	0	1	1	1	1							124	186,000

Table TDA-5 continued

Spillway Bay Number																							Total	Total
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Feet	Spill
vertical gate opening (ft.)																							(ft)	(cfs)
14	14	14	14	14	14	12	12	12	0	0	0	0	1	1	1	1	1						125	187,500
14	14	14	14	14	14	12	12	12	0	0	0	0	1	1	1	1	1	1					126	189,000
14	14	14	14	14	14	12	12	12	0	0	0	0	1	1	1	1	1	1	1				127	190,500
14	14	14	14	14	14	12	12	12	0	0	0	0	1	1	1	1	1	1	1	1			128	192,000
14	14	14	14	14	14	12	12	12	0	0	0	0	2	2	2	2	2	2	2	2			136	204,000
14	14	14	14	14	14	12	12	12	0	0	0	0	3	3	3	3	3	3	3	3			144	216,000
14	14	14	14	14	14	12	12	12	0	0	0	0	4	4	4	4	4	4	4	4			152	228,000
14	14	14	14	14	14	12	12	12	0	0	0	0	5	5	5	5	5	5	5	5			160	240,000
14	14	14	14	14	14	12	12	12	0	0	0	0	6	6	6	6	6	6	6	6			168	252,000
14	14	14	14	14	14	12	12	12	0	0	0	0	7	7	7	7	7	7	7	7			176	264,000
14	14	14	14	14	14	12	12	12	0	0	0	0	8	8	8	8	8	8	8	8			184	276,000
14	14	14	14	14	14	12	12	12	0	0	0	0	9	9	9	9	9	9	9	9			192	288,000
14	14	14	14	14	14	12	12	12	0	0	0	0	10	10	10	10	10	10	10	10			200	300,000
14	14	14	14	14	14	12	12	12	0	0	0	0	11	11	11	11	11	11	11	11			208	312,000
14	14	14	14	14	14	12	12	12	0	0	0	0	12	12	12	12	12	12	12	12			216	324,000
14	14	14	14	14	14	12	12	12	0	0	0	0	12	12	12	12	12	12	12	12	6		222	333,000
14	14	14	14	14	14	12	12	12	0	0	0	0	12	12	12	12	12	12	12	12	12		228	342,000
14	14	14	14	14	14	12	12	12	0	0	0	0	12	12	12	12	12	12	12	12	12	6	234	351,000
14	14	14	14	14	14	14	14	14	0	0	0	0	14	14	14	14	14	14	14	14	14	7	259	388,500
14	15	15	15	15	15	15	15	15	0	0	0	0	15	15	15	15	15	15	15	15	15	7	276	414,000
14	16	16	16	16	16	16	16	16	0	0	0	0	16	16	16	16	16	16	16	16	16	8	294	441000
14	17	17	17	17	17	17	17	17	0	0	0	0	17	17	17	17	17	17	17	17	17	8	311	466500
15	18	18	18	18	18	18	18	18	0	0	0	0	18	18	18	18	18	18	18	18	18	9	330	495000

NOTE 1: Bays 14 through 21 should be open incrementally a foot at a time to get to the desired spill.

Section 4 John Day Dam

John Day Dam

1. Fish Passage Information. The locations of fish passage facilities at John Day Lock and Dam are shown on Figures JDA-1 and JDA-2. Dates for project operations for fish purposes and special operations are listed in Table JDA-1.

1.1. Juvenile Fish Passage

1.1.1. Juvenile Bypass Facilities Description. Juvenile fish bypass facilities at John Day Dam, completed in 1987, with the new Smolt Monitoring Facility (SMF) completed in 1998, include one vertical barrier screen (VBS), submersible traveling screen (STS) and one 14" diameter orifice per gatewell in each of the project's 16 turbine units for a total of 48 orifices. The bypass collection conduit leads to a transport channel which carries collected juvenile fish to the river below the dam when the smolt monitoring facility is not in operation (bypass mode). Differential between the forebay and bypass conduit is controlled by the tainter gate.

1.1.2 Smolt Monitoring Facilities Description. During the juvenile sampling season, flow with collected fish from the JBS is sent over the crest gate and down an elevated chute to the dewatering structure. Most of the flow is dewatered and the remaining water, 30 cfs, is directed to the transport flume and past a switch gate. This gate directs fish to either the sampling building or directly to the outfall (emergency bypass only). Fish diverted for sampling pass a fish and debris separator, where debris and adult fish are directed into a separate discharge flume, leading to the outfall. Juvenile fish are interrogated by PIT tag detectors and are diverted either to the outfall or to the laboratory building for sampling (shown in **Figure JDA-1**).

1.1.3. Juvenile Migration Timing. Juvenile passage timing has been determined by past gatewell and SMF sampling at John Day Dam (**Table JDA-2.**) Ongoing research shows that daytime operation shows significant daytime passage (results to date). Bull trout, lamprey, juvenile sturgeon, and other listed salmonids shall be recorded in the by-catch of the smolt monitoring facilities. The juvenile bypass system will operate through December 15. Sample collection in lab will operate through September 15. PIT interrogation will continue through November 30, weather permitting. Maintenance of juvenile fish facilities is scheduled from approximately December 16 through March 31 to minimize impact on downstream migrants and reduce the possibility of adult fallbacks through turbine units. During this time the juvenile bypass system will be dewatered.

1.1.3.1. Peak passage occurs between 2300 and 2400 hours with a long period of elevated passage until dawn, when passage decreases. Passage increases dramatically at dusk (about 2000 hours). Gatewell sampling data indicate that roughly 80% of the juvenile migrants pass John Day Dam between 2100 and 0600 hours. During the peak spring juvenile migration period at John Day Dam, 40% of the spring chinook and steelhead daily passage occurred between 0700 and 2200 hours. Note the above information is for powerhouse passage only. Recent radio-tracking and hydroacoustic information indicates different passage patterns for the spillway and project when spill is occurring 24 hours a day.

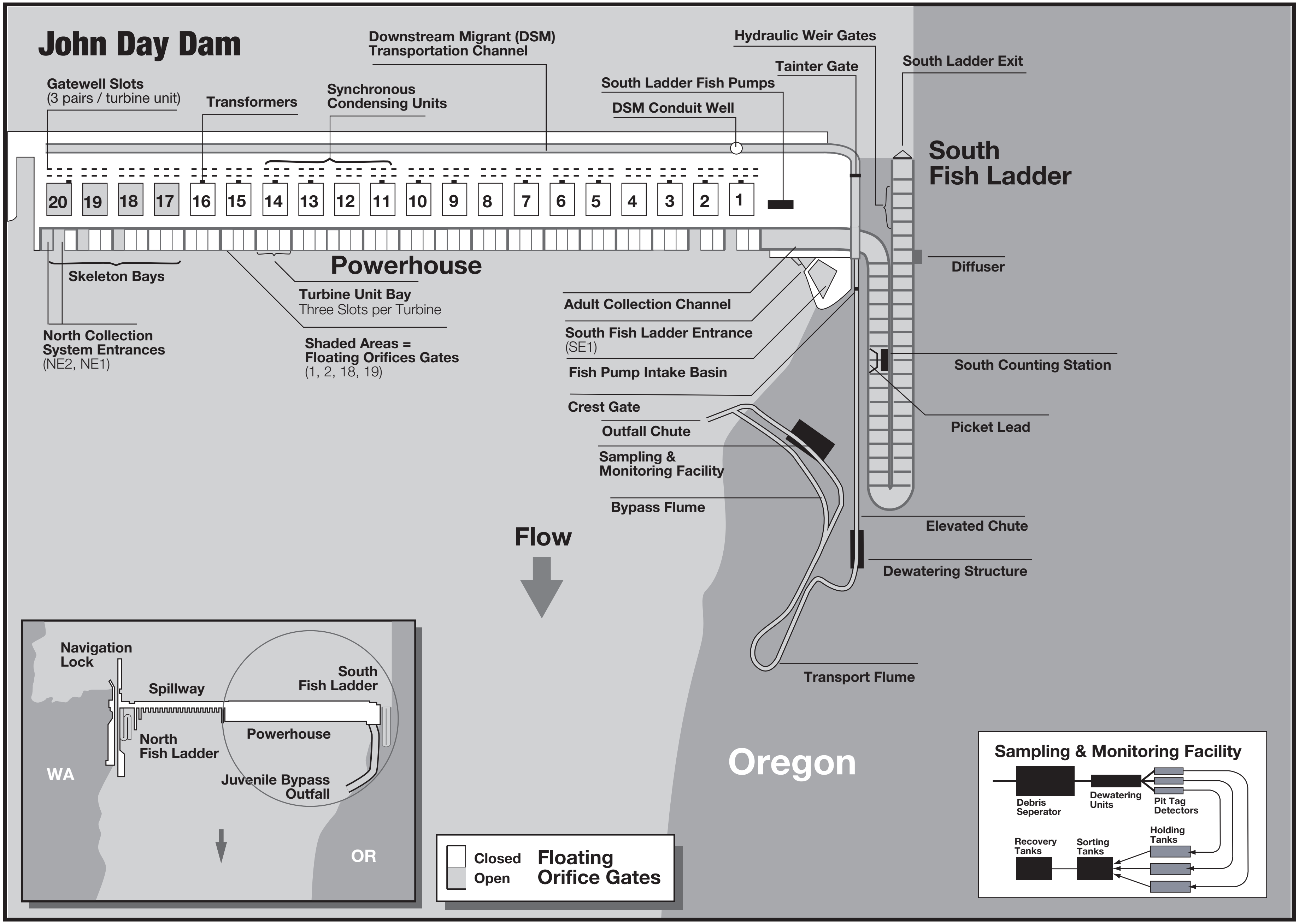


Figure JDA-1 John Day South Fish Ladder, Powerhouse Collection System, and Juvenile Fish Bypass System.

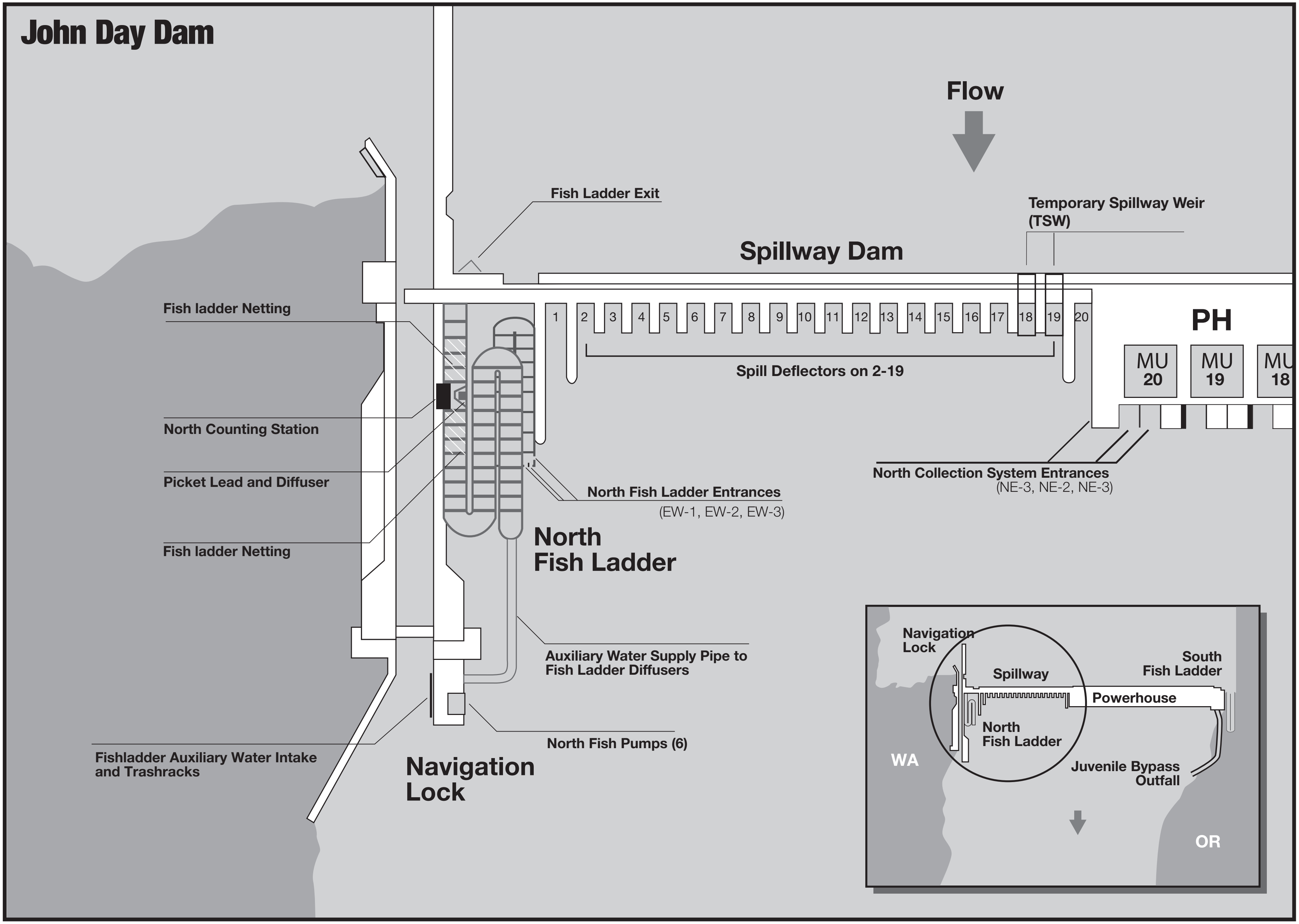


Figure JDA-2 John Day Dam Spillway and North Fish Ladder.

Table JDA-1. Dates of project operations for fish purposes at John Day, 2008-9

March 2008

Task Name	Start	Finish	FPP Reference
Maintenance of Juvenile Facilities	3/1/08	3/31/08	Jda 1.1.3
TDG Monitoring	3/1/08	2/28/09	App D Table 4
Adult Fish Passage Season	3/1/08	11/30/08	Jda 2.5.1.2
1% limitations	**3/1/08**	**2/28/09**	**Jda 5.1**
1% Soft	3/1/08	3/31/08	Jda 5.1
1% Hard	4/1/08	10/31/08	Jda 5.1
1% Soft	11/1/08	2/28/09	Jda 5.1
Weekly Reports	3/1/08	2/28/09	Jda 3.3.1
TSW Evaluation	**3/24/08**	**7/20/08**	**App A JDA 2.2**
Installation	3/24/08	3/26/08	App A JDA 2.2.2
Direct Test	3/27/08	3/30/08	App A JDA 2.2.3
In Season Test	4/20/08	7/20/08	App A JDA 2.2.3
Avian Abatement in Place	4/1/08	4/1/08	Jda 2.4.1.1 j
Juvenile Fish Passage Season	4/1/08	11/30/08	Jda 2.4.1.2
Operate Gatewell Orifices	4/1/08	12/15/08	Jda 2.4.1.2.g
Special Unit Raking	4/1/08	7/1/08	Jda 2.4.1.2.b
Continue Avian Abatement Measures	4/1/08	8/31/08	Jda 2.4.1.2.l
Adult Fish Counting Visual 0400 - 2000 PST	4/1/08	10/31/08	Jda 1.2.2.1
Spill for Fish	4/10/08	8/31/08	App E
Adult Lamprey Study	5/1/08	10/15/08	App A JDA 2.1
Spill Through Bay 2	9/1/08	11/30/08	Jda 2.2
Additional DSM Channel Operation	11/30/08	12/15/08	Jda 2.4.1.3 a
Maintenance of Adult Fish Facilities	12/1/08	2/28/09	Jda 1.2.2.2
Screens Remain in Place	12/1/08	12/15/08	Jda 2.4.1.3 a
Maintenance of Juvenile Facilities	12/16/08	2/28/09	Jda 1.1.3
Annual Report	1/31/09	1/31/09	Jda 3.3.4

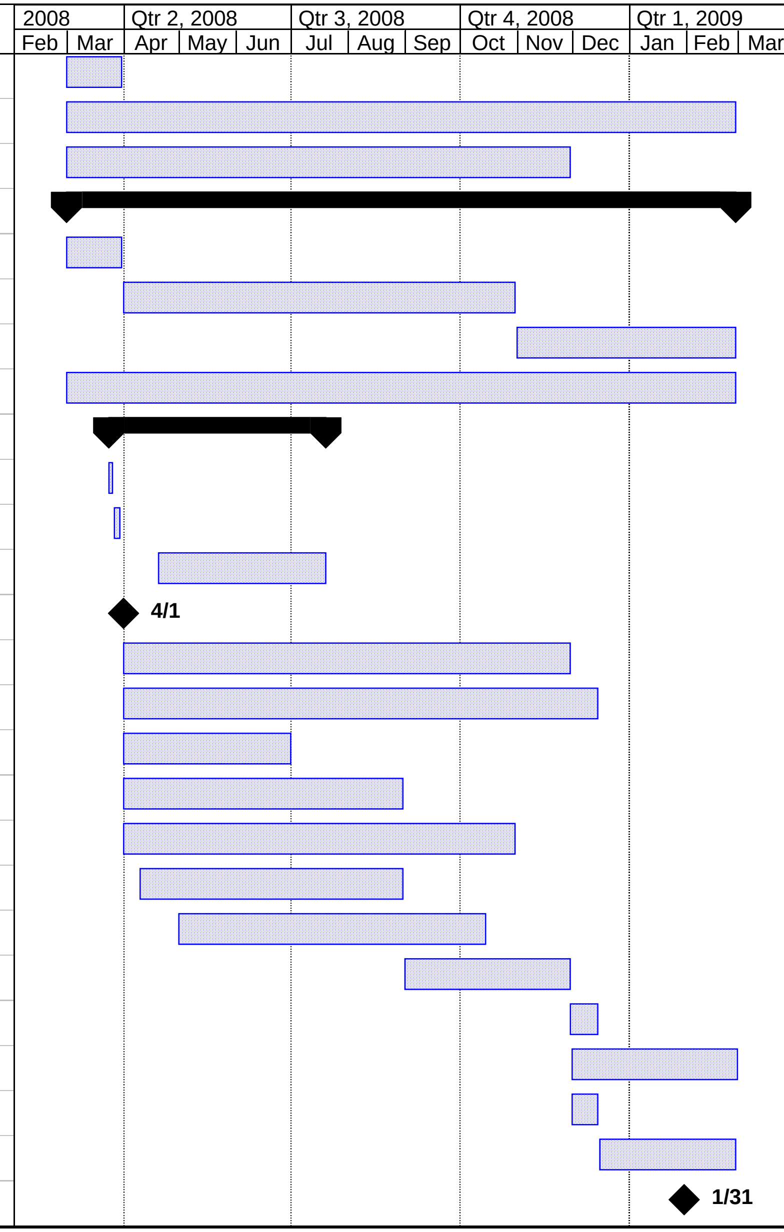


Table JDA-2. John Day 10%, 50%, and 90% juvenile passage dates, 1995 to 2006, with duration of middle 80% in days.

Yearling Chinook				
	10 %	50%	90 %	# of Days
1999	22-Apr	13-May	31-May	40
2000	20-Apr	9-May	28-May	39
2001	6-May	27-May	20-Jun	46
2002	1-May	17-May	1-Jun	32
2003	3-May	19-May	2-Jun	31
2004	28-Apr	16-May	30-May	33
2005	25-Apr	12-May	22-May	28
2006	25-Apr	11-May	24-May	30
2007	2-May	13-May	25-May	24
MEDIAN	28-Apr	14-May	30-May	34
MIN	20-Apr	9-May	22-May	24
MAX	6-May	27-May	20-Jun	46

Subyearling Chinook				
	10 %	50%	90 %	# of Days
1999	18-Jun	29-Jun	25-Jul	38
2000	6-Jun	29-Jun	3-Aug	59
2001	27-Jun	30-Jul	22-Aug	57
2002	20-Jun	30-Jun	20-Jul	31
2003	6-Jun	27-Jun	30-Jul	55
2004	14-Jun	28-Jun	23-Jul	40
2005	19-Jun	5-Jul	27-Jul	39
2006	14-Jun	3-Jul	18-Jul	35
2007	25-Jun	8-Jul	17-Jul	23
MEDIAN	16-Jun	30-Jun	26-Jul	41
MIN	6-Jun	27-Jun	17-Jul	23
MAX	27-Jun	30-Jul	22-Aug	59

Unclipped Steelhead				
	10 %	50%	90 %	# of Days
1999	26-Apr	23-May	5-Jun	41
2000	18-Apr	5-May	28-May	41
2001	28-Apr	5-May	30-May	33
2002	19-Apr	19-May	8-Jun	51
2003	30-Apr	28-May	4-Jun	36
2004	30-Apr	23-May	2-Jun	34
2005	1-May	14-May	24-May	24
2006	24-Apr	13-May	29-May	36
2007	29-Apr	13-May	28-May	30
MEDIAN	27-Apr	13-May	29-May	33
MIN	18-Apr	5-May	24-May	24
MAX	1-May	28-May	8-Jun	51

Hatchery Steelhead				
	10 %	50%	90 %	# of Days
1999	29-Apr	28-May	7-Jun	40
2000	15-Apr	2-May	24-May	40
2001	2-May	17-May	10-Jun	40
2002	24-Apr	14-May	6-Jun	44
2003	2-May	29-May	4-Jun	34
2004	7-May	20-May	29-May	23
2005	4-May	19-May	26-May	23
2006	28-Apr	10-May	29-May	32
2007	4-May	12-May	26-May	23
MEDIAN	2-May	16-May	30-May	30
MIN	15-Apr	2-May	24-May	23
MAX	7-May	29-May	10-Jun	44

Coho				
	10 %	50%	90 %	# of Days
1999	30-Apr	22-May	2-Jun	34
2000	5-May	13-May	8-Jun	35
2001	17-May	1-Jun	14-Aug	90
2002	7-May	1-Jun	12-Jun	37
2003	9-May	30-May	8-Jun	31
2004	12-May	27-May	12-Jun	32
2005	5-May	16-May	3-Jun	30
2006	10-May	26-May	12-Jun	27
2007	5-May	16-May	4-Jun	31
MEDIAN	8-May	24-May	6-Jun	31
MIN	30-Apr	13-May	2-Jun	24
MAX	17-May	1-Jun	14-Aug	90

Sockeye (Wild + Hatchery)				
	10 %	50%	90 %	# of Days
1999	10-May	17-May	1-Jun	23
2000	30-Apr	14-May	9-Jun	41
2001	1-Jun	14-Jun	27-Jun	27
2002	9-May	21-May	2-Jun	25
2003	10-May	19-May	2-Jun	24
2004	20-May	1-Jun	12-Jun	24
2005	16-May	21-May	31-May	16
2006	7-May	20-May	30-May	24
2007	9-May	25-May	7-Jun	30
MEDIAN	9-May	20-May	2-Jun	25
MIN	30-Apr	14-May	30-May	16
MAX	1-Jun	14-Jun	27-Jun	41

1.2. Adult Fish Passage.

1.2.1. Facilities Description. The adult fish passage facilities at John Day Dam include a north shore fish ladder that passes fish from entrances at the north end of the spillway, and a south shore fish ladder that passes fish from entrances along a collection channel which extends the full length of the powerhouse. Auxiliary water is provided to all collection systems by pumping from the tailrace. South auxiliary water also includes forebay water from the fish turbines. Counting stations are provided in both fishways.

1.2.2. Adult Migration Timing and Counting. Upstream migrants are present at John Day Dam throughout the year and adult passage facilities are operated year round. Adult fish (salmon, steelhead, shad, and lamprey) are normally counted from February 20 through December 7 (**Table JDA-3**), and these data appear daily (or every three days during video counting periods) on the Corps adult count website. Migration timing data for these species, except shad, appear in **Table JDA-4**. Sturgeon and bull trout are also counted and recorded on the WDFW fish counters' daily summary sheet comments section, and these data are summarized in the Annual Fish Passage Report, but do not appear on the Corps daily website total due to relative infrequency of passage.

1.2.2.1. The adult fish counting schedule is shown in **Table JDA-3**.

Table JDA-3. Adult fish counting schedule.

Period	Counting Method
April 1 – October 31	Visual count 0400 – 2000 PST

1.2.2.2. Annual winter maintenance of adult fish facilities is scheduled from December 1 through February (in-water work period) to minimize impacts on upstream migrants.

1.2.2.3. Adult fish migration timing has been calculated for John Day Dam from count data collected by the Corps since 1968. **Table JDA-4** summarizes adult fish passage timing through 2007. The primary passage period and the earliest and latest peaks of migration recorded are listed for each species (except shad). Peak lamprey migration timing for only the years 2000-2006 appears in this table.

Table JDA-4. John Day Dam adult migration timing, 1968-2007.

Species	Count Period	Earliest Peak	Latest Peak
Spring Chinook	4/1 - 6/5	4/14	5/22
Summer Chinook	6/6 - 8/5	6/7	8/2
Fall Chinook	8/6 – 10/31	9/2	9/25
Steelhead	4/1 – 10/31	8/25	10/6
Sockeye	4/1 – 10/31	6/21	7/10
Coho	4/1 – 10/31	9/4	10/26
Lamprey	4/1 – 10/31	7/16	8/12

2. Project Operation.

2.1. General.

2.1.1. Research, non-routine maintenance, other fish related activities, and construction activities will not be conducted within 100' of any fishway entrance or exit, within 50' of any other part of the adult fishway, or directly in, above, or adjacent to any fishway, unless coordinated by the project, Portland District Operations and/or Planning, or CENWP Construction office through FPOM or FFDRWG. Currently coordinated special operations related to research are described in **Appendix A**. Alternate actions will be considered by district and project biologists in conjunction with the Regional fish agencies on a case by case basis. Emergency situations should be dealt with immediately by the project in coordination with the project or district biologist. If unavailable, the biologists will be informed of steps taken to correct the situation immediately following the incident. All activities within boat restricted zone (BRZ) will be coordinated at least two weeks in advance with the project, unless it is deemed an emergency (see also **Overview** for coordination guidance).

2.2. Spill Management. See the 2008 Fish Operations Plan (Appendix E) for more information. Spill patterns formulated with spillway deflectors in place are provided in Table JDA-9. These will be used for both adult and juvenile patterns. Minimum spill of 25% is to provide adequate tailrace egress for juvenile salmonids. Spill from Bay 2 (1 stop or 1.6K) is provided for adult attraction during daylight hours between September 1 through November 30. Provisions are in place for deviations from normal spill patterns for barge traffic entering the navigation lock and have been coordinated with the fish agencies and tribes through the proper fish regulatory forums (TMT, FPOM, FFDRWG, etc.).

2.3. Total Dissolved Gas (TDG) Management and Control. Total dissolved gas (TDG) levels at Bonneville are monitored in accordance with the Dissolved Gas Monitoring Program, Appendix D

2.3.1 Excessive total TDG levels, which may harm fish, will be controlled to the extent possible, subject to river flow conditions. Control measures will include system spill allocations through the spill priority list issued by Reservoir Control Center (RCC), nighttime or daytime spill limits, and shaping of spill discharge.

2.4. Juvenile Fish Passage Facilities.

2.4.1. Operating Criteria.

2.4.1.1. December 1 through March 31 (Winter Maintenance Period).

> **a.** Remove debris from the forebay, all trash racks, and gatewell slots, so that these areas are debris-free on April 1.
>
> **b.** Inspect all VBSs for damage, holes, debris accumulations, or protrusions (video inspection acceptable). Clean and repair when necessary.

c. Inspect and operate each STS.

d. By April 1, place STSs in each intake slot of all operational units unless otherwise coordinated with the fish agencies and tribes.

e. Inspect and, where necessary, clean and/or repair all gatewell orifices and orifice lighting systems, such that these systems are debris-free and operable on April 1.

f. Check automatic control calibration/operation for the DSM tainter gate and other necessary sensors weekly and recalibrate as necessary. Report summaries of equipment recalibration in the weekly Smolt Monitoring Facility (SMF) operation monitoring reports.

g. Inspect, maintain and, where necessary, repair the DSM conduit tainter gate.

h. Inspect and, where necessary, correct any deficiencies of walls and floor of DSM conduit, raceway, and outfall.

i. Inspect and, where necessary, repair spill gates and the associated control system. Spillways, except for coordinated exceptions, must be able to achieve standard spill patterns on April 1.

j. Avian **Abatement Measures.** Avian abatement measures shall be in place by April 1. Repair avian predator control lines as soon as possible following damage or removal. Install and maintain new avian predator control lines in locations determined to be significantly impacted by avian predators. Avian hazing will occur March 1 – September 30. However, there will be no avian abatement measures, other than avian lines, performed from September through March each year.

k. Smolt Monitoring Facility: Insure all of the following items are fully operational:

1. Dewatering facilities, including weir gates, clean perforated plates, the screens (free of holes or gaps), and the screen cleaner brush system.

2. All valves and auxiliary water systems.

3. Flushing water valves and their perforated plates.

4. All gates, including the crest, tainter, switch, and rotating gates.

5. Fish and debris separator, including perforated plates and the adult passage chamber.

6. PIT tag detectors.

7. All sampling building systems, including holding tanks, valves, and conduits. (Note: A more specific list can be found in the Smolt Monitoring Facility Operation and Maintenance Manual.)

2.4.1.2. April 1 through November 30 (Fish Passage Season). Juvenile fish protection devices (submersible traveling screens (STS)); will be in place prior to the beginning of the juvenile fish passage season. Screens will remain in operation through December 15 to prevent adult salmonids from falling back through turbine units, even though the juvenile passage season officially ends November 30.

a. Measure gatewell drawdown across the trashrack a minimum of once per week. Remove debris from forebay and trash racks as required to maintain less than 1.5' of drawdown in gatewell. If VBS drawdown reaches 1.2’, the Project will inspect the screen and prepare to clean it.

b. Units 1 through 5 will be raked, if necessary as determined by ROV inspection, monthly between April 1 and July 1. Units 6 through 10 or units 11 through 16 will be alternately raked with units 1 through 5 from April 1 through July 1. After July 1, units will be raked as necessary as determined by ROV inspection, or as needed to avoid exceeding gatewell drawdown criterion.

c. Debris accumulations in the forebay of 300' or more in any direction from the face of the dam will be removed within 48 hours. Debris removal efforts should continue until the debris load has been removed.

d. If debris loads are obvious in the forebay, trash will be raked in front of the affected units weekly until the debris load has been removed.

e. Additional raking will occur whenever trash accumulations are suspected because of increased differential (1.5') across the trash racks, or as determined by the project biologist in reference to indicators such as increased juvenile fish descaling at the dam, deteriorating fish condition as noted by SMF personnel, or increased accumulations of tumbleweeds in the forebay. Gatewell orifices of the unit being raked must be closed during the raking operation.

f. Inspect each STS, VBS, and orifices once per month (or 720 hours run time). Video inspections are acceptable. More frequent inspections may be required under the following conditions: deterioration of fish condition, increased debris load in bypass system, and other indications of STS or VBS malfunction or failure. If STS or VBS damage or plugging is detected, follow procedures in **Section 3. Fish Facilities Maintenance**. Records of inspections will be reported in weekly fishway status reports and provided to FPOM. Unit 2 will operate when unit 1 is out of service for STS inspections.

g. Open all gatewell orifices (April 1 – December 15). Inspect orifice lights daily to assure that the orifice lights are operating. Replace all burned out orifice lights within 24 hours. Close and open each orifice three times daily, or more frequently, to be determined by the project biologist, as necessary due to heavy debris accumulations in gatewells. If a unit goes out of service, orifices are to remain open in associated gatewells for a 24-hour period afterward to allow fish to escape the gatewells into the DSM.

h. Observe each STS amp and/or watt meter readings at least once per shift. If an STS failure occurs, then follow procedures in **Section 3. Fish Facilities Maintenance**.

i. Inspect all STS gatewells daily. The project will clean gatewells before the gatewell water surface becomes half covered with debris. If, due to the volume of debris, it is not possible to keep the gatewell surfaces at least clear, they will be cleaned at least once daily. Turbines with a gatewell fully covered with debris will not be operated except to be in compliance with other coordinated fish measures, and then only on a last on/first off basis. The powerhouse gatewell orifices will be closed during the cleaning operation. After debarking a gatewell, cycle the orifice in that gatewell. Check gatewell drawdown.

j. Efforts should be made to keep all petroleum out of gatewells. Project environmental section will determine cleanup efforts if needed. Regardless of unit operating status, oil accumulations will be dealt with promptly.

k. Coordinate gatewell cleaning, when using a dip basket, with personnel operating the Smolt Monitoring Facility.

l. Reinstall or repair avian predator control lines as soon as possible following damage or removal. Install and maintain new avian predator control lines in locations determined to be significantly impacted by avian predators. Implement other avian abatement (hazing) as necessary from April through August only.

m. Turbine units without a full complement of rotating STSs will not operate, except to be in compliance with other coordinated fish measures.

n. Maintain water level in the bypass conduit between 4.0’ – 5.0’, as measured at Unit 16.

o. Smolt Monitoring Facility. Ensure the proper function of sampling systems. Particular attention is directed toward the following:

> **1.** Dewatering facilities, including the screens being free of holes or gaps, and the screen cleaner brush system.
>
> **2.** All valves and auxiliary water systems.
>
> **3.** Flushing water valves and their perforated plates.

4. All gates, including the crest, tainter, switch, and rotating gates.

5. Fish and debris separator, including perforated plates and the adult passage chamber.

6. Pit tag detectors.

7. All sampling building systems, including holding tanks, valves, and conduits.

8. Dewater the Primary Dewatering Structure to remove adult fish that have accumulated in the structure, as determined by the project biologist. This should be performed during daylight hours only when the water temperature is below 70 degrees F. Do not dewater facility if water temperature is 70^{o} F or greater. The number of adult salmonids, by species, shall be reported in the subsequent Weekly Fish Status Report.

9. The smolt monitoring facility (SMF) will be monitored on a 24 hours per day, 7 days per week 4/1 – 9/15 basis by the project fish personnel to ensure its proper functioning and provide quick response to an emergency. Inspect every 2 hours Therefore, the system will be fully staffed while the SMF is in operation (i.e., crest gate is deployed and the secondary dewatering structure is receiving fish-laden flow).

10. Cycle Primary Dewatering Screen (PDS) sweepers twice per shift (6 per day) during low to normal debris loads. If debris loads increase, increase frequency of screen sweeper cycling as determined by the project biologist through inspections.

11. A person on duty will perform a walking inspection of the entire SMF system every two hours to ensure safe passage conditions.

12. Particular attention will be paid to the fish/debris separator (FDS) that needs to be visually inspected every 30 minutes to prevent injury and/or mortality to passing fish.

13. During any high debris loading periods (likely during spring run off) additional personnel may be required to keep the Fish/Debris Separator (FDS) free of any obstruction to fish passage. The project biologist will decide to assign a person to remove debris from the FDS on a shift basis (possible constant, 24 hours/day presence) for as long as it is necessary to assure the safety of passing fish.

14. For adult fish removal from the PDS area when river temperatures reach 70°F or greater, all fish handling will be coordinated through FPOM.

2.4.1.3. December 1 through March 31 (Winter Maintenance Period).

a. Screens (STS, ESBS) will remain in place through December 15 to prevent adult salmonids from falling back through turbine units, thereby shortening some aspects of the winter maintenance period by two weeks. To reduce adult fallback mortality, the juvenile bypass system, or JBS channel will operate from November 30 through December 15. Priority units will be left screened during this period to the extent practicable (barring operational failure), and screens from non-priority units will only be removed when necessary to begin maintenance. If units are required for operation during this period, and are unscreened, they will be operated on a last on/first off basis. After December 15, all STSs may be removed.

b. Dewater DSM channel only when required for inspection, maintenance, or structural modifications (see **section 5. Dewatering Plans**; also, paragraph **3.2.1.2.** Juvenile Bypass System). The outage period will be minimized to the extent practicable.

c. All units are available to meet power demands.

2.5. Adult Fish Passage Facilities.

2.5.1. Operating Criteria.

2.5.1.1. December 1 through February (Winter Maintenance Period).

a. Inspect and calibrate all staff gages, water level sensors, and indicators. Repair and/or clean where necessary.

b. Dewater and inspect repair as needed all ladders and all other dewatered sections of fish facilities for projections, debris, or plugged orifices which could injure fish, or slow their progress up the ladder.

c. Inspect for and, when necessary, clear debris in ladder exits.

d. Reinstall picket leads at counting stations prior to watering up ladders during maintenance.

e. Repair or, when necessary, upgrade netting and padding at top of north fish ladders to address the fish jumping problem in this area.

2.5.1.2. March 1 through November 30 (Fish Passage Season).

a. All Adult Facilities.

1. Water depth over fish ladder weirs: 1' +/-0.1'. When shad numbers exceed 5000 fish per day per count station, water depth should be increased to 1.3' +/- 0.1'.

2. Measure water temperatures at the count stations of each ladder and include the weekly means in the status report. When water temperature reaches 70^{o} F all fish handling activities will be coordinated with the Regional fish agencies through FPOM prior to any action to verify protocols that will be followed.

3. Head on all entrances: 1' to 2' (1.5' optimum). Refer to paragraph **3.3.1**. when unable to achieve head criteria.

4. A water velocity of 1.5' to 4 fps per second (2 fps optimum) shall be maintained in all channels and the lower ends of the fish ladders that are below the tailwater. Floating orifice gates 1, 2, 18, and 19 open and operate three fish pumps to maintain fishway criteria. The entrance gate should remain at 8’ depth submergence or greater to be in criteria.

5. Maximum of 0.5' head on attraction water intakes and trash racks at all the ladder exits, with a 0.3' maximum head on all picket leads. Debris shall be removed when significant amounts accumulate.

6. Staff gages and water level indicators will be readable at all water levels encountered during the fish passage period, and calibration checked weekly. Recalibrate ASAP if out of calibration.

7. Main entrance weir depths: 8' or greater below tailwater. Maintain tailwater elevation greater than 158’msl to stay within criteria operation range for the entrance weirs.

8. Count station crowders shall be at maximum width that allows count or video tape accuracy. The minimum count slot width shall be no less than 18 inches. If passage is impaired by narrow count slot conditions, the count slot will be widened until proper passage conditions are achieved, despite count accuracy. Project biologists, FFU, and WDFW fish counters shall coordinate to achieve optimum count slot passage and/or count accuracy conditions. If counting is temporarily discontinued due to unscheduled events, the crowder shall be fully opened. The crowder shall remain in operating position during the counters’ hourly ten minute break periods.

b. North Fishway.

1. Operate one entrance weir (EW-1) at 8’ or greater weir depth. Entrance head: 1’ to 2’ (1.5’ optimum). Testing will be conducted to determine if the use of one entrance at greater than 8’ depth allows better passage conditions. (Study plan will be developed through the AFEP Studies Review Work Group.)

2. Starting September 1, spill from Bay 2 (1 stop or 1.5K) for adult attraction during daylight hours through November.

3. Maintain netting and padding for the North fishway to address the adult salmonid jumping problem. All holes in the netting large enough to catch or allow escapement of an adult salmonid must be closed.

c. South Fishway. Operate entrance weir SE-1.

d. Powerhouse.

1. Operate entrances NE-1 and NE-2.

2. Operate four powerhouse floating orifices (1, 2, 18, and 19) and open associated auxiliary water diffusers. (See also **2.5.1.2.a.4.**). **During the fish turbine #3 overhaul in 2008, floating orifice gates 18 and 19 will be closed.**

3. From 0400 to 2000 hours, operate unit 1 near 100 megawatts (+/- 10 MW) to facilitate best entrance conditions. If additional load is required by BPA, unit 1 may be operated at above 100MW, but it should be the last to be brought up to full load when demand increases and the first to drop off when demand decreases. (See also Load Shaping Guidelines, **Appendix C**).

2.5.1.3. December 16 through February (Winter Maintenance Period).

a. Operate according to fish passage season standards, except facilities may be dewatered or operated out of criteria for maintenance or repair. Outage periods will be minimized to the extent practicable.

b. Only one of the two adult fish passage facilities may be out of service at a time. The other facility must be operated at full passage season criteria unless specially coordinated with the Regional fish agencies through FPOM. However, operation of unit 2 may be substituted for unit 1 without special coordination when the south fishway is in service.

c. Pull picket leads at counting stations and have crowders adjusted such that the counting slots are fully opened at the end of the counting season (this will be done shortly after adult fish counting ends).

d. Maximum of 0.5' head on attraction water intakes and trash racks at all ladder exits. Debris shall be removed when significant amounts accumulate.

3. Facility Monitoring and Reporting.

3.1. Inspections.

3.1.1. The results of all inspections and the readiness of the facilities for operation will be reported to the FPOM at the meeting immediately prior to the fish passage season.

3.1.2. During fish passage season, fish passage facilities will be inspected at least twice per day/seven days a week to assure operation according to established criteria.

3.1.3. During winter maintenance season, fish passage facilities will be inspected once per day/at seven days a week.

3.1.4. More frequent inspections of some facility components will occur as noted throughout the text.

3.1.5 Additional fishway inspections may be performed by FFU and fish agencies.

3.2. Zebra Mussel Monitoring. A zebra mussel monitoring program will continue. These organisms have become a serious problem elsewhere in the country and may become introduced into the Columbia River basin. Inspections should also be made when dewatering all project facilities.

3.3. Reporting.

3.3.1. Project biologists shall prepare weekly reports throughout the year summarizing project operations. The weekly reports will provide an overview of how the project and the fish passage facilities operated during the week and an evaluation of resulting fish passage conditions. The reports shall include:

a. **A**ny out-of-criteria situations observed and subsequent corrective actions taken;

b. **A**ny equipment malfunctions, breakdowns, or damage along with a summary of resulting repair activities;

c. **A**dult fishway control calibrations;

d. STS and VBS inspections;

e. AWS closures (i.e. cleaning times);

f. **A**ny unusual activities which occurred at the project which may affect fish passage.

3.3.2. The weekly reports shall cover a Sunday through Saturday period and they shall be e-mailed to CENWP-OD and other interested parties as soon as possible the following week, with a copy to CENWD-PDW-R RCC.

3.3.3. The project biologists shall prepare a memo for the record for any negative impact to fish or fishways. This memo will be sent to FPOM by the next working day. Items that shall be included in the memo are:

a. Time and date.

b. Nature of activity that lead to fish impact.

c. Agency responsible for the impact, or the reportee if no responsible party can be identified.

d. Fish numbers, species, origin, discernible external injuries, tags, etc.

e. Future actions to avoid a similar impact.

f. Any relevant photos.

3.3.4. The project biologists shall prepare an annual report by January 31, summarizing the operation of the project fish passage facilities for the previous year.

a. The report will cover from the beginning of one adult fish facility winter maintenance period to the beginning of the next.

b. The annual report also will include a description of all actions taken to discourage avian predation at the project, with an overview of the effectiveness of the activities in discouraging avian predation.

c. The annual report will be provided to CENWP-OD in time for distribution to FPOM members at the February meeting.

4. Fish Facilities Maintenance.

4.1. General.

4.1.1. Routine Maintenance. Scheduled fishway maintenance, to the extent practicable, will be conducted during periods when passage has been documented to be at its lowest to minimize impacts to migrating salmonids. Maintenance activities that occur during the fish passage period, and that may affect fish passage, will be reported in the weekly reports (**section 3.3**).

4.1.1.1. Staff gages will be installed, cleaned, and/or repaired as required.

4.2. Juvenile Fish Passage Facilities.

4.2.1. Routine Maintenance.

4.2.1.1. Submersible Traveling Screens. The STS system may receive preventive maintenance or repair at any time during the year as necessary. Most maintenance will occur during the winter maintenance period when all STSs may be removed from the intakes. During the designated juvenile passage season, a turbine unit cannot operate without a full compliment of functioning STSs.

4.2.1.2. Juvenile Bypass System. The juvenile bypass facilities may receive preventive maintenance at any time of the year as deemed necessary in coordination with FPOM. During the juvenile fish passage season, this will normally be above water work, such as maintenance of automatic systems, air lines, electrical systems, and monitoring equipment. During the winter maintenance period, the system is dewatered. The system is visually inspected in all accessible areas for damaged equipment and areas that may cause potential problems to juvenile fish. Identified problems will be repaired by project maintenance or the contractor as soon as possible. Extended repair projects will be coordinated through FPOM.

4.2.1.3. Turbines and Spillway. Maintenance and routine repair of project turbines and spillways is a regular and recurring process which requires that units be shut down for extended periods of time (see **section 5**. Dewatering Plans.) Maintenance schedules for these turbines and spillways will be coordinated through FPOM. Certain turbine and spillway discharges at the projects are secondarily used to attract adult fish near fishway entrances to keep predator fish from accumulating in the area of juvenile release sites and to move juveniles downstream away from the project. The maintenance schedules for these turbines and spillways will reflect equal weight given to fish, power, and water management and will be coordinated with the appropriate fish agencies. Units that should not be scheduled for maintenance during the fish passage season are 1, 2, and 5. Some types of turbine maintenance will require testing turbine operation throughout the full operating range before returning it to normal service.

4.2.2. Non-Routine Maintenance. Non-routine maintenance of facilities will be carried out as described below. Activities that will have a significant impact on juvenile fish passage shall be coordinated through FPOM on a case-by-case basis by project and CENWP-OD biologists. The CENWP-OD biologists will be notified as soon as possible after it becomes apparent that maintenance repairs are required. The Project Operations Manager has the authority to initiate work prior to notifying CENWP-OD when delay of the work will result in an unsafe situation for people, property, or fish. Information required by CENWP-OD includes:

a. Description of the problem.

b. Type of outage required.

c. Impact on facility operation.

d. Length of time for repairs.

e. Expected impacts on fish passage.

4.2.2.1. Submersible Traveling Screens. If an STS or VBS is damaged or inoperative in an operating unit, the unit will be regarded as an unscreened unit. The screen will be repaired or replaced before returning the unit to service.

4.2.2.2. Juvenile Bypass System.

a. The juvenile bypass system is automatically controlled. If the automatic system fails, it will be operated manually until automation repairs are made. If the orifices become plugged with debris, the turbine will not be operated until it has been cleaned.

b. Inspect all STS gatewells daily. The project will clean gatewells before the water surface becomes one half covered with debris. If, due to the volume of debris, it is not possible to keep the gatewell surfaces at least half clear, they will be cleaned at least daily. Turbines with a gatewell fully covered with debris will not be operated except on a last on/first off basis if required to be in compliance with other coordinated fish measures. The gatewell orifices must be closed during the cleaning process. Juvenile mortality numbers will be monitored in all gatewells, as potential indicators of gatewell environment problems. Mortality estimates will be recorded and reported in the weekly status reports.

c. If the bypass system fails in the powerhouse conduit, tainter gate, or transportation outfall making the system unsafe for fish, an action decision will be made in coordination with the FPOM. During this emergency operating mode, power generation will be minimized to the extent practicable. If this operating mode is expected to last longer than four days, then all units required for generation will be sequentially shut down, fish salvaged from the gatewells, the STSs removed, and the unit restarted. The orifice gates will be closed during this process.

d. During fishway inspection activities, VBSs may be found plugged with debris, damaged or not properly seated. In these cases, the associated unit will be regarded as if unscreened and repairs will be made before returning the unit to operation.

4.2.2.3. Turbines and Spillways.

a. If a spill gate becomes inoperable, the operators will make the changes necessary to accommodate the spill and then immediately notify the operations supervisor and project biologist to determine the best pattern to follow until repairs can be made. This interim operation shall be coordinated with the FPOM through the district biologist who will provide additional guidance to the project.

b. Unit 2 will replace unit 1 for adult attraction whenever unit 1 is not operating.

4.3. Adult Passage Facilities.

4.3.1. Routine Maintenance. Maintenance activities that occur during the fish passage period and that may affect fish passage will be reported in the weekly reports (**section 3.0**).

4.3.1.1. Fishway Auxiliary Water Systems. John Day Dam has tailwater pump auxiliary water systems. Preventive maintenance and normal repair are carried out throughout the year. Trash racks for the AWS intakes will be raked when drawdown exceeds criteria. When practicable, rake trash racks during the time of day when fish passage is least affected.

During the annual navigation lock maintenance outage, the north fish ladder auxiliary water is shut off for about half a day. This is required to allow divers to clean off the navigation lock discharge sill so that a bulkhead can be placed.

4.3.1.2. Powerhouse and Spillway Fish Collection Systems. Preventive maintenance and repair occurs throughout the year as needed. During the adult fish passage season, this maintenance will not involve operation that will cause failure to comply with the adult fishway criteria, unless coordinated through FPOM. During the winter maintenance period, an inspection will occur through dewatering or divers per discretion of the project biologists. One additional underwater diver/ROV will occur during August 1 - 15. Timing of this inspection will be coordinated through FPOM. The project biologist or alternate Corps fish personnel will attend all dewatering and inspection activities potentially involving fish (see **section 5**. Dewatering Plans).

4.3.1.3. Adult Fish Ladders and Counting Stations. The adult fish ladders will be dewatered once each year during the winter maintenance period. Unless specially coordinated, only one ladder will be dewatered at a time, with the other ladder capable operating within criteria. During this time the ladders are inspected for necessary maintenance needs and potential fish passage problems. These include blocked orifices, projections into the fishway that may injure fish, unstable weirs, damaged picket leads, exit gate problems, loose diffuser gratings, unreadable or damaged staff gauges, defective diffuser valves, and malfunctioning equipment at the counting stations. Potential problems identified throughout the passage year that do not impact fish passage, as well as those identified during the dewatered period, are then repaired. Trash racks at the ladder exits will be raked when criteria are exceeded. When practicable, rake trash racks during the time of day when fish passage would be least affected. Fish count station windows, light panels, and crowder panels will be cleaned, as needed, to achieve accurate counts and, when practicable, during the time of day when fish passage is least affected. North netting installed on the ladders to prevent fish leaping will be inspected daily and maintained when necessary. Summaries of inspections will be included in the weekly activity report.

4.3.2. Non-Routine Maintenance. Maintenance activities that occur during the fish passage period and that may affect fish passage will be reported in the weekly reports (section 2.6.). Non-routine maintenance that will significantly affect the operation of a facility, such as repair of displaced diffuser gratings, will be coordinated through FPOM. Coordination procedures for non-routine maintenance of adult facilities are the same as for juvenile facilities (section 3.2.2).

4.3.2.1. Fishway Auxiliary Water Systems. The fishway auxiliary water systems are mostly automated. If the automatic system fails, the system will be operated manually by project personnel. This will allow the fish facility to operate according to criteria while the automatic system is repaired. When this operation becomes necessary, project personnel will increase the surveillance of the adult system to ensure that criteria are being met. The FPOM will work with the project to determine the best operation in the event of an AWS failure during the adult passage season.

a. South Ladder. If one of the three auxiliary water turbines fails, assuming all three turbines are being used to meet criteria, the output of the two remaining turbines will be increased to meet adult fishway criteria. If a second turbine unit fails, the adult fish facility will be operated as follows until a fishway head of 1' is achieved.

1. Increase discharge of the remaining unit to maximum capacity.

2. Close NE-1.

3. Leave NE-2 at a depth of 8'.

4. Close the remaining floating submerged orifice gate entrances starting at the north end.

5. Leave the south powerhouse entrance weir (SE-1) at 8' depth below the tailwater surface.

6. If the above criteria are still not achieved, then reduce entrance weirs in depth to 6', or then to 4' if necessary, until more auxiliary water becomes available. Then reverse the above procedure.

If all three turbine units fail, operate as follows until repairs can be made:

1. SE-1 will be open with the weir crest 6' below the tailwater surface.

2. Close NE1 and NE2.

3. Cross channel bulkheads will be placed in the powerhouse collection channel between units 2 and 3.

4. The floating orifice gate in front of unit 2 will be closed, leaving the floating orifice gate in front of unit 1 open. (See also **2.5.1.2.a.4.**)

b. North Ladder. This system cannot operate according to the adult fishway criteria under any conditions due to design limitations. Three of the six available pumps can be operated simultaneously. If one pump fails, one of the standby pumps will be started. This routine will be followed until the available pumps can no longer meet the adult fishway criteria. If this occurs, EW1 will be set at the maximum weir depth needed to maintain fishway criteria. Present design capability: 2 pumps with tailwater <160 msl; 3 pumps with tailwater >160 msl.

4.3.2.2. Powerhouse and Spillway Fish Collection Systems. John Day Dam contains several types of fishway entrances. In most cases, if failures occur, the entrance can be operated manually by project personnel until repairs are made. When this operation becomes necessary, project personnel will increase the surveillance of the adult system to ensure criteria are being met. In those cases in which the failure will not allow the entrance to be operated manually, the gate will be maintained, to the extent possible, in an operational position. If this is not possible, the entrance will be repaired expediently and the entrance will be returned to manual or automatic control at the earliest possible date.

4.3.2.3. Adult Fish Ladders and Counting Stations. Pickets with excessive spacing (greater than 1"), erosion of concrete around the picket leads, or missing pickets can allow fish into areas where escape is not possible. The north count station upstream picket leads have an exit hatch that can be opened to allow fish to escape. Repair will be required for picket lead failure at the south count station. In the instances of picket lead failure or concrete erosion, the timing and method of repair will depend upon the severity of the problem. The decision of whether or not to dewater the fishway and repair any problem will be made in coordination with the FPOM.

4.3.2.4. Diffuser Gratings. Diffuser chambers for adding auxiliary water to fish ladders and collection channels are covered by gratings attached by several different methods. Diffuser gratings are normally inspected during the winter maintenance period to assure integrity. These inspections are done by either dewatering the fishway and/or collection channel, or by using video cameras and divers or other methods to inspect the gratings underwater. Diffuser gratings may come loose during the fish passage season due to a variety of reasons. Daily inspections of the fish ladders and collection systems should include looking for any flow changes that may indicate problems with diffuser gratings. If a diffuser grating is known to or suspected of having moved, creating an opening into a diffuser chamber, efforts must immediately be taken to correct the situation and minimize impacts on adult fish in the fishway. If possible, a video inspection should be made as soon as possible to determine the extent of the problem. If diffusers gratings are found to be missing or displaced, close associated diffuser, a method of repair shall be developed and coordinated with FPOM. Repairs shall be made as quickly as possible unless coordinated differently.

5. Turbine Unit Operation and Maintenance. Unit operating priority is shown in **Table JDA-5**, including that time when synchronous condensing occurs. Unit maintenance schedules will be reviewed by project and district biologists for fish impacts.

Table JDA-5. Turbine unit operating priority for John Day Dam.

Season	Time of Day	Unit Operating Priority
March 1 through November	24 hours/day	5, 1, 2, 3, then 4 and 6-16 in any order.
December 1 through February	0600-2000 hrs	5, then unpaired units in any order
	2000-0600 hrs	5, then any unit

5.1. Guidelines for operating units within the 1% turbine efficiency range at various heads are shown in **Tables JDA-6** to **JDA-8**. To the extent technically feasible, turbines will be operated within +/- 1% of best turbine efficiency, unless operation outside of that range is necessary to meet load requirements of the BPA administrator, consistent with the BPA System Load Shaping Guidelines (**Appendix C**), or to comply with other coordinated fish measures. The System Load Shaping Guidelines apply between April 1 and October 31. However, during the rest of the year, the project will continue to operate units within the 1% turbine efficiency range, except as specifically requested by BPA for power production.

5.2. Juvenile fish passage decreases through units from south to north, making inefficient operation of unit 16 least likely to impact fish. Based on this, if it is necessary to select turbines to operate outside the 1% efficiency range, they will be selected in sequence from north to south.

However, allowance will also be given to special project requirements for stable voltage control which require load distribution between transformer banks

6. Dewatering Plans. Guidelines for dewatering and fish handling plans (Appendix F) have been developed and are followed for dewatering project facilities. These plans include consideration for fish safety and are consistent with the following general guidance. The appropriate plans are reviewed by participants before each salvage operation. The project fish biologist and/or alternate Corps fish personnel will attend all project activities involving fish handling. The fish agencies and tribes will be encouraged to participate in all ladder dewaterings. During the pumping or draining operation to dewater a portion or all, the water level will not be allowed to drop so low it strands fish. Personnel shall remain present onsite during pumping operations to ensure stranding does not occur or a water level sensor that deactivates the dewatering process will be used.

6.1. Adult Fish Ladders.

6.1.1. Routine Maintenance.

6.1.1.1. When possible, operate ladders to be dewatered at orifice flow, with the AWS off, for at least 24 hours, but not more than 96 hours prior to dewatering.

6.1.1.2. The project biologist will assure that fish rescue equipment is available, and will coordinate to ensure adequate numbers of personnel will be available to move fish out of the dewatered ladder.

6.1.1.3. Project personnel will install head gates to shut down ladder flow. Where possible, a flushing flow of 1-2" will be maintained in the ladder until fish are rescued.

6.1.1.4. The project biologist or alternate Corps fish personnel will oversee fish rescue when the ladders are dewatered. The project biologist will invite fish agency and/or tribal biologists to participate in the dewatering activities. Captured fish will then be transported to the forebay or tailwater, depending on the fish life stage (adults to forebay, juveniles to tailrace), for release. If a ladder is dewatered in the spring or summer, steelhead kelts should be released into the tailrace.

6.1.1.5. Orifice blocking devices, which are placed in the lower-most weirs to prevent fish from re-ascending the dewatered portion of the adult fishway, shall have ropes attached to them by project operations and be tied off to fishway railings. The blocking devices shall be removed just before the fishway is returned to service. These devices will be noted on the pre-water-up checklist maintained by project fish biologists. This will prevent the orifice blocks from being unintentionally left in place following fishway water-up.

6.2. Non-Routine Maintenance.

6.2.1. When possible, discontinue auxiliary water and operate ladder at reduced flow as long as possible up to 72 hours prior to dewatering.

6.2.2. Follow guidance in paragraphs **6.4.1.3.** through **6.4.1.6**.

6.3. Powerhouse Fish Collection System.

6.3.1. Routine Maintenance. During the pumping or draining operation to dewater a portion or the entire collection channel, the water will not be allowed to drop to a level which strands fish. Personnel shall remain present onsite during pumping operations to ensure that stranding does not occur. The project biologist will assure that all necessary rescue equipment is available. The project biologist or alternate Corps fish personnel will provide technical guidance on fish safety and will assist directly in rescue operations.

6.4. Juvenile Bypass System.

6.4.1. Routine Maintenance. It is normal practice, when draining the juvenile bypass channel, to flush the channel with only the bypass orifices in bay 16 open. Bay 16 gatewells will be dipped in advance to minimize the number of fish contained in this flushing water during fish passage season.

Table JDA-6. Turbine units with standard-length submersible traveling screens installed.

Head **(Feet)**	**Lower Generator Limits**		**Upper Generator Limits**	
	MW	**CFS**	**MW**	**CFS**
80	65.4	11,338	118.0	20,472
81	66.7	11,416	120.8	20,671
82	68.1	11,492	123.6	20,864
83	69.4	11,566	126.4	21,052
84	70.8	11,638	129.1	21,234
85	72.1	11,707	131.9	21,411
86	72.9	11,692	134.7	21,593
87	73.7	11,676	137.5	21,770
88	74.5	11,661	140.2	21,942
89	75.3	11,646	143.0	22,110
90	76.1	11,632	145.8	22,274
91	77.0	11,622	146.9	22,164
92	77.9	11,613	148.0	22,057
93	78.8	11,604	149.1	21,951
94	79.7	11,595	150.2	21,848
95	80.6	11,585	151.3	21,746
96	81.7	11,604	151.6	21,532
97	82.8	11,623	151.8	21,323
98	83.8	11,640	152.1	21,118
99	84.9	11,657	152.4	20,917
100	86.0	11,674	152.7	20,720
101	86.9	11,675	154.9	20,800
102	87.9	11,677	155.2	20,613
103	88.8	11,678	155.2	20,378
104	89.7	11,679	155.2	20,149
105	90.6	11,680	155.2	19,923
106	91.4	11,658	155.2	19,711
107	92.1	11,637	155.2	19,503
108	92.8	11,615	155.2	19,299
109	93.6	11,594	155.2	19,098
110	94.3	11,574	155.2	18,901

NOTE: The turbine efficiency table was revised to reflect information using a 2001 Unit 9 NS index test and a 1962 model test with STS adjustment Factor (Table JDA- 6 revised, 2005). Table prepared by HDC dated November 2002.

Table JDA-7. Turbine units with extended-length submersible bar screens installed.

Head (Feet)	Lower Generator Limits		Upper Generator Limits	
	MW	CFS	MW	CFS
85	69.6	11,396	111.5	18,269
86	70.3	11,381	113.7	18,402
87	71.1	11,366	115.9	18,531
88	71.9	11,351	118.1	18,657
89	72.6	11,336	120.3	18,779
90	73.4	11,322	122.5	18,898
91	74.3	11,313	122.9	18,717
92	75.1	11,304	123.2	18,540
93	76.0	11,295	123.6	18,367
94	76.9	11,285	123.9	18,197
95	77.7	11,276	124.3	18,031
96	78.8	11,294	124.4	17,841
97	79.8	11,312	124.6	17,654
98	80.9	11,329	124.7	17,472
99	81.9	11,346	124.8	17,293
100	82.9	11,361	125.0	17,117
101	83.8	11,363	126.6	17,163
102	84.7	11,364	128.3	17,207
103	85.6	11,365	129.9	17,250
104	86.5	11,367	131.6	17,293
105	87.4	11,367	133.2	17,334

NOTE: The turbine efficiency tables are being revised to reflect new information for John Day Dam. This table is based on data from Little Goose Dam (LGS-5).

Table JDA-8. Turbine units without screens:

Head(Feet)	Lower Generator Limits		Upper Generator Limits	
	MW	CFS	MW	CFS
80	71.7	12,305	122.8	21,074
81	73.2	12,391	125.7	21,290
82	74.7	12,473	128.7	21,500
83	76.1	12,554	131.6	21,703
84	77.6	12,631	134.6	21,901
85	79.1	12,707	137.5	22,093
86	80.0	12,690	140.1	22,223
87	80.9	12,674	142.6	22,349
88	81.7	12,657	145.1	22,471
89	82.6	12,641	147.6	22,591
90	83.5	12,625	150.2	22,707
91	84.5	12,616	151.7	22,656
92	85.5	12,606	153.2	22,606
93	86.4	12,596	154.8	22,556
94	87.4	12,586	155.1	22,321
95	88.4	12,576	155.2	22,062
96	89.6	12,597	155.2	21,797
97	90.8	12,617	155.2	21,538
98	92.0	12,636	155.2	21,284
99	93.1	12,655	155.2	21,035
100	94.3	12,673	155.2	20,792
101	95.3	12,675	155.2	20,554
102	96.4	12,676	155.2	20,321
103	97.4	12,678	155.2	20,092
104	98.4	12,679	155.2	19,868
105	99.4	12,680	155.2	19,649
106	100.2	12,656	155.2	19,442
107	101.0	12,633	155.2	19,239
108	101.8	12,610	155.2	19,040
109	102.6	12,587	155.2	18,845
110	103.5	12,565	155.2	18,653

NOTE: The turbine efficiency table was revised to reflect information using a 2001 Unit 9 NS index test and a 1962 model test (Table JDA- 8 revised, 2006). Table prepared by HDC dated November 2002.

6.5. Turbines.

6.5.1. Remove juvenile fish from the gatewell(s) that will be drained. This is done by use of a special dipping basket. Dipping is not required when fish screens have been removed. Immediately before setting the headgates, spin the unit to move fish out of the draft tube.

6.5.2. If the turbine unit draft tube is to be dewatered and the turbine unit has been idle for any length of time, it will be briefly operated when possible, at speed/no load, and stop logs will then be placed immediately.

6.5.3. If a turbine unit is idle and partially dewatered, and tail logs are to be put into place, an adequate safety pool may be maintained for up to 4 days to accommodate fish trapped in the draft tube. If longer timeframes are needed for the safety pool, project fisheries will coordinate with FPOM on a case-by-case basis. Adequate inspections will need to be conducted to ensure that the safety pool is maintained and fish are in good condition. Water levels in the draft tube will not be allowed to drop to a level that strands fish.

6.5.4. Fish rescue personnel will inspect dewatered turbine draft tubes, scroll cases, and intakes as soon as they can gain access and the water levels reach a depth permitting visual inspection. The project biologist or alternative fish personnel will provide technical guidance on fish safety and will directly participate in fish salvage.

6.5.5. The project biologist will assure that all necessary rescue equipment is available.

7. Forebay Debris Removal.

7.1. Debris at projects can impact fish passage conditions. It can plug or block trash racks, VBSs, gatewell orifices, dewatering screens, separators, and facility piping resulting in impingement, injuries, and descaling of fish. Removing debris at its source in the forebay is sometimes necessary to maintain safe and efficient fish passage conditions, navigation, and other project activities. In this case, the only viable alternative is to spill to pass the debris.

7.2. Special spill operations that don't follow the normal spill schedule or volume limits will be coordinated prior to their execution. Normally, the project shall contact CENWP-OD at least two workdays prior to the day the special operation is required. Using information provided by the project, CENWP-OD will coordinate with FPOM and with RCC, as necessary. Once the coordination is complete, RCC will issue a teletype detailing the special operations.

8. Response to Hazardous Materials Spills. John Day Project's guidance for responding to hazardous substance spills is contained in its Emergency Spill Response Plan. This guidance will be followed in case of a spill.

8.1. Project Fisheries will be contacted as soon as possible after a hazardous material release and prior to any modification to fishway operations. The project biologist will in turn contact the CENWP-OD biologist and FPOM. Attempts should be made to first contact the project biologist on duty. During fish passage season there is a project biologist on duty seven days a week. If a project biologist cannot be reached by radio or in the office, attempts to contact Project Fisheries will occur in the following order:

1. Bob Cordie- home and mobile numbers are available in the Control Room.

2. Miro Zyndol- home and mobile numbers are available in the Control Room.

3. Bern Klatte (503-808-4318) or Tammy Mackey (503-808-4305).

9. Endnotes.

a. Hydroacoustic Monitoring of Downstream Migrant Juvenile Salmonids at John Day Dam in 1983. R. Magne et. al., US COE research Report. 35 pp. plus appendices.

b. Hydroacoustic Monitoring of Downstream Migrant Juvenile Salmonids at John Day Dam 1984-85. R. Magne et. al. , US COE Research Report. 29 pp. plus appendices.

c. Hydroacoustic Evaluation of Juvenile Salmonid Fish Passage at John Day Dam in Summer 1986. Sue Kuehl, BioSonics, Inc. Final Report. Prepared for US COE under Contract No. DACW57-86-C-0088. 61 pp. plus appendices.

d. Hydroacoustic Evaluation of the Spill Program for Fish Passage at John Day Dam in 1987. L. Johnson et. al., Associated Fish Biologists, Inc. Final Report prepared for US COE under Contract No. DACW57-87-C-0077. 71 pp. plus appendices.

Table JDA-9. Spill patterns for John Day Dam.

BAY NUMBER																				STOPS	Kcfs
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20		
0	**3**	**2**	**1**																	6	9.6
0	**3**	**2**	**2**																	7	11.2
0	**3**	**3**	**2**																	8	12.8
0	**3**	**3**	**2**	**1**																9	14.4
0	**3**	**3**	**2**	**2**																10	16.0
0	**3**	**3**	**2**	**2**	**1**															11	17.6
0	**3**	**3**	**2**	**2**	**2**															12	19.2
0	**3**	**3**	**2**	**2**	**2**	**1**														13	20.8
0	**3**	**3**	**2**	**2**	**2**	**2**														14	22.4
0	**3**	**3**	**2**	**2**	**2**	**2**	**1**													15	24.0
0	**3**	**3**	**3**	**2**	**2**	**2**	**1**													16	25.6
0	**3**	**3**	**3**	**2**	**2**	**2**	**2**													17	27.2
0	**3**	**3**	**3**	**2**	**2**	**2**	**2**	**1**												18	28.8
0	**3**	**3**	**3**	**3**	**2**	**2**	**2**	**1**												19	30.4
0	**3**	**3**	**3**	**3**	**3**	**2**	**2**	**1**												20	32.0
0	**3**	**3**	**3**	**3**	**3**	**2**	**2**	**2**												21	33.6
0	**3**	**3**	**3**	**3**	**3**	**2**	**2**	**2**	**1**											22	35.2
0	**3**	**3**	**3**	**3**	**3**	**2**	**2**	**2**	**2**											23	36.8
0	**3**	**3**	**3**	**3**	**3**	**2**	**2**	**2**	**2**	**1**										24	38.4
0	**3**	**3**	**3**	**3**	**3**	**2**	**2**	**2**	**2**	**2**										25	40.0
0	**3**	**3**	**3**	**3**	**3**	**2**	**2**	**2**	**2**	**2**	**1**									26	41.6
0	**3**	**3**	**3**	**3**	**3**	**2**	**2**	**2**	**2**	**2**	**2**									27	43.2
0	**3**	**3**	**3**	**3**	**3**	**3**	**2**	**2**	**2**	**2**	**2**									28	44.8
0	**3**	**3**	**3**	**3**	**3**	**3**	**2**	**2**	**2**	**2**	**2**	**1**								29	46.4
0	**3**	**3**	**3**	**3**	**3**	**3**	**2**	**2**	**2**	**2**	**2**	**2**								30	48.0
0	**3**	**3**	**3**	**3**	**3**	**3**	**2**	**2**	**2**	**2**	**2**	**2**	**1**							31	49.6
0	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**2**	**2**	**2**	**2**	**2**	**1**							32	51.2
0	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**2**	**2**	**2**	**2**	**2**	**2**							33	52.8
0	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**2**	**2**	**2**	**2**	**2**	**2**	**1**						34	54.4
0	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**2**	**2**	**2**	**2**	**2**	**2**	**2**						35	56.0
0	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**1**					36	57.6
0	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**					37	59.2
0	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**1**				38	60.8
0	**4**	**3**	**3**	**3**	**3**	**3**	**3**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**1**				39	62.4
0	**4**	**4**	**3**	**3**	**3**	**3**	**3**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**1**				40	64.0
0	**4**	**4**	**4**	**3**	**3**	**3**	**3**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**1**				41	65.6
0	**4**	**4**	**4**	**4**	**3**	**3**	**3**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**1**				42	67.2
0	**4**	**4**	**4**	**4**	**3**	**3**	**3**	**3**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**1**				43	68.8
0	**4**	**4**	**4**	**4**	**3**	**3**	**3**	**3**	**3**	**2**	**2**	**2**	**2**	**2**	**2**	**1**				44	70.4
0	**4**	**4**	**4**	**4**	**4**	**3**	**3**	**3**	**3**	**2**	**2**	**2**	**2**	**2**	**2**	**1**				45	72.0
0	**4**	**5**	**4**	**4**	**4**	**3**	**3**	**3**	**3**	**2**	**2**	**2**	**2**	**2**	**2**	**1**				46	73.6
0	**4**	**5**	**4**	**4**	**4**	**3**	**3**	**3**	**3**	**2**	**2**	**2**	**2**	**2**	**2**	**2**				47	75.2

Table JDA-9 (cont). Spill patterns for John Day Dam.

BAY NUMBER																				STOPS	Kcfs
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20		
0	4	5	4	4	4	3	3	3	3	2	2	2	2	2	2	2	1			48	76.8
0	4	5	4	4	4	3	3	3	3	3	2	2	2	2	2	2	1			49	78.4
0	4	5	4	4	4	3	3	3	3	3	3	2	2	2	2	2	1			50	80.0
0	4	5	5	4	4	3	3	3	3	3	3	2	2	2	2	2	1			51	81.6
0	4	5	5	4	4	4	3	3	3	3	3	2	2	2	2	2	1			52	83.2
0	4	5	5	4	4	4	3	3	3	3	3	3	2	2	2	2	1			53	84.8
0	4	5	5	4	4	4	3	3	3	3	3	3	3	2	2	2	1			54	86.4
0	4	5	5	4	4	4	3	3	3	3	3	3	3	3	2	2	1			55	88.0
0	4	5	5	4	4	4	3	3	3	3	3	3	3	3	3	2	1			56	89.6
0	4	5	5	4	4	4	4	3	3	3	3	3	3	3	3	2	1			57	91.2
0	4	5	5	4	4	4	4	4	3	3	3	3	3	3	3	2	1			58	92.8
0	4	5	5	5	4	4	4	4	3	3	3	3	3	3	3	2	1			59	94.4
0	4	5	5	5	4	4	4	4	3	3	3	3	3	3	3	2	2			60	96.0
0	4	5	5	5	4	4	4	4	4	3	3	3	3	3	3	2	2			61	97.6
0	4	5	5	5	4	4	4	4	4	3	3	3	3	3	3	2	2	1		62	99.2
0	4	5	5	5	4	4	4	4	4	4	3	3	3	3	3	2	2	1		63	100.8
0	4	5	5	5	4	4	4	4	4	4	3	3	3	3	3	3	2	1		64	102.4
0	4	5	5	5	4	4	4	4	4	4	4	3	3	3	3	3	2	1		65	104.0
0	4	4	4	4	3	3	4	3	4	3	3	3	3	4	3	4	3	4	3	66	105.6
0	4	4	4	4	3	3	4	3	4	3	4	3	3	4	3	4	3	4	3	67	107.2
0	4	4	4	4	4	3	4	3	4	3	4	3	3	4	3	4	3	4	3	68	108.8
0	4	4	4	4	4	3	4	3	4	3	4	3	3	4	3	4	4	4	3	69	110.4
0	4	4	4	4	4	3	4	3	4	3	4	3	3	4	4	4	4	4	3	70	112.0
0	4	4	4	4	4	3	4	3	4	3	4	3	4	4	4	4	4	4	3	71	113.6
0	4	4	4	4	4	4	4	3	4	3	4	3	4	4	4	4	4	4	3	72	115.2
0	4	4	4	4	4	4	4	4	4	3	4	3	4	4	4	4	4	4	3	73	116.8
0	4	4	4	4	4	4	4	4	4	4	4	3	4	4	4	4	4	4	3	74	118.4
0	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	3	75	120.0
0	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	76	121.6
0	4	5	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	77	123.2
0	4	5	5	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	78	124.8
0	4	5	5	4	4	4	4	4	4	4	4	4	4	4	4	4	4	5	4	79	126.4
0	4	5	5	4	4	4	4	4	4	4	4	4	4	4	4	5	4	5	4	80	128.0
0	4	5	5	4	4	4	4	4	4	4	4	4	4	5	4	5	4	5	4	81	129.6
0	4	5	5	5	4	4	4	4	4	4	4	4	4	5	4	5	4	5	4	82	131.2
0	4	5	5	5	4	4	5	4	4	4	4	4	4	5	4	5	4	5	4	83	132.8
0	4	5	5	5	4	4	5	4	5	4	4	4	4	5	4	5	4	5	4	84	134.4
0	4	5	5	5	4	4	5	4	5	4	5	4	4	5	4	5	4	5	4	85	136.0
0	4	5	5	5	5	4	5	4	5	4	5	4	4	5	4	5	4	5	4	86	137.6
0	4	5	5	5	5	4	5	4	5	4	5	4	4	5	4	5	5	5	4	87	139.2
0	4	5	5	5	5	4	5	4	5	4	5	4	4	5	5	5	5	5	4	88	140.8
0	4	5	5	5	5	5	5	4	5	4	5	4	4	5	5	5	5	5	4	89	142.4
0	4	5	5	5	5	5	5	4	5	4	5	4	5	5	5	5	5	5	4	90	144.0

Table JDA-9 (cont). Spill patterns for John Day Dam.

BAY NUMBER																				STOPS	Kcfs
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20		
0	4	5	5	5	5	5	5	5	5	4	5	4	5	5	5	5	5	5	4	91	145.6
0	4	5	5	5	5	5	5	5	5	5	5	4	5	5	5	5	5	5	4	92	147.2
0	4	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	4	93	148.8
0	4	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	94	150.4
0	4	6	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	95	152.0
0	4	6	6	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	96	153.6
0	4	6	6	5	5	5	5	5	5	5	5	5	5	5	5	5	5	6	5	97	155.2
0	4	6	6	5	5	5	5	5	5	5	5	5	5	5	5	6	5	6	5	98	156.8
0	4	6	6	5	5	5	5	5	5	5	5	5	5	6	5	6	5	6	5	99	158.4
0	4	6	6	6	5	5	5	5	5	5	5	5	5	6	5	6	5	6	5	100	160.0
0	4	6	6	6	5	5	6	5	5	5	5	5	5	6	5	6	5	6	5	101	161.6
0	4	6	6	6	5	5	6	5	6	5	5	5	5	6	5	6	5	6	5	102	163.2
0	4	6	6	6	5	5	6	5	6	5	6	5	5	6	5	6	5	6	5	103	164.8
0	4	6	6	6	6	5	6	5	6	5	6	5	5	6	5	6	5	6	5	104	166.4
0	4	6	6	6	6	5	6	5	6	5	6	5	5	6	5	6	6	6	5	105	168.0
0	4	6	6	6	6	5	6	5	6	5	6	5	5	6	6	6	6	6	5	106	169.6
0	4	6	6	6	6	6	6	5	6	5	6	5	5	6	6	6	6	6	5	107	171.2
0	4	6	6	6	6	6	6	5	6	5	6	5	6	6	6	6	6	6	5	108	172.8
0	4	6	6	6	6	6	6	6	6	5	6	5	6	6	6	6	6	6	5	109	174.4
0	4	6	6	6	6	6	6	6	6	6	6	5	6	6	6	6	6	6	5	110	176.0
0	4	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	5	111	177.6
0	4	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	112	179.2
0	4	6	7	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	113	180.8
0	4	6	7	6	6	6	6	6	6	6	6	6	6	6	6	6	6	7	6	114	182.4
0	4	6	7	6	6	6	6	6	6	6	6	6	6	6	6	7	6	7	6	115	184.0
0	4	6	7	6	6	6	6	6	6	6	6	6	6	7	6	7	6	7	6	116	185.6
0	4	6	7	7	6	6	6	6	6	6	6	6	6	7	6	7	6	7	6	117	187.2
0	4	6	7	7	6	6	7	6	6	6	6	6	6	7	6	7	6	7	6	118	188.8
0	4	6	7	7	6	6	7	6	7	6	6	6	6	7	6	7	6	7	6	119	190.4
0	4	6	7	7	6	6	7	6	7	6	7	6	6	7	6	7	6	7	6	120	192.0
0	4	6	7	7	7	6	7	6	7	6	7	6	6	7	6	7	6	7	6	121	193.6
0	4	6	7	7	7	6	7	6	7	6	7	6	6	7	6	7	7	7	6	122	195.2
0	4	6	7	7	7	6	7	6	7	6	7	6	6	7	7	7	7	7	6	123	196.8
0	4	6	7	7	7	7	7	6	7	6	7	6	6	7	7	7	7	7	6	124	198.4
0	4	6	7	7	7	7	7	6	7	6	7	6	7	7	7	7	7	7	6	125	200.0
0	4	6	7	7	7	7	7	7	7	6	7	6	7	7	7	7	7	7	6	126	201.6
0	4	6	7	7	7	7	7	7	7	7	7	6	7	7	7	7	7	7	6	127	203.2
0	4	6	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	6	128	204.8
0	4	6	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	129	206.4
0	4	6	8	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	130	208.0
0	4	6	8	7	7	7	7	7	7	7	7	7	7	7	7	7	7	8	7	131	209.6
0	4	6	8	7	7	7	7	7	7	7	7	7	7	7	7	8	7	8	7	132	211.2
0	4	6	8	7	7	7	7	7	7	7	7	7	7	8	7	8	7	8	7	133	212.8

Table JDA-9 (cont). Spill patterns for John Day Dam.

BAY NUMBER																				STOPS	Kcfs
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20		
0	4	6	8	8	7	7	7	7	7	7	7	7	7	8	7	8	7	8	7	134	214.4
0	4	6	8	8	7	7	8	7	7	7	7	7	7	8	7	8	7	8	7	135	216.0
0	4	6	8	8	7	7	8	7	8	7	7	7	7	8	7	8	7	8	7	136	217.6
0	4	6	8	8	7	7	8	7	8	7	8	7	7	8	7	8	7	8	7	137	219.2
0	4	6	8	8	8	7	8	7	8	7	8	7	7	8	7	8	7	8	7	138	220.8
0	4	6	8	8	8	7	8	7	8	7	8	7	7	8	7	8	8	8	7	139	222.4
0	4	6	8	8	8	7	8	7	8	7	8	7	7	8	8	8	8	8	7	140	224.0
0	4	6	8	8	8	8	8	7	8	7	8	7	7	8	8	8	8	8	7	141	225.6
0	4	6	8	8	8	8	8	7	8	7	8	7	8	8	8	8	8	8	7	142	227.2
0	4	6	8	8	8	8	8	8	8	7	8	7	8	8	8	8	8	8	7	143	228.8
0	4	6	8	8	8	8	8	8	8	8	8	7	8	8	8	8	8	8	7	144	230.4
0	4	6	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	7	145	232.0
0	4	6	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	146	233.6
0	4	6	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	9	8	147	235.2
0	4	6	8	8	8	8	8	8	8	8	8	8	8	8	8	9	8	9	8	148	236.8
0	4	6	8	8	8	8	8	8	8	8	8	8	8	9	8	9	8	9	8	149	238.4
0	4	6	8	9	8	8	8	8	8	8	8	8	8	9	8	9	8	9	8	150	240.0
0	4	6	8	9	8	8	9	8	8	8	8	8	8	9	8	9	8	9	8	151	241.6
0	4	6	8	9	8	8	9	8	9	8	8	8	8	9	8	9	8	9	8	152	243.2
0	4	6	8	9	8	8	9	8	9	8	9	8	8	9	8	9	8	9	8	153	244.8
0	4	6	8	9	9	8	9	8	9	8	9	8	8	9	8	9	8	9	8	154	246.4
0	4	6	8	9	9	8	9	8	9	8	9	8	8	9	8	9	9	9	8	155	248.0
0	4	6	8	9	9	8	9	8	9	8	9	8	8	9	9	9	9	9	8	156	249.6
0	4	6	8	9	9	9	9	8	9	8	9	8	8	9	9	9	9	9	8	157	251.2
0	4	6	8	9	9	9	9	8	9	8	9	8	9	9	9	9	9	9	8	158	252.8
0	4	6	8	9	9	9	9	9	9	8	9	8	9	9	9	9	9	9	8	159	254.4
0	4	6	8	9	9	9	9	9	9	9	9	8	9	9	9	9	9	9	8	160	256.0
0	4	6	8	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	8	161	257.6
0	4	6	8	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	162	259.2
0	4	6	8	9	9	9	9	9	9	9	9	9	9	9	9	9	9	10	9	163	260.8
0	4	6	8	9	9	9	9	9	9	9	9	9	9	9	9	10	9	10	9	164	262.4
0	4	6	8	9	9	9	9	9	9	9	9	9	9	10	9	10	9	10	9	165	264.0
0	4	6	8	10	9	9	9	9	9	9	9	9	9	10	9	10	9	10	9	166	265.6
0	4	6	8	10	9	9	10	9	9	9	9	9	9	10	9	10	9	10	9	167	267.2
0	4	6	8	10	9	9	10	9	10	9	9	9	9	10	9	10	9	10	9	168	268.8
0	4	6	8	10	9	9	10	9	10	9	10	9	9	10	9	10	9	10	9	169	270.4
0	4	6	8	10	10	9	10	9	10	9	10	9	9	10	9	10	9	10	9	170	272.0
0	4	6	8	10	10	9	10	9	10	9	10	9	9	10	9	10	10	10	9	171	273.6
0	4	6	8	10	10	9	10	9	10	9	10	9	9	10	10	10	10	10	9	172	275.2
0	4	6	8	10	10	10	10	9	10	9	10	9	9	10	10	10	10	10	9	173	276.8
0	4	6	8	10	10	10	10	9	10	9	10	9	10	10	10	10	10	10	9	174	278.4
0	4	6	8	10	10	10	10	10	10	9	10	9	10	10	10	10	10	10	9	175	280.0
0	4	6	8	10	10	10	10	10	10	10	10	9	10	10	10	10	10	10	9	176	281.6

Table JDA-9 (cont). Spill patterns for John Day Dam.

BAY NUMBER																				STOPS	Kcfs
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20		
0	4	6	8	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	9	177	283.2
0	4	6	8	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	178	284.8
0	4	6	8	10	10	10	10	10	10	10	10	10	10	10	10	10	10	11	10	179	286.4
0	4	6	8	10	10	10	10	10	10	10	10	10	10	10	10	11	10	11	10	180	288.0
0	4	6	8	10	10	10	10	10	10	10	10	10	10	11	10	11	10	11	10	181	289.6
0	4	6	8	10	10	10	11	10	10	10	10	10	10	11	10	11	10	11	10	182	291.2
0	4	6	8	10	10	10	11	10	11	10	10	10	10	11	10	11	10	11	10	183	292.8
0	4	6	8	10	10	10	11	10	11	10	11	10	10	11	10	11	10	11	10	184	294.4
0	4	6	8	10	11	10	11	10	11	10	11	10	10	11	10	11	10	11	10	185	296.0
0	4	6	8	10	11	10	11	10	11	10	11	10	10	11	10	11	11	11	10	186	297.6
0	4	6	8	10	11	10	11	10	11	10	11	10	10	11	11	11	11	11	10	187	299.2
0	4	6	8	10	11	11	11	10	11	10	11	10	10	11	11	11	11	11	10	188	300.8
0	4	6	8	10	11	11	11	10	11	10	11	10	11	11	11	11	11	11	10	189	302.4
0	4	6	8	10	11	11	11	11	11	10	11	10	11	11	11	11	11	11	10	190	304.0
0	4	6	8	10	11	11	11	11	11	11	11	10	11	11	11	11	11	11	10	191	305.6
0	4	6	8	10	11	11	11	11	11	11	11	11	11	11	11	11	11	11	10	192	307.2
0	4	6	8	10	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	193	308.8
0	4	6	8	10	11	11	11	11	11	11	11	11	11	11	11	11	11	12	11	194	310.4
0	4	6	8	10	11	11	11	11	11	11	11	11	11	11	11	12	11	12	11	195	312.0
0	4	6	8	10	11	11	11	11	11	11	11	11	11	12	11	12	11	12	11	196	313.6
0	4	6	8	10	11	11	12	11	11	11	11	11	11	12	11	12	11	12	11	197	315.2
0	4	6	8	10	11	11	12	11	12	11	11	11	11	12	11	12	11	12	11	198	316.8
0	4	6	8	10	11	11	12	11	12	11	12	11	11	12	11	12	11	12	11	199	318.4
0	4	6	8	10	12	11	12	11	12	11	12	11	11	12	11	12	11	12	11	200	320.0

Section 5 McNary Dam

McNary Dam

1. Fish Passage Information. The locations of fish passage facilities at McNary Lock and Dam are shown in **Figure MCN-1**. Dates of project operations for fish purposes and special operations are listed in **Table MCN-2**.

1.1. Juvenile Fish Passage.

1.1.1. Facilities Description. The juvenile facilities at McNary Dam consist of extended-length submersible bar screens with flow vanes, vertical barrier screens, gatewell orifices, a concrete collection channel with emergency bypass outlets, primary and secondary dewatering structures, a pipeline/corrugated metal flume for transporting juvenile fish to the transportation facilities or bypassing them back to the river, and a full-flow PIT tag detection system. Juvenile transportation facilities at McNary include: a separator to sort juvenile fish by size and to separate them from adult fish; a flume system for distributing fish among the raceways; covered raceways for holding fish; sampling facilities; an office and sampling building with fish marking facilities; barge and truck loading facilities; and PIT tag detection and deflection systems.

1.1.2. Juvenile Migration Timing. Juvenile migration timing at McNary Dam is indicated in **Table MCN-1**. The dates in the table are based on juvenile fish collection numbers and do not reflect FGE or spill passage. Salmon, steelhead, bull trout, lamprey, and other species are routinely counted. Maintenance of juvenile fish passage facilities that may impact juvenile fish passage or facility operations should be conducted during the winter maintenance season.

Table MCN-1. Juvenile migration timing at McNary Dam based on juvenile fish collection numbers.

% Collection	2003	2004	2005	2006	2007
Yearling Chinook					
10%	4/29	4/27	5/3	4/21	5/2
90%	5/29	5/31	5/29	5/19	5/26
Sub-yearling Chinook					
10%	6/18	6/22	6/16	6/12	6/23
90%	7/29	7/18	7/3	7/19	7/29
Clipped Steelhead					
10%	4/29	4/23	4/19	4/23	4/30
90%	6/2	5/31	5/29	5/23	5/24
Unclipped Steelhead					
10%	4/27	4/23	5/1	4/19	4/28
90%	6/4	6/4	5/27	5/27	5/26
Sockeye					
10%	5/3	5/15	5/11	5/4	5/12
90%	5/27	6/14	5/31	5/29	6/1

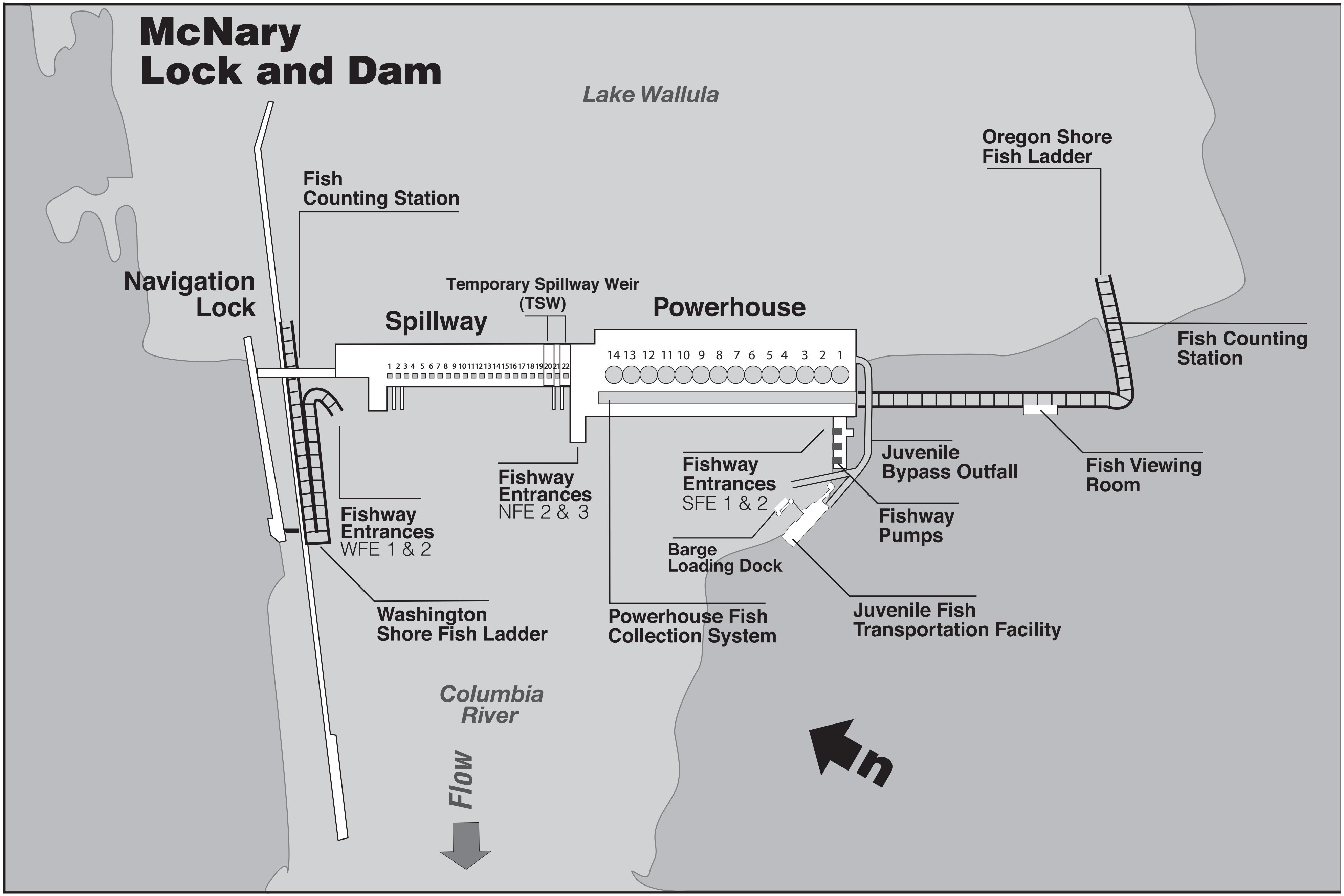
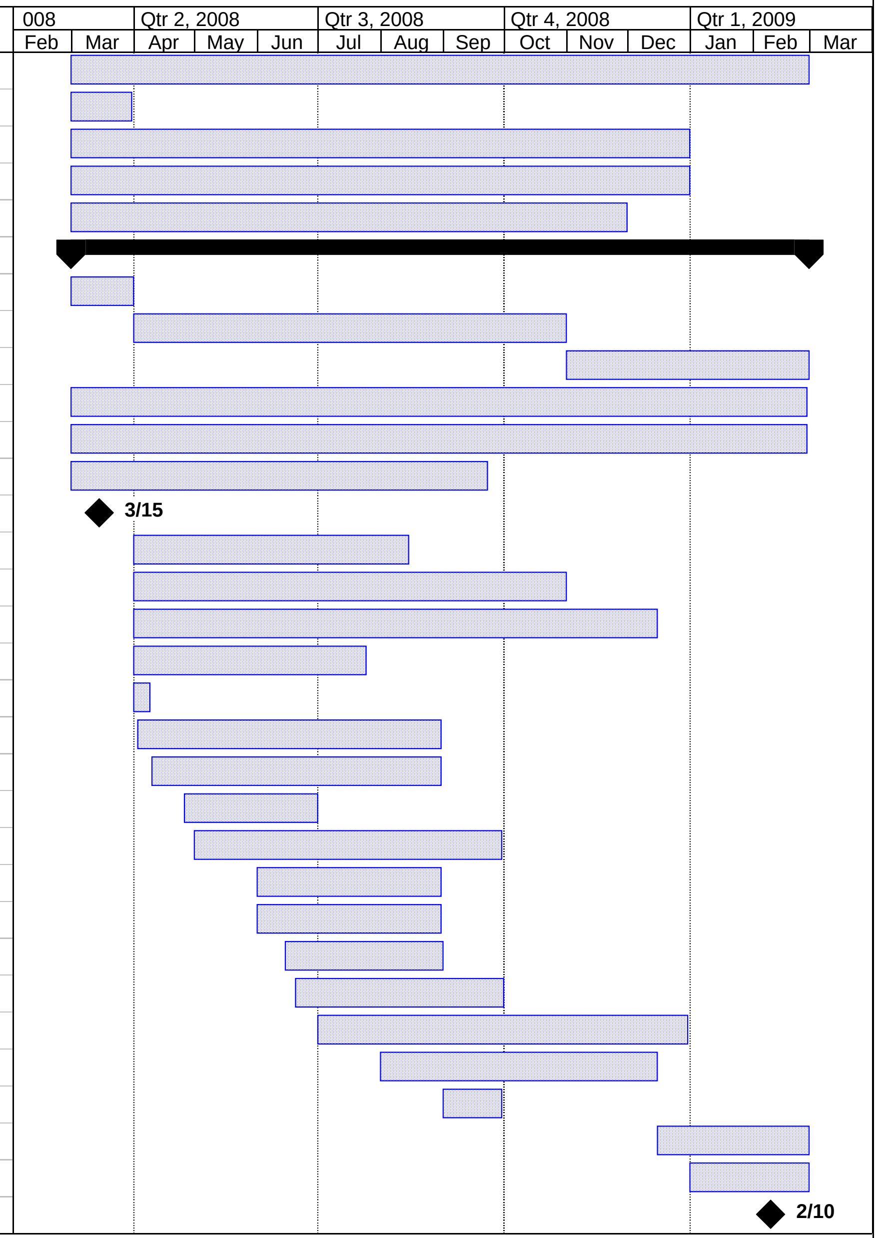


Figure MCN -1 McNary Lock and Dam General Site Plan

Table MCN-2. Dates of project operations for fish purposes at McNary, 2008-9

March 2008

Task Name	Start	Finish	FPP Reference
TDG Monitoring	3/1/08	2/28/09	App D Table 4
Maintenance of Juvenile Facilities	3/1/08	3/31/08	Mcn 2.3.1.1
Adult Passage Period	3/1/08	12/31/08	Mcn 2.3.2.2
Weekly Reports	3/1/08	12/31/08	Mcn 2.3.3.1
Operate Turbines for Fish Passage	3/1/08	11/30/08	Mcn 4.1
1% limitations	**3/1/08**	**2/28/09**	**Mcn 4.1.1**
1% Soft	3/1/08	3/31/08	Mcn 4.1.1
1% Hard	4/1/08	10/31/08	Mcn 4.1.1
1% Soft	11/1/08	2/28/09	Mcn 4.1.1
Headgate Repair	3/1/08	2/28/09	App A Mcn 1.4
New Unit Oil Coolers	3/1/08	2/28/09	App A Mcn 1.5
DC and Preferred AC Upgrade	3/1/08	9/23/08	App A Mcn 1.7
Final Report	3/15/08	3/15/08	Mcn 2.3.3.4
Back flush orifices twice daily	4/1/08	8/15/08	Mcn 2.3.1.2.c.6
Adult Fish Counting (Visual 0400 - 2000) PST	4/1/08	10/31/08	Mcn 1.2.2
Operate Juvenile Facilities	4/1/08	12/15/08	Mcn 2.3.1
Evaluation of Juvenile Salmonid Passage and Su	4/1/08	7/25/08	App A Mcn 2.1
TSW Installation	4/1/08	4/9/08	App A Mcn 1.3
Estimate of hydrosystem latent mortality	4/3/08	8/31/08	App A Mcn 2.2
Spill for Juvenile Fish	4/10/08	8/31/08	App E
Waterfowl Nesting	4/26/08	7/1/08	App A Mcn 1.8
MNA Pedestal	5/1/08	9/30/08	App A Mcn 1.10
Lamprey Separator study	6/1/08	8/31/08	App A Mcn 2.3
Adult Lamprey Passage Study	6/1/08	8/31/08	App A Mcn 2.4
Water Temperature Measurement	6/15/08	8/31/08	App B 4.g(3)
Juvenile Fish Transportation	6/20/08	9/30/08	App B 3
Dewatering System Improvement	7/1/08	12/31/08	App A Mcn 1.11
Turbines - Gates in Standard Position	8/1/08	12/15/08	Mcn 4.2.1
Underwater Sounding Inspections	9/1/08	9/30/08	App A Mcn 1.9
Maintenance of Juvenile Facilities	12/16/08	2/28/09	Mcn 2.3.1.1
Maint of Upstream Passage Facilities	1/1/09	2/28/09	Mcn 1.2.2
Draft Final Report	2/10/09	2/10/09	Mcn 2.3.3.4



1.2. Adult Fish Passage.

1.2.1. Facilities Description. The adult fish passage facilities at McNary consist of separate north and south shore facilities.

1.2.1.2. The north shore facilities are made up of a fish ladder with counting station, submerged orifice PIT tag antennas in the ladder, a small collection system, and a gravity-flow auxiliary water supply system. The gravity-flow auxiliary water supply system has a turbine unit installed on it, operated by North Wasco County PUD. The gravity-flow auxiliary water supply system takes water from the forebay through two conduits, passes the water through a turbine unit or through a bypass/energy dissipater when the turbine unit is not in operation, and distributes the water through a diffuser system at the bottom of the ladder and in the transportation channel. The north shore collection system has three downstream entrances and a side entrance into the spillway basin. Two of the downstream entrances are used during normal operation.

1.2.1.3. The south shore facilities are comprised of a fish ladder with counting station, submerged orifice PIT tag antennas in the ladder and antennas at the counting station, two south shore entrances, a powerhouse collection system, and gravity and pumped auxiliary water supply systems.

1.2.1.4. The powerhouse collection system contains three downstream entrances and one side entrance into the spillway basin at the north end of the powerhouse, twelve operating floating orifices, and a common transportation channel. At the north end of the powerhouse, two of the downstream entrances are used during normal operation with the other downstream and side entrances closed. The gravity-flow auxiliary water is provided by one conduit from the forebay and supplies the diffusers at the bottom of the ladder at tailwater level. The pumped auxiliary water is supplied by three electric pumps with variable-pitched blades. Two pumps are capable of providing the required flow when the third pump is bulkheaded to prevent water from flowing back through the pump to the river. The electric pumps supply the auxiliary water for the diffusers at the entrances and in the transportation channel. Excess water from the primary dewatering structure in the juvenile fish collection channel is routed to the adult collection system at the north end of the powerhouse.

1.2.2. Adult Migration Timing. Upstream migrants are present at McNary Dam throughout the year and adult passage facilities are operated year round. Maintenance of adult fish facilities is scheduled for January and February to minimize impacts on upstream migrants. Facilities are usually shut down one shore at a time for maintenance. Adult fish (salmon, steelhead, shad, and lamprey) are counted as per **Table MCN-3;** these data appear daily on the Corps adult count website. Salmon migration timing data appear in **Table MCN-4**. Sturgeon and bull trout are also counted and recorded on the WDFW fish counters' daily summary sheet comments section; and these data are summarized in the Annual Fish Passage Report, but do no appear on the Corps daily website total due to relative infrequency of passage.

Table MCN-3. Adult fish counting schedule at McNary Dam.

Period	Counting Method
April 1 – October 31	Visual count 0400 - 2000 PST

Table MCN-4. Adult migration timing at McNary Dam based on fish counts, 1954-2007.

Species	Count Period	Date of Peak Passage	
		Earliest	Latest
Spring chinook	4/1-6/8	4/20	5/26
Summer chinook	6/9-8/8	6/17	7/26
Fall chinook	8/9-10/31	9/10	9/25
Steelhead	4/1-10/31	7/9	10/13
Coho	4/1-10/31	9/5	10/11
Sockeye	4/1-10/31	6/23	7/16

2. Project Operation.

2.1. Spill Management. See the 2008 Fish Operations Plan (**Appendix E**) for more information.

2.1.1. Involuntary spill at McNary is the result of river flow exceeding powerhouse capacity, insufficient generation loads to pass the river flow, turbine unit outages (forced or scheduled), or the failure of a key component of the juvenile fish passage facility which forces the project to spill to provide juvenile fish passage. Spill at McNary shall be distributed in accordance with the adult fish passage spill pattern included at the end of this section in **Table MCN-7**. Special spills for juvenile fish passage will be provided as detailed in Appendices A and E.

2.1.2. If spill occurs during the summer, it may be shaped as follows:

1) If spill is projected to be 20% or less of total project outflow, spill should be spread out during the nighttime hours, or
2) If spill is projected to be greater than 20% of total project outflow, spill should be spread out during the next 24 hours.

This spill shaping would be considered a soft constraint and will be coordinated through the RCC. If possible, when powerhouse generation load/spill changes greater then 50,000 cfs are made, they should be ramped over a one-hour period to minimize rapid flow changes in the juvenile fish collection channel.

2.2 Dissolved Gas Management and Control. Total dissolved gas (TDG) levels at McNary are monitored in accordance with the Dissolved Gas Monitoring Program, **Appendix D.**

2.3. Operating Criteria.

2.3.1. Juvenile Fish Passage Facilities. Operate from April 1 through September 30 for juvenile fish bypass, collection, and transportation and from October 1 through December 15 for bypassing adult fallbacks. Operate according to the criteria listed below and in **Appendix B**

(Corps' Juvenile Fish Transportation Program Operating Criteria) for the bypassing, collection, and transportation of juvenile salmonids. The transportation program may be revised in accordance with the ESA Section 10 permit and the NOAA Fisheries biological opinion.

2.3.1.1 Winter Maintenance Period (December 16 through March 31). Check and perform maintenance as required on the items listed below.

a. Forebay Area and Intakes.

1. Remove debris from forebay and trashracks.

2. Rake trashracks.

3. Remove debris from gatewell slots.

4. Measure and log drawdown in gatewell slots.

5. Inspect and repair gatewell dip net as needed.

b. Extended-Length Submersible Bar Screens, Flow Vanes, and Vertical Barrier Screens.

1. Maintenance completed on all ESBSs.

2. Inspect ESBSs for good running order and operate debris cleaner one trial run (dogged off at deck level).

3. Inspect flow vanes to make sure they are in good condition and all surfaces are smooth. Repair as needed.

4. Inspect all VBSs at least once per year by either raising the VBS and visually inspecting or inspecting with an underwater video camera.

c. Collection Channel.

1. Orifice lights are operational.

2. Orifices clean and valves operating correctly.

3. Orifice air backflush system works correctly.

4. Netting over handrails and orifice chutes maintained and in good condition.

5. Plastic covers over orifice chutes maintained and in good condition and clean so orifice flow is visible.

d. Dewatering Structure and Flume.

1. Inclined and side dewatering screens are clean and in good condition with no gaps between screen panels, no damaged panels, and no missing silicone.

2. Cleaning brush systems are maintained and operating correctly.

3. All valves in good condition and operating correctly.

4. Stilling well water level sensing device inspected and operable.

5. Flume and pipe interiors smooth with no rough edges.

6. Maintain full-flow PIT tag system as required. Coordinate with PSMFC.

e. Transportation Facilities.

1. Flume switch gate is maintained and operational.

2. Flume is smooth with no rough edges.

3. Perforated plate and bar screen edges are smooth with no rough edges.

4. Wet separator and fish distribution system maintained and operating as designed.

5. Brushes on all crowders in good condition or new.

6. Crowders maintained and operating properly.

7. All valves, slide gates, and switch gates maintained and operating correctly.

8. Raceway and tank retainer screens set in place with no holes or sharp wires protruding.

9. Barge and truck loading pipes are free of debris, cracks, or blockages.

10. Barge loading boom maintained and tested.

11. All sampling equipment should be maintained and operating correctly.

12. Maintain juvenile PIT tag system as required (see “Columbia Basin PIT Tag Information System, General Gate Maintenance and Inspection, Walla Walla District”, February 2003). Coordinate with PSMFC.

f. Avian Predation Areas (Forebay and Tailrace). Inspect bird wires, water cannon, and other deterrent devices and repair or replace as needed. Where possible, install additional bird wires or other deterrent devices to cover areas of known avian predation activity. Prepare avian abatement contract as needed.

g. Fish Transport Trailers.

1. All systems are maintained, including refrigeration system, and operating properly.

2. No leaks around air stone fittings; repair where necessary.

3. Plugs should be placed in end of air stones.

4. Turn air stones on lathe if necessary to allow free air passage through stones.

5. Each trailer should carry two hoses of the right size with the necessary cam lock caps.

6. All air and water valves should operate correctly.

7. Overall condition of trailer should be maintained and in good condition including hatch covers, release gates, and oxygen manifold system.

h. Maintenance Records. Record all maintenance and inspections.

2.3.1.2. Fish Passage Period (April 1 through December 15).

a. Forebay Area and Intakes.

1. Remove debris from forebay.

2. Inspect gatewell slots daily for debris, fish buildup, and contaminating substances (particularly oil). Clean gatewells before they become half covered with debris. If, due to the volume of the debris, it is not possible to keep the gatewell at least half clear, they should be cleaned at least once daily. If flows through an orifice or results from fish sampling give indications that an orifice may be partially obstructed with debris, the orifice(s) will be closed and backflushed to remove the obstruction. If the obstruction can not be removed, the orifice shall be closed and the alternate orifice for that gatewell slot shall be operated. If both orifices become obstructed or plugged with debris, the turbine unit will not be operated until the gatewell and orifices are cleared of debris.

3. If a visible accumulation of contaminating substances (such as oil) is detected in a gatewell and it cannot be removed within 24 hours, the gatewell orifices shall be closed immediately and the turbine unit shut down within one hour until the material has been removed and any problems corrected. A preferred method for removing oil from the water surface is to install absorbent socks, booms, or pads capable of encapsulating the material, tied off with a rope for later disposal. Action should be taken as soon as possible to remove the oil from the gatewell so the orifice can be reopened to allow the fish to exit the gatewell. Orifices shall not be closed for longer than 48 hours.

4. Remove debris from forebay and trashracks as required to minimize impacts on fish condition. Additional raking may be required when heavy debris loads are present in the river. Fish quality will also be an indicator of debris buildup on the trashracks. Project biologist shall determine when additional trash raking is required.

5. Coordinate cleaning efforts with personnel operating juvenile collection facilities.

6. Dip bulkhead gatewell slots to remove fish prior to installing bulkhead for dewatering bulkhead slot.

b. Extended-Length Submersible Bar Screens and Vertical Barrier Screens.

1. Operate ESBSs with flow vanes attached to screen.

2. Operate ESBSs with debris cleaners in automatic mode. Set cleaning frequency as required to maintain good fish condition, with initial settings of every 15 minutes. Increase or decrease cleaning frequency if needed to maintain clean screens.

3. Inspect ESBSs in at least 3 operating turbine units per week by means of underwater video. Spot-check VBSs at the same time.

4. Conduct additional ESBS inspections if fish condition warrants it.

5. If an ESBS is damaged or fails during the juvenile fish passage season, follow procedures detailed under unscheduled maintenance of ESBSs (**see section 3.1.2.1**). In no case should a turbine unit be operated with a missing or a known non-operating or damaged ESBS, or VBS. Turbine units shall not operate for more than 10 hours, *<u>and preferably less than 3 hours</u>*, with ESBSs in place and orifices closed. Orifice closure time should be minimized by efficient planning and completion of the work to be done (e.g. having equipment, materials, and personnel ready before orifices are closed).

6. Make formal determination at end of season as to adequacy of bar screen panels and debris cleaner brushes and replace components as necessary.

7. Measure head differentials across VBSs daily during times of debris. Clean and inspect VBS when head differentials reach 1.5'. When a head differential of 1.5' is reached, the respective turbine unit should be operated at a reduced generation loading if the VBSs cannot be cleaned within 8 hours, to minimize loading on the VBS and potential fish impingement.

8. Inspect at least 4 VBSs in 2 different turbine units between the spring and summer migration periods. Both turbine units should have been operated frequently during the spring. If a debris accumulation is noted, inspect other VBSs and clean debris as necessary.

9. Inspect all vertical barrier screens at least once per year and whenever pulled for cleaning. Since VBSs associated with the northern turbine units (generally units 9-14) rarely need cleaning, they should be pulled and inspected at least twice per year. Repair as needed.

c. Collection Channel.

1. Orifices clean and operating. Operate at least one orifice per gatewell slot (preferably the south orifice). *If orifices must be closed to repair any part of the facility, do not close orifices in operating turbine units with ESBSs in place for longer than 10 hours. If possible, keep to less than 3 hours.* During periods of high fish numbers or high debris, this time period may be less. Reduce turbine unit loading to the lower end of the 1% efficiency range if deemed necessary by the project biologist. Monitor fish conditions in gatewells hourly or more frequently during orifice closure periods.

2. Orifice lights operational and operating on open orifices. Orifice lights and area lights may be turned off the evening before the channel is dewatered at the end of the season (dewatering occurs on December 16 or later) to encourage fish to exit the channel volitionally. Area lights can be turned on briefly for personnel access if necessary.

3. Replace all burned out orifice lights within 24 hours of notification. Orifice lights shall remain lighted 24 hours/day.

4. Orifice jets hitting no closer than 3’ from back wall, collection channel full.

5. Orifice valves are either fully open or closed.

6. Backflush orifices at least once per day and more frequently if required. During periods of high fish and debris passage, April 1 through August 15, orifices should be inspected and backflushed twice daily or more frequently as determined by the project biologist, to keep orifices clean. If debris is causing continual orifice plugging problems in a particular turbine unit gatewell, the respective turbine unit generation may be restricted to the lower end of the 1%

turbine efficiency range to minimize orifice plugging problems.

7. The netting along handrails should be maintained in good condition with no holes or gaps in the netting.

8. Plastic covers over orifice chutes in good condition.

d. Dewatering Structure.

1. No gaps between panels or missing silicone in side and inclined screens.

2. Trash sweeps operating correctly.

3. The project biologist shall determine the frequency of operation of the trash sweeps. The sweeps should operate at a frequency to maintain a clean screen given present debris loads. Frequency of operation may vary from as low as once every 15 minutes to once every 2 or more hours. This frequency should coincide with the ESBS cycle time.

4. If automated cleaning system problems occur, project personnel shall operate cleaners at least once per shift unless determined differently by the project biologist.

5. The dewatering structure may be dewatered twice during the season, during low fish passage periods in June and September, for inspection and cleaning of the dewatering screens. Before dewatering occurs, the project biologist must notify CENWW-OD-T who in turn will coordinate the proposed action with NOAA Fisheries and other FPOM participants.

6. Lights at the dewatering structure should be turned off at night, unless needed for personnel access, to encourage fish to move downstream volitionally.

e. Transportation Facilities. Note: Normal operations when not transporting fish in the spring is to operate the juvenile bypass facilities in full flow bypass to the river. During this operation, fish may be periodically routed through the transportation facilities to sample fish for the Smolt Monitoring Program or for routine sampling to monitor facility descaling and fish condition. Sampling during full flow bypass operations will be coordinated on an as needed basis. Sampling during the spring is normally done every other day per **Appendix B**.

1. There should be no holes or gaps between screen panels. All silicone sealer should be in good condition.

2. Crowder screen brushes should be in good operating condition.

3. Assure that retainer screens in raceways and tanks are clean with no holes or protruding wires.

4. Operate wet separator and fish distribution system as designed.

5. Project personnel shall release ice blocks through each 10-inch bypass line, one to three times per day as warranted by woody debris loads, during the spring as a preventative measure for debris plugging. Additional ice blocks shall be passed down the pipelines during high debris periods as needed to keep the pipes debris free. Releasing ice blocks through the pipes should continue during the summer when transporting fish, as determined by the project biologist to keep the pipelines debris free.

6. Truck and barge loading facilities should be kept in good operating condition.

7. Inform PSMFC, in advance if possible, of situations that cause the PIT tag system to become inoperable (e.g. power outages) or that could result in confounding the interpretation of PIT tag data (e.g. bypassing fish from raceways to the river, operating in primary bypass mode without an operational full-flow detector, emergency dewaterings).

f. Avian Predation Areas (Forebay, Tailrace, and Collection Channel).

1. Bird wires and other avian deterrent devices should be monitored to assure they are in good condition. Any broken wires or devices should be replaced as soon as possible.

2. Harassment program in place to deter avian predation in areas actively used by birds and not covered by bird wires or other devices.

3. Project biologists shall routinely monitor project areas to determine areas of active avian predation and, if possible, adjust harassment program to cover these areas or install bird wires or other deterrent devices to discourage avian predation activities. Grebes should be routinely captured in the juvenile fish channel and released below the dam, in coordination with USDA/Wildlife Services.

g. Inspection and Record Keeping. Inspect all facilities according to fish facilities monitoring plan. Record all inspections.

2.3.2. Adult Fish Passage Facilities. Operate the adult fish passage facilities according to the following criteria.

2.3.2.1. Winter Maintenance Period (January 1 through February 28).

a. Inspect all staff gages and water level indicators. Repair and/or clean where necessary.

b. Dewater all ladders and inspect all dewatered sections of fish facilities for projections, debris, or plugged orifices which could injure fish or impede fish passage up the ladder. Fish ladder exit trashracks must have smooth surfaces where fish pass, and must have downstream edges that are adequately rounded or padded. Inspect all diffuser gratings and chambers annually by dewatering or by using divers or video inspection techniques. All diffuser gratings and chambers are to be dewatered and physically inspected at least every 3 years. Repair deficiencies.

c. Inspect for and clean debris from the fish ladder exits. All trashracks and picketed leads must be clean and installed correctly.

d. Calibrate all water level measuring devices, as necessary, for proper facility operations.

e. Inspect all spill gates and ensure that they are operable.

f. Fish pumps maintained and ready for operation.

g. Maintain adult PIT tag system as required. Coordinate with PSMFC.

2.3.2.2. Fish Passage Period (March 1 through December 31).

a. Fishway Ladders. Water depth over weirs: 1' to 1.3'.

b. Counting Windows. The minimum counting slot width should be 18". All equipment should be maintained and in good condition. The counting window and backboard should be cleaned as needed to maintain good visibility.

c. Head on all Fishway Entrances. Head range: 1' to 2'.

d. Channel Velocity. 1.5' to 4' per second.

e. North Shore Entrances (WFE 1 & 2).

1. Operate 2 downstream gates.

2. Weir depth: 8' or greater below tailwater.

f. North Powerhouse Entrances (NFE 2 & 3).

1. Operate 2 downstream gates.

2. Weir depth: 9' or greater below tailwater.

g. Floating Orifice Gates. Operate 12 floating orifices (O.G. numbers 1, 3, 4, 8, 14, 21, 26, 32, 37, 41, 43, and 44).

h. South Shore Entrances (SFE 1 & 2).

1. Operate 2 entrances.

2. Weir depth: 9' or greater below tailwater.

i. Head on Trashracks.

1. Maximum head of 0.5' on ladder exits.

2. Maximum head on picketed leads shall be 0.5'. Normal head differential on clean leads is 0.3'.

3. Trashracks and picketed leads installed correctly.

j. Staff Gages and Water Level Indicators. All staff gages should be readable at all water levels encountered during the fish passage period. Repair or clean as necessary.

k. Inform PSMFC, in advance if possible, of situations that cause the PIT tag system to become inoperable (e.g. power outages) or that could result in confounding the interpretation of PIT tag data (e.g. emergency dewaterings).

l. Facility Inspections.

1. Powerhouse operators shall inspect facilities once per day shift and check computer monitor information at least once during each back shift.

2. Project biologists shall inspect facilities three times per week. Inspect all facilities according to fish facilities monitoring program.

3. Picketed leads shall be inspected during all inspections to ensure they are clean and in the correct position (all the way down).

4. Project personnel shall check calibration of fishway control system twice per month to ensure that it is kept within calibration. This may be done as part of routine fishway inspections.

5. Inspect fishways daily for foreign substances (particularly oil). If substances are found, corrective actions should be undertaken immediately.

6. Record all inspections.

2.3.3. Facility Monitoring and Reporting. Project biologists shall inspect fish passage facilities at the frequencies listed in the juvenile and adult fish facilities operating criteria sections.

2.3.3.1. Project biologists shall prepare weekly reports, from March 1 through December 31, summarizing project operations. The weekly reports should provide an overview of how the project and the fish passage facilities operated during the week and an evaluation of resulting fish passage conditions.

2.3.3.2. The reports shall include:

> **a.** **A**ny out-of-criteria situations observed and subsequent corrective actions taken;
>
> **b.** **A**ny equipment malfunctions, breakdowns, or damage along with a summary of resulting repair activities;
>
> **c.** **A**dult fishway control calibrations;
>
> **d.** ESBS and VBS inspections;
>
> **g.** **A**ny unusual activities which occurred at the project which may affect fish passage.

2.3.3.3. The weekly reports shall cover a Friday through Thursday time period and shall be sent to CENWW-OD-T by noon the following Monday via electronic mail.

2.3.3.4. Project biologists shall prepare a draft annual report by February 10 and a final report by March 15 summarizing the operation of the project fish passage facilities for the previous year. The annual report shall also include a description of all actions taken to discourage avian predation at the project, with an overview of the effectiveness of the activities in discouraging avian predation.

2.3.3.5. Project biologists also inspect project facilities once per month and during dewaterings for the presence of zebra mussels. Biologists shall provide a report to CENWW-OD-T on a monthly basis summarizing zebra mussel inspections.

3. Project Maintenance. Project biologists should be present to provide technical guidance at all project activities that may involve fish handling. All dewaterings shall be accomplished in accordance with approved project dewatering and fish handling plans. When river temperatures reach 70 degrees Fahrenheit or greater, all adult fish handling will be coordinated through CENWW-OD-T. Dewatering and fish handling plans were reviewed and revised in 2000 to ensure that they comply with Appendix F, Guidelines for Dewatering and Fish Handling Plans.

3.1. Juvenile Fish Passage Facilities.

3.1.1. Scheduled Maintenance. Scheduled maintenance of the juvenile facilities is conducted during the entire year. Long-term maintenance or modifications of facilities that require them to be out of service for extended periods of time are conducted during the winter maintenance period from December 16 through March 31. During the fish passage season parts of the facilities are maintained on a daily, weekly, or longer interval to keep them in proper operating condition.

3.1.2. Unscheduled Maintenance. Unscheduled maintenance is the correction of any situation that prevents the facilities from operating according to criteria or that will impact fish passage or survival. Maintenance of facilities such as ESBSs, which sometimes break down during the fish passage season, will be carried out as described below. In these cases, repairs will be made as prescribed and CENWW-OD-T notified for further coordination. Unscheduled maintenance that will have a significant impact on juvenile fish passage shall be coordinated with NOAA Fisheries and other FPOM participants on a case-by-case basis by CENWW-OD-T. CENWW-OD-T will be notified as soon as possible after it becomes apparent that maintenance repairs are required. The Operations Manager has the authority to initiate work prior to notifying CENWW-OD-T when in his opinion delay of the work will result in an unsafe situation for people, property, or fish. Information required by CENWW-OD-T includes:

a. Description of the problem.

b. Type of outage required.

c. Impact on facility operation.

d. Length of time for repairs.

e. Expected impacts on fish passage and proposed measures to mitigate them.

3.1.2.1 Extended-Length Submersible Bar Screens. The ESBSs are inspected periodically throughout the juvenile migration season with a video monitoring system. If a screen is found to be damaged it will be removed and either replaced with a spare ESBS or repaired and returned to service. A turbine unit shall not be operated with a known damaged or nonfunctioning ESBS or VBS, or without a full complement of ESBSs, flow vanes, and VBSs. If a screen fails on a weekend or at night when maintenance crews are not available, the respective turbine unit will be shut down and generation switched to another, fully screened unit. If all screened turbine units are in service, water may be spilled until the affected screen can be removed and repaired or replaced.

3.1.2.2. Vertical Barrier Screen Cleaning. The ESBSs deflect fish and water up the gatewell slots as part of the fish collection process. Each gatewell has a VBS located vertically between the bulkhead slot and the operating gate slot. The VBSs keep guided juvenile and adult fish from passing through the bulkhead slot into the operating gate slot where the fish can pass back into the turbine intake. The VBSs are designed to distribute the flow evenly through the screens to minimize fish impingement and descaling. The water surface elevations in the gatewells are routinely measured to determine head differential across the VBSs caused by debris plugging the

VBSs. VBSs are to be pulled and cleaned when head differentials reach 1.5'. Prior to pulling a VBS for cleaning, the turbine unit loading will be lowered to the lower end of the 1% turbine efficiency range and the gatewell dipped with a gatewell basket to remove all fish present in the gatewell unless doing so results in increased mortality (e.g. high numbers of adult or juvenile shad in gatewells). Immediately after dipping, the VBS shall be raised and impinged debris hosed off. The turbine unit shall remain operating at the lower end of the 1% turbine efficiency range while the VBS is being cleaned so gatewell flow will carry the debris into the operating gatewell, where it will pass through the turbine unit. Immediately after cleaning the VBS, the VBS shall be lowered to the normal operating position to prevent fish passage from the bulkhead slot into the operating gate slot. The VBSs shall not be raised longer than 30 minutes with the turbine unit running. If VBSs can not be cleaned within one workday of the head differential reaching 1.5', the turbine unit loading will be lowered to the lower end of the 1% turbine efficiency range until the VBS can be cleaned. If the cleaning frequency of VBSs exceeds project personnel’s cleaning capability of approximately 10 VBSs per day, 7 days per week, project personnel will notify CENWW-OD-T. Then CENWW-OD-T will coordinate with NOAA Fisheries and other FPOM participants regarding an exemption to dipping gatewells prior to cleaning VBSs. An exemption to dipping gatewells prior to cleaning VBSs will be based on fish numbers and TDG levels. If a VBS is found to be damaged during an inspection or cleaning, the VBS panel will be repaired or replaced with a spare panel. The turbine unit will not be operated with a known damaged VBS.

3.1.2.3. Gatewell Orifices. Each gatewell has two orifices with valves to allow fish to exit the gatewell. Under normal operation, one orifice per gatewell (normally the south orifice) is operated. If an orifice becomes blocked with debris or is damaged, it will be closed and the alternate orifice for that gatewell operated until repairs can be made. If both orifices are blocked with debris, damaged, or must be kept closed, the turbine unit will be taken out of service until repairs can be made. If there is a major failure with the bypass system that prevents the gatewell orifices from operating, traveling screens and bar screens will remain in operation. Turbine units shall not be operated with blocked or closed orifices for longer than 10 hours. During any orifice closure, project personnel shall monitor gatewells for signs of fish problems or mortality. If repairs are expected to take longer than two days, a salvage program will be initiated to dip the juveniles from the gatewells with a gatewell basket until repairs are made and the system watered up again or orifices opened. Juvenile fish shall not remain in gatewells longer than 48 hours. During periods of high fish passage, it may be necessary to cease operation of turbine units with ESBSs in place and with closed orifices in less than 10 hours, depending on fish numbers and condition. Spill may occur to provide an alternate avenue for fish passage during facility outages.

3.1.2.4. Dewatering Structure. The dewatering structure acts as a transition from the collection channel to the bypass pipe/flume. An inclined screen and a side dewatering screen allow excess water to be bled off, with all fish and remaining water transitioning into the bypass pipe. Some of the excess water is discharged into the adult fish facility auxiliary water supply system and some is used as the water supply for the transportation facilities. The dewatering structure contains trash sweeps and an air-burst system for cleaning the dewatering screens of impinged debris. If a trash sweep breaks and interferes with juvenile fish passage through the structure or if a screen is damaged, an emergency bypass system in the collection channel may be used to bypass juveniles while repairs are made. Operation of the emergency bypass system requires the juvenile bypass system to be dewatered and stoplogs inserted at the upstream end of the dewatering structure. The emergency bypass is then opened and the bypass system operated with one orifice per gatewell open. Spill may also be required to bypass juvenile fish while in emergency bypass operations. Prior to any emergency dewatering of the collection channel, CENWW-OD-T will be notified. Then CENWW-OD-T will be responsible for notifying NOAA Fisheries and other FPOM participants of the action and coordinating changes in spill or other project operations.

3.1.2.5. Bypass Pipe/Flume. The bypass pipe/corrugated metal flume transports juveniles to either the transportation facilities or to the river below the project through the primary bypass pipe. If there is a problem with the flume that interferes with its operation, the emergency bypass system in the collection system can be opened and all of the fish in the bypass system diverted into the ice and trash sluiceway and passed to the river through the north powerhouse ice and trash sluiceway exit.

3.1.2.6. Transportation Facilities. The transportation facilities can be operated to either collect and hold juveniles for the transportation program or to separate fish by species (based on fish size), enumerate the fish through the sampling system, and bypass part or all of the fish back to the river (secondary bypass). If part of the facility malfunctions or is damaged, efforts will first be made to bypass the fish around the damaged area. If this is not possible, the switch gate in the bypass flume will be used to bypass fish directly to the river until repairs can be made (primary bypass).

3.2. Adult Fish Passage Facilities.

3.2.1. Scheduled Maintenance. Scheduled maintenance of a facility that must be dewatered to work on or whose maintenance will have a <u>significant effect</u> on fish passage will be done during the January and February winter maintenance period. Maintenance of facilities that will have <u>no effect</u> on fish passage may be conducted at any time. Maintenance is normally conducted on one fish ladder at a time during the winter to provide some fish passage at the project at all times. When facilities are not being maintained during the winter maintenance period, they will be operated according to normal criteria unless otherwise coordinated with NOAA Fisheries and other FPOM participants.

3.2.2. Unscheduled Maintenance. Unscheduled maintenance that will significantly affect the operation of a facility will be coordinated with NOAA Fisheries and other FPOM participants. Coordination procedures for unscheduled maintenance of adult facilities are the same as for juvenile facilities (see section 3.1.2.). If part of a facility malfunctions or is damaged during the fish passage season and the facility can still be operated within criteria without any detrimental effects on fish passage, repairs may not be conducted until the winter maintenance period or until fewer numbers of fish are passing the project. If part of a facility is damaged or malfunctions that may significantly impact fish passage, it will be repaired as soon as possible.

3.2.2.1. Fish Ladders and Counting Stations. The fish ladders contain tilting weirs, fixed weirs, counting stations with picket leads, and fish exits with trashracks. If any part of the fish ladder fails or is blocked with debris during the fish passage season, efforts will first be made to correct the problem without dewatering the ladder. Trashracks, picket leads, tilting weir mechanisms, and counting stations can sometimes be repaired or maintained without dewatering the ladder. The decision to dewater the ladder and make repairs during the fish passage season or wait until the winter maintenance period will be made after coordination with the fish agencies and tribes.

3.2.2.2. North Shore Auxiliary Water Supply System. The auxiliary water for the north shore fish ladder is provided by gravity-flow from the forebay. The water passes either through a turbine unit or through a bypass system. The turbine/bypass system is operated by North Wasco County PUD. During normal operations, when the turbine unit is operating, water passes through conduits 3 and 4 to the turbine unit. From the turbine unit, the water discharges into an open pool where it feeds into ladder diffusers. If there are problems with the turbine unit, automatic valves close and the auxiliary water is diverted through conduits 1 and 3A to the baffled bypass system within the old fish lock, where the hydraulic head is dissipated and the water discharged into the diffuser pool.

3.2.2.3. South Shore Auxiliary Water Supply System. The south shore auxiliary water is made up of a combination of gravity flow from the forebay and pumped water from the tailrace. The gravity flow supplies the diffusers above weir 253 (diffusers 7 through 14) and the pumps supply the diffusers below weir 253 (diffusers 1 through 7 and the main unit diffusers). Diffuser 7 is where both systems meet and is supplied by either gravity flow or pumped flow. The gravity flow diffusers are regulated by rotovalves and the pumped flow diffusers by sluice gates. If a rotovalve fails, the nearest closed rotovalve will be opened to supply the flow. If more rotovalves fail than there are closed valves the sluice gates in diffusers 3 through 7 will be opened more to provide the required transportation flows. If any sluice gates fail, the sluice gates nearest it will be opened further to make up the water. If one pump fails, the other two pumps will be operated to maintain the facilities within criteria. If two pumps fail, NFE3 will be closed and SFE1, SFE2, and NFE2 will be operated as deep as possible to maintain the 1' to 2' head differential. If all three pumps fail and the outage is expected to last six days or longer, the powerhouse transportation channel will be bulkheaded off at the junction pool and SFE1 and SFE2 operated a deep as possible and to maintain the 1' to 2' head differential. If a depth of 6' on both gates cannot be maintained, SFE2 will be closed. If all three pumps fail and the outage is expected to last five days or less, CENWW-OD-T will be notified and in turn will coordinate with NOAA Fisheries and other FPOM participants. If the gravity flow and pumped auxiliary water supply systems both fail, the powerhouse transportation channel will be bulkheaded off at the junction pool, SFE2 closed, and SFE1 operated at 6' below tailwater until repairs can be made.

3.2.2.4. Fishway Entrances. The fishway entrances consist of main entrance weirs with hoists and automatic controls, and floating orifices that regulate themselves with tailwater fluctuations. If any of the automatic controls malfunction, the weirs can be operated manually by project personnel and kept within criteria. If there is a further failure that prevents the entrance from being operated manually, the entrance may be lowered down and left in an operating position or an alternate entrance opened until repairs can be made. If a floating orifice fails, it will be pulled out of the water and replaced with a spare floating orifice.

3.2.2.5. Diffuser Gratings. Diffuser chambers for adding auxiliary water to fish ladders and collection channels are covered by gratings attached by several different methods. Diffuser gratings are normally checked during the winter maintenance period to make sure they are in place. These inspections are done by either dewatering and physically inspecting the diffuser gratings, or by using underwater video cameras, divers, or other methods. Diffuser gratings may come loose during the fish passage season due to a variety of reasons. Daily inspections of fish ladders and collection systems should include looking for any flow changes that may indicate problems with diffuser gratings. If a diffuser grating is known or suspected to have moved, creating an opening into a diffuser chamber, efforts must immediately be taken to correct the situation and minimize impacts on adult fish in the fishway. Coordination of the problems should begin immediately through the established unscheduled maintenance coordination procedure (see section 3.1.2). If possible, a video inspection should be made as soon as possible to determine the extent of the problem. If diffuser gratings are found to be missing or displaced, creating openings into the diffuser chambers, a method of repair shall be developed and coordinated with the fish agencies and tribes through the established coordination procedure. Repairs shall be made as quickly as possible unless coordinated differently.

4. Turbine Unit Operation and Maintenance.

4.1. Turbine Unit Operation. When in operation, turbine units will be operated to enhance adult and juvenile fish passage from March 1 through November 30. During this time period turbine units will be operated as needed to meet generation requirements in the following order: 1, 2, 3 through 10 (in any order), and then 11 through 14 (in any order) when units are available for operation. Unit operating priority may be coordinated differently to allow for fish research, construction, or project maintenance activities. If the project is bypassing juvenile fish back to the river through the juvenile release pipe, turbine units 1 through 4 shall be operated first (if available for operation) to provide positive downstream flows at the outfall. During the summer, (when all collected fish are transported) turbine operating priority may change to north powerhouse loading if warm water temperatures result in increased juvenile fish mortality or if project temperature monitoring indicates a temperature gradient exists across the powerhouse. Under north powerhouse loading, turbine units shall be loaded consecutively from unit 14 back towards unit 1. Turbine units 1, 2, and 3 may also be taken off-line during parts of the summer to avoid adding warmer water to the juvenile fish collection channel. Starting and stopping of units should be avoided if possible during periods of warm water, especially between 1000 and 2400 hours.

4.1.1. Turbine units will be operated within 1% of best efficiency from April 1 through October 31 (as specified in BPA's load shaping guidelines, **Appendix C**) unless operation outside of that range is necessary to:

> 1) meet the load requirements of the BPA Administrator whose load requests will be made in accordance with BPA's policy, statutory requirements, and load shaping guidelines (Appendix C);

2) Roll (speed no load) a turbine unit prior to reduce the number of fish in the scrollcase prior to fish salvage operations;

3) operating a turbine unit solely to provide station service; or

4) be in compliance with other coordinated fish measures. Project personnel shall record when turbine units are operated outside the 1% efficiency range and shall provide the information to BPA on a weekly basis according to the load shaping guidelines. Between November 1 and March 31, turbine units will continue to be operated within the 1% efficiency range except when BPA load requests require the units to be operated outside the 1% range. Guidelines for operation of the turbine units within the 1% efficiency range at various heads are shown in Tables MCN-5 and MCN-6.

Table MCN-5. Turbine unit operating range with extended-length submersible bar screens installed for 1% best efficiency, McNary Dam.

Head (Feet)	Lower Generator Limits (MW)	Lower Generator Limits (CFS)	Upper Generator Limits (MW)	Upper Generator Limits (CFS)
67	37.5	7,934	56.7	11,997
68	38.0	7,911	58.2	12,121
69	38.5	7,887	59.7	12,240
70	**39.0**	**7,864**	**61.2**	**12,355**
71	39.6	7,874	62.1	12,355
72	40.2	7,883	63.1	12,354
73	40.9	7,892	64.0	12,353
74	41.5	7,901	64.9	12,351
75	**42.2**	**7,909**	**65.8**	**12,350**
76	42.8	7,907	66.4	12,282
77	43.4	7,905	67.1	12,216
78	44.0	7,903	67.7	12,151
79	44.6	7,900	68.3	12,088
80	**45.2**	**7,897**	**68.9**	**12,026**
81	45.9	7,893	70.0	12,039
82	46.5	7,889	71.1	12,050
83	47.2	7,884	72.2	12,061

Table MCN-6. Turbine unit operating range without extended-length submersible bar screens installed for 1% best efficiency, McNary Dam.

Head (Feet)	Lower Generator Limits (MW)	Lower Generator Limits (CFS)	Upper Generator Limits (MW)	Upper Generator Limits (CFS)
67	37.7	7,739	57.9	11,887
68	38.2	7,716	59.4	12,009
69	38.7	7,694	60.9	12,128
70	**39.2**	**7,671**	**62.5**	**12,243**
71	39.8	7,681	63.4	12,243
72	40.4	7,691	64.4	12,242
73	41.1	7,699	65.3	12,241
74	41.7	7,708	66.3	12,240
75	**42.4**	**7,716**	**67.2**	**12,239**
76	43.0	7,714	67.9	12,172
77	43.6	7,713	68.5	12,107
78	44.2	7,711	69.1	12,043
79	44.8	7,709	69.7	11,980
80	**45.5**	**7,706**	**70.3**	**11,920**
81	46.1	7,720	71.5	11,961
82	46.8	7,734	72.6	12,000
83	47.4	7,747	73.7	12,038

Note: These tables were revised to reflect new information using the 1998 index test and 1955 Prototype Hill Curve. This table contains the best information currently available.

4.2.Turbine Unit Maintenance. The project turbine unit maintenance schedule will be reviewed annually by project and Operations Division biologists for fish impacts. If possible, maintenance of priority units will be scheduled for non-fish passage periods, or when there are low numbers of fish passing the project. Each turbine unit requires annual maintenance that may take from several days to two weeks. Annual maintenance of all turbine units is normally scheduled during the mid-July to late December time frame. The maintenance of priority units for adult passage is normally conducted in mid-August or November and December, when fewer adults are migrating, to minimize impacts on migrating adults. Turbine units may occasionally require overhauls to repair major problems with the turbine or generator. Overhauls may take over one year to accomplish. Turbine units, governors, exciters, and control systems require periodic maintenance, calibration, and testing which may take them outside of the one percent best efficiency range. This work will be scheduled in compliance with BPA load shaping guidelines (**Appendix C**) to minimize impacts on juvenile fish.

4.2.1. Turbine units at McNary Dam are to be operated with raised operating gates to improve fish passage conditions when ESBSs are installed. To facilitate annual maintenance, operating gates are used to dewater the turbine units. To minimize turbine outage periods to the actual time required for maintenance (during the August 1 through December 15 time period), operating gates may be lowered to the standard operating position and connected to hydraulic cylinders on the afternoon of the last regular workday (normally Thursday) prior to the start of the maintenance. With the operating gate in the standard operating position, turbine units may be operated until 0700 hours of the next regular workday (normally Monday) with generation loads restricted to 60 MWs or less. On the completion of maintenance, the turbine unit can be operated with the operating gates in the standard operating position at 60 MWs or less until the 0700 hours of the first regular workday after the maintenance is completed. <u>The project biologist will be notified when the operating gates are set in the standard operating position. The gatewells will be monitored 2 times per day to observe fish condition while the operating gates are in the standard operating position.</u> If turbine maintenance or the raising of the operating gates to the raised operating position is delayed after the time periods stated above, the turbine unit shall be immediately taken out of service until the work can be accomplished. Operation of turbine units with operating gates in the standard operating position shall be restricted to the August 1 through December 15 time period, and shall not begin until juvenile fish collection numbers drop to less than 10,000 fish per day. No more than 2 turbine units at a time shall be operated with operating gates in the standard operating position and the turbine units will be operated on last on, first off operating priority.

4.2.2. Unwatering turbine units should be accomplished in accordance with project dewatering plans. Prior to dewatering a turbine unit for maintenance, the turbine unit should be spun at speed-no-load, if possible, immediately before installing tailrace stoplogs and headgates to minimize the number of fish in the draft tube and scroll case. If a turbine unit is out of service for maintenance for an extended period of time without tailrace stoplogs in place, efforts should be made to not open the wicket gates if the scroll case must be dewatered at a later date without the unit being spun before hand.

5. Forebay Debris Removal. Debris at projects can impact fish passage conditions. Debris can plug or block trashracks, VBSs, gatewell orifices, dewatering screens, separators, and facility piping resulting in impingement, injuries, and descaling of fish. Removing debris at its source in the forebay is sometimes necessary to maintain safe and efficient fish passage conditions, navigation, and other project activities. Debris can be removed from the forebay by: physically encircling the debris with log booms and pulling it to shore with boats where it can be removed with a crane, removing the debris from the top of the dam using a crane and scoop, or passing the debris through the spillway with special powerhouse operations and spill. The preferred option is to remove debris at each project when possible to avoid passing debris on to the next project downstream. This is not always possible at each project as some projects do not have forebay debris removal capability. In this case, the only viable alternative is to spill to pass the debris.

5.1. All special spills (other than normal spill patterns for ongoing spill operations) and project operations for passing debris will be coordinated prior to the operations taking place. Each project shall contact CENWW-OD-T at least two workdays prior to the day they want the special project operations for spilling to pass debris. Then CENWW-OD-T shall coordinate the special operations with RCC, NOAA Fisheries, and other FPOM participants. Project personnel shall provide CENWW-OD-T the reason for the debris spill request including an explanation of project facilities being impacted by the debris, the date and time of the requested spill, and any special powerhouse or other operations required to move the debris to the spillway. When a debris spill is coordinated and approved, RCC shall issue a teletype detailing the specifics of the special operations.

Table MCN-7. McNary Dam spill pattern for fish passage.
(Discharge in kcfs at forebay elevation 339)

Spill	Bay																					Total
kcfs	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	Stops
3.9																			2				2
7.8																			2	2			4
9.5																			2.5	2.5			5
11.7																		2	2	2			6
13.4																		2	2.5	2.5			7
15.6																	2	2	2	2			8
17.3																	2	2.5	2.5	2			9
19.5															2		2	2	2	2			10
21.2															2		2	2.5	2.5	2			11
23.4													2		2		2	2	2	2			12
25.1													2		2		2	2.5	2.5	2			13
27.3											2		2		2		2	2	2	2			14
29											2		2		2		2	2.5	2.5	2			15
31.2									2		2		2		2		2	2	2	2			16
32.9									2		2		2		2		2	2.5	2.5	2			17
35.1									2		2		2		2	2	2	2	2	2			18
36.8									2		2		2		2	2	2.5	2	2.5	2			19
39							2		2		2		2		2	2	2	2	2	2			20
40.7							2		2		2		2		2	2	2.5	2	2.5	2			21
42.9					2		2		2		2		2		2	2	2	2	2	2			22
44.6					2		2		2		2		2		2	2	2.5	2	2.5	2			23
46.8					2		2		2		2		2	2	2	2	2	2	2	2			24

* Special care MAY be required to open and close Bays 1 & 22. (This will need to be verified by field testing.)

<u>Opening sequence:</u>

a) Open Bays 2 – 21 first, as specified in the spill pattern table.

b) After Bays 2 - 21 have been set and operating for at least 10 minutes, open Bays 1 & 22 to their desired settings.

<u>Closing Sequence:</u>

a) Close Bays 1 & 22 prior to closing Bays 2-21.

Table MCN-7. McNary Dam spill pattern for fish passage. (continued)
(Discharge in kcfs at forebay elevation 339)

Spill	Bay																						Total
kcfs	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	Stops
48.5					2		2		2		2		2	2	2	2.5	2	2.5	2	2			25
50.7					2		2		2		2		2	2	2	2	2	2	2	2	2		26
52.4					2		2		2		2		2	2	2	2.5	2	2.5	2	2	2		27
54.6					2		2		2		2		2	2	2	2	2	2	2	2	2	2	28
56.3					2		2		2		2		2	2	2	2.5	2	2.5	2	2	2	2	29
58.5					2		2		2		2	2	2	2	2	2	2	2	2	2	2	2	30
60.2					2		2		2		2	2	2	2	2	2.5	2	2.5	2	2	2	2	31
61.9					2		2		2		2	2	2	2.5	2	2.5	2	2.5	2	2.5	2	2	32
63.6					2		2		2		2	2	2	2.5	2	2.5	2.5	2.5	2	2.5	2.5	2	33
65.3					2		2		2		2	2	2	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2	34
67					2		2		2		2	2	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	35
68.7					2		2		2		2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	36
70.4					2		2		2		2.5	2.5	2.5	2.5	2.5	3	2.5	3	2.5	2.5	2.5	2.5	37
71.3	2	3.5	3.5	2	2	2	2	2	2	2	2	2	2	2	2	2	2						37
73	2	3.5	3.5	2.5	2.5	2	2	2	2	2	2	2	2	2	2	2	2						38
74.7	2.5	3.5	3.5	2.5	2.5	2.5	2	2	2	2	2	2	2	2	2	2	2						39
76.3	2.5	4	4	2.5	2.5	2.5	2	2	2	2	2	2	2	2	2	2	2						40
78	2.5	4	4	2.5	2.5	2.5	2.5	2.5	2	2	2	2	2	2	2	2	2						41
79.6	2.5	4.5	4.5	2.5	2.5	2.5	2.5	2.5	2	2	2	2	2	2	2	2	2						42
81.3	2.5	4.5	4.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2	2	2	2	2	2	2						43
82.9	2.5	5	5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2	2	2	2	2	2	2						44
85.1	2.5	5	5	2.5	2.5	2.5	2.5	2.5	2	2	2	2	2	2	2	2	2	2					45

* Special care MAY be required to open and close Bays 1 & 22. (This will need to be verified by field testing.)

Opening sequence:

a) **Open Bays 2 – 21 first, as specified in the spill pattern table.**

b) **After Bays 2 - 21 have been set and operating for at least 10 minutes, open Bays 1 & 22 to their desired settings**.

Closing Sequence:

a) **Close Bays 1 & 22 prior to closing Bays 2-21**

Table MCN-7. McNary Dam spill pattern for fish passage. (continued)
(Discharge in kcfs at forebay elevation 339)

Spill	Bay																						Total
kcfs	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	Stops
86.8	2.5	5	5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2	2	2	2	2	2	2	2					46
88.5	2.5	5	5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2	2	2	2	2	2					47
90.2	2.5	5	5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2	2.5	2	2	2					48
92.4	2.5	5	5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2	2	2	2	2	2	2				49
94.1	2.5	5	5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2	2.5	2	2	2	2				50
95.8	2.5	5	5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2	2.5	2	2				51
98	2.5	5	5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2	2.5	2	2	2	2	2			52
99.7	2.5	5	5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2	2.5	2	2.5	2	2.5	2			53
101.4	3	5	5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2	2.5	2	2.5	2			54
103.1	3	5	5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2			55
105.3	3	5	5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2	2.5	2	2.5	2	2		56
107	3	5	5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2	2		57
108.7	3	5	5	3	3	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2	2		58
110.4	3	5	5	3	3	3	3	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2	2		59
112.1	3	5	5	3	3	3	3	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5		60
114.3	3	5	5	3	3	3	3	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2	2	2	61
116	3.5	5	5	3	3	3	3	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2	2	62
117.7	3.5	5	5	3	3	3	3	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	63
119.4	3.5	5	5	3	3	3	3	3	3	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	64
121.1	3.5	5	5	3	3	3	3	3	3	3	3	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	65
122.8	3.5	5	5	3	3	3	3	3	3	3	3	2.5	3	2.5	3	2.5	2.5	2.5	2.5	2.5	2.5	2.5	66
124.5	3.5	5	5	3	3	3	3	3	3	3	3	2.5	3	2.5	3	2.5	3	2.5	3	2.5	2.5	2.5	67

* Special care MAY be required to open and close Bays 1 & 22. (This will need to be verified by field testing.)

Opening sequence:

a) Open Bays 2 – 21 first, as specified in the spill pattern table.

b) After Bays 2 - 21 have been set and operating for at least 10 minutes, open Bays 1 & 22 to their desired settings.

Closing Sequence:

a) Close Bays 1 & 22 prior to closing Bays 2-21

Table MCN-7. McNary Dam spill pattern for fish passage. (continued)
(Discharge in kcfs at forebay elevation 339)

Spill	Bay																					Total
kcfs	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	Stops
126	3.5	6	6	3	3	3	3	3	3	3	3	2.5	3	2.5	3	2.5	2.5	2.5	2.5	2.5	2.5	2.5	68
127.6	4	6	6	3	3	3	3	3	3	3	3	2.5	3	2.5	3	2.5	3	2.5	2.5	2.5	2.5	2.5	69
129.3	4	6	6	3	3	3	3	3	3	3	3	3	3	2.5	3	2.5	3	2.5	3	2.5	2.5	2.5	70
131	4	6	6	3	3	3	3	3	3	3	3	3	3	3	3	3	3	2.5	3	2.5	2.5	2.5	71
132.7	4	6	6	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	2.5	2.5	72
134.4	4	6	6	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	73
136	4	6	6	3.5	3	3.5	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	74
137.6	4	6	6	3.5	3	3.5	3	3.5	3	3.5	3	3	3	3	3	3	3	3	3	3	3	3	75
139.2	4	6	6	3.5	3	3.5	3	3.5	3	3.5	3	3.5	3	3.5	3	3	3	3	3	3	3	3	76
140.8	4.5	7	7	3.5	3	3.5	3	3.5	3	3	3	3	3	3	3	3	3	3	3	3	3	3	77
142.4	4.5	7	7	3.5	3	3.5	3	3.5	3	3.5	3	3.5	3	3	3	3	3	3	3	3	3	3	78
144	4.5	7	7	3.5	3.5	3.5	3	3.5	3	3.5	3	3.5	3	3.5	3	3	3	3	3	3	3	3	79
145.6	4.5	7	7	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3	3.5	3	3.5	3	3	3	3	3	3	3	3	80
147.2	4.5	7	7	4	3.5	4	3.5	3.5	3.5	3.5	3	3.5	3	3.5	3	3	3	3	3	3	3	3	81
148.8	4.5	7	7	4	3.5	4	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3	3	3	3	3	3	3	3	82
150.4	4.5	7	7	4	3.5	4	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3	3.5	3	3.5	3	3	3	3	83
152	4.5	7	7	4	3.5	4	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3	3.5	3	3.5	3	3	84
153.6	4.5	7	7	4	3.5	4	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3	3	85
155.2	4.5	7	7	4	3.5	4	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	86
157	4.5	8	8	4	3.5	4	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3	3	87
158.6	4.5	8	8	4	3.5	4	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	88
160.2	4.5	8	8	4	3.5	4	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	4	3.5	4	3.5	3.5	3.5	3.5	89

* Special care MAY be required to open and close Bays 1 & 22. (This will need to be verified by field testing.)

Opening sequence:

a) **Open Bays 2 – 21 first, as specified in the spill pattern table.**

b) **After Bays 2 - 21 have been set and operating for at least 10 minutes, open Bays 1 & 22 to their desired settings**.

Closing Sequence:

a) **Close Bays 1 & 22 prior to closing Bays 2-21**

Table MCN-7. McNary Dam spill pattern for fish passage. (continued)
(Discharge in kcfs at forebay elevation 339)

Spill	Bay																						Total
kcfs	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	Stops
161.8	4.5	8	8	4	3.5	4	3.5	3.5	3.5	3.5	3.5	3.5	3.5	4	3.5	4	3.5	4	3.5	4	3.5	3.5	90
163.4	4.5	8	8	4	3.5	4	3.5	3.5	3.5	4	3.5	4	3.5	4	3.5	4	3.5	4	3.5	4	3.5	3.5	91
165	4.5	8	8	4	3.5	4	3.5	4	3.5	4	3.5	4	3.5	4	3.5	4	3.5	4	3.5	4	3.5	4	92
166.6	4.5	8	8	4	3.5	4	3.5	4	3.5	4	3.5	4	3.5	4	3.5	4	4	4	4	4	3.5	4	93
168.2	4.5	8	8	4	3.5	4	3.5	4	3.5	4	3.5	4	4	4	4	4	4	4	4	4	3.5	4	94
169.8	4.5	8	8	4	3.5	4	3.5	4	3.5	4	4	4	4	4	4	4	4	4	4	4	4	4	95
171.4	4.5	8	8	4	3.5	4	3.5	4	3.5	4	4	4	4	4	4	4.5	4	4.5	4	4	4	4	96
173	4.5	8	8	4	3.5	4	3.5	4	3.5	4	4	4	4	4	4	4.5	4.5	4.5	4.5	4	4	4	97
174.6	4.5	8	8	4	3.5	4	3.5	4	3.5	4	4	4	4	4.5	4	4.5	4.5	4.5	4.5	4.5	4	4	98
176.2	5	8	8	4	3.5	4	3.5	4	4	4	4	4	4	4.5	4	4.5	4.5	4.5	4.5	4.5	4	4	99
177.8	5	8	8	4	3.5	4	3.5	4	4	4.5	4	4.5	4	4.5	4	4.5	4.5	4.5	4.5	4.5	4	4	100
179.4	5	8	8	4	3.5	4	3.5	4	4	4.5	4	4.5	4	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4	101
181	5	8	8	4	3.5	4	3.5	4	4	4.5	4	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	102
182.6	5	8	8	4	3.5	4	3.5	4	4	4.5	4	4.5	4.5	4.5	4.5	5	4.5	5	4.5	4.5	4.5	4.5	103
184.2	5	8	8	4	3.5	4	3.5	4	4	4.5	4	4.5	4.5	5	4.5	5	4.5	5	4.5	5	4.5	4.5	104
185.8	5	8	8	4	4	4	4	4	4	4.5	4	4.5	4.5	5	4.5	5	4.5	5	4.5	5	4.5	4.5	105
187.4	5	8	8	4	4	4	4	4.5	4	4.5	4	4.5	4.5	5	4.5	5	5	5	4.5	5	4.5	4.5	106
189	6	8	8	4	4	4	4	4.5	4	4.5	4	4.5	4.5	5	4.5	5	5	5	4.5	5	4.5	4.5	107
190.6	6	8	8	4	4	4	4	4.5	4	4.5	4	4.5	4.5	5	5	5	5	5	5	5	4.5	4.5	108
192.2	6	8	8	4	4	4	4	4.5	4	4.5	4.5	4.5	4.5	5	5	5	5	5	5	5	5	4.5	109
193.8	6	8	8	4.5	4	4.5	4	4.5	4	4.5	4.5	4.5	4.5	5	5	5	5	5	5	5	5	4.5	110
195.4	6	8	8	4.5	4	4.5	4	4.5	4.5	4.5	4.5	5	4.5	5	5	5	5	5	5	5	5	4.5	111

* Special care MAY be required to open and close Bays 1 & 22. (This will need to be verified by field testing.)

<u>Opening sequence:</u>

a) Open Bays 2 – 21 first, as specified in the spill pattern table.

b) After Bays 2 - 21 have been set and operating for at least 10 minutes, open Bays 1 & 22 to their desired settings.

<u>Closing Sequence:</u>

a) Close Bays 1 & 22 prior to closing Bays 2-21

Table MCN-7. McNary Dam spill pattern for fish passage. (continued)
(Discharge in kcfs at forebay elevation 339)

Spill	Bay																						Total
kcfs	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	Stops
197	6	8	8	4.5	4	4.5	4.5	4.5	4.5	5	4.5	5	4.5	5	5	5	5	5	5	5	5	4.5	112
198.6	6	8	8	4.5	4.5	4.5	4.5	5	4.5	5	4.5	5	4.5	5	5	5	5	5	5	5	5	4.5	113
200.2	6	8	8	5	4.5	5	4.5	5	4.5	5	4.5	5	4.5	5	5	5	5	5	5	5	5	4.5	114
201.8	6	8	8	5	4.5	5	4.5	5	4.5	5	4.5	5	5	5	5	5	5	5	5	5	5	5	115
203.4	6	8	8	5	4.5	5	4.5	5	4.5	5	4.5	5	5	5	5	5	6	5	5	5	5	5	116
206.6	6	8	8	5	4.5	5	4.5	5	4.5	5	4.5	5	5	5	6	5	6	5	6	5	5	5	118
209.8	6	8	8	5	4.5	5	4.5	5	4.5	5	4.5	5	6	5	6	5	6	5	6	5	6	5	120
213	6	8	8	5	4.5	5	4.5	5	4.5	5	4.5	5	6	5	6	6	6	6	6	5	6	5	122
216.2	6	8	8	5	5	5	5	5	5	5	5	5	6	5	6	6	6	6	6	5	6	5	124
219.4	7	9	8	5	5	5	5	5	5	5	5	5	6	5	6	6	6	6	6	5	6	5	126
222.6	7	9	8	5	5	5	5	5	5	5	5	5	6	6	6	6	6	6	6	6	6	5	128
225.8	7	9	8	5	5	5	5	5	5	5	5	6	6	6	6	6	6	6	6	6	6	6	130
229	7	9	8	5	5	5	5	5	5	6	6	6	6	6	6	6	6	6	6	6	6	6	132
232.2	7	9	8	5	5	5	5	5	5	6	6	6	6	6	7	6	6	7	6	6	6	6	134
235.4	7	9	8	5	5	5	5	5	5	6	6	6	6	6	7	7	6	7	7	6	6	6	136
238.6	7	9	8	5	5	5	5	5	5	6	6	6	6	7	7	7	7	7	7	6	6	6	138
241.8	7	9	8	5	5	5	5	6	6	6	6	6	6	7	7	7	7	7	7	6	6	6	140
245.1	7	9	8	5	5	5	5	6	6	6	6	6	6	7	7	7	8	7	7	7	6	6	142
248.5	7	9	8	5	5	5	5	6	6	6	6	6	6	7	8	7	8	7	8	7	6	6	144
251.7	7	9	8	5	5	5	5	6	6	7	6	7	6	7	8	7	8	7	8	7	6	6	146
254.9	7	9	8	6	5	6	5	6	6	7	6	7	6	7	8	7	8	7	8	7	6	6	148
258.1	7	9	8	6	5	6	5	6	6	7	6	7	7	7	8	7	8	7	8	7	7	6	150

* Special care MAY be required to open and close Bays 1 & 22. (This will need to be verified by field testing.)

Opening sequence:

a) Open Bays 2 – 21 first, as specified in the spill pattern table.

b) After Bays 2 - 21 have been set and operating for at least 10 minutes, open Bays 1 & 22 to their desired settings.

Closing Sequence:

a) Close Bays 1 & 22 prior to closing Bays 2-21

Table MCN-7. McNary Dam spill pattern for fish passage. (continued)
(Discharge in kcfs at forebay elevation 339)

Spill kcfs	Bay 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	Total Stops
261.4	7	9	8	6	5	6	5	6	6	7	6	7	8	7	8	7	8	7	8	7	7	7	152
264.6	7	9	8	6	6	6	6	6	6	7	6	7	8	7	8	7	8	7	8	7	7	7	154
267.9	7	9	8	6	6	6	6	6	6	7	7	7	8	7	8	8	8	7	8	7	7	7	156
271.3	7	9	8	6	6	6	6	6	6	7	7	7	8	8	8	8	8	8	8	7	7	7	158
274.7	7	9	8	6	6	6	6	6	6	7	7	8	8	8	8	8	8	8	8	8	7	7	160
277.9	7	9	8	6	6	7	6	6	7	7	7	8	8	8	8	8	8	8	8	8	7	7	162
281.3	7	9	8	6	6	7	6	6	7	7	8	8	8	8	8	8	8	8	8	8	8	7	164
284.5	7	9	8	7	6	7	6	7	7	7	8	8	8	8	8	8	8	8	8	8	8	7	166
287.9	7	9	8	7	6	7	6	7	7	8	8	8	8	8	8	8	8	8	8	8	8	8	168
291.1	7	9	8	7	7	7	7	7	7	8	8	8	8	8	8	8	8	8	8	8	8	8	170
294.5	8	9	8	7	7	7	7	7	8	8	8	8	8	8	8	8	8	8	8	8	8	8	172
297.9	8	9	8	7	8	7	8	7	8	8	8	8	8	8	8	8	8	8	8	8	8	8	174
301.3	8	9	8	7	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	176

* Special care MAY be required to open and close Bays 1 & 22. (This will need to be verified by field testing.)

Opening sequence:

a) Open Bays 2 – 21 first, as specified in the spill pattern table.

b) After Bays 2 - 21 have been set and operating for at least 10 minutes, open Bays 1 & 22 to their desired settings.

Closing Sequence:

a) Close Bays 1 & 22 prior to closing Bays 2-21

Section 6 Ice Harbor Dam

Ice Harbor Dam

1. Fish Passage Information. The locations of fish passage facilities at Ice Harbor Lock and Dam are shown in **Figure IHR-1**. Dates of project operations for fish purposes and special operations are listed in **Table IHR-1**.

1.1. Juvenile Fish Passage.

1.1.1. Facilities Description. The juvenile fish passage facilities at Ice Harbor consist of standard length submersible traveling screens, vertical barrier screens, 12" orifices, collection channel and dewatering structure, sampling facilities, transportation flume/pipe to the tailrace below the project, and a full-flow PIT tag detection system.

1.1.2. Juvenile Migration Timing. Juvenile passage timing at Ice Harbor Dam corresponds closely with juvenile passage at Lower Monumental Dam (**Table LMN-2**). Salmon, steelhead, bull trout, lamprey, and other species are routinely counted when sampling occurs at Ice Harbor. Maintenance of juvenile fish passage facilities that may impact juvenile fish passage or facility operations should be conducted during the winter maintenance season.

1.2. Adult Fish Passage.

1.2.1. Facilities Description. The adult fish passage facilities at Ice Harbor are made up of separate north and south shore facilities. The north shore facilities include a fish ladder with counting station, a small collection system, and a pumped auxiliary water supply system. The collection system includes two downstream entrances and one side entrance into the spillway basin. In normal operation one downstream entrance is used and the other two entrances are closed. The auxiliary water is supplied by two electric pumps with a third pump as a backup. The south shore facilities are comprised of a fish ladder with counting station, two south shore entrances, a powerhouse collection system, and a pumped auxiliary water supply system. The powerhouse collection system includes two downstream entrances and one side entrance into the spillway basin at the north end of the powerhouse, four operating floating orifices, and a common transportation channel. One of the downstream north powerhouse entrances and four of the floating orifices are used during normal operation. At the south shore entrances, one entrance is normally used. The auxiliary water is supplied by eight electric pumps of which from six to eight are normally used to provide the required flows. The excess water from the juvenile fish passage facilities is routed into the fish pump discharge chamber to provide additional attraction flow. The upper ends of both ladders have PIT tag detectors.

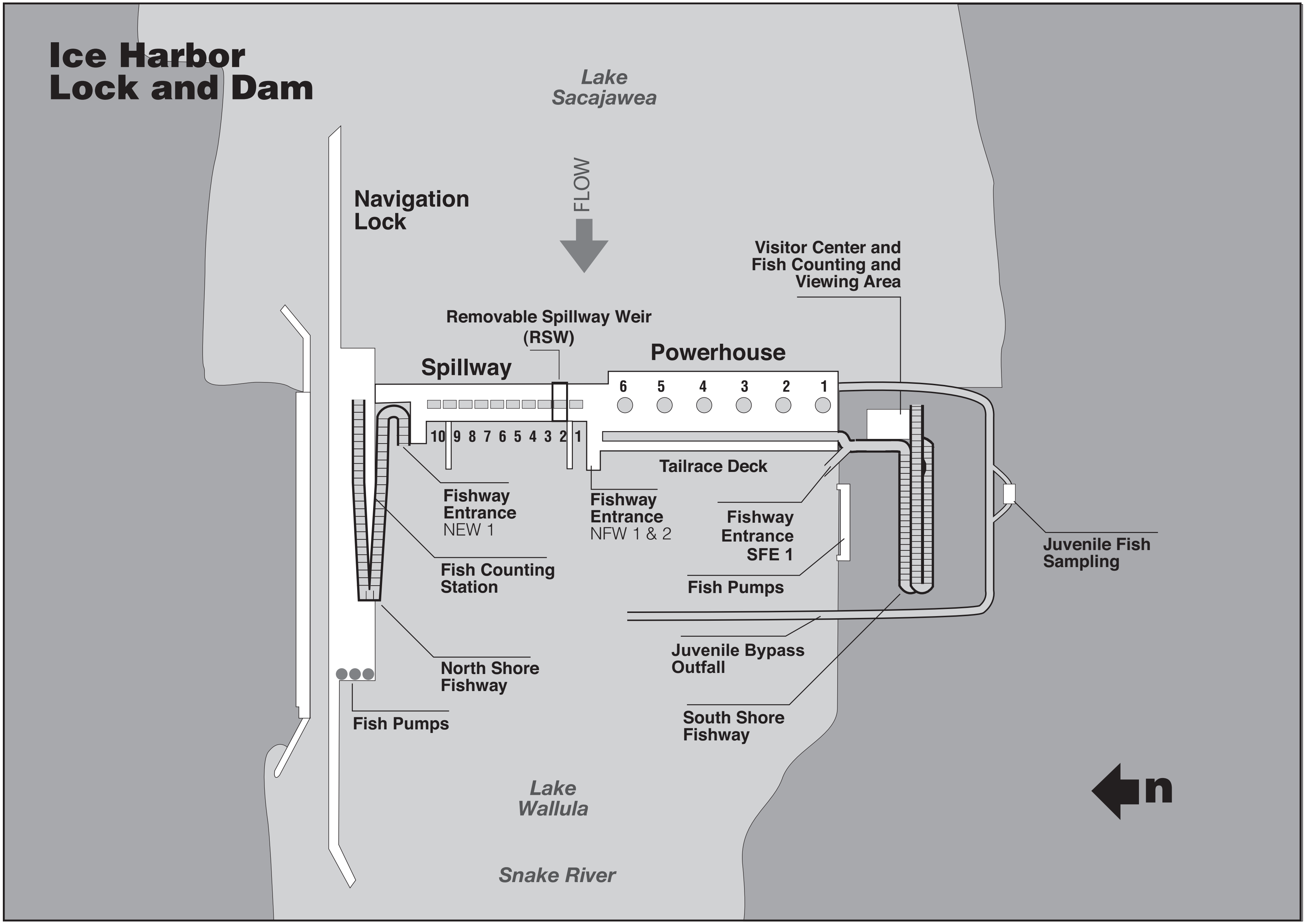
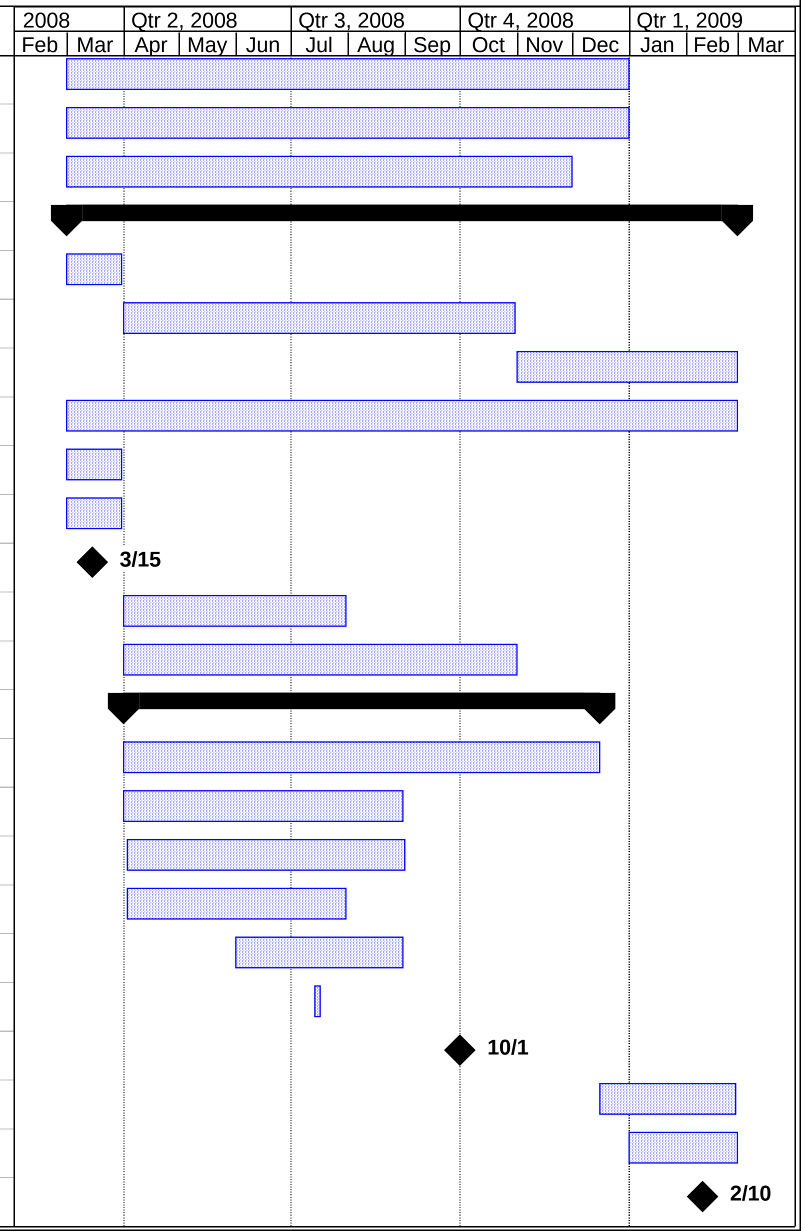


Figure IHR-1 Ice Harbor Lock and Dam General Site Plan

Table IHR-1. Dates of project operations for fish purposes at Ice Harbor, 2008-9

March 2008

Task Name	Start	Finish	FPP Reference
Adult Fish Passage Period	3/1/08	12/31/08	Ihr 2.3.2.2
Weekly Reports	3/1/08	12/31/08	Ihr 2.3.3.1
Operate Turbines for Fish Passage	3/1/08	11/30/08	Ihr 4.1
1% limitations	**3/1/08**	**2/28/09**	**Ihr 4.1.2**
1% Soft	3/1/08	3/31/08	Ihr 4.1.2
1% Hard	4/1/08	10/31/08	Ihr 4.1.2
1% Soft	11/1/08	2/28/09	Ihr 4.1.2
TDG Monitoring	3/1/08	2/28/09	App D Table 4
Winter Maintenance Period Juvenile	3/1/08	3/31/08	Ihr 2.3.1.1.
RSW Tests	3/1/08	3/31/08	App A Ihr 1.3
Final Report	3/15/08	3/15/08	Ihr 2.3.3.3
Back flush orifices once per shift	4/1/08	7/31/08	Ihr 2.3.1.2.c.6
Adult Fish Counting Visual 0400 - 2000 PST	4/1/08	10/31/08	Ihr 1.2.2
Operate juvenile facilities	**4/1/08**	**12/15/08**	**Ihr 2.3.1**
Juvenile Passage Period	4/1/08	12/15/08	Ihr 2.3.1.2
Capture & Tag Adult Salmon & Steelhead	4/1/08	8/31/08	App A Ihr 2.2
Spill for Fish	4/3/08	8/31/08	App E
Impacts of Avian Predation on Salmonid Smolts	4/3/08	7/31/08	App A Ihr 2.1
Adult Lamprey Evaluation	6/1/08	8/31/08	App A Ihr 2.3
Doble Tests	7/14/08	7/17/08	App A Ihr 1.2
1/2 STS May Be Pulled after this date	10/1/08	10/1/08	Ihr 2.3.1.2.b.6
Winter Maintenance Period Juvenile	12/16/08	2/28/09	Ihr 2.3.1.1.
Maintenance of Adult Facilities	1/1/09	2/28/09	Ihr 1.2.2
Draft Final Report	2/10/09	2/10/09	Ihr 2.3.3.3



1.2.2 Adult Migration Timing. Upstream migrants are present at Ice Harbor Dam throughout the year and adult passage facilities are operated year round. Maintenance of adult fish facilities is scheduled for January and February to minimize impacts on upstream migrants. Facilities are usually shut down one shore at a time for maintenance. Adult fish (salmon, steelhead, shad, and lamprey) are counted as per **Table IHR-2**; these data appear daily on the Corps adult count website. Salmon migration timing data appear in **Table IHR-3**. Sturgeon and bull trout are also counted and recorded on the WDFW fish counters' daily summary sheet comments section; and these data are summarized in the Annual Fish Passage Report, but do no appear on the Corps daily website total due to relative infrequency of passage.

Table IHR-2. Adult fish counting schedule at Ice Harbor Dam.

Period	Counting Method
April 1 – October 31	Visual count 0400 - 2000 PST

Table IHR-3. Adult migration timing at Ice Harbor Dam from 1962-2007 based on fish counts.

Species	Counting Period	Date of Peak Passage	
		Earliest	Latest
Spring Chinook	4/1 - 6/11	4/22	5/26
Summer Chinook	6/12 - 8/11	6/12	7/23
Fall Chinook	8/12- 12/15	9/5	9/30
Steelhead	4/1 – 12/15	9/15	10/12
Sockeye	4/1 – 12/15	7/1	9/22

2. Project Operation.

2.1. Spill Management. See the 2008 Fish Operations Plan (**Appendix E**) for more information.

2.1.1. Involuntary spill at Ice Harbor is the result of river flow exceeding powerhouse capacity, insufficient generation loads to pass the river flow, turbine unit outages (forced or scheduled), or the failure of a key component of the juvenile fish passage facility which forces the project to spill to provide juvenile fish passage. Spill at Ice Harbor will be distributed in accordance with the spill patterns listed in **Tables IHR-9,IHR-10, and IHR-11**. Special spills for juvenile fish passage will be provided as detailed in **Appendices A and E**.

2.2. Dissolved Gas Management and Control. Total dissolved gas (TDG) levels at Ice Harbor Dam are monitored in accordance with the Dissolved Gas Monitoring Program, **Appendix D**.

2.3. Operating Criteria.

2.3.1. Juvenile Fish Passage Facilities. Operate from April 1 through October 31 for juvenile fish passage and from November 1 through December 15 for protecting adult fallbacks. The facilities should be operated according to the following criteria:

2.3.1.1. Winter Maintenance Period (December 16 through March 31). Check and perform maintenance as required on the items listed below.

a. Forebay Area and Intakes.

1. Remove debris from forebay and gatewell slots.

2. Rake trashracks just prior to the operating season.

3. Measure drawdown in gatewell slots after cleaning trashracks and with STSs in place.

4. Inspect and repair gatewell dip net as needed.

b. Submersible Traveling Screens and Vertical Barrier Screens.

1. Maintenance completed on all screens.

2. Inspect STSs prior to installation and operate one trial run (dogged off on deck) to ensure proper operation.

3. Log trial Run.

4. Inspect all VBSs at least once per year with an underwater video camera. Repair as needed.

c. Collection Channel.

1. Water-up valve capable of operating when needed.

2. Orifice lights are operational.

3. Orifices clean and valves operating correctly.

4. Orifice air backflush system works correctly.

5. Netting along handrails maintained and in good condition.

6. Netting or covers over orifice chutes maintained and in good condition.

d. Dewatering Structure and Flume.

1. Inclined screen should be clean and in good condition with no gaps between screen panels, damaged panels, or missing silicone.

2. Screen cleaning system (brush and air flush) maintained and operating correctly.

3. Overflow weirs should be maintained, tested, and operating correctly.

4. All valves should be operating correctly.

5. Flume interior should be smooth with no rough edges.

6. Maintain full-flow PIT tag system as required. Coordinate with PSMFC.

e. Sampling Facilities.

1. Flume dewatering structure should be maintained and in good operating condition with no holes or gaps between dewatering screen panels. Silicone sealer should be in good condition.

2. Flume drop gate should be maintained and in good operating condition.

3. The wet separator and fish distribution system should be maintained and ready for operation as designed.

4. All dewatering screens and seals in separator and flume must be in good condition with no holes or gaps between panels, or sharp edges.

5. All valves and switch gates maintained and in good operating condition.

6. All sampling equipment maintained and in good operating condition.

7. Maintain juvenile PIT tag system as required. Coordinate with PSMFC.

f. Avian Predation Areas (Forebay and Tailrace). Inspect bird wires, water cannon, and other deterrent devices and repair or replace as needed. Where possible, install additional bird wires or other deterrent devices to cover areas of known avian predation activity. Prepare avian abatement contract as needed.

g. Maintenance Records. Record all maintenance and inspections.

2.3.1.2. Fish Passage Period (April 1 through December 15).

a. Forebay Area and Intakes.

1. Remove debris from forebay.

2. Remove debris from trashracks as required to maintain less than 1' of additional drawdown in gate slots. Additional raking may be required when heavy debris loads are present in the river. Coordinate turbine unit outages with other project work activities, if possible, to minimize turbine unit outages during the spring.

3. Inspect gatewell slots daily for debris, fish buildup, and contaminating substances (particularly oil). Clean gatewells before they become half covered with debris. If, due to the volume of the debris, it is not possible to keep the gatewell surfaces at least half clear, they should be cleaned at least once daily. If flows through an orifice indicate that an orifice may be partially obstructed with debris, the orifice will be closed and backflushed to remove the obstruction. If the obstruction can not be removed, the orifice shall be closed and the alternate orifice for that gatewell slot shall be operated. If both orifices become obstructed or plugged with debris, the turbine unit shall not be operated until the gatewell and orifices are cleared of debris.

4. If a visible accumulation of contaminating substances (such as oil) is detected in a gatewell and it cannot be removed within 24 hours, the gatewell orifices shall be closed immediately and the turbine unit shut down within one hour until the material has been removed and any problems corrected. A preferred method for removing oil from the water surface is to install absorbent (not adsorbent) socks, booms, or pads capable of encapsulating the material, tied off with a rope for later disposal. Action should be taken as soon as possible to remove the oil from the gatewell so the orifice can be reopened to allow the fish to exit the gatewell. Orifices shall not be closed for longer than 48 hours.

5. Dip bulkhead gatewell slots to remove fish prior to installing bulkhead for dewatering bulkhead slot.

b. Submersible Traveling Screens and Vertical Barrier Screens.

1. Operate STSs in cycling mode when average fork length of sub-yearling chinook or sockeye is greater than 120 mm at Lower Monumental collection facility.

2. Operate STSs in continuous operational mode when average fork length of sub-yearling chinook or sockeye is less than 120 mm at Lower Monumental collection facility, or if there is evidence that smaller juvenile fish are present at the project. Return to cycling mode after one week has passed and re-evaluate.

3. Inspect each STS once per month by means of underwater video. Spot check VBSs at the same time.

4. Record STS amp readings daily.

5. If an STS or VBS is damaged or fails during the juvenile fish passage season, follow procedures detailed under unscheduled maintenance of STSs. In no case should a turbine unit be operated with a missing or a known non-operating or damaged STS or VBS.

6. Up to one-half of the STSs may be removed after October 1 for annual maintenance provided there is no operation of units without screens.

7. Make formal determination at end of season as to adequacy of STS screen mesh and replacement if necessary.

8. Inspect at least 2 VBSs in 2 different turbine units between the spring and summer migration periods. Both turbine units should have been operated frequently during the spring. If a debris accumulation is noted, inspect other VBSs and clean debris as necessary.

c. Collection Channel.

1. Orifices clean and operating. Operate at least one orifice per gatewell slot (preferably the north orifice). If the project is operating at MOP, additional orifices may be operated to maintain a full collection channel. If orifices must be closed to repair any part of the facility, monitor the gatewells hourly (unit is operating) or at least every two hours (unit is not operating) for fish condition and behavior. Also see section 3.1.2.2. to determine if the turbine unit must be shut down and if fish must be dipped from the gatewell(s).

2. Orifice lights operational and operating on open orifices. Orifice lights and area lights may be turned off the evening before the channel is dewatered at the end of the season (dewatering occurs on December 16 or later) to encourage fish to exit the channel volitionally. Area lights can be turned on briefly for personnel access if necessary.

3. Replace all burned out orifice lights within 24 hours of notification. Orifice lights shall remain lighted 24 hours/day.

4. Orifice jets hitting no closer than 3’ from back wall, collection channel full.

5. Orifice valves are either fully open or closed.

6. Backflush orifices at least once per day. During periods of high fish and debris passage, April 1 through July 31, orifices should be inspected and backflushed once per 8-hour shift or more frequently as determined by the project biologist, to keep orifices clean.

7. Water-up valve capable of operating when needed.

8. The netting along handrails should be maintained in good condition with no holes or gaps in the netting.

9. Netting or covers over orifice chutes in good condition.

d. Dewatering Structure.

1. Trash sweep operating correctly. The frequency of sweep should be set as necessary to maintain a clean screen, with a minimum operation of at least once per hour. If automated cleaning system problems occur, operate manually at least once per work shift, or more as necessary, to maintain a clean screen.

2. Clean trapezoidal section at least once per day, and more frequently if required, to maintain a clean condition.

3. Check overflow weirs to make sure they are operating correctly, perform maintenance as required.

4. There should be no gaps between screen panels in the inclined screen or holes in the screen panels.

5. Lights at the dewatering structure should be turned off at night, unless needed for personnel access, to encourage fish to move downstream volitionally.

e. Sampling Facilities.

1. All screens should be inspected to make sure there are no holes or sharp edges.

2. Operate wet separator and fish distribution system as designed. Sample fish twice per week during the main juvenile bypass season to monitor juvenile fish descaling and other fish condition parameters. Sampling is not recommended when water temperatures exceed 70^{o} F unless authorized by an ESA permit. Provide information in weekly report.

3. Crowder screen brushes should be maintained in good operating condition with no holes or sharp edges in the crowder screen.

4. Operate pre-anesthetic system as designed.

5. Inform PSMFC, in advance if possible, of situations that cause the PIT tag system to become inoperable (e.g. power outages) or that could result in confounding the interpretation of PIT tag data (e.g. operating in primary bypass mode without an operational full-flow detector, emergency dewaterings).

f. Avian Predation Areas (Forebay and Tailrace).

1. Bird wires and other avian deterrent devices shall be monitored to assure they are in good condition. Any broken wires or devices shall be replaced as soon as possible.

2. Harassment program in place to deter avian predation in areas actively used by birds and not covered by bird wires or other devices.

3. Project biologists shall routinely monitor project areas to determine areas of active avian predation and, if possible, adjust harassment program to cover these areas or install bird wires or other deterrent devices to discourage avian predation activities.

g. Removable Spillway Weir (RSW). Operational criteria for the RSW are not available at this time (November 2007). Criteria will be provided later by amending the Fish Passage Plan.

h. Inspection and Record Keeping. Inspect all facilities according to fish facilities monitoring plans. Record all maintenance and inspections.

2.3.2. Adult Fish Passage Facilities. Operate the adult fish passage facilities according to the following criteria.

2.3.2.1. Winter Maintenance Period (January 1 through February 28).

a. Inspect all staff gages and water level indicators. Repair and/or clean where necessary.

b. Dewater all ladders and inspect all dewatered sections of fish facilities for projections, debris, or plugged orifices which could injure fish or impede fish passage up the ladder. Fish ladder exit trashracks must have smooth surfaces where fish pass, and must have downstream edges that are adequately rounded or padded. Spare trashracks should be on hand for use as necessary. Inspect all diffuser gratings and chambers annually by dewatering or by using divers or video inspection techniques. All diffuser gratings and chambers are to be dewatered and physically inspected at least every 3 years. Repair deficiencies.

c. Inspect for and clean debris from the fish ladder exits. All trashracks and picketed leads must be clean and installed correctly.

d. Calibrate all water level measuring devices, as necessary, for proper facility operations.

e. Inspect all spill gates and ensure that they are operable.

f. Fish pumps maintained and ready for operation.

g. Maintain adult PIT tag system as required. Coordinate with PSMFC.

h. Maintain the adult fish trap as required. This can also be done outside of the January-February period because the trap is removable.

2.3.2.2. Fish Passage Period (March 1 through December 31).

Note: During extremely high flow periods when tailwater level exceeds elevation 353' msl, the fish pumps may have to be turned off so that the head differential on the auxiliary water supply conduit ceiling slab does not exceed structural design criteria.

a. Fishway Ladders. Water depth over weirs: 1' to 1.3'.

b. Counting Windows. The minimum counting slot width should be 18". All equipment should be maintained and in good condition. The counting window and backboard should be cleaned as needed to maintain good visibility.

c. Head on all Fishway Entrances. Head range: 1' to 2'.

d. North Shore Entrance (NEW 1). Elevation of top of gate when on sill = 332.25'.

1. Operate downstream gate closest to shore.

2. Weir depth: 8' or greater below tailwater. At tailwaters less than elevation 340.25', weirs should be on sill. Note that at low river flow and tailwater, some of the diffusers are above tailwater and project may only be able to maintain a 6' weir depth.

3. North Shore Lower Diffuser Gates: If the tailwater is below elevation 344', the diffuser gates should be fully open. If the tailwater is above elevation 344', the diffuser gates should be one-half open.

e. North Powerhouse Entrances (NFE 1 and 2). Elevation at top of gate when on sill = 332.25'.

1. Operate 1 downstream gate.

2. Weir depth: 8' or greater below tailwater. At tailwaters less than elevation 340.25', weirs should be on sill.

[**Note:** At low tailwater, weirs will bottom out and will be less than 8' below tailwater.]

f. Floating Orifice Gates. Operate 4 floating orifices, two at the northern most and two at the southern most ends. These will be OG1, 4, 10, 12.

g. South Shore Entrance (SFE-1). Elevation of top of gate when on sill = 332.25'.

1. Operate entrance closest to powerhouse.

2. Weir depth: 8' or greater below tailwater. At tailwaters less than elevation 340.25', weirs should be on sill.

[**Note:** At low tailwater, weirs will bottom out and will be less than 8' below tailwater.]

h. Channel Velocity. 1.5' to 4' per second.

i. Head on Trashracks.

1. Maximum head of 0.5' on ladder exits.

2. Maximum head on picketed leads shall be 0.3'.

3. Trashracks and picketed leads installed correctly.

j. Staff Gages and Water Level Indicators. All staff gages should be readable at all water levels encountered during the fish passage period. Repair or clean as necessary.

k. Inform PSMFC, in advance if possible, of situations that cause the PIT tag system to become inoperable (e.g. power outages) or that could result in confounding the interpretation of PIT tag data (e.g. emergency dewaterings).

l. Facility Inspections.

1. Powerhouse operators shall inspect facilities once per day shift and check computer monitor information at least once during each back shift.

2. Project biologists shall inspect facilities three times per week. Inspect all facilities according to fish facilities monitoring program.

3. Picketed leads shall be inspected during all inspections to ensure they are clean and in the correct position (all the way down).

4. Project personnel shall check calibration of fishway control system twice per month to ensure that it is kept within calibration. This may be done as part of routine fishway inspections.

5. Inspect fishways daily for foreign substances (particularly oil). If substances are found, corrective actions should be undertaken immediately.

6. Record all inspections.

2.3.3. Facility Monitoring and Reporting. Project biologists shall inspect fish passage facilities at the frequencies listed in the juvenile and adult fish facilities operating criteria sections.

2.3.3.1. Project biologists shall prepare weekly reports, from March 1 through December 31, summarizing project operations. The weekly reports should provide an overview of how the project and the fish passage facilities operated during the week and an evaluation of resulting fish passage conditions.

2.3.3.2. The reports shall include:

a. Any out-of-criteria situations observed and subsequent corrective actions taken;

b. Any equipment malfunctions, breakdowns, or damage along with a summary of resulting repair activities;

c. Adult fishway control calibrations;

d. ESBS and VBS inspections;

g. Any unusual activities which occurred at the project which may affect fish passage.

2.3.3.3. The weekly reports shall cover a Friday through Thursday time period and shall be sent to CENWW-OD-T by noon the following Monday via electronic mail.

2.3.3.4. Project biologists shall prepare a draft annual report by February 10 and a final report by March 15 summarizing the operation of the project fish passage facilities for the previous year. The annual report shall also include a description of all actions taken to discourage avian predation at the project, with an overview of the effectiveness of the activities in discouraging avian predation.

2.3.3.5. Project biologists also inspect project facilities once per month and during dewaterings for the presence of zebra mussels. Biologists shall provide a report to CENWW-OD-T on a monthly basis summarizing zebra mussel inspections.

3. Project Maintenance. Project biologists should be present to provide technical guidance at all project activities that may involve fish handling. All dewaterings shall be accomplished in accordance with approved project dewatering and fish handling plans. When river temperatures reach 70 degrees Fahrenheit or greater, all adult fish handling will be coordinated through CENWW-OD-T. Dewatering and fish handling plans were reviewed and revised in 2000 to ensure that they comply with Appendix F, Guidelines for Dewatering and Fish Handling Plans.

3.1. Juvenile Fish Passage Facilities.

3.1.1. Scheduled Maintenance. Scheduled maintenance of the juvenile facilities is conducted during the entire year. Long-term maintenance or modifications of facilities that require them to be out of service for extended periods of time are conducted during the winter maintenance period from December 16 through March 31. During the fish passage season parts of the facilities are maintained on a daily, weekly, or longer interval to keep them in proper operating condition.

3.1.2. Unscheduled Maintenance. Unscheduled maintenance is the correction of any situation that prevents the facilities from operating according to criteria or that will impact fish passage or survival. Maintenance of facilities such as STSs, which sometimes break down during the fish passage season, will be carried out as described below. In these cases, repairs will be made as prescribed and CENWW-OD-T notified for further coordination. Unscheduled maintenance that will have a significant impact on juvenile fish passage shall be coordinated with NOAA Fisheries and other FPOM participants on a case-by-case basis by CENWW-OD-T. CENWW-OD-T will be notified as soon as possible after it becomes apparent that maintenance repairs are required. The Operations Manager has the authority to initiate work prior to notifying CENWW-OD-T when in his opinion delay of the work will result in an unsafe situation for people, property, or fish. Information required by CENWW-OD-T includes:

a. Description of the problem.

b. Type of outage required.

c. Impact on facility operation.

d. Length of time for repairs.

e. Expected impacts on fish passage and proposed measures to mitigate them.

3.1.2.1 Submersible Traveling Screens. The STSs are inspected periodically throughout the juvenile migration season with a video monitoring system. If a screen is found to be damaged it will be removed and either replaced with the spare STS or repaired and returned to service. A turbine unit shall not be operated with a known damaged or nonfunctioning STS or without a full complement of STSs. If an STS fails on a weekend or at night when maintenance crews are not available, the respective turbine unit will be shut down and generation switched to another fully screened unit. If all screened turbine units are in service, additional water may be spilled until the effected STS can be removed and repaired or replaced.

3.1.2.2 Gatewell Orifices. Each gatewell has two 12" orifices with air operated valves to allow fish to exit the gatewell. Under normal operation, one orifice per gatewell is operated. To minimize blockage from debris, orifices are cycled and back flushed at least once per day, and more frequently if required by heavy debris loads. If an air valve fails or is blocked with debris, the valve should be closed and the alternate orifice for that gatewell operated until repairs can be made. If both orifices are blocked with debris, damaged, or must be kept closed, the turbine unit will be taken out of service until repairs can be made. If repairs are to take longer than 48 hours, juvenile fish will be dipped from the gatewell with a gatewell dip basket in accordance with the project dewatering and fish-handling plan.

3.1.2.3 Dewatering Structure. The dewatering structure acts as a transition from the collection channel to the corrugated metal flume. An inclined screen allows excess water to be bled off, with all fish and remaining water transitioning into the corrugated metal flume. The excess water is discharged into the adult fish facility auxiliary water supply system and is also used as the water supply for the sampling facilities. The dewatering structure contains a trash sweep for cleaning the rectangular portion of the inclined screen, and an air blow back system for cleaning the transition (trapezoidal) section of the screen. The dewatering screen has a set of differential pressure sensors for determining head differential across the screen. If the sensors detect a 0.15 foot differential it initiates continuous screen cleaning. If the sensors detect a differential of .30 foot it closes all but 3 orifices (unit 1 orifices remain open) in the juvenile collection channel. Both conditions trigger an alarm at the control panel and in the control room. If the trash sweep breaks and interferes with juvenile fish passage through the structure or if the inclined screen or other component of the structure is damaged, the orifices may need be closed and the collection channel dewatered to allow repairs to be made. If the orifices are closed and the collection channel dewatered, the traveling screens will remain in operation. Fish will be allowed to accumulate in the gatewells for up to 2 days. If repairs are expected to take longer than 2 days, a salvage program will be initiated to remove fish from gatewells, with a gatewell dip basket, until repairs can be made and the system watered up again. While the collection channel is out of service, project personnel shall monitor gatewells for signs of fish problems or mortality. Spill may be provided as an alternative avenue for fish passage during the collection channel outage.

3.1.2.4 Bypass Flume/Pipe. The bypass flume/pipe transports fish to the sampling facilities and to the tailrace below the project. If there is a problem with the flume/pipe that requires it to be dewatered, procedures will be taken similar to **section 3.1.2.3**.

3.1.2.5 Sampling Facilities. Under normal operation, juvenile fish are routed around the sampling facilities, except when sampling is being conducted. If there is a problem with the sampling facilities when it is in operation, the drop gate will be lowered to keep all juvenile fish in the bypass flume/pipe to bypass them directly to the river below the project. All fish in the sampling facility will then be released back to the river prior to sampling if there are any problems with holding them in the sample tank until they can be sampled.

3.2. Adult Fish Passage Facilities.

3.2.1. Scheduled Maintenance. Scheduled maintenance of a facility that must be dewatered to work on or whose maintenance will have a <u>significant effect</u> on fish passage will be done during the January and February winter maintenance period. Maintenance of facilities that will have <u>no effect</u> on fish passage may be conducted at any time. Maintenance is normally conducted on one fish ladder at a time during the winter to provide some fish passage at the project at all times. When facilities are not being maintained during the winter maintenance period, they will be operated according to normal criteria unless otherwise coordinated with NOAA Fisheries and other FPOM participants.

3.2.2. Unscheduled Maintenance. Unscheduled maintenance that will significantly affect the operation of a facility will be coordinated with NOAA Fisheries and other FPOM participants. Coordination procedures for unscheduled maintenance of adult facilities are the same as for juvenile facilities (see section 3.1.2.). If part of a facility malfunctions or is damaged during the fish passage season, and the facility can still be operated within criteria without any detrimental effects on fish passage, repairs may not be conducted until the winter maintenance period or until fewer numbers of fish are passing the project. If part of a facility is damaged or malfunctions that may significantly impact fish passage, it will be repaired as soon as possible.

3.2.2.1 Fish Ladders and Counting Stations. The fish ladders contain fixed weirs, counting stations with picket leads, and fish exits with trashracks. If any part of the ladder fails or is blocked with debris during the fish passage season, efforts will first be made to correct the problem without dewatering the ladder. Trashracks, picket leads, and counting stations can sometimes be repaired or maintained without dewatering the ladder. The decision to dewater the ladder and make repairs during the fish passage season or wait until the winter maintenance period will be made after coordination with the fish agencies and tribes.

3.2.2.2 North Shore Auxiliary Water Supply System. The north shore facilities contain three electric pumps that provide auxiliary water to the diffusers at the bottom of the ladder and at the entrances. During normal operation two pumps are required to provide the necessary auxiliary water. If a pump fails during two-pump operation, the pump on standby will be operated to provide the necessary flows. If two or all three pumps fail, the NEW1 weir will be maintained at a level of 6' below tailwater until repairs are made.

3.2.2.3 South Shore Auxiliary Water Supply System. The south shore auxiliary water is supplied by eight electric pumps and 150 to 180 cfs of excess water from the juvenile fish passage facilities. Fluctuating tailwater levels require from six to eight pumps to be operated to provide the auxiliary water. If one pump fails, a standby pump will be started to keep the fishway within criteria. If more pumps fail, this procedure will continue until all the standby pumps are in operation. If criteria cannot be met due to fish pump outages within 24 hours, the floating orifices should be closed in the following order: OG-12, OG-10, OG-8, and OG-6. If the required head differential of 1' to 2' cannot be reached when the floating orifices are closed, SSE 1 and NFE 2 will be closed equally at 1' intervals until it is reached or until the weirs are 5' below tailwater. Then the remaining floating orifices should be closed in the following order: OG-4, OG-1, and OG-2. If there is still not enough auxiliary water to maintain the head differential on the two main entrances, NFE 2 will be closed, the transportation channel bulkheaded off at the junction pool, and SSE 1 operated as deep as possible to maintain the head differential. If it cannot be maintained at a depth of 6' or greater, the weir will remain at 6' regardless of the head.

3.2.2.4 Fishway Entrances. The fishway entrances consist of main entrance weirs with hoists and automatic controls, and floating orifices which regulate themselves with tailwater fluctuations. If any of the automatic controls malfunction, the weirs can be operated manually by project personnel and kept within criteria. If there is a further failure which prevents the entrance from being operated manually, an alternate entrance will be opened until repairs can be made. If a floating orifice fails, it will be pulled out of the water and the entrance bulkheaded off until the floating orifice is repaired.

3.2.2.5 Diffuser Gratings. Diffuser chambers for adding auxiliary water to fish ladders and collection channels are covered by gratings attached by several different methods. Diffuser gratings are normally checked during the winter maintenance period to make sure they are in place. These inspections are done by either dewatering and physically inspecting the diffuser gratings, or by using underwater video cameras, divers, or other methods. Diffuser gratings may come loose during the fish passage season due to a variety of reasons. Daily inspections of fish ladders and collection systems should include looking for any flow changes that may indicate problems with diffuser gratings. If a diffuser grating is known or suspected to have moved, creating an opening into a diffuser chamber, efforts must immediately be taken to correct the situation and minimize impacts on adult fish in the fishway. Coordination of the problems should begin immediately through the established unscheduled maintenance coordination procedure (see section 3.1.2). If possible, a video inspection should be made as soon as possible to determine the extent of the problem. If diffuser gratings are found to be missing or displaced, creating openings into the diffuser chambers, a method of repair shall be developed and coordinated with the fish agencies and tribes through the established coordination procedure. Repairs shall be made as quickly as possible unless coordinated differently.

4. Turbine Unit Operation and Maintenance.

4.1. Turbine Unit Operation. When in operation, turbine units will be operated to enhance adult and juvenile fish passage from March 1 through November 30. During this time period turbine units will be operated as needed to meet generation requirements in the priority order shown in Table IHR-4. Model studies of Ice Harbor Dam show that spilling at lower river flows can cause eddying in front of the powerhouse. To provide the best fish passage conditions during periods of spill, it is extremely important that the turbine units operate in a specific operating order to minimize eddying conditions. The original and desired unit prioritization is 1, 3, 6, 4, 2, 5. However, Unit 2 now operates as a fixed bladed machine after the repair to oil leaks, and increased potential for vibration on start-up; it is desired to minimize the number of start/stops of this unit. Also, a transformer has failed at the Sacajawea Substation. To meet these needs, priority of unit 3 is necessary as noted in Table IHR-4. This operation is designed to minimize the start /stops of unit 2. Unit 3 and 1 priority will be switched after the transformer is replaced late 2009.

Table IHR-4. Turbine unit operating priority for Ice Harbor Dam.

Season	Time of Day	Unit Priority*
March 1 – November 30 (No spill)	24 hours	3, 1, 4, then 5 and 6 (any order), 2
March 1 – November 30 (Spill)	24 hours	3, 1, 6, 4, 5, and 2
December 1 – February 28	24 hours	Any Order

Note: If unit 3 is out of service, operate unit 4 in place of unit 3. .

4.1.1. The hours of operations may be coordinated and adjusted in-season by CENWW-OD-T (through coordination with TMT) if fish passage or other conditions at the project require it. Unit operating priority may be coordinated differently to allow for fish research, construction, or project maintenance activities. If a turbine unit is taken out of service for maintenance or repair, the next unit in the priority list shall be operated.

4.1.2. Turbine units will be operated within 1% of best efficiency from April 1 through October 31 (as specified in BPA's load shaping guidelines, **Appendix C**) unless operation outside of that range is necessary to:

1) meet the load requirements of the BPA Administrator whose load requests will be made in accordance with BPA's policy, statutory requirements, and load shaping guidelines (Appendix C);

2) Roll (speed no load) a turbine unit prior to reduce the number of fish in the scrollcase prior to fish salvage operations;

3) operating a turbine unit solely to provide station service; or

4) be in compliance with other coordinated fish measures. Project personnel shall record when turbine units are operated outside the 1% efficiency range and shall provide the information to BPA on a weekly basis according to the load shaping guidelines. Between November 1 and March 31, turbine units will continue to be operated within the 1% efficiency range except when BPA load requests require the units to be operated outside the 1% range. Guidelines for operation of the turbine units within the 1% efficiency range at various heads are shown in **Tables IHR-5 through IHR-8**.

4.1.3. All of the lower Snake River powerhouses may be required to keep one generating turbine unit on line at all times to maintain power system reliability. During low flows, there may not be enough river flow to meet this generation requirement and required minimum spill. Under these circumstances the power generation requirement will take precedence over the minimum spill requirement. At Ice Harbor Dam, minimum generation requirements are 9-10 kcfs for turbine units 1 – 3 and 11 – 12 kcfs for turbine units 4-6.

Table IHR-5. The 1% best efficiency ranges for turbine units 1-3 with STSs.

Head (Ft)	Lower Generator Limits (MW)	(CFS)	Upper Generator Limits (MW)	(CFS)
85	**51**	**8,029**	**88**	**13,850**
86	52	8,055	89	13,845
87	53	8,079	90	13,840
88	53	8,103	91	13,834
89	54	8,127	92	13,829
90	**55**	**8,149**	**93**	**13,824**
91	56	8,155	94	13,846
92	56	8,161	96	13,869
93	57	8,166	97	13,890
94	58	8,172	98	13,912
95	**58**	**8,177**	**99**	**13,932**
96	59	8,194	100	13,925
97	60	8,212	101	13,918
98	61	8,228	102	13,911
99	61	8,245	103	13,904
100	**62**	**8,261**	**104**	**13,921**
101	63	8,308	104	13,774
102	64	8,354	104	13,630
103	65	8,400	104	13,488
104	66	8,444	104	13,350
105	**67**	**8,488**	**104**	**13,214**

Table IHR-6. The 1% best efficiency ranges for turbine units 1-3 without STSs.

Head (FT)	Lower Generator Limits (MW)	(CFS)	Upper Generator limits (MW)	(CFS)
85	**51**	**7,907**	**79**	**12,331**
86	51	7,932	80	12,326
87	52	7,956	81	12,322
88	53	7,980	82	12,317
89	54	8,003	83	12,313
90	**55**	**8,025**	**84**	**12,308**
91	55	8,031	85	12,328
92	56	8,037	86	12,348
93	56	8,042	87	12,367
94	57	8,047	88	12,386
95	**58**	**8,052**	**89**	**12,405**
96	59	8,070	90	12,398
97	59	8,087	91	12,392
98	60	8,103	92	12,386
99	61	8,119	93	12,380
100	**62**	**8,135**	**94**	**12,374**
101	62	8,182	94	12,334
102	63	8,227	95	12,295
103	64	8,272	95	12,256
104	65	8,316	96	12,219
105	**66**	**8,359**	**97**	**12,182**

NOTE: Tables based on the 1956 model test and 1994 unit 3 index test. (IHR-5 revised 2005)

Table IHR-7. The 1% best efficiency ranges for turbine units 4-6 with STSs.

Head (FT)	Lower Generator Limits		Upper Generator limits	
	(MW)	(CFS)	(MW)	(CFS)
85	**58**	**9,065**	**108**	**16,787**
86	59	9,076	110	16,804
87	60	9,086	111	16,820
88	61	9,096	113	16,835
89	62	9,105	114	16,850
90	**63**	**9,114**	**116**	**16,864**
91	63	9,112	117	16,875
92	64	9,110	119	16,886
93	65	9,107	120	16,896
94	65	9,105	121	16,906
95	**66**	**9,102**	**123**	**16,916**
96	67	9,112	124	16,884
97	68	9,121	125	16,852
98	69	9,130	126	16,821
99	69	9,138	127	16,787
100	**70**	**9,146**	**127**	**16,581**
101	71	9,141	127	16,398
102	71	9,137	127	16,218
103	72	9,132	127	16,041
104	73	9,127	127	15,868
105	**73**	**9,123**	**127**	**15,698**

Table IHR-8. The 1% best efficiency ranges for turbine units 4-6 without STSs.

Head (FT)	Lower Generator Limits		Upper Generator limits	
	(MW)	(CFS)	(MW)	(CFS)
85	**61**	**9,350**	**103**	**15,934**
86	62	9,361	105	15,950
87	62	9,371	106	15,966
88	63	9,381	108	15,980
89	64	9,391	109	15,994
90	**65**	**9,400**	**111**	**16,007**
91	66	9,398	112	16,018
92	66	9,396	113	16,029
93	67	9,393	115	16,039
94	68	9,391	116	16,048
95	**69**	**9,389**	**117**	**16,057**
96	70	9,398	119	16,027
97	70	9,408	120	15,997
98	71	9,417	121	15,967
99	72	9,426	122	15,938
100	**73**	**9,434**	**123**	**15,909**
101	74	9,429	125	16,078
102	74	9,424	127	16,164
103	75	9,419	127	15,991
104	76	9,414	127	15,822
105	**76**	**9,410**	**127**	**15,656**

NOTE: Tables based on the 1978 model test and 1993 unit 6 index test (IHR-7&8 revised 2005).

4.2. Turbine Unit Outages During High River Flow Periods. During high spring flows, turbine unit outages for inspecting fish screens, repairing research equipment such as hydroacoustic or radio telemetry equipment, and other fish items may cause increased spill at a project in order to maintain reservoir levels within operating levels. This may result in TDG levels exceeding standards. It is important that this work be conducted when scheduled to ensure that facilities are working correctly and not injuring migrating fish, and that important fish research data is collected. To facilitate this work, reservoir storage may be utilized to minimize impacts from taking turbine units out of service and increasing spill. At Ice Harbor, this special operation may take place when river flows are above 100 kcfs or when increasing spill levels will result in TDG levels exceeding standards. The activities covered under these operations will be coordinated with and approved by the TMT whenever possible.

4.2.1. For scheduled inspection or repair of research equipment, reservoirs shall be drafted to MOP and allowed to fill to 1' above the 1’ MOP operating range as the work is accomplished. After the work, reservoirs will be slowly drafted back to the MOP operating range. When inspection or repair work can be scheduled ahead of time, the following process will be followed:

a. Project personnel shall schedule turbine unit outages through the approved turbine outage scheduling procedure by noon of the Tuesday of the week prior to the outage.

b. Project personnel shall also contact CENWW-OD-T and RCC by the same time period and inform them of the intended work.

c. The RCC will coordinate the work activities through the TMT.

d. After coordination with the TMT, RCC shall issue a teletype through the CBTT issuing instructions to project and BPA personnel for the scheduled work.

e. Spill will be increased by one spill bay stop setting (about 1.7 kcfs) above passing inflow to slowly lower the level of Ice Harbor pool to MOP prior to the scheduled work taking place.

f. When the work takes place, additional spill will not be provided and the reservoir will be allowed to refill until the reservoir is 1' above the normal MOP range (a 2' pondage from where the pool was when the work started). At this point, screen inspections shall stop. (At Snake River projects, this should allow about one normal workday for the scheduled work.)

g. At the conclusion of the work, the reservoir shall be drafted back down to the MOP range utilizing a one spill bay stop increase in spill above passing inflow.

h. If work, such as screen inspections, is not finished, project personnel shall schedule another turbine unit outage for a date where it can be implemented again.

4.2.2. If the work that needs to be done is of an emergency nature that does not normally require the turbine unit to be taken out of service (such as a failed hydroacoustic transducer versus a failed fish screen), and can not wait for the above process to be implemented, project personnel shall notify CENWW-OD-T and RCC to get approval to do the work. If approval to do the work is given, the turbine unit shall be taken out of service and the reservoir level allowed to increase until it reaches 1' above the MOP operating range. At this point, the turbine unit must be returned to service and the reservoir will be drafted back to the MOP range using one spill bay stop setting above passing inflows.

4.3. Turbine Unit Maintenance. The project turbine unit maintenance schedule will be reviewed annually by project and Operations Division biologists for fish impacts. If possible, maintenance of priority units will be scheduled for non-fish passage periods, or when there are low numbers of fish passing the project. Each turbine unit requires annual maintenance that may take from several days to two weeks. Annual maintenance of all turbine units is normally scheduled during the mid-July to late November time frame. The maintenance of priority units for adult passage is normally conducted in mid-August, when fewer adults are migrating, to minimize impacts on migrating adults. Turbine units may occasionally require overhauls to repair major problems with the turbine or generator. Overhauls may take over one year to accomplish. Turbine units, governors, exciters, and control systems require periodic maintenance, calibration, and testing which may take them outside of the 1% turbine efficiency range. This work will be scheduled in compliance with BPA load shaping guidelines **(Appendix C)** to minimize impacts on juvenile fish.

4.3.1. Unwatering turbine units should be accomplished in accordance with project dewatering plans. Prior to dewatering a turbine unit for maintenance, the turbine unit should be spun at speed-no-load, if possible, immediately before installing tailrace stoplogs and headgates to minimize the number of fish in the draft tube and scroll case. If a turbine unit is out of service for maintenance for an extended period of time without tailrace stoplogs in place, efforts should be made to not open the wicket gates if the scroll case must be dewatered at a later date without the unit being spun before hand.

5. Forebay Debris Removal. Debris at projects can impact fish passage conditions. Debris can plug or block trashracks, VBSs, gatewell orifices, dewatering screens, separators, and facility piping resulting in impingement, injuries, and descaling of fish. Removing debris at its source in the forebay is sometimes necessary to maintain safe and efficient fish passage conditions, navigation, and other project activities. Debris can be removed from the forebay by: physically encircling the debris with log booms and pulling it to shore with boats where it can be removed with a crane, removing the debris from the top of the dam using a crane and scoop, or passing the debris through the spillway with special powerhouse operations and spill. The preferred option is to remove debris at each project when possible to avoid passing debris on to the next project downstream. This is not always possible at each project, as some projects do not have forebay debris removal capability. In this case, the only viable alternative is to spill the debris.

5.1. All special spills (other than normal spill patterns for ongoing spill operations) and project operations for passing debris will be coordinated prior to the operations taking place. Each project shall contact CENWW-OD-T at least two workdays prior to the day they want the special project operations for spilling to pass debris. CENWW-OD-T shall coordinate the special operations with RCC, NOAA Fisheries, and other FPOM participants. Project personnel shall provide CENWW-OD-T the reason for the debris spill request, including an explanation of project facilities being impacted by the debris, the date and time of the requested spill, and any special powerhouse or other operations required to move the debris to the spillway. When a debris spill is coordinated and approved, RCC shall issue a teletype detailing the specifics of the special operations.

Table IHR-9. Ice Harbor high gate spill pattern. Deflectors in all bays. No RSW.

Spill Bay										Total Stops	Total Spill (kcfs)
1	2	3	4	5	6	7	8	9	10		
		5								5	8.5
		5							1	6	10.2
		5						1	1	7	11.9
		5						1.5	1.5	8	13.6
		5						2	2	9	15.4
		5		5						10	17.0
		5		5					1	11	18.7
		5.5		5.5					1	12	20.4
		5.5		5.5				1	1	13	22.1
		5.5		5.5				1.5	1.5	14	23.8
		5		5		5				15	25.5
		5		5		5			1	16	27.2
		5.5		5.5		5			1	17	28.9
		5.5		5.5		5.5			1.5	18	30.5
		6		6		6			1	19	32.0
		5		5		5		5		20	34.0
		5		5		5		5	1	21	35.7
		5.5		5		5		5.5	1	22	37.3
		5.5		5.5		5.5		5.5	1	23	39.0
		6		5.5		5.5		6	1	24	40.6
		6		6		6		6	1	25	42.1
		5	5	5		5		5	1	26	44.2
		5.5	5	5		5		5.5	1	27	45.8
		5.5	5	5.5		5.5		5.5	1	28	47.5
		5.5	5.5	5.5		5.5		6	1	29	49.1
		5.5	5.5	6		6		6	1	30	50.7
		6	6	6		6		6	1	31	52.2
		6	6	6.5		6.5		6	1	32	54.0
		6.5	6.5	6.5		6.5		6	1	33	55.8
		6	6	5	5	5		6	1	34	57.5
		6	6	5	5	6		6	1	35	59.1
		6	6	6	5	6		6	1	36	60.7
		6	6	6	6	6		6	1	37	62.3
		6	6	6	6	7		6	1	38	64.1
		6	6	6	6	7		7	1	39	65.7
		6	6	6	7	7		7	1	40	67.4
		6	6	7	7	7		7	1	41	69.1
		6	7	7	7	7		7	1	42	70.8
		7	7	7	7	7		7	1	43	72.5
6		6	6	6	6	7		6	1	44	74.1
6		6	6	6	7	7		6	1	45	75.8
6		6	6	7	7	7		6	1	46	77.5
6		6	7	7	7	7		6	1	47	79.2
6		7	7	7	7	7		6	1	48	80.9
6		6	6	6	6	6	6	6	1	49	82.5

Table IHR-9 . Ice Harbor high gate spill pattern. Deflectors in all bays. No RSW.

Spill Bay										Total	Total Spill
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**Stops**	**(kcfs)**
6		6	6	6	6	7	6	6	1	50	84.2
6		6	6	6	7	7	6	6	1	51	85.9
6		6	6	6	7	7	6	7	1	52	87.6
6		6	6	7	7	7	6	7	1	53	89.3
6		6	7	7	7	7	6	7	1	54	91.0
6		7	7	7	7	7	6	7	1	55	92.7

Table IHR-10. Ice Harbor RSW 30% spill pattern

Spill Bay										Total	Total	Total
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**Stops**	**Spill (kcfs)**	**River (kcfs)**
0	rsw	0	0	0	0	0	0	0	0	0	8.4	28.0
0	rsw	0	0	0	0	0	0	0	1	1	10.1	33.7
0	rsw	0	0	0	0	0	0	1	1	2	11.8	39.4
0	rsw	0	0	0	0	0	1	1	1	3	13.5	45.1
0	rsw	0	0	0	0	1	1	1	1	4	15.2	50.8
0	**rsw**	**0**	**0**	**0**	**1**	**1**	**1**	**1**	**1**	**5**	**17.0**	**56.5**
0	rsw	5	0	0	0	0	0	0	1	6	18.6	61.8
0	rsw	5	0	0	0	0	0	1	1	7	20.3	67.5
0	rsw	5	0	0	0	0	1	1	1	8	22.0	73.2
0	rsw	5	0	0	0	1	1	1	1	9	23.7	78.9
0	**rsw**	**5**	**0**	**0**	**1**	**1**	**1**	**1**	**1**	**10**	**25.4**	**84.6**
0	rsw	5	0	5	0	0	0	0	1	11	27.0	90.0
0	rsw	5	0	5	0	0	0	1	1	12	28.7	95.7
0	rsw	5	0	5	0	0	1	1	1	13	30.4	101.4
0	rsw	5	0	5	0	0	1	1	2	14	32.1	107.0
0	**rsw**	**5**	**0**	**5**	**0**	**0**	**1**	**2**	**2**	**15**	**33.8**	**112.7**
0	rsw	5	0	5	0	0	2	2	2	16	35.5	118.4
0	rsw	6	0	5	0	0	2	2	2	17	37.2	123.9
0	rsw	6	0	6	0	0	2	2	2	18	38.8	129.4
0	rsw	6	0	6	0	1	2	2	2	19	40.5	135.1
0	**rsw**	**6**	**0**	**6**	**0**	**2**	**2**	**2**	**2**	**20**	**42.2**	**140.8**
0	rsw	5	0	5	0	5	2	2	2	21	44.0	146.5
0	rsw	5	0	5	0	6	2	2	2	22	45.6	152.0
0	rsw	5	0	6	0	6	2	2	2	23	47.3	157.6
0	rsw	6	0	6	0	6	2	2	2	24	48.9	163.1
0	**rsw**	**6**	**0**	**6**	**0**	**6**	**2**	**3**	**2**	**25**	**50.6**	**168.7**
0	rsw	6	0	6	0	6	2	4	2	26	52.3	174.3
0	rsw	6	0	6	0	6	2	5	2	27	54.0	179.9
0	rsw	6	0	6	0	6	2	6	2	28	55.6	185.4
0	rsw	6	0	6	1	6	2	6	2	29	57.3	191.1
0	**rsw**	**6**	**0**	**6**	**2**	**6**	**2**	**6**	**2**	**30**	**59.0**	**196.8**
0	rsw	6	0	6	3	6	2	6	2	31	60.7	202.4
0	rsw	6	0	6	4	6	2	6	2	32	62.4	208.0
0	rsw	6	0	6	5	6	2	6	2	33	64.1	213.5
0	rsw	6	0	6	6	6	2	6	2	34	65.7	219.1

Table IHR-11. Ice Harbor RSW 45 kcfs/Spill Cap spill pattern.

Spill Bay											
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**Total Stops**	**Total Spill (kcfs)**
0	rsw	0	0	0	0	0	0	0	0	0	8.4
0	rsw	0	0	0	0	0	0	0	1	1	10.1
0	rsw	0	0	0	0	0	0	1	1	2	11.8
0	rsw	0	0	0	0	0	1	1	1	3	13.5
0	rsw	0	0	0	0	1	1	1	1	4	15.2
0	**rsw**	**0**	**0**	**0**	**1**	**1**	**1**	**1**	**1**	**5**	**17.0**
0	rsw	0	5	0	0	0	0	0	1	6	18.6
0	rsw	0	5	0	0	0	0	1	1	7	20.3
0	rsw	0	5	0	0	0	1	1	1	8	22.0
0	rsw	0	5	0	0	1	1	1	1	9	23.7
0	**rsw**	**0**	**5**	**0**	**5**	**0**	**0**	**0**	**0**	**10**	**25.3**
0	rsw	0	5	0	5	0	0	0	1	11	27.0
0	rsw	0	5	0	5	0	0	1	1	12	28.7
0	rsw	0	5	0	5	0	1	1	1	13	30.4
0	rsw	0	5	0	5	1	1	1	1	14	32.1
0	**rsw**	**0**	**5**	**0**	**5**	**1**	**1**	**1**	**2**	**15**	**33.8**
0	rsw	0	5	0	5	1	1	2	2	16	35.5
0	rsw	0	5	0	5	1	2	2	2	17	37.2
0	rsw	0	5	0	5	2	2	2	2	18	38.9
0	rsw	0	5	0	5	2	2	2	3	19	40.6
0	**rsw**	**0**	**5**	**0**	**5**	**2**	**2**	**3**	**3**	**20**	**42.3**
0	rsw	0	5	0	5	5	2	2	2	21	44.0
0	rsw	0	6	0	5	5	2	2	2	22	45.6
0	rsw	0	6	0	6	5	2	2	2	23	47.3
0	rsw	0	6	0	6	6	2	2	2	24	48.9
0	**rsw**	**0**	**6**	**5**	**5**	**5**	**1**	**1**	**2**	**25**	**50.7**
0	rsw	0	6	5	5	5	1	2	2	26	52.4
0	rsw	0	6	5	5	5	2	2	2	27	54.1
0	rsw	0	6	6	5	5	2	2	2	28	55.7
0	rsw	0	6	6	5	5	2	3	2	29	57.4
0	**rsw**	**0**	**6**	**6**	**5**	**5**	**2**	**4**	**2**	**30**	**59.1**
0	rsw	0	6	6	5	5	2	5	2	31	60.7
0	rsw	0	6	6	5	5	3	5	2	32	62.4
0	rsw	0	6	6	5	5	4	5	2	33	64.1
0	rsw	0	6	6	5	5	5	5	2	34	65.8
0	**rsw**	**1**	**6**	**6**	**5**	**5**	**5**	**5**	**2**	**35**	**67.5**
0	rsw	2	6	6	5	5	5	5	2	36	69.2
0	rsw	3	6	6	5	5	5	5	2	37	70.9
0	rsw	4	6	6	5	5	5	5	2	38	72.6
0	rsw	5	6	6	5	5	5	5	2	39	74.2
0	**rsw**	**6**	**6**	**6**	**5**	**5**	**5**	**5**	**2**	**40**	**75.9**

Note: The normal minimum spill level is 15.2 kcfs.

Table IHR-11. Ice Harbor RSW 45 kcfs/Spill Cap spill pattern (continued).

Spill Bay											
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**Total Stops**	**Total Spill (kcfs)**
0	rsw	6	6	6	6	5	5	5	2	41	77.5
0	rsw	6	6	6	6	6	5	5	2	42	79.2
0	rsw	6	6	6	6	6	6	5	2	43	80.9
0	rsw	6	6	6	6	6	6	6	2	44	82.5
0	**rsw**	**7**	**6**	**6**	**6**	**6**	**6**	**6**	**2**	**45**	**84.1**
0	rsw	7	7	6	6	6	6	6	2	46	85.7
0	rsw	7	7	7	6	6	6	6	2	47	87.3
0	rsw	7	7	7	7	6	6	6	2	48	88.9
0	rsw	7	7	7	7	7	6	6	2	49	90.5
0	**rsw**	**7**	**7**	**7**	**7**	**7**	**7**	**6**	**2**	**50**	**92.1**
0	rsw	7	7	7	7	7	7	7	2	51	93.7
0	rsw	8	7	7	7	7	7	7	2	52	95.3
0	rsw	8	8	7	7	7	7	7	2	53	96.9
0	rsw	8	8	8	7	7	7	7	2	54	98.5
0	**rsw**	**8**	**8**	**8**	**8**	**7**	**7**	**7**	**2**	**55**	**100.1**
0	rsw	8	8	8	8	8	7	7	2	56	101.7
0	rsw	8	8	8	8	8	8	7	2	57	103.3
0	rsw	8	8	8	8	8	8	8	2	58	104.9
0	rsw	9	8	8	8	8	8	8	2	59	106.6
0	**rsw**	**9**	**9**	**8**	**8**	**8**	**8**	**8**	**2**	**60**	**108.3**
0	rsw	9	9	9	8	8	8	8	2	61	110.0
0	rsw	9	9	9	9	8	8	8	2	62	111.7
0	rsw	9	9	9	9	9	8	8	2	63	113.4

Section 7 Lower Monumental Dam

Lower Monumental Dam

1. Fish Passage Information. The locations of fish passage facilities at Lower Monumental Lock and Dam are shown in **Figure LMN-1**. Dates of project operations for fish purposes and special operations are listed in **Table LMN-2**.

1.1. Juvenile Fish Passage.

1.1.1. Facilities Description. The Lower Monumental juvenile facilities consist of standard length submersible traveling screens, vertical barrier screens, 12" orifices, collection gallery, dewatering structure, and bypass flume to the tailrace below the project. Transportation facilities consist of a separator to sort juvenile fish by size and to separate them from adult fish, sampling facilities, raceways, office and sampling building, truck and barge loading facilities, and PIT tag detection and deflector systems.

1.1.2. Juvenile Migration Timing. Juvenile migration timing at Lower Monumental Dam is indicated in **Table LMN-1**. The dates in the table are based on juvenile fish collection numbers and do not reflect FGE or spill passage. Salmon, steelhead, bull trout, lamprey, and other species are routinely counted. Maintenance of juvenile fish passage facilities that may impact juvenile fish passage or facility operations should be conducted during the winter maintenance season.

Table LMN-1. Juvenile migration timing at Lower Monumental Dam based on juvenile fish collection numbers.

% Collection	2003	2004	2005	2006	2007
Clipped Yearling Chinook					
10%	4/12	4/16	4/19	5/2	5/12
90%	5/27	5/17	5/17	5/19	5/20
Unclipped Yearling Chinook					
10%	4/23	4/16	4/16	4/29	5/12
90%	6/2	5/21	5/19	5/24	5/22
Sub-yearling Chinook					
10%	6/5	5/16	6/2	5/26	5/30
90%	7/20	7/13	6/30	7/2	7/8
Clipped Steelhead					
10%	5/1	4/23	4/20	4/29	5/12
90%	5/30	6/4	5/20	5/22	5/21
Unclipped Steelhead					
10%	5/1	4/17	5/6	5/2	5/12
90%	5/31	6/1	5/24	5/22	5/23

Note: Migration timing calculations affected by later fish collection start dates in 2006 and 2007.

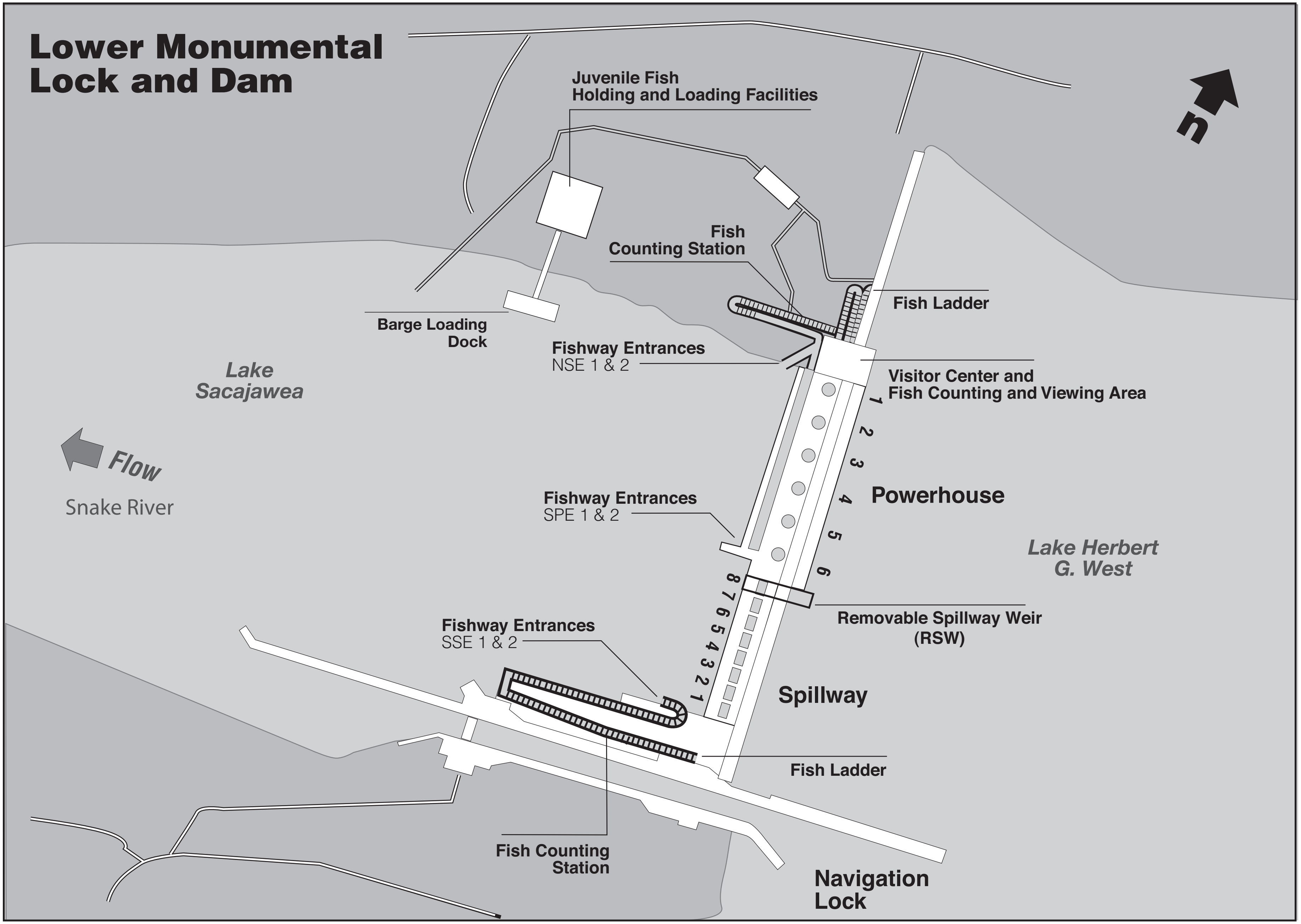
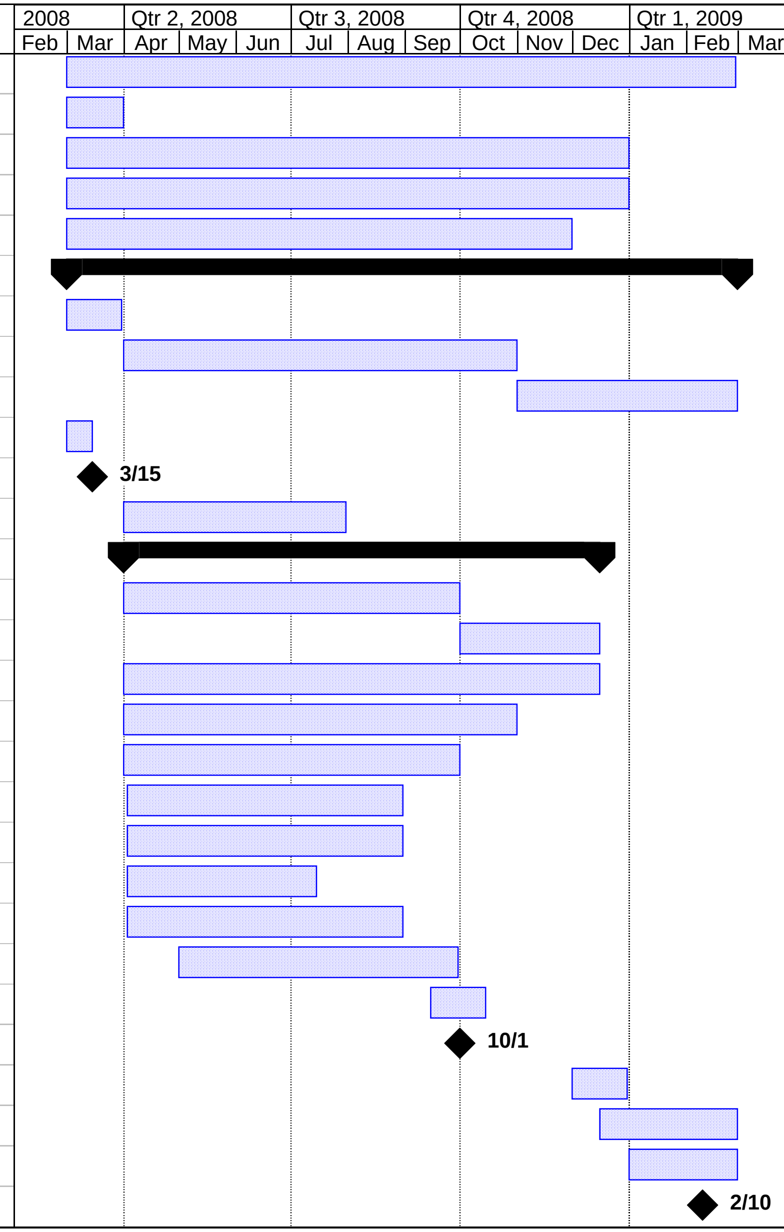


Figure LMN-1 Lower Monumental Lock and Dam General Site Plan

Table LMN-2. Dates of project operations for fish purposes at Lower Monumental, 2008-9

March 2008

Task Name	Start	Finish	FPP Reference
TDG Monitoring	3/1/08	2/28/09	App D Table 4
Winter Maintenance Period Juvenile	3/1/08	3/31/08	Lmn 2.3.1.1.
Adult Fish Passage Period	3/1/08	12/31/08	Lmn 2.3.2.2
Weekly Reports	3/1/08	12/31/08	Lmn 2.3.3.1
Operate Turbines for Fish Passage	3/1/08	11/30/08	Lmn 4.1
1% limitations	**3/1/08**	**2/28/09**	**Lmn 4.1.1**
1% Soft	3/1/08	3/31/08	Lmn 4.1.1
1% Hard	4/1/08	10/31/08	Lmn 4.1.1
1% Soft	11/1/08	2/28/09	Lmn 4.1.1
Lower Monumental RSW Installation	3/1/08	3/15/08	App A Lmn 1.4
Final Report	3/15/08	3/15/08	Lmn 2.3.3.4
Back flush orifices once per shift	4/1/08	7/31/08	Lmn 2.3.1.2.c.6
Operate juvenile facilities	**4/1/08**	**12/15/08**	**Lmn 2.3.1**
Operate for Juvenile Fish passage	4/1/08	9/30/08	Lmn 2.3.1
Operate for Adult Fallback	10/1/08	12/15/08	Lmn 2.3.1
Juvenile Passage Period	4/1/08	12/15/08	Lmn 2.3.1.2
Adult Fish Counting (Visual 0400 - 2000)	4/1/08	10/31/08	Lmn 1.2.2
Gantry Intake Crane	4/1/08	10/1/08	App A Lmn 1.6
Spill for Fish	4/3/08	8/31/08	App E
RSW Post Construction Evaluation	4/3/08	8/31/08	App A Lmn 2.2
Evaluate the Impacts of Avian Predation	4/3/08	7/15/08	App A Lmn 2.1
Bull Trout Pit Tag Study	4/3/08	8/31/08	App A Lmn 2.3
Juvenile Fish Transportation	5/1/08	9/30/08	App B 3
500 KV Disconnect Replacement	9/15/08	10/15/08	App A Lmn 1.2
1/2 STS May Be Pulled	10/1/08	10/1/08	Lmn 2.3.1.2.b.6
Tailrace Crane	12/1/08	12/31/08	App A Lmn 1.5
Winter Maintenance Period Juvenile	12/16/08	2/28/09	Lmn 2.3.1.1.
Maintenance of Adult Facilities	1/1/09	2/28/09	Lmn 1.2.2
Draft Final Report	2/10/09	2/10/09	Lmn 2.3.3.4



1.2. Adult Fish Passage.

1.2.1. Facilities Description. The adult fish passage facilities at Lower Monumental are comprised of north and south shore fish ladders and collection systems with a common auxiliary water supply. The north shore fish ladder connects to two north shore entrances and the powerhouse collection system. The powerhouse collection system has two downstream entrances at the south end of the powerhouse (a former side entrance has been permanently closed), and a common transportation channel. Two north shore entrances, two downstream south powerhouse entrances, and none of the floating orifices will be used during the 2008 fish passage season. The south shore fish ladder has two downstream entrances (a former side entrance has been permanently closed). The auxiliary water is supplied by three turbine-driven pumps located in the powerhouse on the north side of the river. The water is pumped into a supply conduit that travels under the powerhouse collection channel, distributing water to the powerhouse diffusers, and then under the spillway to the diffusers in the south shore collection system. Excess water from the juvenile fish bypass system (approximately 200-240 cfs) is added to the auxiliary water supply system for the powerhouse collection system.

1.2.2 Adult Migration Timing. Upstream migrants are present at Lower Monumental Dam throughout the year and adult passage facilities are operated year round. Maintenance of adult fish facilities is scheduled for January and February to minimize impacts on upstream migrants. Facilities are usually shut down one shore at a time for maintenance. Adult fish (salmon, steelhead, shad, and lamprey) are counted as per **Table LMN-3**; these data appear daily on the Corps adult count website. Salmon migration timing data appear in **Table LMN-4**. Sturgeon and bull trout are also counted and recorded on the WDFW fish counters' daily summary sheet comments section; and these data are summarized in the Annual Fish Passage Report, but do no appear on the Corps daily website total due to relative infrequency of passage.

Table LMN-3. Adult fish counting schedule at Lower Monumental Dam.

Period	Counting Method
April 1 – October 31	Visual count 0400 - 2000 PST

Table LMN-4. Adult migration timing at Lower Monumental Dam from 1969-2007 based on fish counts.

Species	Counting Period	Date of Peak Passage	
		Earliest	Latest
Spring Chinook	4/1 - 6/13	4/20	5/27
Summer Chinook	6/14 - 8/13	6/14	7/12
Fall Chinook	8/14 - 10/31	9/13	9/30
Steelhead	4/1 - 10/31	9/15	10/13
Sockeye	4/1 - 10/31	6/24	7/25

2. Project Operation.

2.1. Spill Management. See the 2008 Fish Operations Plan (**Appendix E**) for more information.

2.1.2. Involuntary spill at Lower Monumental is the result of river flow exceeding powerhouse capacity, insufficient generation loads to pass the river flow, turbine unit outages (forced or scheduled), or the failure of a key component of the juvenile fish passage facility which forces the project to spill to provide juvenile fish passage. Spill at Lower Monumental shall be distributed in accordance with the spill patterns included at the end of this section, Tables LMN-9 and LMN-10. Generally, Table LMN-10 is preferred for fish passage pending development of a different "high gate" spill pattern emphasizing spillway bay 8. If dissolved gas becomes an issue, the RCC may direct the project to use Table LMN-9. Special spills for juvenile fish passage will be provided as detailed in Appendixes A and E.

2.1.3. To improve tailrace juvenile egress conditions and minimize eddying, it is recommended that the Lower Monumental project be operated as shown in **Table LMN-5** while voluntarily spilling for fish passage. If possible, involuntary spill under the flow levels shown should follow these project operations also.

2.2. Dissolved Gas Management and Control. Total dissolved gas (TDG) levels at Lower Monumental are monitored in accordance with the Dissolved Gas Monitoring Program, **Appendix D**.

2.3. Operating Criteria.

2.3.1. Juvenile Fish Passage Facilities. Operate from April 1 through September 30 for juvenile fish bypass, collection and transportation, and from October 1 through December 15 for bypassing adult fallbacks. Operate the juvenile facilities according to the criteria listed below and in **Appendix B** for bypassing, collection, and transportation of juvenile salmonids. The transportation program may be revised in accordance with the ESA Section 10 permit and the NOAA Fisheries biological opinion.

2.3.1.1. Winter Maintenance Period (December 16 through March 31). Check and perform maintenance as required on the items listed below.

a. Forebay Area and Intakes.

1. Remove debris from forebay and gatewell slots.

2. Rake trashracks just prior to the operating season.

3. Measure drawdown in gatewell slots after cleaning trashracks and with STSs in place.

4. Inspect and repair gatewell dip net as needed.

b. Submersible Traveling Screens and Vertical Barrier Screens.

1. Maintenance completed on all screens.

2. Inspect STSs prior to installation and operate one trial run (dogged off on deck) to ensure proper operation.

3. Log results of trial run.

4. Inspect all VBSs with an underwater video camera at least once per year. Repair as needed.

c. Collection Channel.

1. Water-up valve capable of operating when needed.

2. Orifice lights are operational.

3. Orifices clean and valves operating correctly.

4. Orifice air backflush system works correctly.

d. Dewatering Structure and Flume.

1. Inclined screen clean and in good condition with no gaps between screen panels, damaged panels, or missing silicone.

2. Screen cleaning system (brush and air flush) maintained and operating correctly.

3. Overflow weirs should be maintained, tested and operating correctly.

4. All valves should be operating correctly.

5. Flume interior should be smooth with no rough edges.

e. Transportation Facilities.

1. Primary bypass flume switch gate maintained and in good operating condition.

2. Flume interior smooth with no rough edges.

3. Perforated plate edges smooth with no rough edges.

4. Wet separator and fish distribution system should be maintained and ready for operation as designed.

5. Brushes and screens on crowders in good condition with no holes in screens or rough edges.

6. Crowders maintained, tested, and operating correctly.

7. All valves, slide gates, and switch gates maintained and in good operating condition.

8. Retainer screens in place with no holes in screens or sharp wires protruding.

9. Barge and truck loading pipes should be free of debris, cracks, or blockages. Truck and barge loading hose couplings should have no rough edges and barge loading boom should be maintained and tested.

10. All sampling equipment should be maintained and in good operating condition prior to watering up the facilities.

11. Maintain juvenile PIT tag system as required (see "Columbia Basin PIT Tag Information System, General Gate Maintenance and Inspection, Walla Walla District", February 2003). Coordinate with PSMFC.

12. Mini- and midi-tanks maintained and in good operating condition.

f. Avian Predation Areas (Forebay and Tailrace). Inspect bird wires, water cannon, and other deterrent devices and repair or replace as needed. Where possible, install additional bird wires or other deterrent devices to cover areas of known avian predation activity. Prepare avian abatement contract as needed.

g. Maintenance Records. Record all maintenance and inspections.

2.3.1.2. Fish Passage Period (April 1 through December 15).

a. Forebay Area and Intakes.

1. Remove debris from forebay.

2. Log gatewell drawdown differentials in bulkhead slots at least once a week.

3. Remove debris from forebay and trashracks as required to maintain less than 1' of additional drawdown in gate slots. Additional raking may be required when heavy debris loads are present in the river. Coordinate turbine unit outages with other project work activities, if possible, to minimize turbine unit outages during the spring.

4. Inspect gatewell slots daily (preferably early in day shift) for debris, fish buildup, and contaminating substances (particularly oil). Clean gatewells before they become half covered with debris. If, due to the volume of the debris, it is not possible to keep the gatewell surfaces at least half clear, they should be cleaned at least once daily. If flows through an orifice or fish conditions give indications that an orifice may be partially obstructed with debris, the orifice will be closed and backflushed to remove the obstruction. If the obstruction cannot be removed, the orifice shall be closed and the alternate orifice for that gatewell slot shall be operated. If both orifices become obstructed or plugged with debris, the turbine unit will not be operated until the gatewell and orifices are cleared of debris.

5. If a visible accumulation of contaminating substances (such as oil) is detected in a gatewell and it cannot be removed within 24 hours, the gatewell orifices shall be closed immediately and the turbine unit shut down within one hour until the material has been removed and any problems corrected. A preferred method for removing oil from the water surface is to install absorbent (not adsorbent) socks, booms, or pads capable of encapsulating the material, tied off with a rope for later disposal. Action should be taken as soon as possible to remove the oil from the gatewell so the orifice can be reopened to allow fish to exit the gatewell. Orifices shall not be closed for longer than 48 hours.

6. Coordinate cleaning efforts with personnel operating juvenile collection facilities.

7. Dip bulkhead gatewell slots to remove fish prior to installing bulkhead for dewatering bulkhead slot.

b. **Submersible Traveling Screens, Vertical Barrier Screens, and Operating Gates**.

1. Operate STSs in cycling mode when average fork length of sub-yearling or sockeye is greater than 120 mm.

2. Operate STSs in continuous operational mode when average fork length of sub-yearling chinook or sockeye is less than 120 mm or if fish condition deteriorates. Return to cycling mode after one week has passed and re-evaluate.

3. Inspect each STS once per month by means of underwater video. Spot check VBSs at the same time.

4. Record STS amp readings daily.

5. If an STS is damaged or fails during the juvenile fish passage season, follow procedures detailed under unscheduled maintenance of STSs. In no case should a turbine unit be operated with a missing or a known non-operating or damaged STS.

6. Half of the STSs may be pulled after October 1 for maintenance as long as unscreened turbine units are not operated.

7. Make formal determination at end of season as to adequacy of STS mesh and replacement if necessary.

8. Inspect at least 2 VBSs in 2 different turbine units between the spring and summer migration periods. Both turbine units should have been operated frequently during the spring. If a debris accumulation is noted, inspect other VBSs and clean debris as necessary.

9. Turbine units are to be operated with *raised* operating gates to improve fish guidance efficiency when STSs are installed (April 1 through December 15), except as provided for in Section 4.3., Turbine Unit Maintenance.

c. Collection Channel.

1. Orifices clean and operating. Operate at least one orifice per gatewell slot (preferably the north orifice). If the project is operating at MOP, additional orifices may be operated to maintain a full collection channel. If orifices must be closed to repair any part of the facility, monitor the gatewells hourly (unit is operating) or at least every two hours (unit is not operating) for fish condition and behavior. Also see section 3.1.2.2. to determine if the turbine unit must be shut down and if fish must be dipped from the gatewell(s).

2. Orifice lights operational and operating on open orifices. Orifice lights and area lights may be turned off the evening before the channel is dewatered at the end of the season (dewatering occurs on December 16 or later) to encourage fish to exit the channel volitionally. Area lights can be turned on briefly for personnel access if necessary.

3. Replace all burned out orifice lights within 24 hours of notification. Orifice lights shall remain lighted 24 hours/day.

4. Orifice jets hitting no closer than 3' from back wall, collection channel full.

5. Orifice valves are either fully open or closed.

6. Backflush orifices at least once per day and more frequently if required. During periods of high fish and debris passage, April 1 through July 31, orifices should be inspected and backflushed once per 8-hour shift or more frequently as determined by the project biologist, to keep orifices clean.

7. Water-up valve capable of operating when needed.

d. Dewatering Structure.

1. Trash sweep operating correctly. The frequency of the sweep should be set as necessary to maintain a clean screen, with a minimum operation of at least once per hour. Operate the air flush as specified by the project biologist to maintain a clean screen.

2. Hand clean trapezoidal section as often as required to maintain in clean condition, with a minimum of once per day.

3. Check overflow weirs to make sure they are operating correctly, perform maintenance as required.

4. There should be no gaps between screen panels or damaged panels in the inclined screen.

5. Lights at the dewatering structure should be turned off at night, unless needed for personnel access, to encourage fish to move downstream volitionally.

e. Transportation Facilities.

1. All screens should be inspected to make sure there are no holes or sharp edges.

2. Crowder screen brushes should be maintained in good operating condition, with no holes or sharp edges on crowder screens.

3. Inspect raceway and tank retainer screens to make sure they are clean with no holes or protruding wires.

4. Operate wet separator and fish distribution system as designed.

5. Truck and barge loading facilities in good operating condition.

6. Inform PSMFC, in advance if possible, of situations that cause the PIT tag system to become inoperable (e.g. power outages) or that could result in confounding the interpretation of PIT tag data (e.g. bypassing fish from raceways to the river, operating in primary bypass mode without an operational full-flow detector, emergency dewaterings).

f. Avian Predation Areas (Forebay and Tailrace).

1. Bird wires and other avian deterrent devices should be monitored to assure they are in good condition. Any broken wires or devices should be replaced as soon as possible.

2. Harassment program in place to deter avian predation in areas actively used by birds and not covered by bird wires or other devices.

3. Project biologists shall routinely monitor project areas to determine areas of active avian predation and, if possible, adjust harassment program to cover these areas or install bird wires or other deterrent devices to discourage avian predation activities.

g. Removable Spillway Weir (RSW). Operational criteria for the new RSW are not available at this time (February 2008). Criteria will be provided later by amending the Fish Passage Plan.

h. Inspection and Record Keeping.

1. Inspect fish facilities at least once every 8 hours. Inspect all facilities according to fish facilities monitoring program.

2. Record all maintenance and inspections.

2.3.2. Adult Fish Passage Facilities. Operate the adult fish passage facilities according to the following criteria.

2.3.2.1. Winter Maintenance Period (January 1 through February 28).

a. Inspect all staff gages and water level indicators. Repair and/or clean where necessary.

b. Dewater all ladders and inspect all dewatered sections of fish facilities for projections, debris, or plugged orifices which could injure fish or impede fish passage up the ladder. Fish ladder exit trashracks must have smooth surfaces where fish pass, and must have downstream edges that are adequately rounded or padded. Spare trashracks should be on hand for use as necessary. Inspect all diffuser gratings and chambers annually by dewatering or by using divers or video inspection techniques. All diffuser gratings and chambers are to be dewatered and physically inspected at least every 3 years. Repair deficiencies.

c. Inspect for and clean debris from the fish ladder exits. All trashracks and picketed leads must be clean and installed correctly.

d. Calibrate all water level measuring devices, as necessary, for proper facility operations.

e. Inspect all spill gates and ensure that they are operable.

f. Fish pumps maintained and ready for operation.

g. Maintain adult PIT tag system as required. Coordinate with PSMFC.

2.3.2.2. Fish Passage Period (March 1 through December 31). **Note:** Ice Harbor pool may be operated at minimum operating pool (MOP), between elevations 437' and 438' msl, as part of the Corps' efforts for improving migration conditions for juvenile salmonids. This may result in some of the adult fishway entrances at Lower Monumental Dam bottoming out on their sills prior to reaching criteria depths. Continuous operation at MOP may also result in increased pumping head on the auxiliary water supply pumps, decreasing the amount of water supplied by the pumps.

a. Fishway Ladders. Water depth over weirs: 1' to 1.3'.

b. Counting Windows. The minimum counting slot width should be 18". All equipment should be maintained and in good condition. The counting window and backboard should be cleaned as needed to maintain good visibility.

c. Head on all Fishway Entrances. Head range: 1' to 2'.

d. North Shore Entrances (NSE 1 & 2). Elevation of top of gate when on sill = 429'.

1. Operate both gates.

2. Weir depth: 8' or greater below tailwater.

e. Floating Orifice Gates. No floating orifice gates will be operated.

f. South Powerhouse Entrances (SPE 1 & 2). Elevation at top of gate when on sill = 432'.

1. Operate both downstream gates.

2. Weir depth: 8' or greater below tailwater. At tailwaters below elevation 440', weirs should be on sill.

g. South Shore Entrances (SSE 1 & 2). Elevation of top of gate when on sill = 431'.

1. Operate both downstream gates.

2. Weir depth: SSE 1 operate 8' or greater below tailwater. SSE 2 raised 6' above sill. At tailwaters below elevation 439', SSE 1 weir should be on sill.

h. Channel Velocity. 1.5' to 4' per second.

i. Head on Trashracks.

1. Maximum head of 0.5' on ladder exits.

2. Maximum head on south shore picketed leads shall be 0.3'. Maximum head on north shore picketed leads shall be 0.4'.

3. Trashracks and picketed leads installed correctly.

j. Staff Gages and Water Level Indicators. All staff gages should be readable at all water levels encountered during the fish passage period. Repair or clean as necessary.

k. Facility Inspections.

1. Powerhouse operators shall inspect facilities once per day shift and check computer monitor information at least once during each back shift.

2. Project biologists shall inspect facilities three times per week. Inspect all facilities according to fish facilities monitoring program.

3. Picketed leads shall be inspected during all inspections to ensure they are clean and in the correct position (all the way down).

4. Project personnel shall check calibration of fishway control system twice per month to ensure that it is kept within calibration. This may be done as part of routine fishway inspections.

5. Inspect fishways daily for foreign substances (particularly oil). If substances are found, corrective actions should be undertaken immediately.

6. Record all inspections.

2.3.3. Facility Monitoring and Reporting. Project biologists shall inspect fish passage facilities at the frequencies listed in the juvenile and adult fish facilities operating criteria sections.

2.3.3.1. Project biologists shall prepare weekly reports, from March 1 through December 31, summarizing project operations. The weekly reports should provide an overview of how the project and the fish passage facilities operated during the week and an evaluation of resulting fish passage conditions.

2.3.3.2. The reports shall include:

a. Any out-of-criteria situations observed and subsequent corrective actions taken;

b. Any equipment malfunctions, breakdowns, or damage along with a summary of resulting repair activities;

c. Adult fishway control calibrations;

d. STS and VBS inspections;

e. Any unusual activities which occurred at the project which may affect fish passage.

2.3.3.3. The weekly reports shall cover a Friday through Thursday time period and shall be sent to CENWW-OD-T by noon the following Monday via electronic mail.

2.3.3.4. Project biologists shall prepare a draft annual report by February 10 and a final report by March 15 summarizing the operation of the project fish passage facilities for the previous year. The annual report shall also include a description of all actions taken to discourage avian predation at the project, with an overview of the effectiveness of the activities in discouraging avian predation.

2.3.3.5. Project biologists also inspect project facilities once per month and during dewaterings for the presence of zebra mussels. Biologists shall provide a report to CENWW-OD-T on a monthly basis summarizing zebra mussel inspections.

3. Project Maintenance. Project biologists should be present to provide technical guidance at all project activities that may involve fish handling. All dewaterings shall be accomplished in accordance with approved project dewatering and fish handling plans. When river temperatures reach 70 degrees Fahrenheit or greater, all adult fish handling will be coordinated through CENWW-OD-T. Dewatering and fish handling plans were reviewed and revised in 2000 to ensure that they comply with **Appendix F**, Guidelines for Dewatering and Fish Handling Plans.

3.1. Juvenile Fish Passage Facilities.

3.1.1. Scheduled Maintenance. Scheduled maintenance of the juvenile facilities is conducted during the entire year. Long-term maintenance or modifications of facilities that require them to be out of service for extended periods of time are conducted during the winter maintenance period from December 16 through March 31. During the fish passage season parts of the facilities are maintained on a daily, weekly, or longer interval to keep them in proper operating condition.

3.1.2. Unscheduled Maintenance. Unscheduled maintenance is the correction of any situation that prevents the facilities from operating according to criteria or that will impact fish passage or survival. Maintenance of facilities such as STSs, which sometimes break down during the fish passage season, will be carried out as described below. In these cases, repairs will be made as prescribed and CENWW-OD-T notified for further coordination. Unscheduled maintenance that will have a significant impact on juvenile fish passage shall be coordinated with NOAA Fisheries and other FPOM participants on a case-by-case basis by CENWW-OD-T. CENWW-OD-T will be notified as soon as possible after it becomes apparent that maintenance repairs are required. The Operations Manager has the authority to initiate work prior to notifying CENWW-OD-T when in his opinion delay of the work will result in an unsafe situation for people, property, or fish. Information required by CENWW-OD-T includes:

a. Description of the problem.

b. Type of outage required.

c. Impact on facility operation.

d. Length of time for repairs.

e. Expected impacts on fish passage and proposed measures to mitigate them.

3.1.2.1. Submersible Traveling Screens. The STSs are inspected periodically throughout the juvenile migration season with a video monitoring system. If a screen is found to be damaged it will be removed and either replaced with the spare STS or repaired and returned to service. A turbine unit shall not be operated with a known damaged or nonfunctioning STS or without a full complement of STSs. If an STS fails on a weekend or at night when maintenance crews are not available, the respective turbine unit will be shut down and generation switched to another, fully screened unit. If all screened turbine units are in service, water may be spilled until the effected STS can be removed and repaired or replaced.

3.1.2.2. Gatewell Orifices. Each gatewell has two 12" orifices with air operated valves to allow fish to exit the gatewell. Under normal operation, one orifice per gatewell is operated. To minimize blockage from debris, orifices are cycled and backflushed at least once per day, and more frequently if required by heavy debris loads. If an air-valve fails, the valve should be closed and the alternate orifice for that gatewell operated until repairs can be made. If both orifices are blocked with debris, damaged, or must be kept closed, the turbine unit will be taken out of service until repairs can be made. If repairs are to take longer than 48 hours, juvenile fish will be dipped from the gatewell with a gatewell dip basket. During any closure event of orifices in an operating turbine unit, gatewells will be checked hourly. During times of high fish passage or if there is evidence of any difficulty in holding fish in gatewells, fish are to be dipped from the gatewells at a more frequent interval.

3.1.2.3. Dewatering Structure. The dewatering structure acts as a transition from the collection channel to the corrugated metal flume. An inclined screen allows excess water to be bled off, with all fish and remaining water transitioning into the corrugated metal flume. The excess water is discharged into the adult fish facility auxiliary water supply system and is also used as the water supply for the transportation facilities. The dewatering structure contains a trash sweep and air burst system for cleaning the inclined screen of impinged debris. If the cleaning systems break and interfere with juvenile fish passage through the structure or if the inclined screen is damaged, an emergency bypass system at the upstream end of the dewatering structure will be used to bypass juveniles while repairs are made. Operation of the emergency bypass system requires the juvenile bypass system to be dewatered and stoplogs inserted at the upstream end of the inclined screen. The emergency bypass is then opened and the bypass system operated with 6 gatewell orifices open. Orifices will then need to be routinely rotated, every three hours, in order to let juveniles emigrate from all of the gatewells. While the facilities are in emergency bypass operation, project personnel shall monitor gatewells for signs of fish problems or mortality. Spill may be provided as an alternative avenue for fish passage during a collection channel outage.

3.1.2.4. Bypass Flume. The corrugated metal flume transports juveniles to either the transportation facilities or to the river below the project (primary bypass). If there is a problem with the flume that interferes with its operation, the emergency bypass system at the upper end of the flume can be opened and all of the fish in the bypass system diverted to the river below the project through the emergency bypass pipe while repairs are made.

3.1.2.5. Transportation Facilities. The transportation facilities can be operated to collect and hold juveniles for the transportation program or to bypass them back to the river (secondary bypass). If part of the facility malfunctions or is damaged, efforts will first be made to bypass the fish around the damaged area. If this is not possible, the fish will be bypassed to the river via the primary bypass pipe.

3.2. Adult Fish Passage Facilities.

3.2.1. Scheduled Maintenance. Scheduled maintenance of a facility that must be dewatered to work on or whose maintenance will have a <u>significant effect</u> on fish passage will be done during the January and February winter maintenance period. Maintenance of facilities that will have <u>no effect</u> on fish passage may be conducted at any time. Maintenance is normally conducted on one fish ladder at a time during the winter to provide some fish passage at the project at all times. When facilities are not being maintained during the winter maintenance period, they will be operated according to normal criteria unless otherwise coordinated with NOAA Fisheries and other FPOM participants.

3.2.2. Unscheduled Maintenance. Unscheduled maintenance that will significantly affect the operation of a facility will be coordinated with NOAA Fisheries and other FPOM participants. Coordination procedures for unscheduled maintenance of adult facilities are the same as for juvenile facilities (see section 3.1.2.). If part of a facility malfunctions or is damaged during the fish passage season and the facility can still be operated within criteria without any detrimental effects on fish passage, repairs may not be conducted until the winter maintenance period or until fewer numbers of fish are passing the project. If part of a facility is damaged or malfunctions that may significantly impact fish passage, it will be repaired as soon as possible.

3.2.2.1. Fish Ladders and Counting Stations. The fish ladders contain fixed weirs, counting stations with picket leads, and fish exits with trashracks. If any part of the ladder fails or is blocked with debris during the fish passage season, efforts will first be made to correct the problem without dewatering the ladder. Trashracks, picket leads, and counting stations can sometimes be repaired or maintained without dewatering the ladder. The decision to dewater the ladder and make repairs during the fish passage season or wait until the winter maintenance period will be made after coordination with the fish agencies and tribes.

3.2.2.2. Auxiliary Water Supply System. The auxiliary water for the fish ladders and the collection systems is supplied by three turbine-driven pumps on the north shore, with at least two pumps being required for normal operation. If one, two, or all three pumps fail, the fishway will be adjusted in the following manner until repairs can be made: SPE 2 and SSE 2 will be closed and SPE 1 raised to provide the required 1' to 2' head differential in the system. If the desired head differential cannot be reached by the time SPE 1 reaches 5' below tailwater, SPE 1 should be closed, the collection channel bulkheaded off at the junction pool, and NSE 1 and 2 and SSE 1 operated as deep as possible to maintain the head. If it cannot be maintained at a depth greater than 6', the weirs should be maintained at 6' regardless of the head differential.

3.2.2.3. Fishway Entrances. The fishway entrances consist of main entrance weirs with hoists and automatic controls. If any of the automatic controls malfunction, the weirs can be operated manually by project personnel and kept within criteria. If there is a further failure which prevents an entrance from being operated manually, the weirs can usually be left in a lowered position while repairs are being conducted or the entrance closed and the water redistributed to other entrances while repairs are made.

3.2.2.4. Diffuser Gratings. Diffuser chambers for adding auxiliary water to fish ladders and collection channels are covered by gratings attached by several different methods. Diffuser gratings are normally checked during the winter maintenance period to make sure they are in place. These inspections are done by either dewatering and physically inspecting the diffuser gratings, or by using underwater video cameras, divers, or other methods. Diffuser gratings may come loose during the fish passage season due to a variety of reasons. Daily inspections of fish ladders and collection systems should include looking for any flow changes that may indicate problems with diffuser gratings. If a diffuser grating is known or suspected to have moved, creating an opening into a diffuser chamber, efforts must immediately be taken to correct the situation and minimize impacts on adult fish in the fishway. Coordination of the problems should begin immediately through the established unscheduled maintenance coordination procedure (see **section 3.1.2**). If possible, a video inspection should be made as soon as possible to determine the extent of the problem. If diffuser gratings are found to be missing or displaced, creating openings into the diffuser chambers, a method of repair shall be developed and coordinated with the fish agencies and tribes through the established coordination procedure. Repairs shall be made as quickly as possible unless coordinated differently.

4. Turbine Unit Operation and Maintenance.

4.1. Turbine Unit Operation. When in operation, turbine units will be operated to enhance adult and juvenile fish passage from March 1 through November 30. During this time period turbine units will be operated as needed to meet generation requirements in the priority order shown in **Table LMN-5**. Unit operating priority may be coordinated differently to allow for fish research, construction, or project maintenance activities. If a turbine unit is taken out of service for maintenance or repair, the next unit on the priority list shall be operated. Also see **Section 2.1, Spill Management**.

Table LMN-5. Turbine unit operating priority for Lower Monumental Dam.

Season	River Flow	Spill Level	Unit Priority
Mar 1 – Nov 30	Less than 75 kcfs	While Spilling 50%	2, 5*, 3, 4, 6 then 1
	75 to 100 kcfs	While Spilling 45%	2, 5*, 3, 4, 6 then 1
	Over 100 kcfs	While Spilling 50% or to Gas Cap	1**, 5*, 2, 3, 4, then 6
	Any River Flow	No Spill	2, 3, 4, 5, 6 then 1***
Dec 1 – Feb 28	Any River Flow	Any Spill Level, Including No spill	Any Order

*If U5 is OOS, run U4. **If U1 is OOS, run U2. ***If no spill is occurring, U1 may be operated at any priority level at the discretion of project personnel. **NOTE**: U1 has fixed-pitch blades and can operate only at about 130 megawatts.

4.1.1. Turbine units will be operated within 1% of best efficiency from April 1 through October 31 (as specified in BPA's load shaping guidelines, **Appendix C**) unless operation outside of that range is necessary to:

1) meet the load requirements of the BPA Administrator whose load requests will be made in accordance with BPA's policy, statutory requirements, and load shaping guidelines (**Appendix C**);

2) Roll (speed no load) a turbine unit prior to reduce the number of fish in the scrollcase prior to fish salvage operations;

3) operating a turbine unit solely to provide station service; or

4) be in compliance with other coordinated fish measures. Project personnel shall record when turbine units are operated outside the 1% efficiency range and shall provide the information to BPA on a weekly basis according to the load shaping guidelines. Between November 1 and March 31, turbine units will continue to be operated within the 1%

efficiency range except when BPA load requests require the units to be operated outside the 1% range. Guidelines for operation of the turbine units within the 1% efficiency range at various heads are shown in **Tables LMN-6 through LMN-11.**

4.1.2. All of the lower Snake River powerhouses may be required to keep one generating turbine unit on line at all times to maintain power system reliability. During low flows, there may not be enough river flow to meet this generation requirement and required minimum spill. Under these circumstances the power generation requirement will take precedence over the minimum spill requirement. At Lower Monumental Dam, minimum generation requirements are 11 - 12 kcfs for turbine units 1 – 3 and 11 – 14 kcfs for turbine units 4-6.

4.2. Turbine Unit Outages During High River Flow Periods. During high spring flows, turbine unit outages for inspecting fish screens, repairing research equipment such as hydroacoustic or radio telemetry equipment, and other fish items may cause increased spill at a project in order to maintain reservoir levels within operating levels. This may result in TDG levels exceeding standards. It is important that this work be conducted when scheduled to ensure that facilities are working correctly and not injuring migrating fish, and that important fish research data is collected. To facilitate this work, reservoir storage may be utilized to minimize impacts from taking turbine units out of service and increasing spill. At Lower Monumental, this special operation shall take place when river flows are above 120 kcfs or when increasing spill levels will result in TDG levels exceeding standards. The activities covered under these operations will be coordinated with and approved by the TMT whenever possible.

4.2.1. For scheduled inspection or repair of research equipment, reservoirs shall be drafted to MOP and allowed to fill to 1' above the 1’ MOP operating range as the work is accomplished. After the work, reservoirs will be slowly drafted back to the MOP operating range. When inspection or repair work can be scheduled ahead of time, the following process will be followed:

a. Project personnel shall schedule turbine unit outages through the approved turbine outage scheduling procedure by noon of the Tuesday of the week prior to the outage.

b. Project personnel shall also contact CENWW-OD-T and RCC by the same time period and inform them of the intended work.

c. The RCC will coordinate the work activities through the TMT.

d. After coordination with the TMT, RCC shall issue a teletype through the CBTT issuing instructions to project and BPA personnel for the scheduled work.

e. Spill will be increased by one spillbay stop setting (about 1.7 kcfs) above passing inflow to slowly lower the level of Lower Monumental pool to MOP prior to the scheduled work taking place.

f. When the work takes place, additional spill will not be provided and the reservoir will be allowed to refill until the reservoir is 1' above the normal MOP range (a 2' pondage from where the pool was when the work started). At this point, screen inspections shall stop. (At Snake River projects, this should allow about one normal workday for the scheduled work.)

g. At the conclusion of the work, the reservoir shall be drafted back down to the MOP range utilizing a one spillbay stop increase in spill above passing inflow.

h. If work, such as screen inspections, is not finished, project personnel shall schedule another turbine unit outage for a date where it can be implemented again.

4.2.2. If the work that needs to be done is of an emergency nature that does not normally require the turbine unit to be taken out of service (such as a failed hydroacoustic transducer versus a failed fish screen), and can not wait for the above process to be implemented, project personnel shall notify CENWW-OD-T and RCC to get approval to do the work. If approval to do the work is given, the turbine unit shall be taken out of service and the reservoir level allowed to increase until it reaches 1' above the MOP operating range. At this point, the turbine unit must be returned to service and the reservoir will be drafted back to the MOP range using one spillbay stop setting above passing inflows.

Table LMN-6. The 1% operating efficiency range for turbine unit 1 with STSs.

Head	Lower Generator Limits		Upper Generator Limits	
Feet	MW	CFS	MW	CFS
85	**106.9**	**18,185**	**113.8**	**19,346**
86	108.6	18,222	115.4	19,361
87	110.2	18,258	116.9	19,375
88	111.8	18,292	118.5	19,388
89	113.5	18,325	120.1	19,400
90	**115.0**	**18,338**	**121.6**	**19,394**
91	116.4	18,335	123.1	19,390
92	117.8	18,331	124.6	19,385
93	119.2	18,328	126.0	19,381
94	120.6	18,323	127.5	19,375
95	**121.9**	**18,304**	**128.9**	**19,354**
96	123.3	18,310	130.4	19,367
97	124.7	18,315	131.9	19,379
98	126.1	18,321	133.5	19,390
99	127.5	18,326	135.0	19,401
100	**128.8**	**18,316**	**136.4**	**19,396**
101	130.3	18,322	138.1	19,430
102	131.7	18,328	139.8	19,463
103	133.1	18,334	141.5	19,494
104	134.5	18,340	143.2	19,525
105	**135.9**	**18,331**	**144.8**	**19,539**

Table LMN-7. The 1% operating efficiency range for turbine unit 1 without STSs.

Head	Lower Generator Limits		Upper Generator Limits	
Feet	MW	CFS	MW	CFS
85	**108.5**	**18,234**	**115.3**	**19,383**
86	110.1	18,268	116.9	19,395
87	111.8	18,301	118.5	19,406
88	113.4	18,332	120.1	19,416
89	115.1	18,361	121.7	19,425
90	**116.7**	**18,390**	**123.3**	**19,433**
91	118.1	18,384	124.8	19,426
92	119.5	18,377	126.3	19,418
93	120.9	18,370	127.7	19,411
94	122.3	18,364	129.2	19,403
95	**123.7**	**18,356**	**130.7**	**19,394**
96	125.1	18,360	132.2	19,404
97	126.5	18,362	133.7	19,413
98	127.9	18,365	135.3	19,421
99	129.3	18,367	136.8	19,430
100	**130.7**	**18,369**	**138.3**	**19,437**
101	132.2	18,373	140.0	19,468
102	133.6	18,376	141.7	19,498
103	135.0	18,380	143.4	19,526
104	136.4	18,382	145.1	19,554
105	**137.9**	**18,385**	**146.8**	**19,581**

NOTE: Turbine unit 1 has fixed-pitch blades. Tables based on 1962 model test and 2005 U1 abbreviated index test.

Table LMN-8. Lower Monumental 1% operating efficiency range for turbine units 2-3 with standard length submersible traveling screens installed.

Head	Lower Generator Limits		Upper Generator Limits	
Feet	MW	CFS	MW	CFS
80	**62.2**	**10,817**	**114.4**	**19,891**
81	63.5	10,892	117.2	20,106
82	64.8	10,964	120.0	20,314
83	66.1	11,035	122.8	20,517
84	67.3	11,103	125.6	20,714
85	**68.6**	**11,169**	**128.5**	**20,905**
86	69.4	11,154	131.0	21,056
87	70.2	11,140	133.5	21,204
88	70.9	11,125	136.1	21,348
89	71.7	11,111	138.6	21,488
90	**72.4**	**11,097**	**141.2**	**21,625**
91	73.3	11,088	141.6	21,418
92	74.1	11,079	142.0	21,216
93	75.0	11,071	142.4	21,018
94	75.8	11,061	142.8	20,824
95	**76.7**	**11,052**	**143.2**	**20,634**
96	77.7	11,071	143.3	20,416
97	78.8	11,088	143.5	20,203
98	79.8	11,105	143.6	19,994
99	80.8	11,121	143.8	19,789
100	**81.8**	**11,137**	**144.0**	**19,589**
101	82.7	11,138	145.9	19,641
102	83.6	11,140	147.8	19,692
103	84.5	11,141	149.7	19,741
104	85.4	11,142	151.6	19,789
105	**86.2**	**11,143**	**153.5**	**19,837**
106	86.9	11,122	154.9	19,822
107	87.6	11,101	155.2	19,632
108	88.4	11,081	155.2	19,420
109	89.1	11,061	155.2	19,221
110	**89.8**	**11,041**	**155.2**	**19,007**

NOTE: The turbine efficiency tables were revised to reflect new information using a 2002 index test and original 1975 turbine model test. Table is based on information provided by HDC in letter to NWW dated August 20, 2003 (Table LMN-8 revised 2005).

Table LMN-9. Lower Monumental 1% operating efficiency range for turbine units 2-3 without standard length submersible traveling screens.

Head	Lower Generator Limits		Upper Generator Limits	
Feet	MW	CFS	MW	CFS
80	**62.8**	**10,772**	**112.1**	**19,234**
81	64.1	10,846	114.8	19,442
82	65.4	10,919	117.6	19,644
83	66.6	10,989	120.3	19,840
84	67.9	11,057	123.1	20,031
85	**69.2**	**11,123**	**125.8**	**20,216**
86	70.0	11,109	128.3	20,363
87	70.8	11,094	130.8	20,506
88	71.6	11,080	133.3	20,645
89	72.3	11,066	135.8	20,781
90	**73.1**	**11,052**	**138.3**	**20,913**
91	74.0	11,043	138.7	20,714
92	74.8	11,035	139.1	20,518
93	75.7	11,026	139.5	20,327
94	76.5	11,017	139.9	20,140
95	**77.4**	**11,009**	**140.3**	**19,956**
96	78.4	11,027	140.4	19,746
97	79.5	11,044	140.6	19,540
98	80.5	11,061	140.7	19,338
99	81.5	11,078	140.9	19,141
100	**82.6**	**11,093**	**141.0**	**18,947**
101	83.5	11,095	142.9	18,998
102	84.3	11,096	144.8	19,047
103	85.2	11,098	146.7	19,095
104	86.1	11,099	148.5	19,142
105	**87.0**	**11,100**	**150.4**	**19,188**
106	87.7	11,079	151.8	19,173
107	88.4	11,059	153.2	19,159
108	89.1	11,038	154.6	19,145
109	89.9	11,019	155.2	19,016
110	**90.6**	**10,999**	**155.2**	**18,818**

NOTE: The turbine efficiency tables were revised to reflect new information using a 2002 index test and original 1975 turbine model test. Table is based on information provided by HDC in letter to NWW dated August 20, 2003 (Table LMN-9 revised 2005).

Table LMN-10. Lower Monumental 1% operating efficiency range for turbine units 4-6 with standard length submersible traveling screens installed.

Head	Lower Generator Limits		Upper Generator Limits	
Feet	MW	CFS	MW	CFS
80	**84.3**	**14,189**	**115.1**	**19,364**
81	85.4	14,181	116.8	19,392
82	86.5	14,174	118.5	19,419
83	87.6	14,166	120.3	19,445
84	88.7	14,158	122.0	19,469
85	**89.8**	**14,150**	**123.8**	**19,493**
86	91.0	14,160	125.5	19,519
87	92.2	14,169	127.2	19,545
88	93.4	14,178	128.9	19,569
89	94.6	14,187	130.6	19,593
90	**95.7**	**14,195**	**132.3**	**19,616**
91	96.9	14,196	133.9	19,613
92	98.0	14,197	135.4	19,610
93	99.2	14,197	136.9	19,607
94	100.3	14,198	138.5	19,603
95	**101.4**	**14,198**	**140.0**	**19,600**
96	102.3	14,170	140.5	19,456
97	103.2	14,142	141.0	19,315
98	104.1	14,114	141.5	19,177
99	105.1	14,087	142.0	19,042
100	**106.0**	**14,061**	**142.5**	**18,909**
101	107.3	14,091	143.9	18,909
102	108.5	14,120	145.4	18,909
103	109.8	14,149	146.8	18,909
104	111.1	14,177	148.2	18,909
105	**112.4**	**14,204**	**149.6**	**18,909**
106	113.5	14,203	151.6	18,981
107	114.5	14,202	153.6	19,051
108	115.6	14,200	155.2	19,099
109	116.6	14,199	155.2	18,894
110	**117.7**	**14,198**	**155.2**	**18,694**

NOTE: The turbine efficiency tables were revised to reflect new information using a 2002 index test and original 1975 turbine model test. Table is based on information provided by HDC in letter to NWW dated August 20, 2003 (Table LMN-9 revised 2005).

Table LMN-11. Lower Monumental 1% operating efficiency range for turbine units 4-6 without standard length submersible traveling screens.

Head	Lower Generator Limits		Upper Generator Limits	
Feet	MW	CFS	MW	CFS
80	**84.0**	**13,999**	**113.9**	**18,975**
81	85.1	13,992	115.6	19,002
82	86.2	13,985	117.3	19,029
83	87.3	13,977	119.1	19,054
84	88.4	13,969	120.8	19,079
85	**89.5**	**13,962**	**122.5**	**19,102**
86	90.7	13,971	124.2	19,128
87	91.9	13,981	125.9	19,153
88	93.1	13,990	127.6	19,177
89	94.2	13,998	129.3	19,201
90	**95.4**	**14,006**	**131.0**	**19,224**
91	96.5	14,007	132.5	19,221
92	97.7	14,008	134.0	19,218
93	98.8	14,009	135.5	19,215
94	99.9	14,010	137.1	19,211
95	**101.1**	**14,010**	**138.6**	**19,208**
96	102.0	13,982	139.1	19,067
97	102.9	13,954	139.6	18,929
98	103.8	13,928	140.1	18,794
99	104.7	13,901	140.5	18,662
100	**105.6**	**13,875**	**141.0**	**18,532**
101	106.9	13,904	142.5	18,532
102	108.2	13,933	143.9	18,532
103	109.4	13,962	145.3	18,532
104	110.7	13,989	146.7	18,532
105	**112.0**	**14,017**	**148.1**	**18,532**
106	113.1	14,015	150.1	18,602
107	114.1	14,014	152.0	18,670
108	115.2	14,013	154.0	18,738
109	116.2	14,011	155.2	18,725
110	**117.3**	**14,010**	**155.2**	**18,531**

NOTE: The turbine efficiency tables were revised to reflect new information using a 2002 index test and original 1975 turbine model test. Table is based on information provided by HDC in letter to NWW dated August 20, 2003 (Table LMN-11 revised 2005).

4.3. Turbine Unit Maintenance. The project turbine unit maintenance schedule will be reviewed annually by project and Operations Division biologists for fish impacts. If possible, maintenance of priority units will be scheduled for non-fish passage periods, or when there are low numbers of fish passing the project. Each turbine unit requires annual maintenance that may take from several days to two weeks. Annual maintenance of all turbine units is normally scheduled during the mid-July to late November time frame. The maintenance of priority units for adult passage is normally conducted in mid-August, when fewer adults are migrating, to minimize impacts on migrating adults. Turbine units may occasionally require overhauls to repair major problems with the turbine or generator. Overhauls may take over one year to accomplish. Turbine units, governors, exciters, and control systems require periodic maintenance, calibration, and testing which may take them outside of the one percent best efficiency range. This work will be scheduled in compliance with BPA load shaping guidelines (Appendix C) to minimize impacts on juvenile fish. Transformers are Doble tested every 3 years. Testing may need to be more frequent if there is a known problem with a transformer. These tests normally take 2 to 3 workdays. To conduct the testing, the distribution lines have to be disconnected from the transformers and normal generation stopped. One turbine unit will operate in a speed-no-load condition to provide project power and operation of fish passage facilities. Spill may be provided to meet minimum required project discharges during the testing hours. The Doble tests are normally scheduled for the August or early September time period to minimize impacts on adult and juvenile fish passage.

4.3.1. Turbine units are to be operated with raised operating gates to improve fish passage conditions when STSs are installed, except as provided below. To facilitate annual maintenance, operating gates are used to dewater the turbine units. To minimize turbine outage periods to the actual time required for maintenance (during the July 1 through December 15 time period), operating gates in one turbine unit may be lowered to the standard operating position and connected to hydraulic cylinders on the afternoon of the last regular workday (normally Thursday) prior to the start of the maintenance. With the operating gates in the standard operating position, the turbine unit may be operated until 0700 hours of the next regular workday (normally Monday). On the completion of maintenance, the turbine unit can be operated with the operating gates in the standard operating position until 0700 hours of the first regular workday after the maintenance is completed. If turbine maintenance or the raising of the operating gates to the raised operating position is delayed after the time periods stated above, the turbine unit shall be immediately taken out of service until the work can be accomplished. Operation of turbine units with operating gates in the standard operating position shall be restricted to the July 1 through December 15 time period, and shall not occur unless at least 4 other turbine units are available for service. No more than 1 turbine unit at a time shall be operated with operating gates in the standard operating position and the turbine unit will be operated on last on, first off operating priority.

4.3.2. Unwatering turbine units should be accomplished in accordance with project dewatering plans. Prior to dewatering a turbine unit for maintenance, the turbine unit should be spun at speed-no-load, if possible, immediately before installing tailrace stoplogs and headgates to minimize the number of fish in the draft tube and scroll case. If a turbine unit is out of service for maintenance for an extended period of time without tailrace stoplogs in place, efforts should be made to not open the wicket gates if the scroll case must be dewatered at a later date without the unit being spun before hand.

5. Forebay Debris Removal. Debris at projects can impact fish passage conditions. Debris can plug or block trashracks, VBSs, gatewell orifices, dewatering screens, separators, and facility piping resulting in impingement, injuries, and descaling of fish. Removing debris at its source in the forebay is sometimes necessary to maintain safe and efficient fish passage conditions, navigation, and other project activities. Debris can be removed from the forebay by: physically encircling the debris with log booms and pulling it to shore with boats where it can be removed with a crane, removing the debris from the top of the dam using a crane and scoop, or passing the debris through the spillway with special powerhouse operations and spill. The preferred option is to remove debris at each project when possible to avoid passing debris on to the next project downstream. This is not always possible at each project as some projects do not have forebay debris removal capability. In this case, the only viable alternative is to spill the debris.

5.1. All special spills (other than normal spill patterns for ongoing spill operations) and project operations for passing debris will be coordinated prior to the operations taking place. Each project shall contact CENWW-OD-T at least two workdays prior to the day they want the special project operations for spilling to pass debris. The CENWW-OD-T shall coordinate the special operations with RCC, NOAA Fisheries, and other FPOM participants. Project personnel shall provide CENWW-OD-T the reason for the debris spill request including an explanation of project facilities being impacted by the debris, the date and time of the requested spill, and any special powerhouse or other operations required to move the debris to the spillway. When a debris spill is coordinated and approved, RCC shall issue a teletype detailing the specifics of the special operations.

Table LMN-12. Bulk spill pattern for river flows less than 120 kcfs (120 - 130 kcfs).

Spill Bay/Stops								Total	Total
1	2	3	4	5	6	7	8	Stops	Spill
0	0	0	0	0	0	0	0	0	0.0
0	0	0	0	0	0	0	4	4	6.2
0	0	0	0	0	1	0	4	5	7.3
0	0	0	0	0	1	0	5	6	9.0
0	1	0	0	0	1	0	5	7	10.1
0	2	0	0	0	1	0	5	8	11.8
0	3	0	0	0	1	0	5	9	13.6
0	3	0	0	0	2	0	5	10	15.3
0	**3**	**0**	**0**	**0**	**3**	**0**	**5**	**11**	**17.1**
0	3	0	0	0	4	0	5	12	18.7
0	3	0	0	1	4	0	5	13	19.8
0	3	0	0	1	5	0	5	14	21.5
1	3	0	0	1	5	0	5	15	22.6
1	2	0	1	1	5	0	6	16	23.6
1	1	1	1	1	6	0	6	17	24.7
1	1	1	1	2	6	0	6	18	26.4
1	1	1	2	2	6	0	6	19	28.1
1	1	1	2	5	5	0	5	20	29.8
2	1	1	2	5	5	0	5	21	31.5
2	1	2	2	5	5	0	5	22	33.2
2	2	2	2	5	5	0	5	23	34.9
3	2	2	2	5	5	0	5	24	36.7
3	3	2	2	5	5	0	5	25	38.5
3	3	2	2	5	5	1	5	26	39.6
3	3	2	2	5	5	2	5	27	41.3
3	3	2	3	5	5	2	5	28	43.1
3	3	3	3	5	5	2	5	29	44.9
3	3	3	3	5	5	2	6	30	46.6
3	3	3	3	5	6	2	6	31	48.3
3	3	3	3	6	6	2	6	32	50.0
3	3	3	3	6	6	3	6	33	51.8
3	3	3	3	6	6	4	6	34	53.4
3	3	3	3	6	6	5	6	35	55.1
3	3	3	3	6	6	6	6	36	56.8
3	3	3	4	6	6	6	6	37	58.4
3	3	4	4	6	6	6	6	38	60.0
3	4	4	4	6	6	6	6	39	61.6
4	4	4	4	6	6	6	6	40	63.2
4	4	4	5	6	6	6	6	41	64.9
4	4	5	5	6	6	6	6	42	66.6
4	5	5	5	6	6	6	6	43	68.3
5	5	5	5	6	6	6	6	44	70.0
5	5	5	6	6	6	6	6	45	71.7
5	5	6	6	6	6	6	6	46	73.4

Table LMN-12. Lower Monumental Dam bulk spill pattern for <u>river flows less than 120 kcfs (120 - 130 kcfs) continued</u>.

Spill Bay/Stops								Total Stops	Total Spill
1	2	3	4	5	6	7	8		
5	6	6	6	6	6	6	6	47	75.1
6	6	6	6	6	6	6	6	48	76.8
6	6	6	6	6	6	6	7	49	78.5
6	6	6	6	6	6	7	7	50	80.2
6	6	6	6	6	7	7	7	51	81.9
6	6	6	6	7	7	7	7	52	83.6
6	6	6	7	7	7	7	7	53	85.3
6	6	7	7	7	7	7	7	54	87.0
6	7	7	7	7	7	7	7	55	88.7
7	7	7	7	7	7	7	7	56	90.4
7	7	7	7	7	7	7	8	57	92.2
7	7	7	7	7	7	8	8	58	94.0
7	7	7	7	7	8	8	8	59	95.8
7	7	7	7	8	8	8	8	60	97.6
7	7	7	8	8	8	8	8	61	99.4
7	7	8	8	8	8	8	8	62	101.2
7	8	8	8	8	8	8	8	63	103.0
8	8	8	8	8	8	8	8	64	104.8
8	8	8	8	8	8	8	9	65	106.5
8	8	8	8	8	8	9	9	66	108.2
8	8	8	8	8	9	9	9	67	109.9
8	8	8	8	9	9	9	9	68	111.6
8	8	8	9	9	9	9	9	69	113.3
8	8	9	9	9	9	9	9	70	115.0
8	9	9	9	9	9	9	9	71	116.7
9	9	9	9	9	9	9	9	72	118.4
9	9	9	9	9	9	9	10	73	120.1
9	9	9	9	9	9	10	10	74	121.8
9	9	9	9	9	10	10	10	75	123.5
9	9	9	9	10	10	10	10	76	125.2

Table LMN-13. Lower Monumental Dam spill pattern for river flows sustained above 120 kcfs (120 to 130 kcfs).

Spill Bay/Stops								Total	Total
1	2	3	4	5	6	7	8	Stops	Spill
0	0	0	0	0	0	0	1	1	1.1
1	0	0	0	0	0	0	1	2	2.2
1	0	0	0	0	0	1	1	3	3.3
1	1	0	0	0	0	1	1	4	4.4
1	1	0	0	0	1	1	1	5	5.5
1	1	1	0	0	1	1	1	6	6.6
1	1	1	0	1	1	1	1	7	7.7
1	1	1	1	1	1	1	1	8	8.8
1	1	1	1	1	1	1	2	9	10.5
1	1	1	1	1	1	1	3	10	12.3
1	1	1	1	1	1	1	4	11	13.9
1	1	1	1	1	1	1	5	12	15.6
1	1	1	1	1	1	2	5	13	17.3
1	1	1	1	1	2	2	5	14	19.0
1	1	1	1	2	2	2	5	15	20.7
1	1	1	2	2	2	2	5	16	22.4
1	1	2	2	2	2	2	5	17	24.1
1	2	2	2	2	2	2	5	18	25.8
2	2	2	2	2	2	2	5	19	27.5
2	2	2	2	2	2	3	5	20	29.3
2	2	2	2	2	3	3	5	21	31.1
2	2	2	2	3	3	3	5	22	32.9
2	2	2	3	3	3	3	5	23	34.7
2	2	3	3	3	3	3	5	24	36.5
2	3	3	3	3	3	3	5	25	38.3
3	3	3	3	3	3	3	5	26	40.1
3	3	3	3	3	3	4	5	27	41.7
3	3	3	3	3	4	4	5	28	43.3
3	3	3	3	4	4	4	5	29	44.9
3	3	3	4	4	4	4	5	30	46.5
3	3	4	4	4	4	4	5	31	48.1
3	4	4	4	4	4	4	5	32	49.7
4	4	4	4	4	4	4	5	33	51.3
4	4	4	4	4	4	5	5	34	53.0
4	4	4	4	4	5	5	5	35	54.7
4	4	4	4	5	5	5	5	36	56.4
4	4	4	5	5	5	5	5	37	58.1
4	4	5	5	5	5	5	5	38	59.8
4	5	5	5	5	5	5	5	39	61.5
5	5	5	5	5	5	5	5	40	63.2
5	5	5	5	5	5	5	6	41	64.9
5	5	5	5	5	5	6	6	42	66.6
5	5	5	5	5	6	6	6	43	68.3

Table LMN-13. Lower Monumental Dam spill pattern for river flows sustained above 120 kcfs (120 to 130 kcfs) continued.

Spill Bay/Stops								Total	Total
1	2	3	4	5	6	7	8	Stops	Spill
5	5	5	5	6	6	6	6	44	70.0
5	5	5	6	6	6	6	6	45	71.7
5	5	6	6	6	6	6	6	46	73.4
5	6	6	6	6	6	6	6	47	75.1
6	6	6	6	6	6	6	6	48	76.8
6	6	6	6	6	6	6	7	49	78.5
6	6	6	6	6	6	7	7	50	80.2
6	6	6	6	6	7	7	7	51	81.9
6	6	6	6	7	7	7	7	52	83.6
6	6	6	7	7	7	7	7	53	85.3
6	6	7	7	7	7	7	7	54	87.0
6	7	7	7	7	7	7	7	55	88.7
7	7	7	7	7	7	7	7	56	90.4
7	7	7	7	7	7	7	8	57	92.2
7	7	7	7	7	7	8	8	58	94.0
7	7	7	7	7	8	8	8	59	95.8
7	7	7	7	8	8	8	8	60	97.6
7	7	7	8	8	8	8	8	61	99.4
7	7	8	8	8	8	8	8	62	101.2
7	8	8	8	8	8	8	8	63	103.0
8	8	8	8	8	8	8	8	64	104.8
8	8	8	8	8	8	8	9	65	106.5
8	8	8	8	8	8	9	9	66	108.2
8	8	8	8	8	9	9	9	67	109.9
8	8	8	8	9	9	9	9	68	111.6
8	8	8	9	9	9	9	9	69	113.3
8	8	9	9	9	9	9	9	70	115.0
8	9	9	9	9	9	9	9	71	116.7
9	9	9	9	9	9	9	9	72	118.4
9	9	9	9	9	9	9	10	73	120.1
9	9	9	9	9	9	10	10	74	121.8
9	9	9	9	9	10	10	10	75	123.5
9	9	9	9	10	10	10	10	76	125.2
9	9	9	10	10	10	10	10	77	126.9
9	9	10	10	10	10	10	10	78	128.6
9	10	10	10	10	10	10	10	79	130.3
10	10	10	10	10	10	10	10	80	132.0
10	10	10	10	10	10	10	11	81	133.7
10	10	10	10	10	10	11	11	82	135.4
10	10	10	10	10	11	11	11	83	137.1
10	10	10	10	11	11	11	11	84	138.8
10	10	10	11	11	11	11	11	85	140.5
10	10	11	11	11	11	11	11	86	142.2

Table LMN-13. Lower Monumental Dam spill pattern <u>for river flows sustained above 120 kcfs (120 to 130 kcfs)</u> continued.

Spill Bay Stops								Total Stops	Total Spill
1	2	3	4	5	6	7	8		
10	11	11	11	11	11	11	11	87	143.9
11	11	11	11	11	11	11	11	88	145.6
11	11	11	11	11	11	11	12	89	147.4
11	11	11	11	11	11	12	12	90	149.2
11	11	11	11	11	12	12	12	91	151.0
11	11	11	11	12	12	12	12	92	152.8
11	11	11	12	12	12	12	12	93	154.6
11	11	12	12	12	12	12	12	94	156.4
11	12	12	12	12	12	12	12	95	158.2
12	12	12	12	12	12	12	12	96	160.0
12	12	12	12	12	12	12	13	97	161.7
12	12	12	12	12	12	13	13	98	163.4
12	12	12	12	12	13	13	13	99	165.1
12	12	12	12	13	13	13	13	100	166.8
12	12	12	13	13	13	13	13	101	168.5
12	12	13	13	13	13	13	13	102	170.2
12	13	13	13	13	13	13	13	103	171.9
13	13	13	13	13	13	13	13	104	173.6
13	13	13	13	13	13	13	14	105	175.3
13	13	13	13	13	13	14	14	106	177.0
13	13	13	13	13	14	14	14	107	178.7
13	13	13	13	14	14	14	14	108	180.4
13	13	13	14	14	14	14	14	109	182.1
13	13	14	14	14	14	14	14	110	183.8
13	14	14	14	14	14	14	14	111	185.5
14	14	14	14	14	14	14	14	112	187.2
14	14	14	14	14	14	14	15	113	189.0
14	14	14	14	14	14	15	15	114	190.8
14	14	14	14	14	15	15	15	115	192.6
14	14	14	14	15	15	15	15	116	194.4
14	14	14	15	15	15	15	15	117	196.2
14	14	15	15	15	15	15	15	118	198.0
14	15	15	15	15	15	15	15	119	199.8
15	15	15	15	15	15	15	15	120	201.6

Section 8 Little Goose Dam

<u>Little Goose Dam</u>

1. Fish Passage Information. The locations of fish passage facilities at Little Goose Lock and Dam are shown in **Figure LGS-1**. Dates of project operations for fish purposes and special operations are listed in **Table LGS-1**.

1.1. Juvenile Fish Passage.

1.1.1. Facilities Description. The Little Goose juvenile facilities consist of a bypass system and juvenile transportation facilities. The bypass system contains extended length submersible bar screens with flow vanes, vertical barrier screens, thirty five 12" and one 14" gatewell orifices, a bypass channel running the length of the powerhouse, a metal flume mounted on the face of the dam and the upper end of the fish ladder, a dewatering structure to eliminate excess water, two emergency bypass systems, and a corrugated metal flume to transport the fish to either the transportation facilities or to the river. The transportation facilities include a separator structure, raceways for holding fish, a distribution system for distributing the fish among the raceways, a sampling and marking building, truck and barge loading facilities, and PIT tag detection and deflection systems.

1.1.2. Juvenile Migration Timing. Juvenile migration timing at Little Goose Dam is indicated in **Table LGS-2**. The dates in the table are based on juvenile fish collection numbers and do not reflect FGE or spill passage. Salmon, steelhead, bull trout, lamprey, and other species are routinely counted. Maintenance of juvenile fish passage facilities that may impact juvenile fish passage or facility operations should be conducted during the winter maintenance season.

1.2. Adult Fish Passage.

1.2.1. Facilities Description. The adult fish passage facilities at Little Goose are comprised of one fish ladder on the south shore, two south shore entrances, a powerhouse collection system, north shore entrances with a transportation channel underneath the spillway to the powerhouse collection system, and auxiliary water supply system. The powerhouse collection system is comprised of two downstream entrances and one side entrance into the spillway basin on the north end of the powerhouse, and a common transportation channel. The two downstream entrances at the north end of the collection system and none of the floating orifices will be used during the 2008 fish passage season. The north shore entrances are made up of two downstream facing entrances and a side entrance into the spillway basin with the two downstream entrances operated. The auxiliary water is supplied by three turbine-driven pumps that pump water from the tailrace into the distribution system for the diffusers. Additional water is supplied to the auxiliary water supply system from the juvenile fish facilities primary dewatering structure.

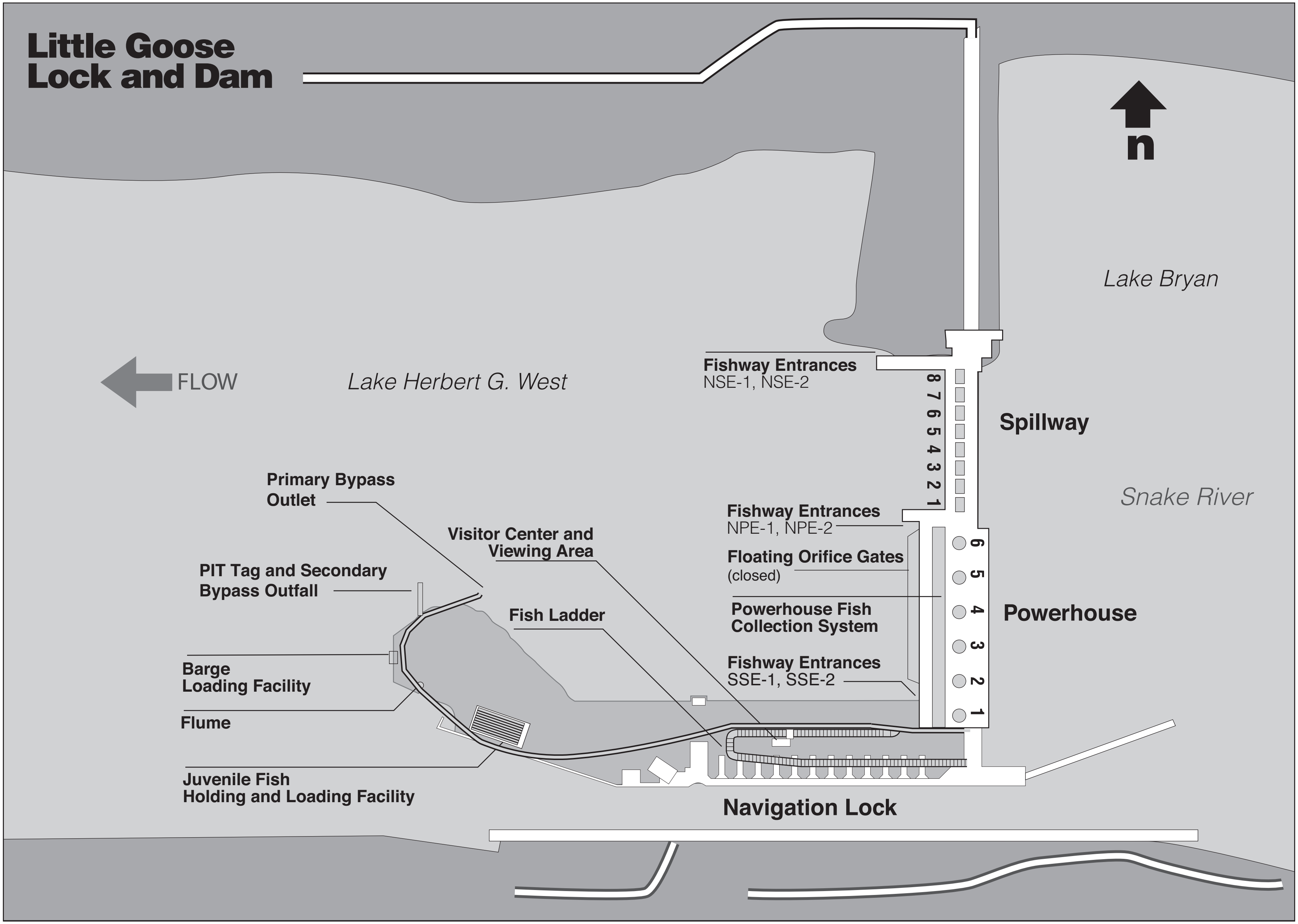


Figure 12 Little Goose Lock and Dam General Site Plan

Table LGS-1. Dates of project operations for fish purposes at Little Goose, 2008-9 — March 2008

Task Name	Start	Finish	FPP Reference
TDG Monitoring	3/1/08	2/28/09	App D Table 4
Winter Maintenance Period Juvenile	3/1/08	3/31/08	Lgs 2.3.1.1.
Adult Fish Passage Period	3/1/08	12/31/08	Lgs 2.3.2.2
Weekly Reports	3/1/08	12/31/08	Lgs 2.3.3.1
Operate Turbines for Fish Passage	3/1/08	11/30/08	Lgs 4.1
1% limitations	**3/1/08**	**2/28/09**	**Lgs 4.1**
1% Soft	3/1/08	3/31/08	Lgs 4.1.1
1% Hard	4/1/08	10/31/08	Lgs 4.1.1
1% Soft	11/1/08	2/28/09	Lgs 4.1.1
Final Report	3/15/08	3/15/08	Lgs 2.3.3.4
Back flush orifices once per shift	4/1/08	7/31/08	Lgs 2.3.1.2.c.6
Operate juvenile facilities	**4/1/08**	**12/15/08**	**Lgs 2.3.1**
Operate for Juvenile Fish Passage	4/1/08	10/31/08	Lgs 2.3.1
Operate for Adult Fallback	11/1/08	12/15/08	Lgs 2.3.1
Juvenile Passage Period	4/1/08	12/15/08	Lgs 2.3.1.2
Adult Fish Counting (Visual 0400 - 2000)	4/1/08	10/31/08	Lgs 1.2.2
Spill for Fish	4/3/08	8/31/08	App E
Adult Passage - Varying Spill Conditions	4/3/08	8/31/08	App A. Lgs 2.1
Bull Trout Pit Tag Study	4/3/08	8/31/08	App A. Lgs 2.2
Juvenile Fish Transportation	4/28/08	10/31/08	App B 3
1/2 ESBSs May Be Pulled	10/1/08	10/1/08	Lgs 2.3.1.2 b 5
Winter Maintenance Period Juvenile	12/16/08	2/28/09	Lgs 2.3.1.1.
Maintenance of Adult Facilities	1/1/09	2/28/09	Lgs 1.2.2
Draft Final Report	2/10/09	2/10/09	Lgs 2.3.3.4

2008 | Qtr 2, 2008 | Qtr 3, 2008 | Qtr 4, 2008 | Qtr 1, 2009
Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Jan | Feb | Mar

3/15
10/1
2/10

Table LGS-2. Juvenile migration timing at Little Goose Dam based on juvenile fish collection numbers.

% Collection	2003	2004	2005	2006	2007
Clipped Yearling Chinook					
10%	4/27	4/25	5/5	4/26	5/8
90%	5/27	5/18	5/16	5/19	5/20
Unclipped Yearling Chinook					
10%	4/24	4/22	4/29	4/19	5/9
90%	6/11	5/25	5/27	5/23	5/23
Sub-yearling Chinook					
10%	6/4	6/9	5/12	5/24	6/7
90%	7/24	7/17	6/20	7/4	7/6
Clipped Steelhead					
10%	4/30	4/28	4/26	4/21	5/10
90%	5/29	6/1	5/16	5/20	5/27
Unclipped Steelhead					
10%	4/28	4/25	4/27	4/20	5/10
90%	5/30	6/2	5/20	5/20	5/30

Note: Migration timing calculations affected by later fish collection start dates in 2006 and 2007.

1.2.2. Adult Migration Timing. Upstream migrants are present at Little Goose Dam throughout the year and adult passage facilities are operated year round. Maintenance of adult fish facilities is scheduled for January and February to minimize impacts on upstream migrants. Facilities are usually shut down one shore at a time for maintenance. Adult fish (salmon, steelhead, shad, and lamprey) are counted as per **Table LGS-3;** these data appear daily on the Corps adult count website. Salmon migration timing data appear in **Table LGS-4**. Sturgeon and bull trout are also counted and recorded on the WDFW fish counters' daily summary sheet comments section; and these data are summarized in the Annual Fish Passage Report, but do not appear on the Corps daily website total due to relative infrequency of passage.

Table LGS-3. Adult fish counting schedule at Little Goose Dam.

Period	Counting Method
April 1 – October 31	Visual count 0400 - 2000 PST

Table LGS-4. Adult migration timing from 1970-2007 based on fish counts at Little Goose Dam.

Species	Counting Period	Date of Peak Passage	
		Earliest	Latest
Spring Chinook	4/1 - 6/15	4/20	6/1
Summer Chinook	6/16 - 8/15	6/14	7/12
Fall Chinook	8/16 - 10/31	9/14	9/30
Steelhead	4/1 - 10/31	9/15	10/14
Sockeye	6/15 - 10/31	6/24	7/25

2. Project Operation.

2.1. Spill Management. See the 2008 Fish Operations Plan (**Appendix E**) for more information.

2.1.2. Involuntary spill at Little Goose is the result of river flow exceeding powerhouse capacity, insufficient generation loads to pass the river flow, turbine unit outages (forced or scheduled), or the failure of a key component of the juvenile fish passage facility which forces the project to spill to provide juvenile fish passage. Spill at Little Goose shall be distributed in accordance with the spill pattern included at the end of this section, Table LGS-9, pending development of a “high gate” spill pattern. Special spills for juvenile fish passage will be provided as detailed in **Appendices A and E**.

2.1.3. During years when fish passage spill is provided at Little Goose, and project biologists or researchers at Little Goose notice an extraordinary congregation of juvenile fish delaying in the forebay, they will notify NOAA Fisheries and CENWW to request a fish flush spill (FFS) that evening. The FFS request will be for up to three hours, 8 pm to 11 pm, and be up to 50% of river flow during those hours, using a uniform spill pattern to lessen dissolved gas entrainment.

2.2. Dissolved Gas Management and Control. Total dissolved gas (TDG) levels at Lower Monumental are monitored in accordance with the Dissolved Gas Monitoring Program, **Appendix D**.

2.3. Operating Criteria.

2.3.1. Juvenile Fish Passage Facilities. Operate from April 1 through October 31 for juvenile fish bypass, collection, and transportation and from November 1 through December 15 for bypassing adult fallbacks. Operate according to the criteria listed below and in **Appendix B** (Corps' Juvenile Fish Transportation Program Operating Criteria) for the bypassing, collection, and transportation of juvenile salmonids. The transportation program may be revised in accordance with the ESA Section 10 permit and the NOAA Fisheries biological opinion.

2.3.1.1. Winter Maintenance Period (December 16 through March 31). Check and perform maintenance as required on the items listed below.

a. Forebay Area and Intakes.

1. Remove debris from forebay and gatewell slots.

2. Rake trashracks just prior to the operating season.

3. Measure drawdown in gatewell slots after cleaning trashracks and with ESBSs in place.

4. Inspect and repair gatewell dip net as needed.

b. Extended-Length Submersible Bar Screens, Flow Vanes, and Vertical Barrier Screens.

1. Maintenance completed on all screens.

2. Inspect ESBSs prior to installation and operate debris cleaner (dogged off on deck) to ensure proper operation.

3. Log results of trial run.

4. Inspect VBSs with an underwater video camera at least once per year. Repair as needed.

5. Inspect flow vanes to make sure they are in good condition and all surfaces smooth. Repair as needed.

c. Collection Channel.

1. Water-up valve capable of operating when needed.

2. Orifice lights are operational.

3. Orifices clean and valves operating correctly.

4. Orifice cycling and air backflush system works correctly.

d. Dewatering Structure and Flume.

1. Inclined screen clean and in good condition with no gaps between screen panels or damaged panels.

2. Cleaning brush and air burst systems maintained and operating correctly.

3. Overflow weirs should be maintained, tested and operating correctly.

4. All valves should be operating correctly.

5. Baffle boards under inclined screen in good condition.

6. Flume interior should be smooth with no rough edges.

e. Transportation Facilities.

1. Flume switch gate maintained and in good operating condition.

2. Flume interior smooth with no rough edges.

3. Perforated plate smooth with no rough edges.

4. Wet separator and fish distribution system maintained and ready for operation as designed.

5. Brushes and screens on crowders in good condition with no holes in screens or rough edges.

6. Crowders maintained, tested, and operating correctly.

7. All valves, slide gates, and switch gates maintained and in good operating condition.

8. Retainer screens in place with no holes in screens or sharp wires protruding.

9. Barge and truck loading pipes free of debris, cracks, or blockages and barge loading boom maintained and tested.

10. All sampling equipment should be maintained and in good operating condition prior to watering up the facilities.

11. Maintain juvenile PIT tag system as required (see "Columbia Basin PIT Tag Information System, General Gate Maintenance and Inspection, Walla Walla District", February 2003). Coordinate with PSMFC.

12. Mini- and midi-tanks maintained and in good operating condition.

f. Avian Predation Areas (Forebay and Tailrace). Inspect bird wires, water cannon, and other deterrent devices and repair or replace as needed. Where possible, install additional bird wires or other deterrent devices to cover areas of known avian predation activity. Prepare avian abatement contract as needed.

g. Maintenance Records. Record all maintenance and inspections.

2.3.1.2. Fish Passage Period (April 1 through December 15).

a. Forebay Area and Intakes.

1. Remove debris from forebay. All floating debris will be removed whenever two acres of debris accumulates in the spring and one acre in the summer and fall.

2. Log drawdown differentials in bulkhead slots at least once a week.

3. Remove debris from forebay and trashracks as required to maintain less than 1' of additional drawdown in gate slots. Additional raking may be required when heavy debris loads are present in the river or when fish condition requires it.

4. Inspect gatewell slots daily (preferably early in day shift) for debris, fish buildup, and contaminating substances (particularly oil). Clean gatewells before they become half covered with debris. If, due to the volume of the debris, it is not possible to keep the gatewell at least half clear, they should be cleaned at least once daily. If flows through an orifice, or fish conditions give indications that an orifice may be partially obstructed with debris, the orifice will be closed and backflushed to remove the obstruction. If the obstruction can not be removed, the orifice shall be closed and the alternate orifice for that gatewell slot shall be operated. If both orifices become obstructed or plugged with debris the turbine unit will not be operated until the gatewell and orifices are cleared of debris.

5. If a visible accumulation of contaminating substances (such as oil) is detected in a gatewell and it cannot be removed within 24 hours, the gatewell orifices shall be closed immediately and the turbine unit shut down within one hour until the material has been removed and any problems corrected. A preferred method for removing oil from the water surface is to install absorbent (not adsorbent) socks, booms, or pads capable of encapsulating the material, tied off with a rope for later disposal. Action should be taken as soon as possible to remove the oil from the gatewell so the orifice can be reopened to allow the fish to exit the gatewell. Orifices shall not be closed for longer than 48 hours.

6. Coordinate cleaning efforts with personnel operating juvenile collection facilities.

7. Dip bulkhead gatewell slots to remove fish prior to installing bulkhead for dewatering a bulkhead slot.

b. Extended-Length Submersible Bar Screens, Vertical Barrier Screens, and Operating Gates.

1. Operate ESBSs with flow vanes attached to screen.

2. Operate ESBSs with debris cleaners in automatic mode. Set cleaning frequency as required to maintain clean screens and good fish condition. Change cleaning frequency as needed.

3. Inspect each ESBS once per month by means of underwater video in April, May, and June. Conduct similar inspections in August and October, focusing on at least three turbine units as the judgment of project personnel dictates. Spot check VBSs at the same time.

4. If an ESBS is damaged or fails during the juvenile fish passage season, follow procedures detailed under unscheduled maintenance of ESBSs (see **section 3.1.2.1**). In no case should a turbine unit be operated with a missing or a known non-operating or damaged ESBS, except as noted.

5. One-half of the ESBSs may be pulled after October 1 for maintenance as long as unscreened turbine units are not operated.

6. Make formal determination at end of season as to adequacy of ESBS bar screen panels and debris cleaner brushes and replace components as necessary.

7. Measure head differentials across VBSs at least once per week from April 1 through June 30 (more frequently if required) and biweekly for the remainder of the operating season. Clean VBS when head differentials reach 1.5'. When a head differential of 1.5' is reached, the respective turbine unit should be operated at a reduced loading, not more than 110 MW, to minimize loading on the VBS and potential fish impingement until the VBS can be cleaned. Clean VBSs as soon as possible after a 1.5' head differential is reached.

8. Inspect at least 2 VBSs in 2 different turbine units between the spring and summer migration periods. Both turbine units should have been operated frequently during the spring. If a debris accumulation is noted, inspect other VBSs and clean debris as necessary.

9. Turbine units are to be operated with *raised* operating gates to improve fish guidance efficiency when ESBSs are installed (April 1 through December 15), except as provided for in **Section 4.3.,** Turbine Unit Maintenance.

c. Collection Channel.

1. Orifices clean and operating. Operate at least one orifice per gatewell slot (preferably the north orifice). If the project is operating at MOP, additional orifices may be operated to maintain a full collection channel. *If orifices must be closed to repair any part of the facility, do not close orifices in operating turbine units with ESBSs in place for longer than 5 hours. If possible, keep to less than 3 hours.* Reduce turbine unit loading to the lower end of the 1% efficiency range if deemed necessary by the project biologist. Monitor fish conditions in gatewells hourly or more frequently during orifice closure periods.

2. Orifice lights operational and operating on open orifices. Orifice lights and area lights may be turned off the evening before the channel is dewatered at the end of the season (dewatering occurs on December 16 or later) to encourage fish to exit the channel volitionally. Area lights can be turned on briefly for personnel access if necessary.

3. Replace all burned out orifice lights within 24 hours of notification. Orifice lights shall remain lighted 24 hours/day.

4. Orifice jets hitting no closer than 3’ from back wall, collection channel full.

5. Orifice valves are either fully open or closed.

6. Backflush orifices at least once per day and more frequently if required. During periods of high fish and debris passage, April 1 through July 31, orifices should be inspected and backflushed once per 8-hour shift or more frequently as determined by the project biologist, to keep orifices clean. If debris is causing continual orifice plugging problems in a particular turbine unit gatewell, the respective turbine unit generation may be restricted to the lower end of the 1% turbine efficiency range to minimize orifice plugging problems.

7. If utilizing the automatic orifice backflush system, inspect as determined by the project biologist (but at least once per 8-hour shift unless coordinated differently) to ensure that the orifices are opening and closing correctly and are clear of debris. The project biologist will determine the frequency of automatic orifice cycling and backflushing to maintain clear orifices.

8. Water-up valve capable of operating when needed.

d. Dewatering Structure.

1. Trash sweep and air burst systems operating correctly. The frequency of screen cleaning should be set as necessary to maintain a clean screen.

2. Hand clean trapezoidal section as often as required to maintain in clean condition, with a minimum of once per day.

3. Check overflow weirs to make sure they are operating correctly, perform maintenance as required.

4. There should be no gaps between screen panels or damaged panels in the inclined screen. Screen panels in place and tightly secured.

5. Lights at the dewatering structure should be turned off at night, unless needed for personnel access, to encourage fish to move downstream volitionally.

e. Transportation Facilities.

1. Operate wet separator and fish distribution system as designed.

2. Crowder screen brushes should be maintained in good operating condition, with no holes or sharp edges on crowder screens. Crowders should be in good operating condition.

3. Inspect raceway and tank retainer screens to make sure they are clean with no holes or protruding wires.

4. Barge and truck loading pipes and related equipment free of debris, cracks, or blockages and in good condition. Barge loading boom in good operating condition

5. Inform PSMFC, in advance if possible, of situations that cause the PIT tag system to become inoperable (e.g. power outages) or that could result in confounding the interpretation of PIT tag data (e.g. bypassing fish from raceways to the river, operating in primary bypass mode without an operational full-flow detector, emergency dewaterings).

f. Avian Predation Areas (Forebay and Tailrace).

1. Bird wires and other avian deterrent devices should be monitored to assure they are in good condition. Any broken wires or devices should be replaced as soon as possible.

2. Harassment program in place to deter avian predation in areas actively used by birds and not covered by bird wires or other devices.

3. Project biologists shall routinely monitor project areas to determine areas of active avian predation and, if possible, adjust harassment program to cover these areas or install bird wires or other deterrent devices to discourage avian predation activities.

g. Inspection and Record Keeping.

1. Inspect fish facilities at least once every 8 hours. Inspect all facilities according to fish facilities monitoring program.

2. Record all maintenance and inspections.

2.3.2. Adult Fish Passage Facilities. Operate the adult fish passage facilities according to the following criteria.

2.3.2.1. Winter Maintenance Period (January 1 through February 28).

a. Inspect all staff gages and water level indicators. Repair and/or clean where necessary.

b. Dewater the ladder and inspect all dewatered sections of fish facilities for projections, debris, or plugged orifices which could injure fish or impede fish passage up the ladder. The fish ladder exit trashrack must have smooth surfaces where fish pass, and must have downstream edges that are adequately rounded or padded. A spare trashrack should be on hand for use as necessary. Inspect all diffuser gratings and chambers, and the fallout fence, annually by dewatering or by using divers or video inspection techniques. All diffuser gratings and chambers are to be dewatered and physically inspected at least every 3 years. Repair deficiencies.

c. Inspect for and clean debris from the fish ladder exit. The trashrack and picketed leads must be clean and installed correctly.

d. Calibrate all water level measuring devices, as necessary, for proper facility operations.

e. Inspect all spill gates and ensure that they are operable.

f. Fish pumps maintained and ready for operation.

2.3.2.2. Fish Passage Period (March 1 through December 31). Note: Lower Monumental pool may be operated at minimum operating pool (MOP), between elevations 537' and 538' msl, as part of the Corps' efforts to improve migration conditions for juvenile salmonids. This may result in some of the adult fishway entrances at Little Goose bottoming out on their sills prior to reaching criteria depths. Continuous operation at MOP may also result in increased pumping head on the auxiliary water supply pumps, decreasing the amount of water supplied by the pumps.

a. Fishway Ladder. Water depth over weirs: 1' to 1.3'.

b. Counting Window. The minimum counting slot width should be 18". All equipment should be maintained and in good condition. The counting window and backboard should be cleaned as needed to maintain good visibility.

c. Head on all Fishway Entrances. Head range: 1' to 2'.

d. North Shore Entrances (NSE 1 & 2). Elev. at top of gates when on sill = 529'.

1. Operate both downstream gates.

2. Weir depth: 6' or greater below tailwater.

e. North Powerhouse Entrances (NPE 1 & 2). Elev. at top of gates when on sill = 532'.

1. Operate both downstream gates.

2. Weir Depth: 7' or greater below tailwater, tailwater permitting. At tailwater below elevation 539', entrance weirs should be on sill.

f. Floating Orifice Gates. No floating orifice gates will be operated. Inspect fish fallout fence for debris buildup, holes, etc.

g. South Shore Entrances (SSE 1 & 2). Elev. of top of gates when on sill = 529'.

1. Operate both gates.

2. Weir depth: 8' or greater below tailwater.

h. Channel Velocity. 1.5' to 4' per second.

i. Tunnel Lights. Lights in the tunnel section under the spillway shall be on during fish passage period.

j. Head on Trashracks.

1. Maximum head of 0.5' on ladder exit.

2. Maximum head on picketed leads shall be 0.3'.

3. Trashrack and picketed leads installed correctly.

k. Staff Gages and Water Level Indicators. All staff gages should be readable at all water levels encountered during the fish passage period. Repair or clean as necessary.

l. Facility Inspections.

1. Powerhouse operators shall inspect facilities once per day shift and check computer monitor information at least once during each back shift.

2. Project biologists shall inspect facilities three times per week. Inspect all facilities according to fish facilities monitoring program.

3. Picketed leads shall be checked during all inspections to ensure they are clean and in the correct position (all the way down and vanes in line with flow).

4. Project personnel shall check calibration of fishway control system twice per month to ensure that it is kept within calibration. This may be done as part of routine fishway inspections.

5. Inspect fishways daily for foreign substances (particularly oil). If substances are found, corrective actions should be undertaken immediately.

6. Record all inspections.

2.3.3. Facility Monitoring and Reporting. Project biologists shall inspect fish passage facilities at the frequencies listed in the juvenile and adult fish facilities operating criteria sections.

2.3.3.1. Project biologists shall prepare weekly reports, from March 1 through December 31, summarizing project operations. The weekly reports should provide an overview of how the project and the fish passage facilities operated during the week and an evaluation of resulting fish passage conditions.

2.3.3.2. The reports shall include:

a. Any out-of-criteria situations observed and subsequent corrective actions taken;

b. Any equipment malfunctions, breakdowns, or damage along with a summary of resulting repair activities;

c. Adult fishway control calibrations;

d. ESBS and VBS inspections;

e. Any unusual activities which occurred at the project which may affect fish passage.

2.3.3.3. The weekly reports shall cover a Friday through Thursday time period and shall be sent to CENWW-OD-T by noon the following Monday via electronic mail.

2.3.3.4. Project biologists shall prepare a draft annual report by February 10 and a final report by March 15 summarizing the operation of the project fish passage facilities for the previous year. The annual report shall also include a description of all actions taken to discourage avian predation at the project, with an overview of the effectiveness of the activities in discouraging avian predation.

2.3.3.5. Project biologists also inspect project facilities once per month and during dewaterings for the presence of zebra mussels. Biologists shall provide a report to CENWW-OD-T on a monthly basis summarizing zebra mussel inspections.

3. Project Maintenance. Project biologists should be present to provide technical guidance at all project activities that may involve fish handling. All dewaterings shall be accomplished in accordance with approved project dewatering and fish handling plans. **When river temperatures reach 70 degrees Fahrenheit or greater, all adult fish handling will be coordinated through CENWW-OD-T.** Dewatering and fish handling plans were reviewed and revised in 2000 to ensure that they comply with Appendix F, Guidelines for Dewatering and Fish Handling Plans.

3.1. Juvenile Fish Passage Facilities.

3.1.1. Scheduled Maintenance. Scheduled maintenance of the juvenile facilities is conducted during the entire year. Long-term maintenance or modifications of facilities that require them to be out of service for extended periods of time are conducted during the winter maintenance period from December 16 through March 31. During the fish passage season parts of the facilities are maintained on a daily, weekly, or longer interval to keep them in proper operating condition.

3.1.2. Unscheduled Maintenance. Unscheduled maintenance is the correction of any situation that prevents the facilities from operating according to criteria or that will impact fish passage or survival. Maintenance of facilities such as ESBSs, which sometimes break down during the fish passage season, will be carried out as described below. In these cases, repairs will be made as prescribed and CENWW-OD-T notified for further coordination. Unscheduled maintenance that will have a significant impact on juvenile fish passage shall be coordinated with NOAA Fisheries and other FPOM participants on a case-by-case basis by CENWW-OD-T. CENWW-OD-T will be notified as soon as possible after it becomes apparent that maintenance repairs are required. The Operations Manager has the authority to initiate work prior to notifying CENWW-OD-T when in his opinion delay of the work will result in an unsafe situation for people, property, or fish. Information required by CENWW-OD-T includes:

a. Description of the problem.

b. Type of outage required.

c. Impact on facility operation.

d. Length of time for repairs.

e. Expected impacts on fish passage and proposed measures to mitigate them.

3.1.2.1. Extended-length Submersible Bar Screens. The ESBSs are inspected periodically throughout the juvenile migration season with a video monitoring system. If a screen is found damaged or malfunctions at any time it will be removed and either replaced with a spare ESBS or repaired and returned to service. A turbine unit shall not be operated during the juvenile bypass season with a missing, known damaged, or non-operating ESBS (except as detailed below). If an ESBS fails on a weekend or at night when maintenance crews are not available, the respective turbine unit will be shut down and generation switched to another fully screened unit. If all screened turbine units are in service, water may be spilled until the effected ESBS can be removed and repaired or replaced.

3.1.2..1.1. During the spring runoff when river flows are at the level where taking a unit out of service and spilling will exceed the TDG limits allowed by state standards, project personnel may operate a turbine unit at <u>110 MWs or less</u> with a failed screen cleaner if there is evidence that the ESBS will not plug with debris. Evidence of this is a lack of debris accumulation in the gatewell and along the face of the powerhouse. This will only happen if an ESBS screen cleaner fails after 1400 hours on a regular workday or any time on a weekend. Project personnel will pull and replace the screen the next morning, weekday or weekend inclusive. If the screen cannot be pulled and repaired first thing the next morning, the turbine unit will be removed from service until the screen can be repaired. If there is evidence that fish are being injured under this operation, by either observing injured fish in the gatewells or injured fish appearing on the separator, the turbine unit will be removed from service immediately. This operation will not take place when daily average river flows are less than total powerhouse capacity and the turbine unit will not be operated during power peaking operations where turbine units are being turned on and off.

3.1.2.2. Gatewell Orifices. Each gatewell has two 12" orifices (gatewell slot 1A has one 14" test orifice) with air operated valves to allow fish to exit the gatewell. Under normal operation, at least one orifice per gatewell is operated. To minimize blockage from debris, orifices should be backflushed every day. If an air valve fails, the valve should be closed and the alternate orifice and air valve for that gatewell operated until repairs can be made. If both orifices are blocked with debris, damaged, or must be kept closed, the turbine unit will be taken out of service until repairs can be made. If repairs are to take longer than 48 hours, juvenile fish will be dipped from the gatewell with a gatewell dip basket.

3.1.2.3. Dewatering Structure. The dewatering structure acts as a transition from the collection channel to the corrugated metal flume. An inclined screen allows excess water to be bled off, with all fish and remaining water transitioning into the corrugated metal flume. The excess water can be either discharged into the river or added to the adult passage facilities auxiliary water supply system, and is also used as the water supply for the transportation facilities. The dewatering structure contains a trash sweep for cleaning the inclined screen of impinged debris. If the trash sweep breaks and interferes with juvenile fish passage through the structure or if the inclined screen is damaged, an emergency bypass system at the upstream end of the dewatering structure can be used, if required, to bypass juveniles while repairs are made. Operation of the emergency bypass system requires the juvenile bypass system to be dewatered and stoplogs inserted at the upstream end of the inclined screen. During this setup process, turbine units may be operated at the lower end of the 1% efficiency range. The emergency bypass is then opened and the bypass system operated with six gatewell orifices open. Orifices will then need to be routinely rotated, at a minimum of every 2 hours, to allow juveniles to emigrate from all of the gatewells. During any orifice closure, gatewells shall be monitored hourly by project personnel for signs of fish problems or mortality. Orifices shall not be closed for longer than 5 hours in an operating turbine unit with ESBSs in place. During periods of high fish passage, orifice closure times may need to be less than 5 hours depending on fish numbers and condition. If orifices are closed, gatewells shall be monitored hourly. Spill may be used as an alternative avenue for fish passage during a collection channel outage.

3.1.2.4. Bypass Flume. The corrugated metal flume transports juveniles to either the transportation facilities or to the river below the project. If there is a problem with the flume that interferes with its operation, an emergency bypass system at the upper end of the flume can be opened and all of the fish in the bypass system diverted to the river below the project through a 30" pipe while repairs are made.

3.1.2.5. Transportation Facilities. The transportation facilities can be operated either to collect and hold juveniles for the transportation program or to bypass them back to the river. If part of the facility malfunctions or is damaged, efforts will first be made to bypass the fish around the damaged area. If this is not possible, the fish will be bypassed around the transportation facilities.

3.2. Adult Fish Passage Facilities.

3.2.1. Scheduled Maintenance. Scheduled maintenance of a facility that must be dewatered to work on or whose maintenance will have a <u>significant effect</u> on fish passage will be done during the January and February winter maintenance period. Maintenance of facilities that will have <u>no effect</u> on fish passage may be conducted at any time. When facilities are not being maintained during the winter maintenance period, they will be operated according to normal criteria unless otherwise coordinated with NOAA Fisheries and other FPOM participants.

3.2.2. Unscheduled Maintenance. Unscheduled maintenance that will significantly affect the operation of a facility will be coordinated with NOAA Fisheries and other FPOM participants. Coordination procedures for unscheduled maintenance of adult facilities are the same as for juvenile facilities (see section 3.1.2.). If part of a facility malfunctions or is damaged during the fish passage season and the facility can still be operated within criteria without any detrimental effects on fish passage, repairs may not be conducted until the winter maintenance period or until fewer numbers of fish are passing the project. If part of a facility is damaged or malfunctions that may significantly impact fish passage, it will be repaired as soon as possible.

3.2.2.1. Fish Ladder and Counting Station. The fish ladder contains fixed weirs, a counting station with picket leads, and a fish exit with trashrack. If any part of the ladder fails or is blocked with debris during the fish passage season, efforts will first be made to correct the problem without dewatering the ladder. Trashracks, picket leads, and counting stations can sometimes be repaired or maintained without dewatering the ladder. The decision to dewater the ladder and make repairs during the fish passage season or wait until the winter maintenance period will be made after coordination with the fish agencies and tribes.

3.2.2.2. Auxiliary Water Supply System. Three turbine-driven pumps on the south shore supply the auxiliary water for the fish ladder and the powerhouse collection system. All three pumps are required for normal operation. Approximately 150 to 180 cfs of excess water from the juvenile fish passage facilities is also added to the auxiliary water supply system. If one, two, or all three pumps fail, the fishway will be adjusted in the following manner to get the best fish passage conditions possible until repairs can be made: first, increase the speed of the operable pump(s). As necessary, then close NSE 2 and NPE 2 and operate NPE 1 to provide the required 1' to 2' head differential. If the desired head differential cannot be maintained at a depth of 5' or greater, then NSE 1 should be raised until a depth of 5' below tailwater is reached. If the head differential cannot be maintained at this point, SSE 1 and 2 should be raised at 1' increments until 6' below tailwater is reached. If the head differential still cannot be maintained, the transportation channel to the north shore should be bulkheaded off at the end of the powerhouse collection channel. Next, NPE 1 should be closed and the powerhouse collection channel bulkheaded off at the junction pool. SSE 1 and 2 should then be operated as deep as possible to maintain the head, but not shallower than 6' regardless of the head.

3.2.2.3. Fishway Entrances. The fishway entrances consist of main entrance weirs with hoists and automatic controls. If any of the automatic controls malfunction, the weirs can be operated manually by project personnel and kept within criteria. If there is a further failure which prevents an entrance from being operated manually, the weirs can usually be left in a lowered position while repairs are being conducted or the entrance closed and the water redistributed to other entrances while repairs are made.

3.2.2.4. Diffuser Gratings. Diffuser chambers for adding auxiliary water to fish ladders and collection channels are covered by gratings attached by several different methods. Diffuser gratings are normally checked during the winter maintenance period to make sure they are in place. These inspections are done either by dewatering and physically inspecting the diffuser gratings, or by using underwater video cameras, divers, or other methods. Diffuser gratings may come loose during the fish passage season due to a variety of reasons. Daily inspections of fish ladders and collection systems should include looking for any flow changes that may indicate problems with diffuser gratings. If a diffuser grating is known or suspected to have moved, creating an opening into a diffuser chamber, efforts must immediately be taken to correct the situation and minimize impacts on adult fish in the fishway. Coordination of the problems should begin immediately through the established unscheduled maintenance coordination procedure (see section 3.1.2). If possible, a video inspection should be made as soon as possible to determine the extent of the problem. If diffuser gratings are found to be missing or displaced, creating openings into the diffuser chambers, a method of repair shall be developed and coordinated with the fish agencies and tribes through the established coordination procedure. Repairs shall be made as quickly as possible unless coordinated differently.

4. Turbine Unit Operation and Maintenance.

4.1. Turbine Unit Operation. Turbine units will be operated to enhance adult and juvenile fish passage from March 1 through November 30. During this time period turbine units will be operated in the priority order shown in **Table LGS-5**. Unit operating priority may be coordinated differently to allow for fish research, construction, or project maintenance activities. Turbine unit operating priority shall be turbine unit 1, then turbine units 2 through 6 (**Table LGS-5**). If more than one turbine unit is operating, maximize discharge (i.e.: operated at the upper 1% limit) through the southernmost turbine units to the extent possible without exceeding 1% guidelines, starting with turbine unit 1. If a turbine unit is taken out of service for maintenance or repair, the next unit in the priority list shall be operated.

4.1.1. T urbine units will be operated within 1% of best efficiency from April 1 through October 31 (as specified in BPA's load shaping guidelines, **Appendix C**) unless operation outside of that range is necessary to:

1) meet the load requirements of the BPA Administrator whose load requests will be made in accordance with BPA's policy, statutory requirements, and load shaping guidelines (**Appendix C**);

2) Roll (speed no load) a turbine unit prior to reduce the number of fish in the scrollcase prior to fish salvage operations;

3) operating a turbine unit solely to provide station service; or

4) be in compliance with other coordinated fish measures. Project personnel shall record when turbine units are operated outside the 1% efficiency range and shall provide the information to BPA on a weekly basis according to the load shaping guidelines. Between November 1 and March 31, turbine units will continue to be operated within the 1% efficiency range except when BPA load requests require the units to be operated outside the 1% range. Guidelines for operation of the turbine units within the 1% efficiency range at various heads are shown in **Tables LGS-6 through LGS-9.**

4.1.2. All of the lower Snake River powerhouses may be required to keep one generating turbine unit on line at all times to maintain power system reliability. During low flows, there may not be enough river flow to meet this generation requirement and required minimum spill. Under these circumstances the power generation requirement will take precedence over the minimum spill requirement. At Little Goose Dam, minimum generation requirements are 11 - 12 kcfs for turbine units 1 – 3 and 17 - 19 kcfs for turbine units 4-6.

Table LGS-5. Turbine unit operating priority for Little Goose Dam.

Season	Time of Day	Unit Priority
March 1 – October 31	24 hours	1, 2, 3, 4, 5, 6 (Maximize discharge through lowest numbered turbine units)
December 1 – February 28	24 hours	Any Order

4.2. Turbine Unit Outages During High River Flow Periods. During high spring flows, turbine unit outages for inspecting fish screens, repairing research equipment such as hydroacoustic or radio telemetry equipment, and other fish items may cause increased spill at a project in order to maintain reservoir levels within operating levels. This may result in TDG levels exceeding standards. It is important that this work be conducted when scheduled to ensure that facilities are working correctly and not injuring migrating fish, and that important fish research data are collected. To facilitate this work, reservoir storage may be utilized to minimize impacts from taking turbine units out of service and increasing spill. At Little Goose, this special operation shall take place when river flows are above 120 kcfs or when increasing spill levels will result in TDG levels exceeding standards. The activities covered under these operations will be coordinated with and approved by the TMT whenever possible.

4.2.1. For scheduled inspection or repair of research equipment, reservoirs shall be drafted to MOP and allowed to fill to 1' above the 1’ MOP operating range as the work is accomplished. After the work, reservoirs will be drafted back to the MOP operating range. When inspection or repair work can be scheduled ahead of time, the following process will be followed:

a. Project personnel shall schedule turbine unit outages through the approved turbine outage scheduling procedure by noon of the Tuesday of the week prior to the outage.

b. Project personnel shall also contact CENWW-OD-T and RCC by the same time period and inform them of the intended work.

c. The RCC will coordinate the work activities through the TMT.

d. After coordination with the TMT, RCC shall issue a teletype through the CBTT issuing instructions to project and BPA personnel for the scheduled work.

e. Spill will be increased by one spillbay stop setting (about 1.7 kcfs) above passing inflow to slowly lower the level of Little Goose pool to MOP prior to the scheduled work taking place.

f. When the work takes place, additional spill will not be provided and the reservoir will be allowed to refill until the reservoir is 1' above the normal MOP range (a 2' pondage from where the pool was when the work started). At this point, screen inspections shall stop. (At Snake River projects, this should allow about one normal workday for the scheduled work.)

g. At the conclusion of the work, the reservoir shall be drafted back down to the MOP range utilizing a one spillbay stop increase in spill above passing inflow.

h. If work, such as screen inspections, is not finished, project personnel shall schedule another turbine unit outage for a date where it can be implemented again.

4.2.2. If the work that needs to be done is of an emergency nature that does not normally require the turbine unit to be taken out of service (such as a failed hydroacoustic transducer versus a failed fish screen), and can not wait for the above process to be implemented, project personnel shall notify CENWW-OD-T and RCC to get approval to do the work. If approval to do the work is given, the turbine unit shall be taken out of service and the reservoir level allowed to increase until it reaches 1' above the MOP operating range. At this point, the turbine unit must be returned to service and the reservoir will be drafted back to the MOP range using one spillbay stop setting above passing inflows.

Table LGS-6. The 1% turbine operating range at Little Goose Dam for units 1-3 with extended-length submersible bar screens installed.

Head (ft)	Lower Generator Limits (MW)	(CFS)	Upper Generator Limits (MW)	(CFS)
85	**69.6**	**11,396**	**111.5**	**18,269**
86	70.3	11,381	113.7	18,402
87	71.1	11,366	115.9	18,531
88	71.9	11,351	118.1	18,657
89	72.6	11,336	120.3	18,779
90	**73.4**	**11,322**	**122.5**	**18,898**
91	74.3	11,313	122.9	18,717
92	75.1	11,304	123.2	18,540
93	76.0	11,295	123.6	18,367
94	76.9	11,285	123.9	18,197
95	**77.7**	**11,276**	**124.3**	**18,031**
96	78.8	11,294	124.4	17,841
97	79.8	11,312	124.6	17,654
98	80.9	11,329	124.7	17,472
99	81.9	11,346	124.8	17,293
100	**82.9**	**11,361**	**125.0**	**17,117**
101	83.8	11,363	126.6	17,163
102	84.7	11,364	128.3	17,207
103	85.6	11,365	129.9	17,250
104	86.5	11,367	131.6	17,293
105	**87.4**	**11,367**	**133.2**	**17,334**

Note: This table is based on the 2003 index test of U3 and the 1962 turbine model test.

Table LGS-7. The 1% turbine operating range at Little Goose Dam for units 1-3 without extended-length submersible bar screens.

Head (ft)	Lower Generator Limits (MW)	(CFS)	Upper Generator Limits (MW)	(CFS)
85	**70.5**	**11,320**	**124.5**	**20,006**
86	71.3	11,305	127.0	20,152
87	72.0	11,290	129.5	20,293
88	72.8	11,276	131.9	20,431
89	73.6	11,262	134.4	20,566
90	**74.4**	**11,247**	**136.9**	**20,696**
91	75.3	11,239	137.3	20,499
92	76.1	11,230	137.7	20,306
93	77.0	11,221	138.0	20,116
94	77.9	11,212	138.4	19,931
95	**78.7**	**11,203**	**138.8**	**19,750**
96	79.8	11,222	139.0	19,541
97	80.9	11,240	139.1	19,338
98	81.9	11,257	139.3	19,138
99	83.0	11,274	139.4	18,942
100	**84.0**	**11,290**	**139.6**	**18,751**
101	84.9	11,291	141.4	18,801
102	85.8	11,293	143.3	18,850
103	86.7	11,294	145.1	18,897
104	87.6	11,295	147.0	18,944
105	**88.5**	**11,296**	**148.8**	**18,989**

Note: This table is based on the 2003 index test of U3 and the 1962 turbine model test.

Table LGS-8. The 1% turbine operating range at Little Goose Dam for units 4-6 with extended-length submersible bar screens installed.

Head (ft)	Lower Generator Limits (MW)	(CFS)	Upper Generator Limits (MW)	(CFS)
85	**87.1**	**13,880**	**119.6**	**19,076**
86	88.2	13,890	121.3	19,102
87	89.3	13,899	122.9	19,127
88	90.5	13,908	124.6	19,151
89	91.6	13,916	126.3	19,174
90	**92.8**	**13,924**	**127.9**	**19,196**
91	93.9	13,925	129.4	19,193
92	95.0	13,925	130.9	19,190
93	96.1	13,926	132.4	19,186
94	97.2	13,926	133.9	19,183
95	**98.3**	**13,926**	**135.3**	**19,179**
96	99.2	13,898	135.8	19,038
97	100.0	13,871	136.3	18,900
98	100.9	13,844	136.8	18,765
99	101.8	13,818	137.3	18,633
100	**102.7**	**13,791**	**137.8**	**18,503**
101	103.9	13,821	139.1	18,503
102	105.2	13,849	140.5	18,503
103	106.4	13,878	141.9	18,503
104	107.7	13,905	143.3	18,503
105	**108.9**	**13,932**	**144.6**	**18,503**

Note: This table is based on the 2003 index test of U4 and the 1975 turbine model test.

Table LGS-9. The 1% turbine operating range at Little Goose Dam for units 4-6 without extended-length submersible bar screens.

Head (ft)	Lower Generator Limits (MW)	(CFS)	Upper Generator Limits (MW)	(CFS)
85	**86.4**	**13,479**	**122.2**	**19,052**
86	87.6	13,488	123.9	19,078
87	88.7	13,497	125.6	19,104
88	89.8	13,506	127.2	19,128
89	91.0	13,514	128.9	19,151
90	**92.1**	**13,522**	**130.6**	**19,174**
91	93.2	13,523	132.1	19,171
92	94.3	13,524	133.7	19,168
93	95.4	13,524	135.2	19,165
94	96.5	13,525	136.7	19,162
95	**97.6**	**13,525**	**138.2**	**19,158**
96	98.4	13,498	138.7	19,018
97	99.3	13,472	139.2	18,880
98	100.2	13,446	139.7	18,745
99	101.1	13,420	140.2	18,613
100	**101.9**	**13,395**	**140.7**	**18,484**
101	103.2	13,423	142.1	18,484
102	104.4	13,451	143.5	18,484
103	105.7	13,478	144.9	18,484
104	106.9	13,505	146.3	18,484
105	**108.1**	**13,532**	**147.7**	**18,484**

Note: This table is based on the 2003 index test of U4 and the 1975 turbine model test.

4.3. Turbine Unit Maintenance. The project turbine unit maintenance schedule will be reviewed annually by project and Operations Division biologists for fish impacts. If possible, maintenance of priority units will be scheduled for non-fish passage periods, or when there are low numbers of fish passing the project. Each turbine unit requires annual maintenance that may take from several days to two weeks. Annual maintenance of all turbine units is normally scheduled during the mid-July to late November time frame. The maintenance of priority units for adult passage is normally conducted in mid-August, when fewer adults are migrating, to minimize impacts on migrating adults. Turbine units may occasionally require overhauls to repair major problems with the turbine or generator. Overhauls may take over one year to accomplish. Turbine units, governors, exciters, and control systems require periodic maintenance, calibration, and testing which may take them outside of the one percent best efficiency range. This work will be scheduled in compliance with BPA load shaping guidelines (**Appendix C**) to minimize impacts on juvenile fish. Transformers are Doble tested every 3 years. Testing may need to be more frequent if there is a known problem with a transformer. These tests normally take 2 to 3 workdays. To conduct the testing, the transmission lines have to be disconnected from the transformers and normal generation stopped. One turbine unit will operate in a speed-no-load condition to provide project power and operation of fish passage facilities. Spill may be provided to meet minimum required project discharges during the testing hours. The Doble tests are normally scheduled for the August or early September time period to minimize impacts on adult and juvenile fish passage.

4.3.1. Turbine units are to be operated with raised operating gates to improve fish passage conditions when ESBSs are installed, except as provided below. To facilitate annual maintenance, operating gates are used to dewater the turbine units. To minimize turbine outage periods to the actual time required for maintenance (during the July 1 through December 15 time period), operating gates in one turbine unit may be lowered to the standard operating position and connected to hydraulic cylinders on the afternoon of the last regular workday (normally Thursday) prior to the start of the maintenance. With the operating gates in the standard operating position, the turbine unit may be operated until 0700 hours of the next regular workday (normally Monday) with generation loads restricted to 100 MWs or less. On the completion of maintenance, the turbine unit can be operated with the operating gates in the standard operating position at 100 MWs or less until 0700 hours of the first regular workday after the maintenance is completed. The project biologist will be notified when the operating gates are set in the standard operating position. The gatewells will be monitored 2 times per day to observe fish condition while the operating gates are in the standard operating position. If turbine maintenance or the raising of the operating gates to the raised operating position is delayed after the time periods stated above, the turbine unit shall be immediately taken out of service until the work can be accomplished. Operation of turbine units with operating gates in the standard operating position shall be restricted to the July 1 through December 15 time period, and shall not occur unless at least 4 other turbine units are available for service. No more than 1 turbine unit at a time shall be operated with operating gates in the standard operating position and the turbine unit will be operated on last on, first off operating priority.

4.3.2. Unwatering turbine units should be accomplished in accordance with project dewatering plans. Prior to dewatering a turbine unit for maintenance, the turbine unit should be spun at speed-no-load, if possible, immediately before installing tailrace stoplogs and headgates to minimize the number of fish in the draft tube and scroll case. If a turbine unit is out of service for maintenance for an extended period of time without tailrace stoplogs in place, efforts should be made to not open the wicket gates if the scroll case must be dewatered at a later date without the unit being spun beforehand.

5. Forebay Debris Removal. Debris at projects can impact fish passage conditions. Debris can plug or block trashracks, VBSs, gatewell orifices, dewatering screens, separators, and facility piping resulting in impingement, injuries, and descaling of fish. Removing debris at its source in the forebay is sometimes necessary to maintain safe and efficient fish passage conditions, navigation, and other project activities. Debris can be removed from the forebay by: physically encircling the debris with log booms and pulling it to shore with boats where it can be removed with a crane, removing the debris from the top of the dam using a crane and scoop, or passing the debris through the spillway with special powerhouse operations and spill. The preferred option is to remove debris at each project when possible to avoid passing debris on to the next project downstream. This is not always possible at each project as some projects do not have forebay debris removal capability. In this case, the only viable alternative is to spill to pass the debris.

5.1. All special spills (other than normal spill patterns for ongoing spill operations) and project operations for passing debris will be coordinated prior to the operations taking place. Each project shall contact CENWW-OD-T at least two workdays prior to the day they want the special project operations for spilling to pass debris. CENWW-OD-T shall coordinate the special operations with RCC, NOAA Fisheries, and other FPOM participants. Project personnel shall provide CENWW-OD-T the reason for the debris spill request including an explanation of project facilities being impacted by the debris, the date and time of the requested spill, and any special powerhouse or other operations required to move the debris to the spillway. When a debris spill is coordinated and approved, RCC shall issue a teletype detailing the specifics of the special operations.

Table LGS-10. Little Goose Dam spill pattern for adult fish passage and for minimizing total dissolved gas levels (based on pool elevation 637).

Spill Bay								Total Stops	Total Spill
1	2	3	4	5	6	7	8		
0	1						0	1	1.8
0	1	1					0	2	3.6
0	1	1	1				0	3	5.5
0	1	1	1	1			0	4	7.3
0	1	1	1	1	1		0	5	9.1
0	1	1	1	1	1	1	0	6	10.9
0	2	1	1	1	1	1	0	7	12.9
0	2	2	1	1	1	1	0	8	14.8
0	2	2	2	1	1	1	0	9	16.8
0	2	2	2	2	1	1	0	10	18.8
0	2	2	2	2	2	1	0	11	20.7
0	2	2	2	2	2	2	0	12	22.7
0	3	2	2	2	2	2	0	13	24.7
0	3	3	2	2	2	2	0	14	26.8
0	3	3	3	2	2	2	0	15	28.9
0	3	3	3	3	2	2	0	16	30.9
0	3	3	3	3	3	2	0	17	33.0
0	3	3	3	3	3	3	0	18	35.0
0	4	3	3	3	3	3	0	19	37.0
0	4	4	3	3	3	3	0	20	39.1
0	4	4	4	3	3	3	0	21	41.2
0	4	4	4	4	3	3	0	22	43.2
0	4	4	4	4	4	3	0	23	45.2
0	4	4	4	4	4	4	0	24	47.3
0	5	4	4	4	4	4	0	25	49.3
0	5	5	4	4	4	4	0	26	51.3
0	5	5	5	4	4	4	0	27	53.4
0	5	5	5	5	4	4	0	28	55.4
0	5	5	5	5	5	4	0	29	57.4
0	5	5	5	5	5	5	0	30	59.5
0	6	5	5	5	5	5	0	31	61.5
0	6	6	5	5	5	5	0	32	63.5
0	6	6	6	5	5	5	0	33	65.6
0	6	6	6	6	5	5	0	34	67.6
0	6	6	6	6	6	5	0	35	69.7
0	6	6	6	6	6	6	0	36	71.7
0	7	6	6	6	6	6	0	37	73.7
0	7	7	6	6	6	6	0	38	75.7
0	7	7	7	6	6	6	0	39	77.7
0	7	7	7	7	6	6	0	40	79.7
0	7	7	7	7	7	6	0	41	81.8

Table LGS-10. Little Goose Dam spill pattern for adult fish passage and for minimizing total dissolved gas levels (Continued).

Spill Bay								Total Stops	Total Spill
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**		
0	7	7	7	7	7	7	0	42	83.9
0	8	7	7	7	7	7	0	43	85.9
0	8	8	7	7	7	7	0	44	87.8
0	8	8	8	7	7	7	0	45	89.9
0	8	8	8	8	7	7	0	46	91.9
0	8	8	8	8	8	7	0	47	94.0
0	8	8	8	8	8	8	0	48	96.0
0	9	8	8	8	8	8	0	49	98.0
0	9	9	8	8	8	8	0	50	100.0
0	9	9	9	8	8	8	0	51	102.0
0	9	9	9	9	8	8	0	52	104.0
0	9	9	9	9	9	8	0	53	106.0
0	9	9	9	9	9	9	0	54	108.1
0	10	9	9	9	9	9	0	55	110.1
0	10	10	9	9	9	9	0	56	112.2
0	10	10	10	9	9	9	0	57	114.3
0	10	10	10	10	9	9	0	58	116.4
0	10	10	10	10	10	9	0	59	118.5
0	10	10	10	10	10	10	0	60	120.5
0	11	10	10	10	10	10	0	61	122.6
0	11	11	10	10	10	10	0	62	124.7
0	11	11	11	10	10	10	0	63	126.8
0	11	11	11	11	10	10	0	64	128.9
0	11	11	11	11	11	10	0	65	131.0
0	11	11	11	11	11	11	0	66	133.0
0	12	11	11	11	11	11	0	67	135.2
0	12	12	11	11	11	11	0	68	137.3
0	12	12	12	11	11	11	0	69	139.4
0	12	12	12	12	11	11	0	70	141.5
0	12	12	12	12	12	11	0	71	143.6
0	12	12	12	12	12	12	0	72	145.7
0	13	12	12	12	12	12	0	73	147.8
0	13	13	12	12	12	12	0	74	149.9
0	13	13	13	12	12	12	0	75	152.0
0	13	13	13	13	12	12	0	76	154.1
0	13	13	13	13	13	12	0	77	156.1
0	13	13	13	13	13	13	0	78	158.2
0	14	13	13	13	13	13	0	79	160.3
0	14	14	13	13	13	13	0	80	162.4
0	14	14	14	13	13	13	0	81	164.5
0	14	14	14	14	13	13	0	82	166.5

Table LGS-10. Little Goose Dam spill pattern for adult fish passage and for minimizing total dissolved gas levels (Continued).

Spill Bay								Total Stops	Total Spill
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**		
0	14	14	14	14	14	13	0	83	168.6
0	14	14	14	14	14	14	0	84	170.7
0	15	14	14	14	14	14	0	85	172.8
0	15	15	14	14	14	14	0	86	174.8
0	15	15	15	14	14	14	0	87	176.9
0	15	15	15	15	14	14	0	88	178.9
0	15	15	15	15	15	14	0	89	181.0
0	15	15	15	15	15	15	0	90	183.1
0	16	15	15	15	15	15	0	91	185.1
0	16	16	15	15	15	15	0	92	187.2
0	16	16	16	15	15	15	0	93	189.2
0	16	16	16	16	15	15	0	94	191.3
0	16	16	16	16	16	15	0	95	193.4
0	16	16	16	16	16	16	0	96	195.4

Note: New spill patterns will be provided for Little Goose prior to the initiation of spill on April 3, 2007.

Table LGS-11. Little Goose Tapered Bulk Spill Pattern for fish research and general use during 2007 season (pool elevation 634). * indicates notes below.**

Spill Bay								Total Stops	Total Spill
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**		
0	3						0	3	5.7
0	4						0	4	7.7
0	4	1					0	5	9.4
1	4	1					0	6	11.2
1	4	2					0	7	13.1
1	5	2					0	8	15.1
1	5	3					0	9	17.1
1	5	3	1				0	10	18.9
1	5	4	1				0	11	20.8
1	5	4	2				0	12	22.8
1	5	4	3				0	13	24.8
1	5	5	3				0	14	26.7
1	5	5	3	1			0	15	28.5
1	5	5	3	2			0	16	30.4
1	5	5	3	3			0	17	32.4
0	5	4	3	3	2	1	0	***18**	34.1
0	5	4	3	3	2	2	0	19	36.0
0	5	4	3	3	3	2	0	20	38.0
0	5	4	3	3	3	3	0	****21**	40.0
0	5	4	4	3	3	3	0	22	42.0
0	5	4	4	4	3	3	0	23	44.0
0	5	4	4	4	4	3	0	24	46.0
0	5	4	4	4	4	4	0	*****25**	47.9
0	5	5	4	4	4	4	0	26	49.9
0	5	5	5	4	4	4	0	27	51.9
0	5	5	5	5	4	4	0	28	53.9
0	5	5	5	5	5	4	0	29	55.9
0	5	5	5	5	5	5	0	30	57.8
0	6	5	5	5	5	5	0	31	59.8
0	6	6	5	5	5	5	0	32	61.8
0	6	6	6	5	5	5	0	33	63.8
0	6	6	6	6	5	5	0	34	65.7
0	6	6	6	6	6	5	0	35	67.7
0	6	6	6	6	6	6	0	36	69.7
0	7	6	6	6	6	6	0	37	71.6
0	7	7	6	6	6	6	0	38	73.6
0	7	7	7	6	6	6	0	39	75.5
0	7	7	7	7	6	6	0	40	77.5
0	7	7	7	7	7	6	0	41	79.4
0	7	7	7	7	7	7	0	42	81.4

Table LGS-11. Little Goose Tapered Bulk Spill Pattern for fish research and general use during 2007 season (Continued).

Spill Bay								Total Stops	Total Spill
1	2	3	4	5	6	7	8		
0	8	7	7	7	7	7	0	43	83.3
0	8	8	7	7	7	7	0	44	85.3
0	8	8	8	7	7	7	0	45	87.3
0	8	8	8	8	7	7	0	46	89.3
0	8	8	8	8	8	7	0	47	91.3
0	8	8	8	8	8	8	0	48	93.2
0	9	8	8	8	8	8	0	49	95.2
0	9	9	8	8	8	8	0	50	97.1
0	9	9	9	8	8	8	0	51	99.1
0	9	9	9	9	8	8	0	52	101.0
0	9	9	9	9	9	8	0	53	102.9
0	9	9	9	9	9	9	0	54	104.9
0	10	9	9	9	9	9	0	55	106.9
0	10	10	9	9	9	9	0	56	108.9
0	10	10	10	9	9	9	0	57	110.9
0	10	10	10	10	9	9	0	58	113.0
0	10	10	10	10	10	9	0	59	115.0
0	10	10	10	10	10	10	0	60	117.0
0	11	10	10	10	10	10	0	61	119.0
0	11	11	10	10	10	10	0	62	121.1
0	11	11	11	10	10	10	0	63	123.1
0	11	11	11	11	10	10	0	64	125.1
0	11	11	11	11	11	10	0	65	127.2
0	11	11	11	11	11	11	0	66	129.2
0	12	11	11	11	11	11	0	67	131.2
0	12	12	11	11	11	11	0	68	133.2
0	12	12	12	11	11	11	0	69	135.3
0	12	12	12	12	11	11	0	70	137.3
0	12	12	12	12	12	11	0	71	139.3
0	12	12	12	12	12	12	0	72	141.4
0	13	12	12	12	12	12	0	73	143.4
0	13	13	12	12	12	12	0	74	145.4
0	13	13	13	12	12	12	0	75	147.4
0	13	13	13	13	12	12	0	76	149.4
0	13	13	13	13	13	12	0	77	151.4
0	13	13	13	13	13	13	0	78	153.4
0	14	13	13	13	13	12	0	79	155.4
0	14	14	13	13	13	13	0	80	157.4
0	14	14	14	13	13	13	0	81	159.4
0	14	14	14	14	13	13	0	82	161.4
0	14	14	14	14	14	13	0	83	163.4

Table LGS-11. Little Goose Tapered Bulk Spill Pattern for fish research and general use during 2007 season (Continued).

Spill Bay								Total Stops	Total Spill
1	2	3	4	5	6	7	8		
0	14	14	14	14	14	14	0	84	165.4
0	15	14	14	14	14	14	0	85	167.4
0	15	15	14	14	14	14	0	86	169.4
0	15	15	15	14	14	14	0	87	171.4
0	15	15	15	15	14	14	0	88	173.4
0	15	15	15	15	15	14	0	89	175.4
0	15	15	15	15	15	15	0	90	177.4
0	16	15	15	15	15	15	0	91	179.3
0	16	16	15	15	15	15	0	92	181.3
0	16	16	16	15	15	15	0	93	183.3
0	16	16	16	16	15	15	0	94	185.2
0	16	16	16	16	16	15	0	95	187.2
0	16	16	16	16	16	16	0	96	189.2

Notes:

1. The total river discharges shown in this table assume 30% spill. Actual total discharge (and thus % spill) may vary slightly for a given spill pattern to keep turbines within 1% of peak efficiency.

2.* This is the spill level (18 total stops or 34.1 kcfs) where the spill pattern starts transitioning from a tapered bulk spill pattern to a uniform spill pattern, with 5 stops retained in Bay 2 to simulate an RSW. This will require 4 spillway gate setting changes between 17 and 18 total stops, rather than just 1. The intent is to transition between the tapered bulk spill pattern and the uniform spill pattern by the time the gas cap is reached.

3.** This is the spill level (21 total stops or 40.0 kcfs) where the spill pattern reaches a nominal uniform spill pattern, with 5 stops retained in Bay 2 to simulate an RSW. This assumes the gas cap will be reached at about 40 kcfs spill discharge. If the actual gas cap is less than 40 kcfs spill, use the spill pattern in this table for the actual gas cap spill discharge, with a larger powerhouse discharge, rather than defaulting to a uniform spill pattern. This will result is less than 30% spill, but is deemed more desirable than disrupting the spill pattern.

4.*** This the approximate powerhouse discharge (110 kcfs) at which full powerhouse capacity is reached, with 6 turbine units operating within 1% peak efficiency rules. This is the maximum river discharge for which 30% spill can be maintained; above this will be a higher % spill.

5. Discharge estimates shown in this table are based on a forebay elevation of 634.0 ft.

6. Once the spill pattern starts transitioning to a uniform spill pattern for gas cap purposes, Bays 1 and 8 are not operated because there are no spillway deflectors in those bays.

7. Powerhouse unit priority should be 1 - 6. If more than one unit is operating, maximize discharge through the southernmost units, starting with Unit 1, to the extent possible without violating 1% peak efficiency rules (e.g.: If powerhouse discharge is 26.0 kcfs, operate Unit 1 at 14.7 kcfs and Unit 2 at 11.3 kcfs, rather than both at 13.0 kcfs.

Section 9 Lower Granite Dam

Lower Granite Dam

1. Fish Passage Information. The locations of fish passage facilities at Lower Granite Lock and Dam are shown in **Figure LWG-1**. Dates of project operations for fish purposes and special operations are listed in **Table LWG-2**.

1.1. Juvenile Fish Passage.

1.1.1. Facilities Description. The Lower Granite juvenile facilities consist of a bypass system and juvenile transportation facilities. The bypass system contains extended length submersible bar screens with flow vanes, improved modified balanced flow vertical barrier screens, gatewell orifices, a bypass channel running the length of the powerhouse, and a bypass pipe to transport the fish to the transportation facilities or to the river. The transportation facilities include an upwell and separator structure to separate the juveniles from the excess water and adult fish, raceways for holding fish, a distribution system for distributing the fish among the raceways or to the barge or back to the river, a sampling and marking building, truck and barge loading facilities, and PIT tag detection and deflection systems.

1.1.2. Juvenile Migration Timing. Juvenile migration timing at Lower Granite Dam is indicated in Table LWG-2. The dates in the table are based on juvenile fish collection numbers and do not reflect FGE or spill passage. Salmon, steelhead, bull trout, lamprey, and other species are routinely counted. Maintenance of juvenile fish passage facilities that may impact juvenile fish passage or facility operations should be conducted during the winter maintenance season.

Table LWG-1. Juvenile migration timing at Lower Granite Dam based on juvenile fish collection numbers.

% Collection	2003	2004	2005	2006	2007
Clipped Yearling Chinook					
10%	4/23	4/25	4/27	4/24	4/21
90%	5/18	5/10	5/10	5/14	5/13
Unclipped Yearling Chinook					
10%	4/14	4/18	4/19	4/3	4/15
90%	5/26	5/22	5/16	5/18	5/15
Sub-yearling Chinook					
10%	6/4	6/8	5/29	5/26	6/3
90%	7/16	7/14	6/17	7/4	7/12
Clipped Steelhead					
10%	4/25	4/27	4/26	4/21	4/28
90%	5/28	5/24	5/16	5/19	5/20
Unclipped Steelhead					
10%	4/19	4/29	4/27	4/19	5/1
90%	5/30	5/24	5/20	5/20	5/21

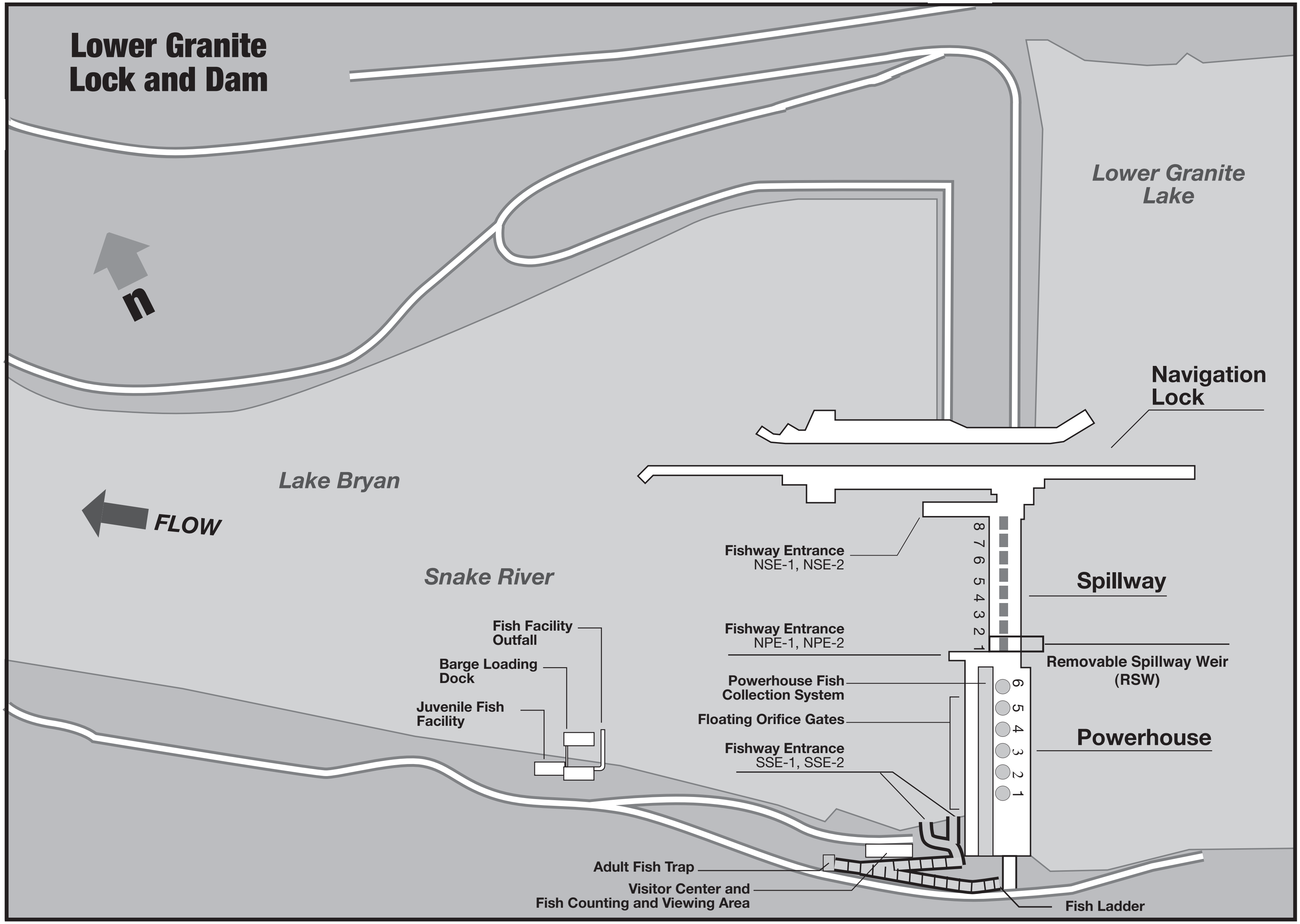
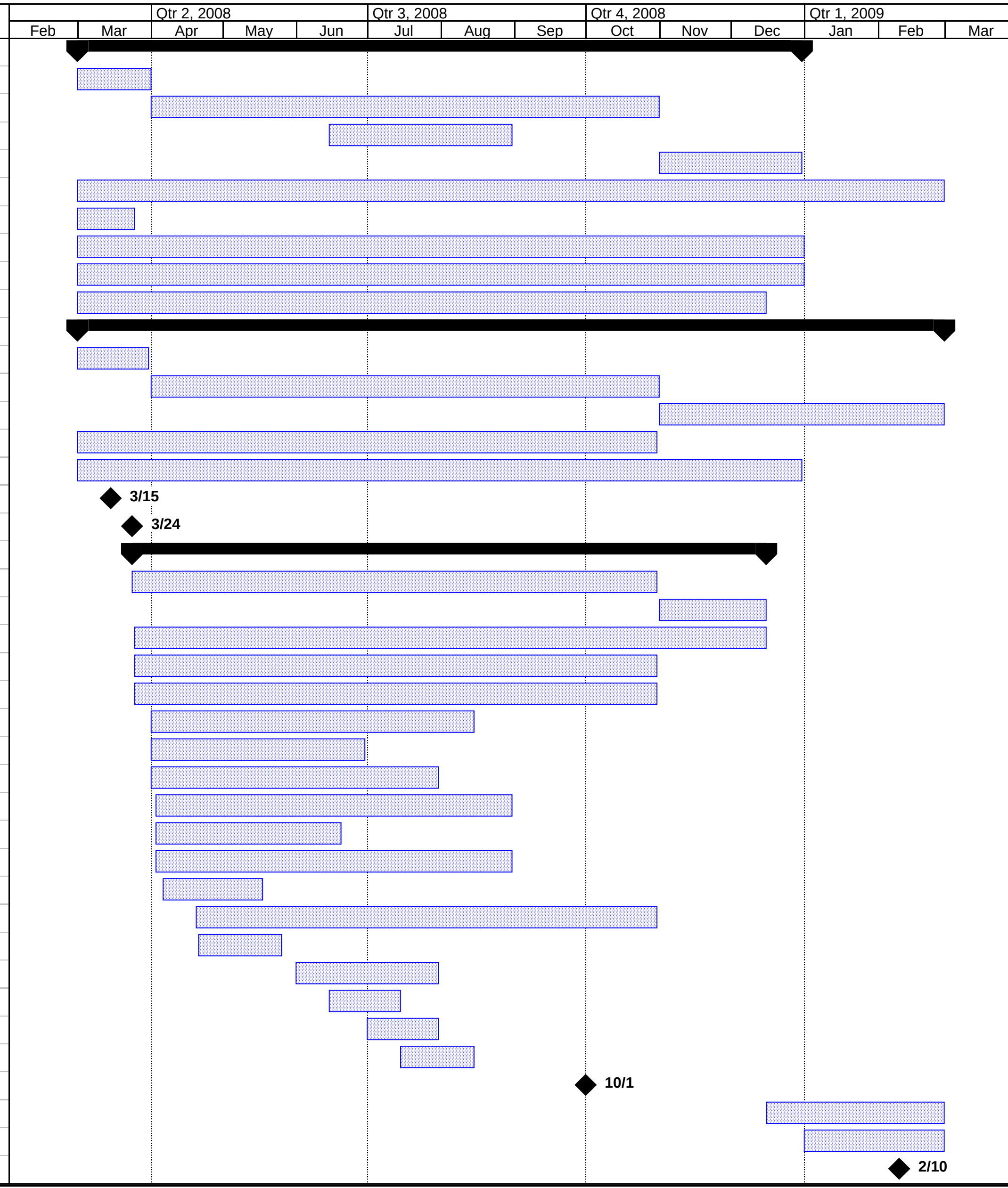


Figure LWG-1 Lower Granite Lock and Dam general site plan.

Table LWG-2. Dates of project operations for fish purposes at Lower Granite, 2008-9

March 2008

Task Name	Start	Finish	FPP Reference
Adult Fish Counting	**3/1/08**	**12/31/08**	**Lwg 1.2.2**
Video 0600 - 1600 PST	3/1/08	3/31/08	Lwg 1.2.2
Visual 0400 - 2000 PST	4/1/08	10/31/08	Lwg 1.2.2
Video 2000 - 0400 PST	6/15/08	8/31/08	Lwg 1.2.2
Video 0600 - 1600 PST	11/1/08	12/31/08	Lwg 1.2.2
TDG Monitoring	3/1/08	2/28/09	App D Table 4
Winter Maintenance Period Juvenile	3/1/08	3/24/08	Lwg 2.3.1.1.
Adult Fish Passage Period	3/1/08	12/31/08	Lwg 2.3.2.2
Weekly Reports	3/1/08	12/31/08	Lwg 2.3.3.1
Operate Turbines for Fish Passage	3/1/08	12/15/08	Lwg 4.1
1% limitations	**3/1/08**	**2/28/09**	**Lwg 4.1.1**
1% Soft	3/1/08	3/31/08	Lwg 4.1.1
1% Hard	4/1/08	10/31/08	Lwg 4.1.1
1% Soft	11/1/08	2/28/09	Lwg 4.1.1
Turbine Unit 2 Repair	3/1/08	10/31/08	App A Lwg 1.2
Evaluate Adults Holding in Fish Ladder	3/1/08	12/31/08	App A Lwg 2.5
Final Report	3/15/08	3/15/08	Lwg 2.3.3.4
ESBS Installed in 4 units	3/24/08	3/24/08	Lwg 2.3.1.1.b.6
Operate juvenile facilities	**3/24/08**	**12/15/08**	**Lwg 2.3.1**
Operate for Juvenile Fish Passage	3/24/08	10/31/08	Lwg 2.3.1
Operate for Adult Fallback	11/1/08	12/15/08	Lwg 2.3.1
Juvenile Passage Period	3/25/08	12/15/08	Lwg 2.3.1.2
Estimate of hydrosystem latent mortality	3/25/08	10/31/08	App A Lwg 2.4
Survival of In-river & Transported Chinook	3/25/08	10/31/08	App A Lwg 2.6
Back flush orifices once per shift	4/1/08	8/15/08	Lwg 2.3.1.2.c.6
Measure Head Differentials Weekly	4/1/08	6/30/08	Lwg 2.3.1.2.b.8
Arc Flash	4/1/08	7/31/08	App A Lwg 1.7
Spill for fish	4/3/08	8/31/08	App E
Performance of Acoustic-tagged and PIT-tagged	4/3/08	6/20/08	App A Lwg 2.2
Bull Trout Pit Tag Study	4/3/08	8/31/08	App A Lwg 2.7
Compare seasonal SARs of early in-river migrati	4/6/08	5/18/08	App A Lwg 2.3
Juvenile Fish Transportation	4/20/08	10/31/08	App B 3
Alternate Barge Release Strategies	4/21/08	5/26/08	App A Lwg 2.1
Main Unit Fire Protection	6/1/08	7/31/08	App A Lwg 1.4
Turbine Unit 3 Cavitation Repair	6/15/08	7/15/08	App A Lwg 1.3
Main Unit Breaker Replacement	7/1/08	7/31/08	App A Lwg 1.6
Power System Stabilizer Install	7/15/08	8/15/08	App A Lwg 1.5
1/2 ESBS may be pulled	10/1/08	10/1/08	Lwg 2.3.1.2.b.6
Winter Maintenance Period Juvenile	12/16/08	2/28/09	Lwg 2.3.1.1.
Maintenance of Adult Facilities	1/1/09	2/28/09	Lwg 1.2.2
Draft Final Report	2/10/09	2/10/09	Lwg 2.3.3.4



1.2. Adult Fish Passage.

1.2.1. Facilities Description. The adult fish passage facilities at Lower Granite are made up of one fish ladder on the south shore, two south shore entrances, a powerhouse collection system, north shore entrances with a transportation channel underneath the spillway to the powerhouse collection system, and an auxiliary water supply system. The powerhouse collection system is comprised of four operating floating orifices, two downstream entrances and one side entrance into the spillway basin on the north end of the powerhouse, and a common transportation channel. Four of the floating orifices and the two downstream entrances at the north end of the collection system are operated. The north shore entrances are made up of two downstream entrances and a side entrance into the spillway basin with the two downstream entrances normally used. The auxiliary water is supplied by three electric pumps that pump water from the tailrace. Two pumps are normally used to provide the required flows. Four weirs in the upper end of the ladder were outfitted with PIT tag detectors in early 2003.

1.2.2. Adult Migration Timing. Upstream migrants are present at Lower Granite Dam throughout the year and adult passage facilities are operated year round. Maintenance of adult fish facilities is scheduled for January and February to minimize impacts on upstream migrants. Facilities are usually shut down one shore at a time for maintenance. Adult fish (salmon, steelhead, shad, and lamprey) are counted as per **Table LWG-3;** these data appear daily on the Corps adult count website. Salmon migration timing data appear in **Table LWG-4**. Sturgeon and bull trout are also counted and recorded on the WDFW fish counters' daily summary sheet comments section; and these data are summarized in the Annual Fish Passage Report, but do no appear on the Corps daily website total due to relative infrequency of passage.

Table LMN-3. Adult fish counting schedule at Little Goose Dam.

Period	Counting Method
March 1 to March 31	Video 0600-1600
April 1 – October 31	Visual count 0400 - 2000 PST
June 15- August 31	Night video counts 2000-0400
November 1- December 31	Video count 0600-1600

Table LWG-4. Adult migration timing at Lower Granite Dam from 1975-2007 based on fish counts.

Species	Counting Period	Date of Peak Passage	
		Earliest	Latest
Spring Chinook	3/1 - 6/17	4/26	5/27
Summer Chinook	6/18 - 8/17	6/18	7/17
Fall Chinook	8/18 - 12/15	9/5	10/6
Steelhead	3/1 - 12/15	9/3	10/16
Sockeye	3/1 - 12/15	7/1	7/19

2. Project Operation.

2.1. Spill Management. See the 2008 Fish Operations Plan (**Appendix E**) for more information.

2.1.1. Involuntary spill at Lower Granite is the result of river flow exceeding powerhouse capacity, insufficient generation loads to pass the river flow, turbine unit outages (forced or scheduled), or the failure of a key component of the juvenile fish passage facility which forces the project to spill to provide juvenile fish passage. Spill at Lower Granite shall be distributed in accordance with the spill patterns included at the end of this section, Tables LWG-9 and LWG-10. Special spills for juvenile fish passage will be provided as detailed in Appendixes A and E.

2.2. Dissolved Gas Management and Control. Total dissolved gas (TDG) levels at Lower Granite are monitored in accordance with the Dissolved Gas Monitoring Program, **Appendix D**.

2.3. Operating Criteria.

2.3.1. Juvenile Fish Passage Facilities. Operate from March 24 through October 31 for juvenile fish bypass, collection, and transportation and from November 1 through December 15 for bypassing adult fallbacks. Operate the juvenile facilities according to the criteria listed below and in Appendix B (Corps' Juvenile Fish Transportation Program Operating Criteria) for the bypassing, collection, and transportation of juvenile salmonids. The transportation program may be revised in accordance with the ESA Section 10 permit and the NOAA Fisheries biological opinion. Project personnel shall retain the authority to dewater the juvenile fish collection system to the extent necessary to prevent frost damage to pipes and other structures during late fall and extended winter operations.

2.3.1.1. Winter Maintenance Period (December 16 through March 24). Check and perform maintenance as required on the items listed below.

a. Forebay Area and Intakes.

1. Remove debris from forebay and gatewell slots.

2. Rake trashracks just prior to the operating season.

3. Measure gatewell drawdown after cleaning trashracks and with ESBSs in.

4. Inspect and repair gatewell dipnet as needed.

b. Extended-Length Submersible Bar Screens (ESBSs), Flow Vanes, and Vertical Barrier Screens (VBSs).

1. Maintenance completed on all screens.

2. Inspect ESBSs prior to installation and operate debris cleaner (dogged off on deck) to ensure proper operation.

3. Log results of trial run.

4. Inspect all VBSs with an underwater video camera at least once per year. Repair as needed.

5. Inspect flow vanes to make sure they are in good condition and all surfaces smooth. Repair as needed.

6. ESBSs installed in at least 4 turbine units (all 6 if possible) by March 24. Remaining ESBSs installed prior to April 1.

c. Collection Channel.

1. Makeup water valves and float control equipment maintained and ready for operation.

2. Orifice lights are operational.

3. Orifices clean and valves operating correctly.

4. Orifice cycling and air backflush system works correctly.

d. Transportation Facilities.

1. 42" and 72" sluice gates maintained and operating correctly.

2. Inclined screen clean and in good condition with no holes in or damage to screen mesh, gaps around screen, or missing silicone.

3. Perforated plate smooth with no rough edges.

4. Wet separator and fish distribution system maintained and ready for operation.

5. Brushes and screens on crowders in good condition; no holes or rough edges.

6. Crowders maintained, tested, and operating correctly.

7. All valves, slide gates, and switch gates maintained and in good condition.

8. Retainer screens in place with no holes in screens or sharp wires protruding.

9. Barge and truck loading pipes should be free of debris, cracks, or blockages and barge loading boom maintained and tested.

10. All sampling equipment should be maintained and in good operating condition prior to watering up the facilities.

11. Maintain juvenile PIT tag system as required (see "Columbia Basin PIT Tag Information System, General Gate Maintenance and Inspection, Walla Walla District", February 2003). Coordinate with PSMFC.

12. Mini- and midi-tanks maintained and in good operating condition.

e. Barges.

1. All engines and pumps maintained and in good operating condition.

2. Fish release openings and related equipment in good operating condition.

3. No rough edges or support beams protruding into compartments.

4. No brass or galvanized fittings in circulation lines.

5. All loading hoses properly installed so fish will not hit sides of compartments or support beams when loading.

6. Loading hoses in good shape with rubber gaskets in cam lock fittings.

7. Inside edges of cam lock joints should be beveled to avoid sharp edges.

8. Warning systems tested and operational.

9. Provide net and/or deck covers.

10. Net pens maintained and installed in barge holds for transport of steelhead kelts or juveniles as required.

11. Deck wash systems fully operational.

12. Oxygen monitoring probes installed and tested; monitoring system operational.

f. Avian Predation Areas (Forebay and Tailrace). Inspect bird wires, water cannon, and other deterrent devices and repair or replace as needed. Where possible, add additional bird wires or other deterrent devices to cover areas of known avian predation activity. Prepare avian abatement contract as needed.

g. Maintenance Records. Record all maintenance and inspections.

2.3.1.2. Fish Passage Period (March 25 through December 15).

a. Forebay Area and Intakes.

1. Remove debris from forebay.

2. Inspect gatewell slots daily for debris, fish buildup, and contaminating substances (particularly oil). Clean gatewells before they become half covered with debris. If, due to the volume of the debris, it is not possible to keep the gatewell at least half clear, they should be cleaned at least once daily. If flows through an orifice, or fish conditions give indications that an orifice may be partially obstructed with debris, the orifice will be closed and backflushed to remove the obstruction. If the obstruction cannot be removed, the orifice shall be closed and the alternate orifice for that gatewell slot shall be operated. If both orifices become obstructed or plugged with debris, the turbine unit will not be operated until the gatewell and orifices are cleared of debris.

3. If a visible accumulation of contaminating substances is detected in a gatewell and it cannot be removed within 24 hours, the gatewell orifices shall be closed immediately and the turbine unit shut down within one hour until the material has been removed and any problems corrected. A preferred method for removing oil from the water surface is to install absorbent socks, booms, or pads capable of encapsulating the material, tied off with a rope for later disposal. Action should be taken as soon as possible to remove the oil from the gatewell so the orifice can be reopened to allow the fish to exit the gatewell. Orifices shall not be closed for longer than 48 hours.

4. Log drawdown differentials in bulkhead slots at least once per week.

5. Remove debris from forebay and trashracks as required to maintain less than 1' of additional drawdown in gate slots. Additional raking may be required when heavy debris loads are present in the river or if fish condition requires it.

6. Coordinate cleaning effort with personnel operating juvenile collection facilities.

7. Dip bulkhead gatewell slots to remove fish prior to installing bulkhead for dewatering bulkhead slot.

b. ESBSs, VBSs, and Operating Gates.

1. ESBSs and flow vanes installed in all operating turbine units by March 24.

2. Operate ESBSs with flow vanes attached to screen.

3. Operate ESBSs with debris cleaners in automatic mode. Set cleaning frequency as required to maintain clean screens and good fish condition. Change cleaning frequency as needed.

4. Inspect each ESBS once per month by means of underwater video in April, May, and June. Conduct similar inspections in August and October, focusing on at least three turbine units as the judgment of project personnel dictates. Spot check VBSs at the same time.

5. If an ESBS is damaged or fails during the juvenile fish passage season, follow procedures detailed under unscheduled maintenance of ESBSs (**see section 3.1.2.1**). In no case should a turbine unit be operated with a missing or a known non-operating or damaged ESBS, except as noted.

6. One-half of the ESBSs may be pulled after October 1 for maintenance as long as unscreened turbine units are not operated.

7. Make formal determination at end of season as to adequacy of ESBS bar screen panels and debris cleaner brush and replace components as necessary.

8. Measure head differentials across VBSs at least once per week from April 1 through June 30 (more frequently if required) and biweekly for the remainder of the operating season. Clean VBS when head differentials reach 1.5'. When a head differential of 1.5' is reached, the respective turbine unit should be operated at a reduced loading, not more than 110 MW, to minimize loading on the VBS and potential fish impingement. Clean VBSs as soon as possible after a 1.5' head differential is reached.

9. Inspect at least two VBSs in two different turbine units between the spring and summer migration periods. Both turbine units should have been operated frequently during the spring. If a debris accumulation is noted, inspect other VBSs and clean debris as necessary.

10. Turbine units are to be operated with *raised* operating gates to improve fish guidance efficiency when ESBSs are installed (March 25 through December 15), except as provided for in Section 4.3., Turbine Unit Maintenance.

c. Collection Channel.

1. Orifices clean and operating. Operate at least one orifice per gatewell slot (preferably the north orifice) unless a unit is scheduled out of service with non-operational fish screens. If the project is operating at MOP, additional orifices may be operated to maintain a full collection channel. *If orifices must be closed to repair any part of the facility, do not close orifices in operating turbine units with ESBSs in place for longer than 5 hours. If possible, keep to less than 3 hours.* Reduce turbine unit loading to the lower end of the 1% efficiency range if deemed necessary by the project biologist. Monitor fish conditions in gatewells hourly or more frequently during orifice closure periods.

2. Orifice lights operational and operating on open orifices. Orifice lights and area lights may be turned off the evening before the channel is dewatered at the end of the season (dewatering occurs on December 16 or later) to encourage fish to exit the channel volitionally. Area lights can be turned on briefly for personnel access if necessary.

3. Replace all burned out orifice lights within 24 hours of notification. Orifice lights shall remain lighted 24 hours/day.

4. Orifice jets hitting no closer than 3’ from back wall, collection channel full.

5. Rotate orifices in fish screens slots weekly (6 open).

6. Orifice valves are either fully open or closed.

7. Backflush orifices in the bulkhead slots every four hours and more frequently if required. During periods of high fish and debris passage, April 1 through August 15, orifices should be inspected and backflushed more frequently as determined by the project biologist, to keep orifices clean. If debris is causing continual orifice plugging problems in a particular turbine unit gatewell, the respective turbine unit generation may be restricted to the lower end of the 1% turbine efficiency range to minimize orifice plugging problems.

8. If utilizing the automatic orifice backflush system, inspect as determined by the project biologist (but at least once per 8-hour shift unless coordinated differently) to ensure that the orifices are opening and closing correctly and are clear of debris. The project biologist will determine the frequency of automatic orifice cycling and backflushing to maintain clear orifices.

9. Makeup water valves and associated float controls operational and maintaining stable channel flow.

d. Transportation Facilities.

1. 42" and 72" sluice gates operational; 42-inch separator remote controller switch fully operational.

2. Maintain stable water conditions in upwell and separator. No holes, broken wires, or gaps in inclined screen. Operate separator and fish distribution system as designed.

3. Crowder screen brushes should be maintained in good operating condition, with no holes or sharp edges on crowder screens. Crowders should be in good operating condition.

4. All valves, slide gates, and switch gates in and around separator and raceways operational.

5. Inspect raceway and tank retainer screens to make sure they are clean with no holes or protruding wire.

6. Barge and truck loading pipes, hoses, and related equipment free of debris, cracks, or blockages and in good condition. Barge loading boom in good operating condition. Barge loading boom remote control system fully operational.

7. Inform PSMFC, in advance if possible, of situations that cause the PIT tag system to become inoperable (e.g., power outages) or that could result in confounding the interpretation of PIT tag data (e.g., bypassing fish from raceways to the river, operating in primary bypass mode without an operational full-flow detector, emergency dewaterings).

e. Avian Predation Areas (Forebay and Tailrace).

1. Bird wires and other avian deterrent devices should be monitored to assure they are in good condition. Any broken wires or devices should be replaced as soon as possible.

2. Harassment program in place to deter avian predation in areas actively used by birds and not covered by bird wires or other devices.

3. Project biologists shall routinely monitor project areas to determine areas of active avian predation and, if possible, adjust harassment program to cover these areas or install bird wires or other deterrent devices to discourage avian predation activities.

f. Removable Spillway Weir (RSW).

1. When the RSW is in operation, the spillgate shall be raised to where it does not touch flow passing down the RSW (about nine stops).

2. When the NWS forecasts Lower Granite inflows to exceed 200,000 cfs, initiate aggressive forebay debris removal so that RSW operation will not be impeded and coordinate with RCC.

3. Initiate partial RSW stow (rotate down to 30-degree position) when Lower Granite inflows exceed 200,000 and when NWS forecasts inflows to exceed 240,000 cfs.

4. Complete RSW stow (complete rotation to the landing pad) when inflows exceed 260,000 cfs, upstream river gage flows are increasing, and the NWS forecasts Lower Granite inflow to exceed 300,000 cfs.

5. Operation of the RSW for short periods of time may be requested by the project biologist through CENWW during low flow years if it appears the juvenile fish transportation facility and barge holding capacities will be exceeded (refer to Appendix B, Juvenile Fish Transportation Plan, Section 4.d.(4)).

g. Inspection and Record Keeping.

1. Inspect fish facilities at least once every 8 hours. Inspect facilities according to fish facilities monitoring program.

2. Record all maintenance and inspections.

2.3.2. Adult Fish Passage Facilities. Operate the adult fish passage facilities according to the following criteria.

2.3.2.1. Winter Maintenance Period (January 1 through February 28).

a. Inspect all staff gages and water level indicators. Repair and/or clean where necessary.

b. Dewater the ladder and inspect all dewatered sections of fish facilities for projections, debris, or plugged orifices which could injure fish or impede fish passage up the ladder. The fish ladder exit trashrack must have smooth surfaces where fish pass, and must have downstream edges that are adequately rounded or padded. A spare trashrack should be on hand for use as necessary. Inspect all diffuser gratings and chambers, and the fallout fence, annually by dewatering or by using divers or video inspection techniques. All diffuser gratings and chambers are to be dewatered and physically inspected at least every 3 years. Repair deficiencies.

c. Inspect for and clean debris from the fish ladder exit. The trashrack and picketed leads must be clean and installed correctly.

d. Calibrate all water level measuring devices, as necessary, for proper facility operations.

e. Inspect all spill gates and ensure that they are operable.

f. Fish pumps maintained and ready for operation.

g. Maintain adult PIT tag system as required. Coordinate with PSMFC.

h. Maintain the adult fish trap as required.

i. Clean debris from the diffuser 14 trashrack (entrance). Check under the diffuser 14 ladder grating for debris accumulation and remove – if necessary. Check limit switch settings on diffuser 14 controller and ensure full operation.

2.3.2.2. Fish Passage Period (March 1 through December 31). Note: Little Goose pool may be operated at minimum operating pool (MOP), between elevations 633' and 634' msl, as part of the Corps' efforts to improve migration conditions for juvenile salmonids. This may result in some of the adult fishway entrances at Lower Granite bottoming out on their sills prior to reaching criteria depths. Continuous operation at MOP may also result in increased pumping head on the auxiliary water supply pumps, decreasing the amount of water supplied by the pumps. Fish pump 1 may be run at the "slow speed" setting to avoid frequent tripping from an overload condition while operating under MOP.

a. Fishway Ladder. Water depth over weirs: 1' to 1.3'.

b. Counting Window. The minimum counting slot width should be 18". All equipment should be maintained and in good condition. The counting window and backboard should be cleaned as needed to maintain good visibility.

c. Head on all Fishway Entrances. Head range: 1' to 2'.

d. North Shore Entrances (NSE 1 & 2). Elevation at top of gates when on sill = 625'.

1. Operate both downstream gates.

2. Weir depth: 7' or greater below tailwater.

e. North Powerhouse Entrances (NPE 1 & 2). Elevation at top of gates, on sill = 628'.

1. Operate both downstream gates.

2. Weir depth: 8' or greater below tailwater. At tailwaters below elevation 636', weirs should be on sill.

f. Floating Orifice Gates. Operate four floating orifices (numbers 1, 4, 7, and 10). Inspect fish fallout fence for debris buildup, holes, etc.

g. South Shore Entrances (SSE 1 & 2). Elevation of top of gates when on sill = 625'.

1. Operate both gates.

2. Weir depth: 8' or greater below tailwater.

h. Channel Velocity. 1.5' to 4' per second. At tailwaters below elevation 633' weirs should be on sill.

i. Tunnel Lights. Lights in the tunnel section under the spillway shall be on during fish passage period.

j. Head on Trashracks.

1. Maximum head of 0.5' on ladder exit.

2. Maximum head on picketed leads shall be 0.3'.

3. Trashrack and picketed leads installed correctly.

k. Staff Gages and Water Level Indicators. All staff gages should be readable at all water levels encountered during the fish passage period. Repair or clean as necessary.

l. Inform PSMFC, in advance if possible, of situations that cause the PIT tag system to become inoperable (e.g. power outages) or that could result in confounding the interpretation of PIT tag data (e.g. emergency dewaterings).

m. Facility Inspections.

1. Powerhouse operators shall inspect adult facilities once per day shift and check computer monitor information at least once during each back shift.

2. Project biologists shall inspect adult facilities at least three times per week. Inspect all facilities according to fish facilities monitoring program.

3. Picketed leads shall be checked during all inspections to ensure they are clean and in the correct position (all the way down).

4. Project personnel shall check calibration of fishway control system twice per month to ensure that it is kept within calibration. This may be done as part of routine fishway inspections. Deviations in readings should be reported to the electrical crew foreman for corrective action.

5. Inspect fishways daily for foreign substances (particularly oil). If substances are found, corrective actions should be undertaken immediately.

6. Record all inspections.

n. Adult Trap Holding Tanks. Protocols for operating the adult trap for research and other activities are covered in Appendix G. This criterion supplements that appendix and governs use of the holding tanks for research or broodstock collection and the water supply for the tanks. The water supply for the trap comes from the diffuser water supply at the top of the ladder and trap operations can affect the amount of water in the ladder proper. Operating all six holding tanks requires an estimated reservoir elevation of approximately 734.5 msl.

1. No holding tanks can be used prior to September 1 of each year if their usage affects the amount of water passing down the fish ladder and a water depth of less than 12 inches of water is maintained over the ladder weirs.

2. After September 1 of each year, the two smaller of the six holding tanks only may be used to hold adult fish, for hatchery broodstock or other research needs, if Lower Granite reservoir is operating within MOP (elevation 733 to 734 msl).

3. Additional holding tanks may be used if Lower Granite reservoir is raised to MOP+1 or greater and a water depth of 12 inches or greater over the ladder weirs is maintained as measured at the diffuser 14 staff gauge.

2.3.3. Facility Monitoring and Reporting. Project biologists shall inspect fish passage facilities at the frequencies listed in the juvenile and adult fish facilities operating criteria sections.

2.3.3.1. Project biologists shall prepare weekly reports, from March 1 through December 31, summarizing project operations. The weekly reports should provide an overview of how the project and the fish passage facilities operated during the week and an evaluation of resulting fish passage conditions.

2.3.3.2. The reports shall include:

a. Any out-of-criteria situations observed and subsequent corrective actions taken;

b. Any equipment malfunctions, breakdowns, or damage along with a summary of resulting repair activities;

c. Adult fishway control calibrations;

d. ESBS and VBS inspections;

e. Any unusual activities which occurred at the project which may affect fish passage.

2.3.3.3. The weekly reports shall cover a Friday through Thursday time period and shall be sent to CENWW-OD-T by noon the following Monday via electronic mail.

2.3.3.4. Project biologists shall prepare a draft annual Adult and Juvenile Monitoring Report by February 10 and a final report by March 15 summarizing the operation of the adult project fish passage facilities for the previous year and giving a brief overview of the juvenile fish operations.. The annual report shall also include a description of all actions taken to discourage avian predation at the project, with an overview of the effectiveness of the activities in discouraging avian predation.

2.3.3.5. Project biologists also inspect project facilities once per month and during dewaterings for the presence of zebra mussels. Biologists shall provide a report to CENWW-OD-T on a monthly basis summarizing zebra mussel inspections.

3. Project Maintenance. Project biologists should be present to provide technical guidance at all project activities that may involve fish handling. All dewaterings shall be accomplished in accordance with approved project dewatering and fish handling plans. When river temperatures reach 70 degrees Fahrenheit or greater, all adult fish handling will be coordinated through CENWW-OD-T. Dewatering and fish handling plans were reviewed and revised in 2000 to ensure that they comply with **Appendix F**, Guidelines for Dewatering and Fish Handling Plans.

3.1. Juvenile Fish Passage Facilities.

3.1.1. Scheduled Maintenance. Scheduled maintenance of the juvenile facilities is conducted throughout the year. Long-term maintenance or modifications of facilities, which require extended out of service periods, are conducted during the winter maintenance period from December 16 through March 24. During the fish passage season parts of the facilities are maintained on a daily, weekly, or longer interval to keep them in proper operating condition.

3.1.2. Unscheduled Maintenance. Unscheduled maintenance is the correction of any situation that prevents the facilities from operating according to criteria or that will impact fish passage or survival. Maintenance of facilities such as ESBSs, which sometimes break down during the fish passage season, will be carried out as described below. In these cases, repairs will be made as prescribed and CENWW-OD-T notified for further coordination. Unscheduled maintenance that will have a significant impact on juvenile fish passage shall be coordinated with NOAA Fisheries and other FPOM participants on a case-by-case basis by CENWW-OD-T. CENWW-OD-T will be notified as soon as possible after it becomes apparent that maintenance repairs are required. The Operations Manager has the authority to initiate work prior to notifying CENWW-OD-T when in his opinion delay of the work will result in an unsafe situation for people, property, or fish. Information required by CENWW-OD-T includes:

a. Description of the problem.

b. Type of outage required.

c. Impact on facility operation.

d. Length of time for repairs.

e. Expected impacts on fish passage and proposed measures to mitigate them.

3.1.2.1. Extended-length Submersible Bar Screens. The ESBSs are inspected periodically throughout the juvenile migration season with a video monitoring system. If a screen is found to be damaged or malfunctions at any time it will be removed and either replaced with a spare ESBS or repaired and returned to service. A turbine unit shall not be operated during the juvenile bypass season with a missing, known damaged, or non-operating ESBS (except as detailed below). If an ESBS fails on a weekend or at night when maintenance crews are not available, the respective turbine unit will be shut down and generation switched to another fully screened unit. If all screened turbine units are in service, water may be spilled until the effected ESBS can be removed and repaired or replaced.

During the spring runoff when river flows are at the level where taking a unit out of service and spilling will exceed the TDG limits allowed by state standards, project personnel may operate a turbine unit at <u>110 MWs or less</u> with a failed screen cleaner if there is evidence that the ESBS will not plug with debris. Evidence of this is a lack of debris in the gatewell and along the face of the powerhouse. This will only happen if an ESBS screen cleaner fails after 1400 hours on a regular workday or any time on a weekend. Project personnel will pull and replace the screen the next morning, weekday or weekend inclusive. If the screen cannot be pulled and repaired first thing the next morning, the turbine unit will be removed from service until the screen can be repaired. If there is evidence that fish are being injured under this operation, by either observing injured fish in the gatewells or injured fish appearing on the separator, the turbine unit will be removed from service immediately. This operation will not take place when daily average river flows are less than total powerhouse capacity and the turbine unit will not be operated during power peaking operations where turbine units are being turned on and off.

3.1.2.2. Gatewell Orifices. Each turbine intake has four orifices, two 10" orifices with air operated valves in the bulkhead slot and two 8" orifices with manually operated slide gates in the fish screen slot, for allowing the fish to exit the slots. Under normal operation, a total of 24 orifices are operated with 18 being bulkhead slot orifices and 6 being fish screen slot orifices. At least one orifice is open in each bulkhead slot with the fish screen slot orifices rotated. If high flow conditions in the collection gallery prevent the operation of all 24 previously mentioned orifices, priority shall be given to operating the 18 bulkhead slot orifices. With the exception of the condition where a turbine unit is out of service for an indefinite period of time (with fish screens non-operational and no fish being diverted into bulkhead slots), the six fish screen slot orifices shall be closed (as needed) prior to closing any bulkhead slot orifices. If an orifice becomes blocked with debris it will normally be cleaned and remain in operation. If an orifice is damaged, it will be closed and the alternate orifice for that gatewell operated until repairs can be made. If both orifices are blocked with debris, damaged, or must be kept closed, the turbine unit will be taken out of service until repairs can be made. If repairs are to take longer than 48 hours, juvenile fish will be dipped from the gatewell with a gatewell dip basket.

3.1.2.3. Bypass Pipe. The bypass pipe goes from the end of the powerhouse bypass channel to the transportation facilities downstream of the dam. All juvenile fish in the bypass system must pass through this to the transportation facilities or to the tailrace. If any part of the bypass pipe is damaged, the gatewell orifices will be closed and the bypass system dewatered until repairs can be made. *Turbine units will not be operated for longer than 5 hours with ESBSs in place and orifices closed. If possible, keep to less than 3 hours.* If an outage takes longer than 5 hours, spill will be provided to bypass juvenile fish. During any orifice closure, gatewells shall be monitored by project personnel for signs of fish problems or mortality. During periods of high fish passage, orifice closure times may be much less than 5 hours depending on fish numbers and condition.

3.1.2.4. Transportation Facilities. The transportation facilities can be operated to either collect and hold juveniles for the transportation program, and/or to bypass them back to the river. If part of the facility malfunctions or is damaged, efforts will first be made to bypass the fish around the damaged area. If this is not possible, the fish will be bypassed around the transportation facilities or the entire bypass system dewatered until repairs are made. Spill may be used as an alternative avenue for fish passage during a bypass system outage.

3.2. Adult Fish Passage Facilities.

3.2.1. Scheduled Maintenance. Scheduled maintenance of a facility that must be dewatered to work on or whose maintenance will have a <u>significant effect</u> on fish passage will be done during the January and February winter maintenance period. Maintenance of facilities that will have <u>no effect</u> on fish passage may be conducted at any time. When facilities are not being maintained during the winter maintenance period, they will be operated according to normal criteria unless otherwise coordinated with NOAA Fisheries and other FPOM participants.

3.2.2. Unscheduled Maintenance. Unscheduled maintenance that will significantly affect the operation of a facility will be coordinated with NOAA Fisheries and other FPOM participants. Coordination procedures for unscheduled maintenance of adult facilities are the same as for juvenile facilities (see section 3.1.2.). If part of a facility malfunctions or is damaged during the fish passage season and the facility can still be operated within criteria without any detrimental effects on fish passage, repairs may not be conducted until the winter maintenance period or until fewer numbers of fish are passing the project. If part of a facility is damaged or malfunctions that may significantly impact fish passage, it will be repaired as soon as possible.

3.2.2.1. Fish Ladder and Counting Station. The fish ladder contains fixed weirs, a counting station with picket leads, an adult fish trap, and a fish exit with trashrack. If any part of the ladder fails or is blocked with debris during the fish passage season, efforts will first be made to correct the problem without dewatering the ladder. Trashracks, picket leads, and counting stations can sometimes be repaired or maintained without dewatering the ladder. If the fish trap malfunctions or is damaged, fish may be passed around it until repairs are made. The decision to dewater the ladder and make repairs during the fish passage season or wait until the winter maintenance period will be made after coordination with the fish agencies and tribes.

3.2.2.2. Auxiliary Water Supply System. Three electric pumps supply the auxiliary water for the fish ladder and the powerhouse collection system. During normal operations and most flow conditions, two pumps are capable of providing the required flows. If a pump fails during the two-pump operation, the pump on standby will be operated to make up the flows. If two pumps fail, NSE 2 and NPE 2 will be closed and NPE 1 raised in 1' increments to provide the required 1' to 2' head differential. If the head cannot be maintained by the time the top of the weir reaches 5', the floating orifices should be closed in the following order: OG-4, OG-7, OG-10, and OG-1. If the head in the system still cannot be maintained at this point, SSE 1 and SSE 2 should be raised in 1' increments until 5' below tailwater is reached. If all three pumps fail, NSE 1 and NPE 1 should be closed, the powerhouse collection channel bulkheaded off at the junction pool, and SSE 1 and SSE 2 operated at 6' below tailwater regardless of the head.

3.2.2.3. Fishway Entrances. The fishway entrances consist of main entrance weirs with hoists and automatic controls, and floating orifices which regulate themselves with tailwater fluctuations. If any of the automatic controls malfunction, the weirs can be operated manually by project personnel and kept within criteria. If there is a further failure which prevents an entrance from being operated manually, the weirs can usually be left in a lowered position while repairs are being conducted or the entrance closed and the water redistributed to other entrances while repairs are made. If a floating orifice fails, it will be pulled out of the water and the entrance bulkheaded off until it is repaired.

3.2.2.4. Diffuser Gratings. Diffuser chambers for adding auxiliary water to fish ladders and collection channels are covered by gratings attached by several different methods. Diffuser gratings are normally checked during the winter maintenance period to make sure they are in place. These inspections are done by either dewatering and physically inspecting the diffuser gratings, or by using underwater video cameras, divers, or other methods. Diffuser gratings may come loose during the fish passage season due to a variety of reasons. Daily inspections of fish ladders and collection systems should include looking for any flow changes that may indicate problems with diffuser gratings. If a diffuser grating is known or suspected to have moved, creating an opening into a diffuser chamber, efforts must immediately be taken to correct the situation and minimize impacts on adult fish in the fishway. Coordination of the problems should begin immediately through the established unscheduled maintenance coordination procedure (see section 3.1.2). If possible, a video inspection should be made as soon as possible to determine the extent of the problem. If diffuser gratings are found to be missing or displaced, creating openings into the diffuser chambers, a method of repair shall be developed and coordinated with the fish agencies and tribes through the established coordination procedure. Repairs shall be made as quickly as possible unless coordinated differently.

3.2.2.5. Fallback Fence. The fallback fence located near the north powerhouse fishway entrances shall be inspected during the winter maintenance period. Loose mesh attached to the frame will be reattached. If any section of the netting is severely damaged, that section will be replaced.

4. Turbine Unit Operation and Maintenance.

4.1. Turbine Unit Operation. When in operation, turbine units will be operated to enhance adult and juvenile fish passage from March 1 through December 15. During this time period turbine units will be operated as needed to meet generation requirements in the priority order shown in Table LWG-4. Unit operating priority may be coordinated differently to allow for fish research, construction, or project maintenance activities. To minimize mortality to juvenile fish passing through the turbine units from April 1 through October 31 (or as long as there is sufficient river flow and/or generation requests to operate turbine units 4, 5, or 6 within 1% of best turbine efficiency), operating priority during nighttime hours from 2000 to 0400 hours shall be units 4, 5, and 6 (in any order) and then units 1, 2, and 3 as needed (Table LWG-4). If a turbine unit is taken out of service for maintenance or repair, the next unit in the priority list shall be operated.

Table LWG-5. Turbine unit operating priority for Lower Granite Dam.

Season	Time of Day	Unit Priority
March 1 – December 15	24 hours	1, 2, 3, then 4-6 (any order)
April 1 – October 31 (If there is enough flow to run priority units)	Nighttime (2000 to 0400 hours)	4-6 (in any order, then 1-3 (as needed)
December 16 – February 28	24 hours	Any Order

4.1.1. Turbine units will be operated within 1% of best efficiency from April 1 through October 31 (as specified in BPA's load shaping guidelines, **Appendix C**) unless operation outside of that range is necessary to:

1) meet the load requirements of the BPA Administrator whose load requests will be made in accordance with BPA's policy, statutory requirements, and load shaping guidelines (**Appendix C**);

2) Roll (speed no load) a turbine unit prior to reduce the number of fish in the scrollcase prior to fish salvage operations;

3) operating a turbine unit solely to provide station service; or

4) be in compliance with other coordinated fish measures. Project personnel shall record when turbine units are operated outside the 1% efficiency range and shall provide the information to BPA on a weekly basis according to the load shaping guidelines. Between November 1 and March 31, turbine units will continue to be operated within the 1% efficiency range except when BPA load requests require the units to be operated outside the 1% range. Guidelines for operation of the turbine units within the 1% efficiency range at various heads are shown in **Tables LWG-6 through LWG-9**.

4.1.2. All of the lower Snake River powerhouses may be required to keep one generating turbine unit on line at all times to maintain power system reliability. During low flows, there may not be enough river flow to meet this generation requirement and required minimum spill. Under these circumstances the power generation requirement will take precedence over the minimum spill requirement. At Lower Granite Dam, minimum generation requirements are 11 - 12 kcfs for turbine units 1 – 3 and 12.5 – 13.5 kcfs for turbine units 4-6.

Table LWG-6. Units 1-3 1% turbine operating range with ESBSs installed.

Head (ft)	Lower Generator Limits		Upper Generator Limits	
	(MW)	(CFS)	(MW)	(CFS)
85	**69.9**	**11,938**	**116.2**	**19,863**
86	70.6	11,922	118.5	20,007
87	71.4	11,906	120.8	20,146
88	72.2	11,890	123.1	20,282
89	73.0	11,875	125.4	20,415
90	**73.7**	**11,859**	**127.7**	**20,544**
91	74.6	11,849	128.1	20,346
92	75.5	11,839	128.5	20,152
93	76.3	11,829	128.8	19,963
94	77.2	11,818	129.2	19,777
95	**78.1**	**11,808**	**129.5**	**19,596**
96	79.1	11,825	129.7	19,385
97	80.2	11,841	129.8	19,179
98	81.2	11,857	130.0	18,978
99	82.3	11,872	130.1	18,780
100	**83.3**	**11,887**	**130.3**	**18,586**
101	84.2	11,890	132.0	18,637
102	85.1	11,892	133.7	18,687
103	86.0	11,895	135.4	18,736
104	86.9	11,897	137.2	18,784
105	**87.8**	**11,899**	**138.9**	**18,830**

Table LWG-7. Unit 1-3 1% turbine operating range without ESBSs installed.

Head (ft)	Lower Generator Limits		Upper Generator Limits	
	(MW)	(CFS)	(MW)	(CFS)
85	**65.7**	**10,897**	**120.6**	**20,010**
86	66.4	10,882	123.0	20,155
87	67.2	10,868	125.4	20,296
88	67.9	10,853	127.8	20,434
89	68.6	10,839	130.2	20,568
90	**69.3**	**10,826**	**132.6**	**20,698**
91	70.2	10,817	133.0	20,500
92	71.0	10,808	133.3	20,305
93	71.8	10,799	133.7	20,115
94	72.6	10,790	134.1	19,929
95	**73.4**	**10,781**	**134.4**	**19,747**
96	74.4	10,797	134.6	19,536
97	75.4	10,813	134.7	19,329
98	76.4	10,827	134.9	19,126
99	77.4	10,842	135.0	18,928
100	**78.3**	**10,855**	**135.2**	**18,734**
101	79.2	10,858	137.0	18,785
102	80.0	10,860	138.8	18,836
103	80.9	10,863	140.6	18,885
104	81.7	10,865	142.4	18,934
105	**82.5**	**10,867**	**144.2**	**18,981**

NOTE: The turbine efficiency tables are being revised to reflect new information using a 2004 Unit 3 NS index test and a 1962 model test regarding extended-length submersible bar screens.

Table LWG-8. The 1% turbine operating range at Lower Granite Dam for units 4-6 with extended-length submersible bar screens installed.

Head (ft)	Lower Generator Limits		Upper Generator Limits	
	(MW)	(CFS)	(MW)	(CFS)
85	**83.9**	**13,761**	**107.2**	**17,586**
86	85.0	13,769	108.9	17,652
87	86.1	13,777	110.7	17,717
88	87.1	13,784	112.4	17,780
89	88.2	13,791	114.2	17,841
90	**89.3**	**13,798**	**115.9**	**17,900**
91	90.3	13,778	117.1	17,878
92	91.2	13,759	118.4	17,857
93	92.1	13,740	119.6	17,836
94	93.1	13,722	120.8	17,815
95	**94.0**	**13,703**	**122.0**	**17,795**
96	95.1	13,707	122.6	17,676
97	96.1	13,711	123.1	17,560
98	97.2	13,714	123.7	17,446
99	98.3	13,717	124.2	17,335
100	**99.4**	**13,720**	**124.8**	**17,225**
101	100.4	13,724	126.0	17,227
102	101.4	13,728	127.3	17,229
103	102.5	13,731	128.6	17,230
104	103.5	13,735	129.8	17,232
105	**104.5**	**13,739**	**131.1**	**17,233**

Table LWG-9. The 1% turbine operating range at Lower Granite Dam for units 4-6 without extended-length submersible bar screens installed.

Head (ft)	Lower Generator Limits		Upper Generator Limits	
	(MW)	(CFS)	(MW)	(CFS)
85	**85.1**	**13,602**	**116.0**	**18,546**
86	86.1	13,600	117.9	18,616
87	87.2	13,597	119.8	18,685
88	88.2	13,595	121.7	18,751
89	89.2	13,592	123.5	18,816
90	**90.3**	**13,589**	**125.4**	**18,879**
91	91.4	13,598	126.8	18,856
92	92.5	13,607	128.1	18,834
93	93.7	13,615	129.4	18,812
94	94.8	13,623	130.8	18,791
95	**95.9**	**13,630**	**132.1**	**18,769**
96	96.9	13,620	132.7	18,645
97	97.9	13,609	133.3	18,523
98	98.9	13,599	133.9	18,403
99	99.9	13,589	134.5	18,285
100	**100.9**	**13,579**	**135.0**	**18,170**
101	101.9	13,579	136.4	18,172
102	102.9	13,580	137.8	18,174
103	104.0	13,580	139.1	18,175
104	105.0	13,581	140.5	18,177
105	**106.0**	**13,581**	**141.9**	**18,179**

NOTE: The turbine efficiency tables were revised to reflect new information using a 2004 unit 3 NS index test and the 1975 model test and extended-length submersible bar screens.

4.2. Turbine Unit Outages During High River Flow Periods. During high spring flows, turbine unit outages for inspecting fish screens, repairing research equipment such as hydroacoustic or radio telemetry equipment, and other fish items may cause increased spill at a project in order to maintain reservoir levels within operating levels. This may result in TDG levels exceeding standards. It is important that this work be conducted when scheduled to ensure that facilities are working correctly and not injuring migrating fish, and that important fish research data are collected. To facilitate this work, reservoir storage may be utilized to minimize impacts from taking turbine units out of service and increasing spill. At Lower Granite, this special operation shall take place when river flows are above 120 kcfs or when increasing spill levels will result in TDG levels exceeding standards. The activities covered under these operations will be coordinated with and approved by the TMT whenever possible.

For scheduled inspection or repair of research equipment, reservoirs shall be drafted to MOP and allowed to fill to 1' above the 1’ MOP operating range as the work is accomplished. After the work, reservoirs will be drafted back to the MOP operating range. When inspection or repair work can be scheduled ahead of time, the following process will be followed:

a. Project personnel shall schedule turbine unit outages through the approved turbine outage scheduling procedure by noon of the Tuesday of the week prior to the outage.
b. Project personnel shall also contact CENWW-OD-T and RCC by the same time period and inform them of the intended work.

c. The RCC will coordinate the work activities through the TMT.

d. After coordination with the TMT, RCC shall issue a teletype through the CBTT issuing instructions to project and BPA personnel for the scheduled work.

e. Spill will be increased by one spillbay stop setting (about 1.7 kcfs) above passing inflow to lower the level of Lower Granite pool to MOP prior to the scheduled work taking place.

f. When the work takes place, additional spill will not be provided and the reservoir will be allowed to refill until the reservoir is 1' above the normal MOP range (a 2' pondage from where the pool was when the work started). At this point, screen inspections shall stop. (At Snake River projects, this should allow about one normal workday for the scheduled work.)

g. At the conclusion of the work, the reservoir shall be drafted back down to the MOP range utilizing a one spillbay stop increase in spill above passing inflow.

h. If work, such as screen inspections, is not finished, project personnel shall schedule another turbine unit outage for a date where it can be implemented again.

If the work that needs to be done is of an emergency nature that does not normally require the turbine unit to be taken out of service (such as a failed hydroacoustic transducer versus a failed fish screen), and cannot wait for the above process to be implemented, project personnel shall notify CENWW-OD-T and RCC to get approval to do the work. If approval to do the work is given, the turbine unit shall be taken out of service and the reservoir level allowed to increase until it reaches 1' above the MOP operating range. At this point, the turbine unit must be returned to service and the reservoir will be drafted back to the MOP range using one spillbay stop setting above passing inflows.

4.3. Turbine Unit Maintenance. The project turbine unit maintenance schedule will be reviewed annually by project and Operations Division biologists for fish impacts. If possible, maintenance of priority units will be scheduled for non-fish passage periods, or when there are low numbers of fish passing the project. Each turbine unit requires annual maintenance that may normally take 2 to 5 weeks. Annual maintenance of all turbine units is normally scheduled during the mid-July to late November time frame. The maintenance of priority units for adult passage is normally conducted during mid-August, when fewer adults are migrating, to minimize impacts on migrating adults. Turbine units may occasionally require overhauls to repair major problems with the turbine or generator. Overhauls may take over one year to accomplish. Turbine units, governors, exciters, and control systems require periodic maintenance, calibration, and testing which may take them outside of the 1% turbine efficiency range. This work will be scheduled in compliance with BPA load shaping guidelines (Appendix C) to minimize impacts on juvenile fish. Transformers are Doble tested every 3 years. Testing may need to be more frequent if there is a known problem with a transformer. These tests normally take 3 to 5 workdays. To conduct the testing, the transmission lines have to be disconnected from the transformers and normal generation stopped. One turbine unit will operate in a speed-no-load condition to provide project power and operation of fish passage facilities. Spill may be provided to meet minimum required project discharges during the testing hours. The Doble tests are normally scheduled for the August or early September time period to minimize impacts on adult and juvenile fish passage.

Turbine units are to be operated with raised operating gates to improve fish passage conditions when ESBSs are installed, except as provided below. To facilitate annual maintenance, operating gates are used to dewater the turbine units. To minimize turbine outage periods to the actual time required for maintenance (during the July 1 through December 15 time period), operating gates in one turbine unit may be lowered to the standard operating position and connected to hydraulic cylinders on the afternoon of the last regular workday (normally Thursday) prior to the start of the maintenance. With the operating gates in the standard operating position, the turbine unit may be operated until 0700 hours of the next regular workday (normally Monday). On the completion of maintenance, the turbine unit can be operated with one operating gates in the standard operating position until 0700 hours of the first regular workday after the maintenance is completed. The project biologist will be notified when the operating gates are set in the standard operating position. The gatewells will be monitored 2 times per day to observe fish condition while the operating gates are in the standard operating position. If turbine maintenance or the raising of the operating gates to the raised operating position is delayed after the time periods stated above, the turbine unit shall be immediately taken out of service until the work can be accomplished. Operation of turbine units with operating gates in the standard operating position shall be restricted to the July 1 through December 15 time period, and shall not occur unless at least four other turbine units are available for service. No more than one turbine unit at a time shall be operated with operating gates in the standard operating position. Unwatering turbine units should be accomplished in accordance with project dewatering plans. Prior to dewatering a turbine unit for maintenance, the turbine unit should be spun at speed-no-load, if possible, immediately before installing tailrace stoplogs and headgates to minimize the number of fish in the draft tube and scroll case. If a turbine unit is out of service for maintenance for an extended period of time without tailrace stoplogs in place, efforts should be made to not open the wicket gates if the scroll case must be dewatered at a later date without the unit being spun before hand.

5. Forebay Debris Removal. Debris at projects can impact fish passage conditions. Debris can plug or block trashracks, VBSs, gatewell orifices, dewatering screens, separators, and facility piping resulting in impingement, injuries, and descaling of fish. Removing debris at its source in the forebay is sometimes necessary to maintain safe and efficient fish passage conditions, navigation, and other project activities. Debris can be removed from the forebay by: physically encircling the debris with log booms and pulling it to shore with boats where it can be removed with a crane, removing the debris from the top of the dam using a crane and scoop, or passing the debris through the spillway with special powerhouse operations and spill. The preferred option is to remove debris at each project when possible to avoid passing a debris problem on to the next project downstream. This is not always possible at each project, as some projects do not have forebay debris removal capability. In this case, the only viable alternative is to spill to pass the debris. All special spills (other than normal spill patterns for ongoing spill operations) and project operations for passing debris will be coordinated prior to the operations taking place. Each project shall contact CENWW-OD-T at least two workdays prior to the day they want the special project operations for spilling to pass debris. CENWW-OD-T shall coordinate the special operations with RCC, NOAA Fisheries, and other FPOM participants. Project personnel shall provide CENWW-OD-T the reason for the debris spill request including an explanation of project facilities being impacted by the debris, the date and time of the requested spill, and any special powerhouse or other operations required to move the debris to the spillway. When a debris spill is coordinated and approved, RCC shall issue a teletype detailing the specifics of the special operations.

Table LWG-10. Lower Granite spillway pattern for fish passage (with RSW operating at pool elevation 734).

Spill Bay								Total Stops	Total Spill
1	2	3	4	5	6	7	8		
3.5	0	1	0	1	1	1	1	8.5	15.2
3.5	0	1	1	1	1	1	1	9.5	16.9
3.5	1	1	1	1	1	1	1	10.5	18.6
3.5	1	1	2	1	1	1	1	11.5	20.4
3.5	1	1	2	1	1	1	2	12.5	22.2
3.5	1	1	2	2	1	1	2	13.5	24.0
3.5	1	1	2	2	2	1	2	14.5	25.8
3.5	1	2	2	2	2	1	2	15.5	27.7
3.5	2	2	2	2	2	1	2	16.5	29.5
3.5	2	2	2	2	2	2	2	17.5	31.3
3.5	2	2	3	2	2	2	2	18.5	36.6
3.5	2	2	3	3	2	2	2	19.5	35.0
3.5	2	2	3	3	3	2	2	20.5	36.9
3.5	2	3	3	3	3	2	2	21.5	38.7
3.5	3	3	3	3	3	2	2	22.5	40.6
3.5	3	3	4	3	3	2	2	23.5	42.4
3.5	3	3	4	4	3	2	2	24.5	44.3
3.5	3	3	4	4	4	2	2	25.5	46.2
3.5	3	4	4	4	4	2	2	26.5	48.0
3.5	4	4	4	4	4	2	2	27.5	49.9
3.5	4	4	4	4	4	2	3	28.5	51.7
3.5	4	4	4	4	4	3	3	29.5	53.6
3.5	4	4	5	4	4	3	3	30.5	55.5
3.5	4	4	5	5	4	3	3	31.5	57.3
3.5	4	4	5	5	5	3	3	32.5	59.2
3.5	4	5	5	5	5	3	3	33.5	61.0
3.5	5	5	5	5	5	3	3	34.5	62.9
3.5	5	5	5	5	5	3	4	35.5	64.8
3.5	5	5	5	5	5	4	4	36.5	66.6
3.5	5	5	6	5	5	4	4	37.5	68.5
3.5	5	5	6	6	5	4	4	38.5	70.3
3.5	5	5	6	6	6	4	4	39.5	72.2
3.5	5	6	6	6	6	4	4	40.5	74.1
3.5	6	6	6	6	6	4	4	41.5	75.9

Note: Minimum involuntary spill with RSW operating is 15.2 kcfs. Note: At approximately 3.5 stops, the tainter gate no longer regulates flow through the RSW. <u>The tainter gate should be raised at least 9 stops so the gate does not interfere with the spillbay flow.</u>Note: Spillbay discharge at pool elevation 734:

Stops	Discharge (kcfs) (without RSW)	Stops	Discharge (kcfs) (without RSW)
1	1.7	5	9.1
2	3.5	6	11.0
3	5.4	7	12.8
4	7.2	8	14.7

Discharge (kcfs) (with RSW)-- RSW 3.5 stops or more 6.7

Table LWG-11. Lower Granite spillway pattern for fish passage (RSW NOT operating, pool elevation 734).

Spillbay Stops								**Total Stops**	**Total Spill (kcfs)**
1 (RSW)	**2**	**3**	**4**	**5**	**6**	**7**	**8**		
Closed	1	1			1	1	2	6.0	10.3
Closed	1	1			1	2	2	7.0	12.1
Closed	2	1			1	2	2	8.0	13.9
Closed	2	2			1	2	2	9.0	15.7
Closed	2	2	1		1	2	2	10.0	17.4
Closed	2	2	1	1	1	2	2	11.0	19.1
Closed	2	2	2	1	1	2	2	12.0	20.9
Closed	2	2	2	1	2	2	2	13.0	22.7
Closed	2	2	2	2	2	2	2	14.0	24.5
Closed	2	2	2	2	2	2	3	15.0	26.4
Closed	2	2	2	2	2	3	3	16.0	28.3
Closed	3	2	2	2	2	3	3	17.0	30.2
Closed	3	3	2	2	2	3	3	18.0	32.1
Closed	3	3	3	2	2	3	3	19.0	34.0
Closed	3	3	3	2	3	3	3	20.0	35.9
Closed	3	3	3	3	3	3	3	21.0	37.8
Closed	3	3	3	3	3	3	4	22.0	39.6
Closed	**3**	**3**	**3**	**3**	**3**	**4**	**4**	**23.0**	**41.4**
Closed	4	3	3	3	3	4	4	24.0	43.2
Closed	4	4	3	3	3	4	4	25.0	45.0
Closed	**4**	**4**	**4**	**3**	**3**	**4**	**4**	**26.0**	**46.8**
Closed	4	4	4	3	4	4	4	27.0	48.6
Closed	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**28.0**	**50.4**
Closed	4	4	4	4	4	4	5	29.0	52.3
Closed	**5**	**4**	**4**	**4**	**4**	**4**	**5**	**30.0**	**54.2**
Closed	5	4	4	4	4	5	5	31.0	56.1
Closed	5	5	4	4	4	5	5	32.0	58.0
Closed	**5**	**5**	**5**	**4**	**4**	**5**	**5**	**33.0**	**59.9**
Closed	5	5	5	4	5	5	5	34.0	61.8
Closed	5	5	5	5	5	5	5	35.0	63.7
Closed	5	5	5	5	5	5	6	36.0	65.6
Closed	5	5	5	5	5	6	6	37.0	67.5

Notes: Patterns in **bold** were evaluated with the Corps' Lower Granite 1:80 physical general model.

APPENDIX A

SPECIAL PROJECT OPERATIONS AND STUDIES

Bonneville Dam[1]

1. Special Project Operations.

RCC will coordinate needed changes with the projects and authorize operations in teletype regulations.

1.1. Spring Creek Hatchery Release. The first hatchery release is expected to occur in early March, followed by special operations for juvenile fish passage as coordinated with the fish agencies through TMT. Project operations for fish passage will be defined by RCC teletype prior to the release.

1.2. Spill. Spill for fish passage will be provided during the spring and summer outmigration seasons in accordance with spill specifications in Appendix E and as coordinated through TMT. Alternative spill patterns to control dissolved gas levels or change fish passage conditions will be coordinated through the FPOM.

1.3. **First Powerhouse Main Unit Rehabilitation**. Work continues on the rehabilitation of main units 7 and 8 at PH1 in 2008. Unit 8 is expected to return to service starting in mid March 2008. Unit 7 is expected to return to service in late 2008. Special operations will be requested for main unit testing once the units are ready to start the initial start up test. Tests will require but are not limited to short term runs above and below the 1% turbine efficiency range, and turbine load rejection testing. Durations of these tests are generally short (less than 6 hours). Tests requiring the units to be outside the 1% operating ranges for longer than this 6 hour period during the fish passage season will be coordinated with the regional fish representative prior to testing. Unit outages associated with line boring operations will need to be specially coordinated to minimize additional spill during the fish passage season. Efforts will be made to minimize outages that require taking units OOS during periods of high TDG levels below BON. The Corps rehabilitation fisheries representative (PM-E) along with Voith Hydro will create an advance schedule outlining line boring activities as to reduce the chances of TDG exceedances due to reduced powerhouse capacity. This schedule will be created prior to line boring activities for all remaining units.

2. Studies.

2.1. Spillway Survival Study. Acoustic telemetry will be used to estimate the survival of yearling and subyearling Chinook salmon and steelhead that pass through the spillway. The purpose of this study is to evaluate the effect of spilling 100 kcfs 24-hours per day during the spring migration and 85 kcfs daytime, TDG cap night spill during the summer. New spill patterns were developed in 2007 and will be again evaluated in 2008. Some fish for this work may be collected at the Bonneville Dam smolt monitoring facility but the bulk of the test fish

[1] The purpose of this section is to notify regional interests of planned activities that will or may affect fish passage. Further coordination may occur as needed.

will be from releases at John Day Dam. BRZ access to install acoustic telemetry receiving nodes will be required prior to the spill season. In-season battery changes will be necessary for hydrophones located in the BON forebay approximately every two weeks. This will require a BRZ permit for forebay access. Also, researchers may request special spill bay operations through RCC and PM-E during the FPP season to flush large woody debris from the forebay side of the spillway. These operations help safeguard the equipment mounted on the spillway pier noses that may be damaged if large debris is allowed to accumulate in these areas.

2.2 Bonneville Second Powerhouse Behavioral Guidance Structure (BGS) Installation and Biological Evaluation.

Installation and Construction- Starting in February of 2008 contractors will be installing individual sections of the new BGS. This will require the setting of large concrete bottom anchors, cabling, and the floating boom portion from a tug and barge. Several open-ended BRZ permits will be needed to accommodate this installation process. Special requirements may be needed to install new floating debris booms at the Washington Shore, CI and Bradford Island fishway Exit areas. Exit and auxiliary water flows at these areas may need to be reduced for short periods of time to facilitate installation. Special forebay operations will be requested after installation in late February to test the placement of the new BGS and to look at its travel when the forebay is raised and lowered. This forebay manipulation will be coordinated through RCC, FFDRWG, and FPOM and will take place approximately the week of 1 March, 2008 for 3 days.

Forebay BGS Salmonid Behavioral Response Study- Acoustic telemetry will be used to evaluate juvenile salmonid response to the BGS, Second Powerhouse and the B2CC. Acoustic equipment installation in the forebay (BGS) will require BRZ permits. Acoustic equipment at the PH will be mounted on 80’ sections of 4” steel pipe attached to every third powerhouse pier nose below the water surface and one section just to the north of the B2CC entrance. These pipe installations are scheduled for March and early April 2008 and will require the closure of the B2CC for short periods of time as well as main unit outages for dive operations. During the study period (15 April through 15 July) several BRZ permits will be required to check or replace equipment.

2.3 Bonneville Second Powerhouse FGE Research.

Juvenile Chinook salmon will be released at three Bonneville Dam Second Powerhouse locations to compare post-passage descaling, injury, and mortality rates and gatewell retention times (as measured by passage timing), during turbine operation at the high and low ends of the 1% peak efficiency range. Releases will be made into turbine intakes just upstream and near the top of trashracks, into gatewells near the top of submersible traveling screens (STS), and into the bypass system collection channel adjacent to turbine unit(s) selected for testing. Each replicate will include releases at the three specified locations during each of the two operational modes; therefore a single replicate test will require six distinct marked groups. All fish used in tests will be tagged with PIT tags and recaptured via separation-by-code (SbyC) at the Second Powerhouse Juvenile Fish Monitoring Facility (JFMF). This test will require a main unit (to be determined) to be operated as needed during specific fish releases. It will also require the unit to be taken off-line for short periods of time to install equipment prior to testing and to dip the gatewell of fish before and after fish releases. Prior to the first releases of Spring Creek fish in 2008 the Corps will be conducting a two(2) day gatewell condition test commencing on Monday and Tuesday March 3 and 4, 2008. These gatewell tests will be conducted at unit 11A. Test fish will be released in the gatewell via a canister release system at both the upper and lower 1% turbine operating ranges each day as well as the B2 JBS channel. This special preseason gatewell testing has been requested by the regional fish managers as well as representatives from the USFWS to help managers decide on what PH2 turbine operation ranges will be used during the newly proposed SCNFH research slated for March 2008. In-season research will be undertaken after the first Spring Creek release in mid to late March 2008. Two other tests will be undertaken either prior or after the next two Spring Creek subyearling releases scheduled for April and May. Researchers will be using their own crane to dip the gatewells. Project support will be needed to mount the trashrack release pipe prior to the start of the tests in mid March. This will require a short outage of the slated unit.

2.4. **Bonneville Chum Salmon Study.** Starting prior to spill operations in mid-April 2007 Pacific Northwest National Laboratories (PNNL) personnel will be installing TDG monitoring stillwells (piezometers) in several gravel sights at both Ives Island and Multnomah Falls below BON Dam. Along with the piezometer installation PNNL researcher will be installing several egg baskets in early spring to replicate a spawned redd. Depending on river flows, special operations may be requested reducing BON outflows which will facilitate divers to safely install equipment and egg baskets. Any and all requests for flow reductions will be coordinated on a case by case basis with RCC.

2.5. Lamprey Passage Evaluations. From early June to the end of August, 1000-2000 adult Lamprey will be captured and tagged with half-duplex PIT tags and released below the dam to evaluate overall passage, including use of the Lamprey Passage Systems (LPS). 600 of these fish will be radio-tagged for an evaluation of reduced fishway entrance flow at Powerhouse 2. On alternating nights from around June 1 to mid August the Washington shore ladder entrance head will be reduce to 0.5' starting at 1000 and ramped back up to normal operations (1.5') at 0400. A final day by day schedule will be supplied to the project to help guide the operators before the research begins. LPS will be operational no later than the middle of May and run until at least October 1.

2.6. Adult Studies Evaluations. Hydroacoustics will be used to evaluate steelhead kelt passage at the B2CC, from 6 March 2008 to the end of the juvenile passage season.

2.7. Sea Lion Predation. Beginning when the first California sea lions return to Bonneville Dam until the last sea lion leaves, usually mid-February until June 1, exclusion gates will be installed at all downstream slots of all entrances and barriers will be installed at B2 FOGs. In addition, NMFS-approved sea lion harassment activities will occur from land during sea lion season.

2.8. All dates shown are approximate and could be advanced or delayed by a week or so depending on various factors such as river flows, contractor schedules, equipment failures, etc. Some evaluations may not proceed. Therefore, a final description of studies and outages being conducted will be coordinated with the region through AFEP (FFDRWG and SRWG), prior to April 1. All special operation requests or schedule changes will be coordinated with the fisheries agencies and tribes through the AFEP and with RCC and BPA.

APPENDIX A: THE DALLES

The Dalles Dam[2]

1. Special Project Operations

RCC will coordinate needed changes with the projects and authorize operations in teletype regulations.

1.1. Spill. Spill for fish passage will be provided during the spring and summer outmigration seasons in accordance with spill specifications in Appendix E and as coordinated through TMT. Alternative spill patterns to control dissolved gas levels or change fish passage conditions will be coordinated through the FPOM.

2. Studies.

2.1. Adult Lamprey Studies. Exit area half-duplex PIT antennas and receivers will be operational to monitor adult lamprey passage no later than mid-May.

2.2. All dates shown are approximate and could be advanced or delayed by a week or so depending on various factors such as river flows, contractor schedules, and equipment failures, etc. The seasonal timing (i.e., prior to, during the 1st week of spill, or during peak flow conditions) of the affects 16' gate openings will be determined via the fisheries agencies through the regional forum. Some evaluations may not proceed. All special operation requests or schedule changes will be coordinated with the fisheries agencies and tribes through the AFEP and with RCC, TMT, and BPA.

[2] The purpose of this section is to notify regional interests of planned activities that will or may affect fish passage. Further coordination may occur as needed.

APPENDIX A: JOHN DAY

John Day Dam[3]

1. Special Project Operations.

1.1. Spill. Spill for fish passage will be provided during the spring and summer outmigration seasons in accordance with spill specifications in Appendix E and as coordinated through TMT. Alternative spill patterns to control dissolved gas levels or change fish passage conditions will be coordinated through the FPOM. Planning dates for spill are from April 10 through August 31 for spring and summer migrants as required in the UPA. Prototype top spillway weirs (TSW) will be evaluated in 2008 to provide information for design of a permanent surface flow outlet system at John Day Dam. The evaluation will compare the performance of two TSWs operating with two different training spill levels. Special spill patterns and treatments for this test are currently under development and are expected to be completed by the end of February. These spill patterns and the TSW test schedule will be coordinated through FPOM, FFDRWG, and RCC upon their completion. The TSW test will occur between 20 April and 20 July. During testing, spill and operation of the TSWs will occur 24-hours per day. Before this test, from April 10 to approximately April 20 (planning dates), spill discharges will be 60% of instantaneous project flow at project flows up to 300,000 cfs from 1800 to 0600 hours as per the 2007 FOP. Above 300,000 cfs project flow, spill discharges will be 180,000 cfs (up to the hydraulic limit of the powerhouse). Following the TSW test, from approximately July 21 through August 31, spill will be 30% of instantaneous project flow 24-hours per day. Spill will be provided in a manner consistent with TDG management to avoid excessive gas supersaturation conditions.

2. Studies.

2.1. Adult Lamprey Studies. Exit area half-duplex PIT antennas and receivers will be operational no later than mid-May to monitor adult lamprey passage. JDA ladders will be evaluated this winter and spring for potential installation of LPS.

2.2. Evaluation of Top Spillway Weirs (TSW)

2.2.1. General. Two prototype spillway weirs that pass ~10 Kcfs each will be installed in Bays 18 and 19. Training spill patterns to support the TSW jets and provide good downstream egress for juvenile salmonids are currently being developed. It is anticipated that two spill levels will be tested to provide spill / TSW efficiency curves. These data will be used for designing surface flow outlet and tailrace improvements at John Day Dam. In addition to passage distribution / efficiency metrics, forebay retention, tailrace egress, and survival will also be estimated for yearling Chinook, steelhead, and subyearling Chinook salmon. Also, prior to the smolt migration a direct survival and injury test using balloon-tagged fish will be conducted.

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[3] The purpose of this section is to notify regional interests of planned activities that will or may affect fish passage. Further coordination may occur as needed.

2.2.2. Installation of TSWs. Two TSWs will be delivered to the Forebay of John Day Dam immediately following the navigation lock maintenance outage – approximately 24 March. The TSWs will be installed into bays 18 and 19. Installation, by barge crane, is expected to take 1-2 days. BRZ access will be required to accomplish this.

2.2.3. TSW Evaluations. There will be two parts to the TSW evaluation: 1) a test of the direct effects of TSW passage on juvenile salmonid survival and injury, and 2) an in-season evaluation of the effects of operating the John Day project with two TSWs and two spill levels on juvenile Chinook and steelhead passage distribution, forebay residence time, tailrace egress conditions, and total survival.

The direct test will occur over a 3-day period immediately following TSW installation, and is intended to provide assurance that the TSWs do not directly injure or kill fish. Balloon-tag methods will be used for this study component. It is anticipated to take most of a work day to open and close both TSWs, therefore during the 3 day direct test, both TSWs will need to operate 24-hours per day. In addition to TSW discharge, approximately 5 Kcfs training spill at Bay 17 will be required during release of test fish.

Provided the TSWs are deemed safe to operate during the juvenile salmon passage season, acoustic telemetry and hydroacoustics will be used to assess passage behavior and survival at the dam. Passage metrics will be collected under two training spill conditions, 30% spill vs. approximately 40% spill. A randomized block design will be used to accomplish this, with each spill treatment lasting 2 or 3 days. The specific design, as well as the upper spill level to be tested is still under development in the Regional Forum. In addition to acoustic telemetry and hydroacoustic evaluations, GPS drogues will be released at the spillway, powerhouse, and juvenile bypass outfall to assess tailrace egress conditions. The period for all of these study components will run from approximately 20 April – 20 July and will depend on fish availability and river conditions. Installation of hydrophones and hydroacoustic transducers will occur in March, prior to the start of spill. Main unit rolling outages will be required for divers to install hydrophone mounts and transducers at the powerhouse. Emergency outages may be requested for replacement or repair of damaged equipment during the study. These will be coordinated through FFDRWG/FPOM and RCC. Approximately every two weeks from May through July, battery changes will be necessary for hydrophones located in the JDA forebay. This will require a BRZ permit for forebay access.

2.3. All dates shown are approximate and could be advanced or delayed by a week or so depending on various factors such as river flows, contractor schedules, and equipment failures, etc. Some evaluations may not proceed. Therefore, a final description of studies and outages being conducted will be coordinated with the region through AFEP (FFDRWG and SRWG), prior to April 1. All special operation requests or schedule changes will be coordinated with the fisheries agencies and tribes through the AFEP and with RCC and BPA.

APPENDIX A: MCNARY

McNary Dam[1]

1. Special Project Operations.

1.1. Spill. Spill for fish passage will be provided during the outmigration season in accordance with spill specifications in Appendix E and as coordinated through TMT. Alternative spill patterns to control dissolved gas levels or change fish passage conditions will be coordinated through the FPOM. During periods of high river flow, spill volumes and the elevation of McNary reservoir may need to be manipulated on a daily or every-other-day basis to provide safe conditions for loading the fish barge at the juvenile fish facility below the dam.

1.2. Doble Tests. Two transformer banks, T1 and T3, and the respective turbine units will be taken out of service for Doble testing in 2008. Turbine units 1 and 2 will be unavailable for up to 4 days during T1 testing, and turbine units 5 and 6 will be also out of service for up to four days during T3 testing. There may be some overlap between the 2 tests. Since McNary Dam has multiple transformer banks and transmission lines, and redundant switching capability, most turbine units will be available for operation during these tests. Turbine unit 1% efficiency operations and turbine priorities will continue to follow fish passage plan requirements. Outage dates will be coordinated with the region as they become available.

1.3. TSW Installation. TSW1 is to be moved from spillbay 22 to spillbay 19 prior to the start of the 2008 spill season. This change will require one or two spill patterns depending on the number of research case studies planned. New spill pattern(s) will be devised prior to the start of the 2008 fish passage season.

1.4. Headgate Repair. This is a long term program to return the headgates to a safe operating condition by adding new roller chain, seals, anodes, and other miscellaneous components. The plan will require short unit outages throughout the year while transporting rebuilt gates from the turbine units to the repair pit and vice versa. Each swap will take from 4 to 6 hours to complete, and take place approximately every 2 months. Headgate movements are to take place concurrently with other outages as they occur, and no special operations outside the Fish Passage Plan are expected.

1.5. New Turbine Unit Oil Coolers. The existing turbine unit thrust bearing oil coolers are failing and are in need of replacement. The project has been replacing the internal oil coolers with external coolers as they fail. The plan is to replace the remaining oil coolers during planned outages rather than through forced outages after internal oil cooler failure. This work started in July, 2007 and will continue into 2008. No special operations are planned.

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[1] The purpose of this section is to notify regional interests of planned activities that will or may affect fish passage. Further coordination may occur as needed.

1.6. Navigation. Short term adjustments in spill patterns, spill discharge rates and/or turbine operations may be required for navigational safety. This includes both commercial tows and fish barges.

1.7. **McNary DC and Preferred AC Upgrades**. Contract 07-C-0025 was awarded on 23 August 2007 to upgrade the existing DC and Preferred AC portion of the station service electrical system at the McNary Dam powerhouse. All contract work within the powerhouse is scheduled to be completed by 23 September 2008. As part of the work, turbine unit outages will be required for installation of seven new electrical panels. During each panel installation, a two unit outage will be required, each outage to last between 2 and 5 days. The outages will be coordinated with powerhouse operations during the month of March 2008. Fish pump outages will be required to facilitate the installation of a new feeder circuit to switchgear. There will be two fish pump outages, each anticipated to last between 1 and 5 days. During pump shutdowns, adult fishway will be configured in accordance with pump outage procedures outlined in the Fish Passage Plan.

1.8. Waterfowl Nesting. From the end of April to the beginning of July, the McNary pool may be restricted to operations to elevations between 337.0 and 340.0 feet in support of waterfowl nesting on Lake Wallula. Pool elevations are also operated between 338.5 and 339.5 feet at least once every 4 days during daylight hours for a period of 4 to 6 hours. A yearly teletype has been issued to regulate the McNary pool in this fashion since at least 1982.

1.9. McNary Dam – Underwater Sounding Inspections. Underwater sounding safety inspections of the McNary Dam stilling basin are planned in September 2008. These soundings are required to be conducted once every 5 years. This will require changes in turbine unit priorities and some restrictions in spill. Water surface is monitored on a continuous basis to determine and account for causes of changes in elevations. During the surveys, turbine units nearest the stilling basin will not be in use, and no spills will be taking place to avoid water level fluctuations. Winter time tests are impractical as this is the time of peak power demand and the highest likelihood of pool fluctuations.

1.10. Pedestal: This contract is to build a 9'x 9'x 12' concrete structure capable of supporting one rotor at the North end of the powerhouse. There is a main water cooling valve that will need to be replaced which may require an outage for Unit (12) for (2 days) between May and September 2008.

1.11. Dewatering System Improvement: The pumping system at McNary is inadequate to support two main unit dewaterings at a time. Between July and December 2008, the dewatering pumps will be replaced. Unit outages may be required for this work for a very short period.

2. Studies.

2.1. Evaluation of Juvenile Salmonid Passage and Survival. A passage and survival study to evaluate the performance of two top-spill weirs (TSW) will be conducted during the spring and summer of 2008. The spring evaluation will consist of one project operation and the summer of two project spill levels. Equipment setup and installation requiring diving and considerable boat activity in the forebay BRZ will take place from February 19 through 31. The spring evaluation will begin April 3 and continue into early June. The summer evaluation will begin later in June and continue until late July. During the evaluations, juvenile salmonids will be collected at the juvenile fish facility for tagging with acoustic tags. The facility will alternate between days of primary bypass and secondary bypass in the spring (April 1 to approximately June 20). Within this time period (approximately April 17 to July 25) during days of primary bypass, the facility will switch to secondary bypass for up to a few hours each day to collect additional fish for tagging if necessary. Tagged fish will be released upstream of the project and monitored as they enter the forebay and pass the project. Also during the evaluation, daily boat access to the forebay BRZ will be required for equipment maintenance. Equipment removal is currently slated to take place from September 8 through 13. Regional coordination will be necessary to determine appropriate spill levels and patterns for spring and summer evaluations. Treatment schedules and test spill patterns will be developed through SRWG and FFDRWG prior to the study.

2.2. Estimate of hydrosystem latent mortality associated with barge and in-river life-history strategies of Snake River spring/summer Chinook salmon. The study will require access to fish collection facilities at Lower Granite, McNary, and Bonneville Dams and access to barges and coordination with barge operations. The study will monitor pathogen prevalence and disease incidence in the barge holds and hydropower bypass facilities along the Snake and Columbia River migration corridor and characterize the impact of transport operations on disease transmission. The study will also asses the impact of loading density and water volume exchange rates on disease dynamics and estimate the incidence of latent mortality associated with the type and severity of infectious disease. This study is being conducted in conjunction with the Alternate Barge Release Strategies Study at Lower Granite which includes early season releases of barged research fish (prior to the start of normally scheduled barge operations). In addition, 6 special releases are scheduled to take place in the vicinity of the Astoria Bridge.

2.3. Developing a separator for Juvenile Lamprey. This study will require access to fish collection facilities at McNary Dam and access to the fish collection channel and orifice trap. In addition, project assistance may be needed to obtain lamprey from bypass collection operations. No special turbine or spill operations will be necessary as al work will take place within the collection channel. Project assistance may be required during installation and removal of test screen material in the JBS exit raceways. Pacific lamprey macropthalmia and ammocoetes collected at the JBS are inadvertently transported downstream during barging and trucking operations to transport juvenile salmonids past dams. The ability to separate lamprey at these operations would allow release of both anadromous and resident lamprey juveniles back into the river after collection. Methods to separate lamprey at JBS exit raceways may provide insights into ways to reduce other sources of juvenile lamprey mortality at dams.

2.4. Evaluation of Adult Pacific Lamprey Passage Success at McNary and Lower Snake River Dams. This study will evaluate passage success for adult Pacific lamprey *Lampetra tridentata* at McNary Dam, Ice Harbor Dam, and the remaining lower Snake River dams and associated river segments using a combination of radio telemetry and half duplex passive integrated transponder (HD PIT) systems. Adult lamprey will be trapped in adult fishways at McNary dams, held and then tagged at the juvenile smolt sampling facility prior to release. This study will require McNary, Ice Harbor and potentially other Snake River dams to provide power for electronics equipment in the fishways and tailrace areas, access for the installation, repair, and testing of electronic and trapping equipment and access for the downloading of data from radio and PIT tag detection equipment. Some project crane support may be needed to install antennas in and near fishways. Maintenance and installation of equipment will occur during the winter maintenance period when adult fishways are dewatered.

APPENDIX A: ICE HARBOR

Ice Harbor Dam[1]

1. Special Project Operations.

1.1. Spill. Spill for fish passage will be provided during the outmigration season in accordance with spill specifications in Appendix E and as coordinated through TMT. Alternative spill patterns to control dissolved gas levels or change fish passage conditions will be coordinated through the FPOM.

1.2. Doble Tests. Three transformer banks, TW3, TW4, and TW0 (station service transformer) and turbine units 3 and 4 will be taken out of service for Doble testing in 2008. The outage is tentatively scheduled for 14-17 July 2008. Since Ice Harbor Dam has multiple transformer banks and transmission lines, and redundant switching capability, the remaining turbine units will be available for operation during these tests. Turbine unit 1% efficiency operations and turbine priorities will continue to follow fish passage plan requirements during these tests.

1.3. Navigation. Short term adjustments in spill patterns, spill discharge rates and/or turbine operations may be required for navigational safety. This includes both commercial tows and fish barges.

1.4. Ice Harbor RSW Tests. Tests are tentatively scheduled for February or March. The RSW developed a significant vibration during the 2007 operating season. To support ongoing research as to the source and solution to this problem CENWW may request short outages of the structure, adjacent spillbay, or Unit 6 to allow for installation of, or collection of vibration data. Should the severity of the vibration issue increase where structural integrity or safe operation of the Project are a concern the RSW will be removed from service. Either the spillway will be closed or the RSW stowed to allow for full spillway capacity. No additional outages are anticipated during the fish passage season to assist operation of the RSW.

1.5 Turbine Unit Priority Change. A major transformer has failed at the Sacajawea Substation which in turn restricts turbine operations at Ice Harbor Dam. Transformer design, build and replacement is expected to take a year or more to complete. Because of power distribution restrictions, the turbine unit priority will be 3, 1, 6, 4, 5, and 2 until the transformer is replaced.

[1] The purpose of this section is to notify regional interests of planned activities that will or may affect fish passage. Further coordination may occur as needed.

2. Studies.

2.1. Evaluate the Impacts of Avian Predation on Salmonid Smolts from the Columbia and Snake Rivers. This is a continuation of a pilot study to determine how various biotic and abiotic factors are associated with differences in steelhead smolt vulnerability to predation by Crescent Island terns and Foundation Island cormorants. The study request PIT tagging both hatchery and wild steelhead collected in the smolt monitoring sample at Lower Monumental and Ice Harbor dams from April though-July. The recorded condition of a fish will be attached to a specific tag code and vulnerability to avian predation will be evaluated using PIT tag recovery data collected from the avian bird colonies. A sample of 500 fish per week is desired. Some collection will take place prior to the start of the regular transport season. The number of fish desired means the collection at times will exceed the numbers of fish needed to determine fish condition. Some fish will also be held greater than the maximum 2 days normally allotted.

2.2 Capture and tag adult salmon and steelhead in the trap at Ice Harbor fish ladder. This activity would take place in support of the adult passage and behavior study planned at Little Goose as well as an evaluation of adult holding in the Lower Granite fish ladder and transition pool in 2008. The trap would be used during the spring and summer spill periods for spring Chinook, steelhead and fall Chinook (April 1 to August 31 spill period). Access to the ladder may be necessary for inspecting and preparing the trap location during the dewatered winter maintenance period. The adult trap itself can be maintained and serviced without unwatering the ladder. Only the trap guides in the channel need to examine during the maintenance period.

2.3. Evaluation of Adult Pacific Lamprey Passage Success at McNary and Lower Snake River Dams. This study will evaluate passage success for adult Pacific lamprey *Lampetra tridentata* at McNary Dam, Ice Harbor Dam, and the remaining lower Snake River dams and associated river segments using a combination of radio telemetry and half duplex passive integrated transponder (HD PIT) systems. Adult lamprey will be trapped in adult fishways at McNary Dam, held and then tagged at the juvenile smolt sampling facility prior to release. This study will require McNary, Ice Harbor and potentially other Snake River dams to provide power for electronics equipment in the fishways and tailrace areas, access for the installation, repair, and testing of electronic and trapping equipment and access for the downloading of data from radio and PIT tag detection equipment. Some project crane support may be needed to install antennas in and near fishways. Maintenance and installation of equipment will occur during the winter maintenance period when adult fishways are dewatered.

APPENDIX A: LOWER MONUMENTAL

Lower Monumental Dam[1]

1. Special Project Operations.

1.1. Spill. Spill for fish passage will be provided during the outmigration season in accordance with spill specifications in Appendix E and as coordinated through TMT. Alternative spill patterns to control dissolved gas levels or change fish passage conditions will be coordinated through the FPOM. During periods of high river flow, spill volumes and the elevation of Lower Monumental reservoir may need to be manipulated on a daily or every-other-day basis to provide safe conditions for loading the fish barge at the juvenile fish facility below the dam.

1.2. 500 KV Disconnect Switch Replacement. The T1 line 500 KV disconnect switch is tentatively scheduled to be replaced in late September or early October 2008. The current switch which failed in January 2007 is a key safety and equipment protection device. This work will require a total powerhouse outage, and 100% spill (except for station service) for up to 2 weeks. This work will be coordinated with other potential outages such as Doble testing.

1.3. Navigation. Short term adjustments are needed outside of the approved spill patterns, spill discharge rates and/or turbine operations may be required for navigational safety. This includes both commercial tows and fish barges.

1.4. RSW. Following completion of the construction of the RSW in mid-March, commissioning and operational validation tests will be not be undertaken, but instead postponed until after the fish passage season. Biological data collection equipment will be installed in March, prior to the fish passage season. Baseline biological data will be collected to validate the structure prior to the fish passage season. No additional outages are anticipated during the fish passage season to assist operation of the RSW. CENWW may request short outages of the structure or adjacent spillbay, or Unit 6 should adjustments need to be made to either the RSW or biological monitoring equipment during the fish passage season. When the RSW is in operation, the spillgate shall be raised to where it does not touch flow passing down the RSW.

1.5. Tailrace Crane: The trolley will be replaced in its entirety and the crane will be brought up to current codes and standards. The installation of new electrical will be isolated from the plant. When the crane is returned to service, power will be restored at the main breaker and testing can occur with the local breakers at the crane. Any power outages will occur in December 2008.

1.6. Gantry Intake Crane: The entire crane is being rehabilitated both mechanically and electrically between April 1 and October 1, 2008. A power outage will occur in April 2008 for 4 hours while the crane bus is isolated from the main power source. Overhead work for cab replacement will occur between May and August 2008 that would require 1 week of intermittent outages of Units 5 and 6 for 8 hours total.

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[1] The purpose of this section is to notify regional interests of planned activities that will or may affect fish passage. Further coordination may occur as needed.

2. Studies.

2.1. Evaluate the Impacts of Avian Predation on Salmonid Smolts from the Columbia and Snake Rivers. This is a continuation of a pilot study to determine how various biotic and abiotic factors are associated with differences in steelhead smolt vulnerability to predation by Crescent Island terns and Foundation Island cormorants. The study request PIT tagging both hatchery and wild steelhead collected in the smolt monitoring sample at Lower Monumental and Ice Harbor dams from April though-July. The recorded condition of a fish will be attached to a specific tag code and vulnerability to avian predation will be evaluated using PIT tag recovery data collected from the avian bird colonies. A sample of 500 fish per week is desired. Some collection will take place prior to the start of the regular transport season.

2.2. Lower Monumental RSW Post Construction Evaluation . A radio telemetry survival study will be conducted with yearling Chinook through Lower Monumental Dam during the spring of 2008. Radio telemetry equipment setup will begin in February and continue until the end of March, 2008. Smolts will be radio tagged, released upstream of the project, and monitored as they pass the project beginning in mid-April. Spill using a high-gate opening alternate bay configuration will be evaluated compared to a flat pattern to maximize passage through the RSW and survival through both the RSW and spillway.

2.3 Bull Trout PIT tag Study – Incidental bull trout passing through the Lower Monumental Juvenile Fish Facility will be collected and held for PIT tag insertion, then released through the Lower Monumental primary bypass outfall. Project duration begins and ends with scheduled juvenile fish facility operations. No special turbine or spill operations will be necessary.

APPENDIX A: LITTLE GOOSE

Little Goose Dam[1]

1. Special Project Operations.

1.1 Spill. Spill for fish passage will be provided during the outmigration season in accordance with spill specifications in Appendix E and as coordinated through TMT. Alternative spill patterns to control dissolved gas levels or change fish passage conditions will be coordinated through the FPOM.

1.2 Navigation. Short term adjustments in spill patterns, spill discharge rates and/or turbine operations may be required for navigational safety. This includes both commercial tows and fish barges.

2. Studies.

2.1 Evaluate Behavior and Passage of Adult Salmon and Steelhead Under Varying Spill Conditions. Adult spring Chinook, steelhead and fall Chinook will be collected at the Ice Harbor fish ladder adult trap, radio-tagged, and released in the forebay of Ice Harbor Dam. The behavior and passage of these fish will be tracked in the tailrace and through the fish ladder at Little Goose Dam under three, or possibly four spill and power house operations. The study is planned for the spring spill season with an optional task to include the summer spill period of approximately June 1 through termination of spill in August.

Radio tag antennas will be placed in the tailrace, at all ladder entrances, at the junction pool, at the ladder exit, at the primary juvenile bypass outfall, and near the navigation lock discharge pipe. There are currently radio antennas in the ladder that will require inspection, repair and/or replacement during the winter dewatered period. Additional antenna locations may include the north shore, the earth fill portion of the dam, and the peninsula. The research biologists may also need access to the tailrace BRZ for radio-tracking antenna placement if barges are necessary to obtain the behavior information needed. In addition to tracking adults, GPS-equipped drogues will be released into selected spillways in order to record and characterize flow patterns in the tailrace under various spill patterns and power house operations. Boat access to the tailrace will be necessary for recovering the drogues as well as the mobile tracking of adults. Spill patterns and power house test treatments will be coordinated through FPOM and the regional fish managers. Once a specific project operating condition has been shown to be detrimental to adult fish passage, the condition will be dropped from the study.

[1] The purpose of this section is to notify regional interests of planned activities that will or may affect fish passage. Further coordination may occur as needed.

2.2 Bull Trout PIT tag Study – Incidental bull trout passing through the Little Goose Juvenile Fish Facility will be collected and held for PIT tag insertion, then released through the Little Goose primary bypass outfall. Project duration begins and ends with scheduled juvenile fish facility operations. No special turbine or spill operations will be necessary.

APPENDIX A: LOWER GRANITE

Lower Granite Dam[1]

1. Special Project Operations.

1.1. Spill. Spill for fish passage will be provided during the outmigration season in accordance with spill specifications in Appendix E and as coordinated through TMT. Alternative spill patterns to control dissolved gas levels or change fish passage conditions will be coordinated through the FPOM. During periods of high river flow, spill volumes and the elevation of Lower Granite reservoir may need to be manipulated on a daily or every-other-day basis to provide safe conditions for loading the fish barge at the juvenile fish facility below the dam.

1.2 Turbine Unit 2 Repair. Turbine unit 2 is currently undergoing rotor pole repair and is estimated to be returned to service by late October 2008. Two weeks of operational tests are needed after the completion of repairs to verify turbine and generator controls, start-up & shut-down sequence operations, relay action, alarms, and other associated components. Operation outside of normal priority may be necessary.

1.3. Turbine Unit 3 Cavitation Repair. Unit 3 us scheduled to be taken OOS for cavitation repair early summer (Approx. Mid June-Mid July, when flows are expected to stay below 60 KCFS) and will remain OOS for approximately 4 months.

1.4 Main Unit Fire Protection. Each main unit will need to be taken OOS for a duration of approx 8 to 10 days one unit at a time to upgrade the fire protection system to a bulk CO2 storage system. Project to start sometime in either June or July depending on runoff. Unit 2 will not need further outage as the unit is already OOS. Unit 3 should also be OOS for cavitation repair and CO2 installation will occur. Unit 1 will be first outage in July and back online before followed by units 4 to 6.

1.5. Power System Stabilizer (PSS) installation on Units 4, 5, 6. Units will be scheduled OOS for approximately 1 week (one unit at a time) to perform the physical installation of PSS. After physical installations are complete, each unit will then be scheduled OOS (one unit at a time) for 1 to 2 days to tie in to existing system and commission each PSS. These outages are estimated to begin in late July to late August during mandatory spill season when river flows are low.

1.6. Main Unit Breaker: Unit 2 is currently out of service and the final testing phase for the main unit breaker replacement will take place in July 2008 when the unit is reassembled. An outage of 5 hours will be needed for Units 1-4 in July 2008 to return power to this unit for final USACE testing.

[1] The purpose of this section is to notify regional interests of planned activities that will or may affect fish passage. Further coordination may occur as needed.

1.7. Arc Flash: Data collection to establish PPE levels or changes to equipment will require various unit outages for personnel safety for 1 hour on 6 different occasions to open cabinet doors for verification purposes between April and July 2008.

2. Studies.

2.1. Alternate Barge Release Strategies. In 2008, NOAA Fisheries will PIT tag yearling Chinook salmon and steelhead to evaluate if an alternate release site for barged fish improves survival. . The study will require one 2000 series barge for transporting the smolts downriver to near Astoria Bridge for release, and a separate towboat will be contracted to move this barge downriver for the release. Six separate alternate site releases on an ebb tide are planned and tagging will occur five days prior to each release. The control group will be transported in a normal barge trip with all other collected fish for release at Skamania. Arrangements have been made to use the NOAA PIT tagging buildings and personnel for the PIT marking. Acoustic marking and BKD sampling will need to take place either in the wet lab or the shed used for gas bubble monitoring. This study may require an increase in the normal facility sampling rate in order to get the required number of fish on marking days. The study will require coordination with other onsite researchers and the project biological staff and this effort has already been initiated. Alternate release site barges are to depart Lower Granite Dam on April 21, April 28, May 5, May 12, May 19, and May 26.

2.2. Comparative Performance of Acoustic-tagged and PIT-tagged Juvenile Salmonids. This study will examine performance differences between fish tagged with only a PIT tag against fish tagged with both a microacoustic tag and PIT tag. The existing PIT tag diversion for the east raceway flume was modified in February 2007. This changed the then existing drop gate into a PIT diversion slide gate capable of rapid response. Only spring fish are to be studied during the 2008 season.

2.3. A study to compare seasonal SARs of early in-river migrating versus transported Snake River yearling anadromous salmonids. At Lower Granite, this study will ask for fish to be collected and held starting April 6 and transported by barge once a week until regularly scheduled transportation operations begin. Samples are to be collected over 2-3 days, then transported by barge on Thursdays. The desired transported sample size is 6,000 wild Chinook and 6,000 wild steelhead per week for five to six weeks beginning approximately April 1. The current tagging level for the inriver migrating group is 2000 fish per week using NOAA Fisheries Survival Study tagging standards. The study will request an increase in the inriver migrating sample size for comparison. An estimated sample size for the in-river migrating group to estimate weekly SARs with 95% confidence interval is being developed.

2.4. Estimate of hydrosystem latent mortality associated with barge and in-river life-history strategies of Snake River spring/summer Chinook salmon. The study will require access to fish collection facilities at Lower Granite, McNary, and Bonneville Dams and access to barges and coordination with barge operations. The study will monitor pathogen prevalence and disease incidence in the barge holds and hydropower bypass facilities along the Snake and Columbia River migration corridor and characterize the impact of transport operations on disease transmission. The study will also asses the impact of loading density and water volume exchange rates on disease dynamics and estimate the incidence of latent mortality associated with the type and severity of infectious disease. This study is being conducted in conjunction with the Alternate Barge Release Strategies Study at Lower Granite which includes early season releases of barged research fish (prior to the start of normally scheduled barge operations). In addition, 6 special releases are scheduled to take place in the vicinity of the Astoria Bridge.

2.5. Evaluate causes of adults holding in the fish ladder and transition pool. Fish tagged at the Ice Harbor adult trap for the behavior and passage study at Little Goose Dam will be again tracked upon entrance in the tailrace at Lower Granite Dam. Ladder conditions at Lower Granite will be monitored and evaluated with respect to adult passage/behavior. Radio antennas currently present in the Lower Granite ladder will be inspected, repaired, or replaced as needed during the 2008 winter maintenance period.

2.6. Estimate survival of in-river and transported yearling Chinook salmon originating from Dworshak hatchery in the lower Columbia River and Estuary with emphasis on increasing understanding of causes of differential delayed mortality. The study will require access to fish collection facilities at Lower Granite and Bonneville Dams and access to barges and coordination with barge operations. The primary goal of this study is to use JSATS acoustic tags and concomitant detection arrays in conjunction with estuary net pens to increase the understanding of the extent and cause of differential delayed mortality of transported and in-river yearling Chinook salmon smolts originating from Dworshak hatchery specifically in the lower Columbia River and Estuary. This study is being conducted in conjunction with the Alternate Barge Release Strategies Study at Lower Granite which includes early season releases of barged research fish (prior to the start of normally scheduled barge operations).

2.7 Bull Trout PIT tag Study – Incidental bull trout passing through the Little Goose Juvenile Fish Facility will be collected and held for PIT tag insertion, the released to the Little Goose primary bypass outfall. Project duration begins and ends with scheduled juvenile fish facility operations. No special turbine or spill operations will be necessary.

APPENDIX B

CORPS OF ENGINEERS JUVENILE

FISH TRANSPORTATION PLAN

Corps of Engineers' Juvenile Fish Transportation Plan[1]

1. Introduction:

a. The Juvenile Fish Transportation Plan describes operations and establishes criteria for the transportation of juvenile salmon and steelhead from Lower Granite, Little Goose, Lower Monumental, and McNary dams (collector dams) to release areas below Bonneville Dam. This work plan supplements normal operating criteria presented in Sections 5, 7, 8, and 9 of the Fish Passage Plan for the collector dams.

b. Collection and transportation is accomplished by theWalla Walla District, Corps of Engineers (CENWW), under an Endangered Species Act (ESA) permit from the National Marine Fisheries Service (NOAA Fisheries). On-site biological assistance is provided by fishery agencies through a contract with Pacific States Marine Fisheries Commission and subcontracts with Washington Department of Fish and Wildlife (WDFW) and Oregon Department of Fish and Wildlife (ODFW). On-site biological assistance is provided by WDFW at Lower Granite, Lower Monumental, and McNary dams and ODFW at Little Goose Dam.

c. The transport program will be coordinated with other fishery monitoring, research, and management activities by CENWW. Coordination will be achieved with the fishery agencies and tribes through NOAA Fisheries, the Pacific States Marine Fisheries Commission (PSMFC), Fish Passage Operations and Maintenance Coordination Team (FPOM), the Technical Management Team (TMT), and other agencies as required.

2. Objective: The objective of CENWW and the transportation program is to transport juvenile fish when the best scientific information indicates doing so will increase adult return rates. This can be achieved by:

a. Providing safe and efficient collection and barge or truck transport of juvenile salmon and steelhead from collector dams to release areas below Bonneville Dam;

b. Identifying and recommending programs or facility changes that would benefit fish collection and transportation or bypass operations;

c. Assuring that collection, transport, and release site facilities are ready for operation prior to the beginning of transport operations;

d. Assuring that collection, transport, and release site facilities are properly maintained throughout the transport season;

e. Establishing operating criteria for facilities, barges, and trucks including fish holding and transport densities, sampling rates, and facility operations and maintenance;

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[1] If any provisions herein conflict with the Corps' 2008 Fish Operations Plan (Appendix E), the latter shall prevail.

f. Coordinating changes needed to accommodate fluctuations in the outmigration with projects, NOAA Fisheries, PSMFC, FPOM, and TMT personnel;

g. Coordinating transport evaluation and other research with the transportation program;

h. Providing the training of new personnel associated with collection and transport facilities and equipment;

i. Providing all parties involved a list of emergency points of contact and appropriate telephone numbers so that any emergency can be coordinated and corrected efficiently;

j. Preparing an annual report detailing transportation activities and results for the previous year, and identifying maintenance, replacement, or modifications needed for the next transport season.

3. Program Duration:

a. Starting Operations: Consistent with the 2008 Fish Operations Plan, the juvenile fish transportation program allows for a variable start date, based on expected river flow. During years when the spring seasonal average river flows in the Snake River are expected to equal or exceed 70 kcfs, transport operations may have a staggered start. Transport operations will begin between April 20 and May 1 at Lower Granite Dam (determined by TMT), followed by Little Goose up to 8 days later, and Lower Monumental up to 3 days after Little Goose. Prior to that date, all collected fish will be bypassed directly to the river. In years when the spring seasonal average river flows are expected to be below 70 kcfs, transport operations will start on March 25 at Lower Granite Dam and on April 1 at Little Goose and Lower Monumental dams. McNary Dam will begin sampling for PIT tags, monitoring facility operations, and the Smolt Monitoring Program (SMP) on April 1. Transport operations at McNary Dam will not begin until conditions specified under paragraph 4.b.(2) are met.

b. Summer Transport Operations: At McNary Dam, summer operations will begin when in-river migration conditions are no longer spring-like (see 4.b.(2) below). At Lower Granite, Little Goose, and Lower Monumental dams, summer operations will begin on June 21. Fish collected during summer operations will be held in shaded raceways or holding tanks. Sampling may convert to 100% when fish numbers at Snake River projects are below 500 fish per day (per PSMFC sampling guidelines) and smaller pickup mounted transport tanks may be used. Steelhead, which state biologists determine are in poor condition or are reverting to the parr stage, may be bypassed to the river.

c. Ending Operations: Transport operations are anticipated to continue through approximately October 31 at Lower Granite and Little Goose, and through September 30 at Lower Monumental and McNary dams. Transport operations may end prior to these dates due to low fish numbers or other operating conditions.

d. Emergency Notification Criteria: Project Biologists will report to the CENWW Transportation Coordinator when high water temperatures or other factors increase collection mortality to 6 percent of daily collection for 3 consecutive days or if daily collection mortality exceeds 10,000 fish. The Transportation Coordinator will evaluate the situation and shall notify NOAA Fisheries and may arrange a conference call, if needed, with TMT to discuss the options of continuing collection and transportation or to bypass fish. In the event of a fish loss exceeding conditions set forth in the ESA Section 10 Permit for the transportation program, the Corps shall notify NOAA Fisheries and reopen consultation as needed. If icing conditions threaten facility integrity or present unsafe conditions on the transport route, transport operations may be terminated early by the project's Operations Manager. Emergency termination or modification of the transportation program will be coordinated by the CENWW Transportation Coordinator with NOAA Fisheries and TMT.

4. Operating Criteria:

a. Early Season, Non-Transport Operations: Prior to April 20 in flow years when fish are not being transported from the Snake River projects, fish collection facilities will be operated in the following manner:

(1) Lower Granite: Juvenile fish will be bypassed via normal separator operations and routed to the mid-river release outfall. All juvenile fish collected will be interrogated for PIT tags and normal 24-hour sampling for the SMP shall take place.

(2) Little Goose: Juvenile fish will be bypassed via normal separator operations and routed to the mid-river release outfall. All juvenile fish collected will be interrogated for PIT tags. Limited sampling may take place every 3 to 5 days to monitor fish condition, ensure sampling systems are operating correctly prior to when transport begins, and to train personnel on facility operations and sampling protocol. Prior to initiating transportation, full 24 hour samples may be taken to determine species composition to help inform a decision to initiate transportation at this project.

(3) Lower Monumental: Juvenile fish will be bypassed via normal separator operations and routed to the secondary bypass outfall. All juvenile fish collected will be interrogated for PIT tags. Limited sampling may take place every 3 to 5 days to monitor fish condition, ensure sampling systems are operating correctly prior to when transport begins, and to train personnel on facility operations and sampling protocol. Prior to initiating transportation, full 24 hour samples may be taken to determine species composition to help inform a decision to initiate transportation at this project.

b. Collection and Transportation: Juvenile fish shall be transported in accordance with the ESA Section 10 permit, the Updated Proposed Action prepared under ESA Section 7 consultation with NOAA Fisheries, and transportation program criteria. During transport operations, collected juvenile fish will be bypassed back to the river if the number of collected fish exceeds or is expected to exceed the facility and barge holding capacities. Holding for transportation will resume when adequate capacities are available to hold and transport fish according to transportation program criteria. Maximum holding time and loading criteria will not be exceeded without CENWW review and approval. Marked or PIT tagged fish will be released to the river if they are part of an approved research study or smolt monitoring program travel time evaluation. Specifics of the transportation program may be altered during the transportation season based on recommendations from the TMT.

(1) At Lower Granite, Little Goose, and Lower Monumental dams, all juvenile fish collected, with the exception of those marked for in-river studies, shall be transported once transport operations begin (paragraph 3.a.). The default dates for fish collection barging operations to begin are April 6 during low flow years (first barge departs April 8)and on April 20 in higher flow years (first barge departs April 21 or 22), continuing through approximately August 15 of each year.

(2) At McNary Dam, fish collected during the spring shall be bypassed back to the river either through the main bypass pipe and full flow PIT tag detection system or through the transportation facilities in order to collect fish for research, fish condition information, and to obtain PIT tag data. The preferred operation when not collecting spring fish for research is full flow bypass to the river. Full flow bypass may be alternated with every other day bypass through the transportation facilities to allow sampling of fish under the SMP. Transportation operations at McNary Dam for subyearling chinook shall not begin until inriver migratory conditions are deteriorating (i.e., no longer spring-like), usually not until around June 20. Spring-like conditions are defined as favorable flow and water temperatures; i.e., river flows are at or above the spring flow target of 220 to 260 kcfs, and ambient water temperatures are below 62^{o}F. When transport operations begin, fish will be collected and held for transportation with all fish collected being transported, with the exception of those marked for in-river studies. During the spring, juvenile fish may be periodically sampled for the SMP and for monitoring facility operations.

c. Peak Migration Periods: For the purpose of transport operations, the peak migration period is defined as beginning when total collection at an individual project reaches 20,000 fish per day (actual peak days may range from 250,000 to 1,000,000 fish per day). Fish will be transported by truck from March 25 through April 6 during low runoff years when early collected fish are transported. Peak migration generally occurs between April 15 and June 10 at Lower Granite, Little Goose, Lower Monumental, and McNary dams. At McNary Dam, a summer peak of subyearling chinook salmon also occurs from late June through mid-August with a smaller peak occurring during this time period at Snake River projects.

d. Collection Facility Operations:

(1) Once transport operations begin, collection facilities will be staffed 24 hours per day until transport operations cease.

(2) Flows and fish passage at juvenile fish separators will be monitored at least every 15 minutes throughout separator operations.

(3) When collection systems are not providing safe fish passage or meeting operating criteria, project operations managers and biologists will make operational changes that are in the best interests of the fish, then notify CENWW as soon as possible. The CENWW Transportation Coordinator will coordinate changes with NOAA Fisheries and TMT.

(4) Fish collection numbers at Lower Granite, Little Goose, and Lower Monumental dams may exceed facility and barge capacities for short periods of time. This is most likely to happen during low flow years when the project is not spilling. During low flow years when there is no spill, CENWW will coordinate with RCC at the beginning of the transport season for permission to spill if a facility appears to be exceeding its carrying capacity. During low flow years, <u>if it appears that holding capacity may be exceeded on a given day</u>, the project biologist shall immediately inform CENWW. The project biologist will report the hourly fish collection numbers, barge arrival time or holding capabilities, along with facility descaling and mortality information. The CENWW Transportation Coordinator shall promptly coordinate this information with RCC and NOAA Fisheries. Spill through the RSW/spillway at the affected project may be requested if it appears that holding capacity will be exceeded or fish condition information indicates that spill passage is a better passage route than bypassing through the facility. If it is determined that the best course of action is to spill, spill operations shall begin prior to the facility reaching its holding capacity (around when the eighth of 10 raceways is filled). Spill may continue until holding capacity becomes available or fish condition improves.

(5) To avoid attracting predatory birds, mortalities should be returned to the river at night if deemed necessary by the project biologist.

(6) Juvenile lamprey are sometimes found in dewatered raceways after truck/barge loading operaitons. If debris is not a problem, lamprey should be promptly and safely flushed or otherwise returned to the river. If debris is a problem, and when practicable, lamprey should be removed by hand or by placing debris in a container that allows lamprey to access water where they can later be returned to the river.

e. <u>Sampling Procedures</u>:

(1) When sampling is being conducted, it will normally be accomplished in accordance with smolt monitoring program sampling guidelines recommended by the PSMFC. Sampling guidelines may occasionally be altered if transportation program or fish research activities require it. Normal alterations of sampling guidelines are to adjust the number of fish sampled to meet approved research needs, to minimize the handling of fish during warm water temperature periods, or to meet deadlines for loading fish transport vehicles.

(2) Fish that are sampled will be counted by electronic counting tunnels and the counts verified and adjusted by hand counts. All fish number estimates, raceway, truck, and barge loading densities and rates will be based on a sample of fish collected. Samples will be taken hourly 24 hours per day. Sample rates will be coordinated with SMP personnel and set by project biologists.

(3) Species composition and weight samples will be taken to determine loading densities for raceways, barges, and trucks. Project personnel will keep a running total of hourly estimates of fish numbers, raceway totals, and direct loading totals for barges based on these estimates. Daily samples for monitoring descaling will include a minimum of 100 fish of the dominant group(s) for which descaling information is recorded. During periods of low fish passage, descaling will be monitored daily for facility operations. Full sample descaling may be conducted instead of 100 fish subsamples as long as it does not impact other facility operations. During extended transport operations (after August 15 at Snake River projects), samples may be evaluated every other day to minimize handling stress and to allow all collected fish to be held in the sample holding tanks.

(4) Where SMP activities are conducted at collector dams, project biologists may utilize daily total information gathered by those personnel.

f. <u>Loading Criteria</u>:

(1) <u>Raceways</u>: Maximum raceway holding capacity will be 0.5 lbs. of fish per gallon of water. Inflow to raceways is approximately 1,200 gallons per minute (gpm) at Lower Granite and Little Goose dams, and 2,400 gpm at Lower Monumental and McNary dams. Individual raceway volume is approximately 12,000 gallons of water at Lower Granite and Little Goose, and 24,000 gallons at Lower Monumental and McNary.

(2) The 0.5 pounds per gallon criterion is not to be exceeded without CENWW review and approval. Such decisions will be coordinated with NOAA Fisheries and TMT and a joint decision whether to exceed criteria or bypass fish to the river will be made based on: (1) species composition; (2) total anticipated collection during the critical holding period; (3) in-river fish passage conditions; and (4) fish condition. Project biologists will provide information to the CENWW Transportation Coordinator upon which to base these decisions.

(3) <u>Distribution Among Raceways</u>: Collected fish should be spread among raceways to minimize crowding and stress, and to reduce the risk of disease transmission. Additional groups should be added to each raceway at the discretion of the project biologist until holding capacity is reached. Whenever possible, small fish will be held in raceways separate from large fish.

(4) <u>Holding Time</u>: Maximum holding time in raceways will be 2 days. An exception to this criterion is instances when additional holding time is needed to collect sufficient fish for tagging to conduct research studies.

(5) <u>Truck and Barge Capacities</u>: Loading criteria are 5 pounds of fish per gpm inflow for barges and 0.5 pounds of fish per gallon of water for trucks. Capacities per vehicle are shown in Table B-1.

Table B-1. Capacities for fish transport vehicles.

Barge	Capacity (gal)	Inflow(gpm)	Fish Capacity (lbs)
SOCKEYE (2127)	85,000	4,600	23,000
BLUEBACK (2817)	85,000	4,600	23,000
STEELHEAD (4382)	100,000	10,000	50,000
COHO (4394)	100,000	10,000	50,000
CHINOOK (8105)	150,000	15,000	75,000
KING SALMON (8106)	150,000	15,000	75,000
8107	150,000	15,000	75,000
8108	150,000	15,000	75,000
Truck	3,500		1,750
Midi-tank	300		150
Mini-tank	150		75

g. <u>Summer Transport Operations</u>:

(1) During the summer, all fish collected at the projects will be routed to the raceways with the most effective shading for holding. Sampling efforts should be minimized, if possible, to limit handling stress on fish. Facility samples may be processed every other day if possible.

(2) At Snake River projects, all collected fish may be routed to the sample tanks when fish numbers drop to an acceptable handling level. At that time all fish collected will be handled as part of the daily sample per smolt monitoring program sampling guidelines. To minimize handling stress, facility samples may be processed every other day. When large trucks are used, fish may be loaded from either the raceways or labs. When mini or midi-tankers are used, Corps and agency project biologists will select the best method of transferring fish from the lab to the tankers.

(3) During summer months at McNary Dam, from June 15 through August 31, water temperatures will be measured along the face of the powerhouse, in B-slot gatewells, and within the collection channel on a daily basis. These temperature measurements will be used for management of project operations per criteria contained in the Fish Passage Plan. During warm water periods, collected fish may be transported by truck or barge on a daily basis to minimize stress and mortality from warm water conditions. Other special operations may be required at McNary Dam during summer months to minimize impacts of project operations on juvenile fish collection during warm water temperature periods (see Fish Passage Plan, section 4.1., Turbine Unit Loading).

(4) During the summer trucking season, if fish collection numbers begin increasing to where it appears the project will have have difficulty transporting the fish with available equipment, the project shall notify the CENWW Transportation Coordinator immediately. The Transportation Coordinator will arrange for an additional transport vehicle if possible or prioritize transport/bypass operations between the projects.

(5) When water temperatures are above 68^0F, all personnel handling fish shall take extra care to minimize stress and other impacts on fish.

h. Facility and Equipment Logbooks and Records: To document collection and transportation activities, the following items will be logged at each dam by either project personnel or state biologists:

(1) Juvenile fish facilities: Records will be maintained recording fish counts by hour, by day, and by species, numbers and species of fish trucked or barged, number and species of fish sampled, descaling rates, and mortality rates. Records will be transmitted daily to CENWW for consolidation and transmittal to CENWD. Facility personnel will follow standard operating procedures (SOP's), and will note in facility logbooks accomplishment of SOP's at various stations at the collection facilities. General observations of fish condition and juvenile fish passage will be documented in facility logbooks by state biologists.

(2) Truck and Barge Logbooks: Each truck and barge shall have a logbook for recording fish loading rates, fish condition, estimated mortalities, area of release, equipment malfunctions, and accomplishment of scheduled work under the SOPs. When consecutive loading of trucks or barges occurs at downstream projects, truck drivers or barge riders will record numbers and condition of fish loaded. Towboat captains will keep logbooks on towboat activities. Barge riders will be authorized as inspectors by the Contracting Officer's Representative to initial entries noting towboat passage, loading, or fish release activities, and comments on barging operations. State biologists will report truck and barge mortality information in their weekly reports.

(3) Weekly Reports: State biologists shall prepare weekly reports documenting daily and weekly collection and transportation numbers, sampling information, facility and sampling mortality, descaling rates, and adult fallbacks. The weekly reports will be used by CENWW for any weekly reports required in the ESA Section 10 permit issued by NOAA Fisheries. State biologists shall distribute the weekly reports to other regionally interested parties as directed by the CENWW Transportation Coordinator.

5. Transport Operations:

a. Truck Operations: Eight 3,500-gallon fish transport trailers and four tractors, three 300-gallon midi-tanks, and three 150-gallon mini-tanks are available for hauling fish. One midi-tank and one mini-tank will be provided at each Snake River collector project. Mini- and midi-tanks are small units that can be mounted onto pickup trucks. Normally during the early spring trucking, transport trucks/trailers will be distributed two at Lower Granite Dam, one at Little Goose Dam, one at Lower Monumental Dam. During late summer trucking, one truck/trailer will be stationed at each dam. Spare trailers will be kept at McNary Dam. Trucks may be redistributed to meet transport demands and when smaller transport vehicles begin operating in late summer.

(1) Truck Release Sites: The normal early spring release site for trucked fish will be at Dalton Point. From August 15 through the end of the transport season, trucks and mini-tanks will be transported by barge from a boat ramp located somewhere downstream of Bonneville dam to a mid-river release area. Mid-river releasing of trucked fish will continue as long as river levels allow safe loading of trucks onto the barge. Dalton point will be utilized as an alternate release site in the case of an emergency or unsafe river conditions for performing the mid-river barge release.

(2) Operation of Truck Life Support Systems: Truck drivers will be trained by project biologists and maintenance personnel on the operation of truck life support systems, the requirements of fish to be met, and signs of stress for which to watch. Routine checks will be made on support systems and fish condition at check points identified by project biologists. Life support system data and information on fish condition will be entered into the truck driver's logbook at each check point and at the release point. The truck driver's logbook will be reviewed by the project biologist upon the truck driver's return after each trip.

(3) If required to maintain transport schedules at the Snake River projects, transport trucks, midi-tanks, and mini-tanks leaving Lower Granite may take on additional fish at Little Goose Dam, or trucks leaving Little Goose may take on additional fish at Lower Monumental Dam. Loading schedules will be coordinated so that fish will be kept separated by size as much as possible.

b. Barge Operations: Eight fish barges and four towboats will be available for use.

(1) Barge Scheduling: Barges with 75,000 pound capacity will operate from Lower Granite Dam. It takes approximately 79 hours to make a trip from Lower Granite Dam to the release area near the Skamania light buoy below Bonneville Dam and return. One barge will leave Lower Granite Dam every-other-day beginning on about April 8 during lower flow years and between April 21 and May 1 during higher flow years. When fish numbers increase, barging operations will switch to one barge leaving Lower Granite daily. When fish numbers decline in late spring, operations will change back to every-other-day barging from Lower Granite Dam, with barging operations continuing through August 15. During spring operations, barges will take on additional fish at Little Goose, and Lower Monumental dams as barge capacity allows. The two medium and two small barges may also be used from Lower Granite Dam for additional barging capacity or they will be used for direct loading of fish at Little Goose Dam. When daily collection exceeds barge capacity, juvenile fish may be spilled per 4.d.(4) above or will be bypassed to the river until collection numbers drop to where juvenile fish can be barged within barge carrying capacity criteria. During the summer, barges traveling from the Snake River projects may stop at McNary Dam to load fish collected there. Barging from McNary Dam may continue after Snake River barging ceases, past August 15, on an every-other-day basis if fish numbers warrant it. Summer barge operations at McNary after August 15 will continue while

collection exceeds 3,500 pounds of fish per day (the capacity of two trucks) or trends indicate numbers will exceed the 3,500 pound trigger number.

(2) Barge Loading: Whenever possible, small and large fish will be loaded in separate compartments in barges.

(3) Barge Riders: Project barge riders will accompany each barge trip, supervising all loading and release operations, and barge operations en-route. Barge riders will be trained on barge operation, maintenance, and emergency procedures by project biologists and maintenance personnel. Barge riders will also be cross-trained in facility operations, and may rotate with facility operators as decided by project management. Barge riders shall be responsible for monitoring fish condition, barge equipment operations, and water quality (temperature and dissolved oxygen levels) at regular intervals during downriver trips. Barge riders shall maintain logbooks and forms recording loading activities and times, loading densities by barge compartment, information on equipment operations, and release locations. Standard operational procedure forms shall be filled out during routine monitoring of equipment operation and shall include fish mortality and water quality data. At each subsequent dam where fish are loaded onto the barge, the barge rider shall make appropriate notations in the logbook and/or appropriate form. The barge rider shall also serve as an inspector for the towboat contract, and record information required by the Contracting Officer's Representative, and shall initial the towboat captain's logbook confirming operational information and lockage times. Any unresolved differences between barge riders and towboat crews shall be reported immediately to the Contracting Officer's Representative.

(4) Barge Release Area: The barge schedule is based on releasing fish between river miles 138 and 144 with arrival at that point pre-determined to occur during nighttime hours to minimize predation impacts. As a reference point, Bonneville Dam is at RM 146. Barge travel time is affected by weather and river flows. Each towboat will be assigned a designated river mile for fish releases to ensure fish are not released in the same area on consecutive trips. Lower Granite project biologists will furnish maps of the release site and clearly designate the assigned river mile for fish release on each trip. As warranted, barge riders may randomly select a barge release site between river miles 138 and 144 to further decrease the ability of predators to prey on fish released from the barge. The alternate release site should be coordinated with the Lower Granite project biologist, if possible.

(5) Barge Lockage Priority: During the fish barging season, April 8 to August 18, fish barges as Government vessels should be provided priority lockage over commercial and recreational traffic when locking through navigation locks, per 33 CFR 207.718(f). However, safety will not be compromised during lockages.

6. Emergency Procedures:

a. Emergency procedures will be followed at any time an emergency occurs, 24 hours per day, 7 days per week during the transport season. Emergencies will be reported to the CENWW Transportation Coordinator as soon as possible.

b. In the event of an emergency (equipment failure at a facility or on a truck or barge, emergency lock outage, chemical spill in the river, etc.), facility workers, truck drivers, and barge riders will be expected to take immediate appropriate actions to protect fish. If time allows, the worker, driver, or rider should consult with his/her supervisor by phone or radio to jointly make emergency decisions. If time does not allow consultation, the worker, driver, or rider must take appropriate action on his/her own initiative, then report to his/her supervisor as soon as possible after the action has been completed.

c. A complete listing of persons to be notified in case of emergencies and their business and home telephone numbers will be provided to each person involved in the transport program. Facility operators, truck drivers, and barge riders will be trained on emergency notification procedures by project biologists and CENWW. For the purpose of reporting an emergency, the person involved will immediately notify his/her supervisor, or the next person up the line until the emergency has been properly reported and corrective action has been initiated. In addition to telephone reporting, barge riders will report emergencies by the towboat radio to the nearest Corps dam. The operator on duty will relay the message to the person or persons identified by the barge rider.

7. Fishery Agency Roles:

a. The fishery agencies provide biological assistance at transportation dams. CENWW contracts for state fish biologists to work at each collector facility.

b. Contracts specify that state agency personnel at collector dams accomplish specific tasks for the Corps including:

(1) Reviewing or conducting handling, inspection, and recording of data from fish sampled at the collection facility;

(2) Evaluating and recording fish condition, and recommending operational changes or inspection of facilities if fish condition indicates a problem;

(3) Providing hand counts of sampled fish, assisting the project biologist in adjusting electronic fish counts, checking hourly and daily fish counts for accuracy, and coordinating facility counts with counts of PSMFC Smolt Monitoring Program personnel where appropriate;

(4) Conducting quality control inspections of collection facilities and transport equipment including visits to other collection facilities when work schedules can be so arranged;

(5) Monitoring the effects of smolt monitoring and research projects on fish condition and transportation activities and reporting impacts, including numbers of fish handled for research purposes and the disposition of those fish, to the project biologist;

(6) Participating in gatewell dipping as required to monitor fish condition;

(7) Preparing weekly reports summarizing fish numbers and transport activities, and;

(8) Preparing accurate text and tabular information in the correct format for project annual reports.

8. Dissemination of Information:

a. Project biologists or agency biologists at each collector dam will be responsible for entering all pertinent information into the computer database and for transmitting daily reports to CENWW. Weekday information will be transmitted by 1500 hours on the day collected. Weekend information will be transmitted to CENWW by 1200 hours on the following Monday.

b. Agency biologists will provide weekly reports detailing fish collection and transportation numbers, descaling estimates, and facility and transportation mortality estimates. The reports will also contain a narrative on project activities and compliance with operating criteria. If research or smolt monitoring activities are occurring at the project, the weekly reports will include information on the number of fish sampled and sacrificed also. Agency biologists shall provide the reports to interested parties within the region.

9. Project Requirements for Fishery Agency Activities and Research:

a. Coordination: Agencies and tribes expecting to work at Corps dams will provide early coordination including work proposals, evidence of approval by CBFWA, copies of ESA permits, and project needs and requirements through written correspondence to the Chief, Operations Division, of CENWW, and shall not start work until written approval has been received. The Corps also expects the PSMFC to coordinate Smolt Monitoring Program sampling guidelines with the Corps on an annual basis.

b. Protocol: To maintain good working relationships and safe working conditions, fishery agencies, tribes, and research organizations will be required to follow courtesy, security, and safety protocols as follows.

(1) Have agency picture identification and present it to project security on arrival;

(2) Check in with the Operations Manager upon first arrival at the project to receive information on who will be the project point of contact, and what courtesy and safety requirements must be followed;

(3) Notify the point of contact whenever arriving or departing from the project so they will know where personnel will be working and when they will be on the project;

(4) Adhere to project clearance, safety, security, and work procedures, including preparing an Activity Hazard Analysis as specified in the Corps Safety Manual, 385-1-1.;

(5) Notify the Operations Manager or his/her representative of unscheduled or non-routine work and activities, and;

(6) Notify the point of contact of expected guests or changes in personnel and assure that these individuals are aware of safety and work procedures.

APPENDIX C

BONNEVILLE POWER ADMINISTRATION'S
SYSTEM LOAD SHAPING GUIDELINES
REGARDING TURBINE OPERATION
AND BEST EFFICIENCY

Bonneville Power Administration's System Load Shaping Guidelines Regarding Turbine Operation and Best Efficiency

1. Background: Out migrating juvenile salmonids have several potential routes of passage past hydroelectric dams on the mainstem Columbia and Snake Rivers, including turbines, mechanical bypass, sluiceways, and spillways. Fish passage survival varies depending on the route of passage. As a result of reported higher mortality rates for fish passage through turbines (Iwamoto and Williams 1993), regional efforts have been focused on providing non-turbine passage routes for juvenile fish as a means to improve fish survival through the FCRPS. Nevertheless, substantial numbers of juvenile fish will continue to pass through turbines; therefore, effort to minimize turbine-related mortality is a priority of the fishery agencies and Indian Tribes, National Oceanic and Atmospheric Administration Fisheries (NOAA Fisheries, formerly National Marine Fisheries Service [NMFS]), U.S. Army Corps of Engineers (Corps), and Bonneville Power Administration (BPA).

Kaplan turbine operating efficiency has a relatively direct effect on fish passage survival. The relationship between survival of juvenile fish passing through Kaplan turbines is positively correlated and roughly linear to the efficiency at which the turbines are operated. Bell (1981) recommended making every effort to operate turbines at best efficiency at a given head during periods of peak fish passage to minimize fish mortality.

2. Turbine Efficiency: For the purposes of this document, best turbine efficiency operation shall be based on efficiency tables provided by the Corps for each project in the Fish Passage Plan (FPP). The Corps shall ensure that these efficiency ranges are based on the best available information, and that updates are coordinated with BPA, the Fish Passage Operation and Maintenance Coordination Team (FPOM), and operating agencies. The tables will be distributed to all operating agencies prior to implementation, allowing up to two weeks after receipt of the tables for implementation.

Operating efficiency of turbines is a result of wicket gate opening and blade angle for a given head (Bell 1981). As a result, there is a family of turbine efficiency curves for each project (or turbine design) for various head differentials. Operational decisions affecting turbine operations are based on efficiency curves for incremental changes in head, as provided by turbine manufacturers or empirical testing.

3. Guidelines:

a. <u>Objective</u>: To reduce the mortality of out migrating juvenile salmonids, BPA will provide the Corps' hydro system projects with generation requests that allow turbines at the Lower Snake (LSN) and Lower Columbia (LCOL) projects to operate within 1% of best efficiency, or as otherwise specified, during the Best Efficiency Operating Period, within the guidelines outlined below.

b. In season Best Efficiency Operating Period: This period is defined as 24 hours per day from April 1 through October 31 for all LCOL river and LSN river projects. BPA will maintain generation requests that allow turbines to operate within 1 percent of best efficiency in accordance with these guidelines. When units operate outside 1% of best efficiency during this period the excursions will be tracked using the codes in Table 1.

c. Off season operations: While not required to do so, during the period of November 1 through March 31 turbines will normally run within the 1% range since it is the optimum point for maximizing the energy output of a given unit of water over time Operation outside 1% is allowed if needed for power generation or other needs. Additional details of the 1% operation may also be found in each project's section of the Fish passage Plan labeled "turbine unit operation and maintenance". There are no reporting requirements for this period.

d. Unit priorities: The Corps should make every effort to adhere to the unit operating priorities specified in the FPP (the order in which turbines are put on or taken of line). The Corps shall follow a unit priority list that specifies which units at each LSN and LCOL project should be operated within the range of best efficiency to minimize impact to salmon stocks. The Corps through the FPOM process will develop a sequence for operating units outside of the 1% of best efficiency range, if it is necessary to operate units in this manner during the fish migration season. Both unit priority sequences will be based on the best available fish passage and turbine efficiency information in the FPP.

e. Project Priorities: If units must be operated out of the 1% of best efficiency range, BPA will make every effort to assure that generation requests to the Corps projects adhere to project priorities (emergencies, spill management, research, etc). These priorities may be developed weekly, based on in-season fish passage information, by the Action Agencies through the Technical Management Team (TMT).

f. Coordination: Coordination will occur through existing interagency coordinating mechanisms, such as the in-season management process described in the 2004 Updated Proposed Action prepared by the Corps, U.S. Bureau of Reclamation, and BPA (Action Agencies).

Coordination is also intended to allow the action agencies sufficient lead time to include system operational changes in their planning activities. Sufficient time is defined as the time needed to enter the information into the GDACs system (COE) and the Columbia Vista model (BPA). This can take up to two weeks to accomplish. If an emergency situation exists, implementation will begin as soon as practical given concurrent operations, hydraulic situations and loads.

Reasonable and prudent operations outside of best efficiency for limitations listed in paragraphs 4.a (system reliability) and 4.b (routine starting) are at the discretion of the BPA and Corps. BPA and the Corps will coordinate with NOAA Fisheries when operation of turbines outside of the best efficiency range may be appropriate under provisions in paragraphs 4.c (total dissolved gas) through 4.h (flood control). Additional coordination may also occur during the next scheduled TMT meeting.

Emergency situations, described in paragraph 4.a (system reliability), that require an immediate change in FCRPS operation will be coordinated directly by the action agencies with NOAA Fisheries when time allows. If coordination of an emergency change in FCRPS operation cannot be completed immediately, information will be supplied to the TMT as soon as practical. The action agencies shall establish points of contact with the appropriate agencies to allow such emergency coordination to occur.

g. Grand Coulee (GCL) and Chief Joseph (CHJ) Flexibility: Within system reliability and firm load limitations, flexibility at GCL and CHJ will be fully used, whenever possible, before generation requests to LCOL and LSN projects are outside the best efficiency range.

4. Limitations for the period April 1 through October 31:
There are a number of conditions that occur in the system that will limit the Corps and BPA ability to operate the turbines continuously within the 1% best efficiency range. These include the following:

a. System Reliability: BPA's ability to operate the power system in a manner that enables the Corps to maximize operation of turbines within best range will be constrained by requirements to maintain system reliability (including requirements necessary for transient and voltage stability of the transmission system), and the ability to meet system response criteria. Additionally, it is necessary to maintain a margin of resource generation on line to fulfill Northwest Power Pool (NWPP), Western Electricity Coordinating Council (WECC), and the North American Electric Reliability Council (NERC) reliability requirements. If BPA overrides the BIOP operations for system reliability, BPA will provide an automated e-mail to the Corps. For longer term emergencies, see Water Management Plan Appendix 1. Emergency Protocols.

BPA's Reliability Criteria for Operations, the Northwest Power Pool Operating Manual, the Western Systems Coordinating Council Operations Committee Handbook, and the North American Electric Reliability Council Operating Manual define system response criteria and margin of resource generation. According to the Regional Act, the Power Sales Contract with the DSIs and House Report 96-976, dated September 16, 1980," the total DSI load will be considered firm for purposes of resource operation."

Predictable instances of deviation from within the best range as a consequence of prudent utility operation for control of short-term system dynamics include:

1) Routine responses to loss of generation, load or transmission within the interconnection including delivery of Operating Reserve Obligation to NWPP members upon request. The duration of these deviations is minimal, but dependent upon recovery by the interconnection member with the problem.

2) Deliberate dropping of generation, i.e., instantaneous interruption of output, to preserve system integrity. This dropping could cause a brief excursion.

b. Routine start up and stop: Routine starting and stopping of generation units are unavoidable deviations, usually short in duration but on occasion can extend beyond the 5 minute reporting window. (see section 5 for reporting criteria)

Implementation of operations 4c through 4h will include a lead time of at least two working days for NOAA Fisheries to evaluate the effects of the proposed actions (non-emergency situations).

c. Total Dissolved Gas Supersaturation (TDG): The TDG levels will be monitored at each project during the fish passage season. Signs of gas bubble disease will be monitored at all Smolt Monitoring Program sampling sites and selected in-river sites. Best turbine efficiency operation may be modified if representative monitoring data indicate that TDG is affecting fish survival. Necessary operational modifications will be coordinated through the process outlined in paragraph 3.f (coordination).

d. Coordinated Fishery Operations: In the event that coordinated fishery operations and approved fishery research are not in accord with operating turbines at best efficiency, operational modifications will be coordinated through the process outlined in paragraph 3.f (Coordination).

e. Flow Augmentation Operations: Flow augmentation requests for LCOL flows at McNary (MCN) are primarily met by water releases from GCL. The decision on whether to use GCL flexibility to provide inflows to MCN at the level necessary to meet the week's LCOL flow request when fish collection is maximized for transport during the flow augmentation period shall be made through the coordination process outlined in paragraph 3.f (coordination).

The TMT flow augmentation requests may exceed the 1% best efficient operation range at LCOL/LSN projects. Meeting this flow request will take precedent over best efficient operations. Coordination of the implementation of the flow requests will occur through the process outlined in paragraph 3.f (coordination).

f. Transport Projects: Resolution of the conflict between spill management and turbine operation within 1% of best efficiency at transport projects during the transport season shall be determined through the coordination process outlined in 3.f., and in accordance with fish transportation guidelines, based on in-season flow and fish passage information. Care should be taken during transition periods close to the upper flow boundary to avoid frequent switching of priorities between spill and generation.

g. Routine Maintenance and Testing: All units at all projects must undergo maintenance and associated testing. The testing necessitates deviation from the 1% best efficiency band for periods of from 15 minutes to 8 hours. Scheduling of maintenance testing will be coordinated through the process outlined in 3.f., to ensure that it is conducted during times of low fish passage within a day to minimize impacts on fish.

h. Flood Control: The FCRPS provides multiple benefits to the region. Flood control is the primary function of many of the projects on the Columbia River. In the event that river flow conditions require flood control operations, operation of turbines within the 1% best efficiency range may be modified or suspended based on the Corps' direction. Allowing excursions from 1% best efficiency for flood control operations would facilitate transportation, reduce excessive dissolved gas levels, and lower the risk of gas bubble disease in fish. Coordination of flood control operations will occur as outlined in paragraph 3.f (coordination). See also paragraphs 4.c (total dissolved gas) and 3.g (Grand Coulee and Chief Joseph Flexibility).

i. Other: In the event that the excursion was not explainable or caused by human error.

5. Quality Control: Significant deviations from 1% will be recorded. Data on unit status will be compiled by BPA during the 1% operating season and provided to the COE monthly. Documentation will be kept when excursions 1) exceed 15 minutes in duration; and or (2) occur five or more times exceeding 5 minutes within a calendar day. The reason (limitation or other factor) for the excursions will be kept in project logs at each dam as well as inserted into the spreadsheet provided by BPA using the reason codes listed in Table 1 below. The COE will annually provide a report to NOAA Fisheries of reportable excursions from the 1% operating range during the 1% operating season.

Upon request of the TMT, a case-by-case brief explanation of the reason(s) for unit operation outside the 1% of best efficiency range, the date, and the length of time outside the range, will be provided by the appropriate parties.

For the report, the following numerical codes will be used to explain the excursions outside the 1% best efficiency range. The codes provide a more simplified method of tracking excursions than using the listed limitations in section 4.

Table 1: Codes for 1% reporting

Code	Reason
1	Equipment reporting errors, including lack of data (GDAC or AGC not operating correctly and not recording the readings, dead band and precision issues)
2	Changing spill levels in support of NMFS Biological Opinion or court order (requested flow augmentation, coordinated fisheries operation)
3	O&M requirements (fish screen inspection, trash racking, doble testing ,or dam safety)
4	Operational tests (index testing, testing or calibrating new or repaired equipment)
5	BPA requested operation (request operation via the AGC)
6	Turbine startup or stops that take longer than 5 minutes
7	Emergency conditions or system failures (these include transmission system emergencies, remedial action schemes (RAS), also see section 4.a system reliability)
8	Fish research
9	Human error
10	Unknown causes
11	Please specify new reason
12	Flood control
13	Reducing TDG levels

APPENDIX D

CORPS OF ENGINEERS PLAN OF ACTION

FOR DISSOLVED GAS MONITORING

IN 2008

CORPS OF ENGINEERS PLAN OF ACTION FOR DISSOLVED GAS MONITORING IN 2008

February 2008

Corps of Engineers Plan of Action for Dissolved Gas Monitoring in 2008

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CORPS OF ENGINEERS PLAN OF ACTION FOR DISSOLVED GAS MONITORING IN 2008

1.0 INTRODUCTION

The U.S. Army Corps of Engineers (USACE) operates many hydropower projects within the Columbia River Basin. One of the impacts of the operation of these hydropower projects is hyper-aeration of the water flowing through the dam spillways, which can lead to gas bubble disease in fish and other biota. The extent of total dissolved gas (TDG) supersaturation depends not only on the magnitude and frequency of spill, but also on the TDG exchange properties at a given structure.

In order to improve juvenile salmon passage and survival past dams on the lower Columbia and Snake rivers, water is spilled through the spillway gates. Passage of juvenile salmon through the spill gates is thought to be a safer passage route as compared to passage through the turbines. This spilling of water, sometimes referred to as "voluntary spill," has been provided at some projects since 1977. Currently, the Corps of Engineers (Corps) spills water at the four Lower Columbia River projects and the four Lower Snake River projects as part of its implementation of the NOAA Fisheries Federal Columbia River Power System Biological Opinion (2004) for salmonids. If the total dissolved gas (TDG) generated by spill exceeds a biological tolerance threshold, the benefits of spill may be negated due to the development of gas bubble trauma (GBT) in the fish and other aquatic biota. To prevent excessive levels of TDG to develop in the rivers, spill is managed so that the average of the twelve highest TDG levels that occur in a single calendar day does not exceed 120% in the tailwaters of a project or 115% in the forebay of the next project downstream. Therefore, in order to effectively manage spill so that so that these TDG levels are not exceeded, a monitoring program has been established. The purpose of this Plan of Action is to outline the details of the overall Corps TDG monitoring program and summarize the role and responsibilities of the Corps as they relate to dissolved gas monitoring. This Plan also identifies channels of communication with other cooperating agencies and interested parties. The Plan summarizes what to measure, how, where, and when to take the measurements and how to analyze and interpret the resulting data. It also provides for periodic review and alteration or redirection of efforts when monitoring results and/or new information from other sources justifies a change. Some information on the complementary activities of other participating agencies is provided at the end of this document. This plan covers the TDG monitoring activities from April 1st, 2008 through March 31st, 2009.

2.0 GENERAL APPROACH

The total dissolved gas (TDG) monitoring program consists of a range of activities designed to provide management information about dissolved gas and spill conditions. These activities include time-series measurements, data analysis, synthesis and interpretation, and calibration of numerical models. Four broad categories of objectives are involved:

1) Data acquisition, to provide decision-makers with synthesized and relevant information to control dissolved gas supersaturation on a real-time basis,
2) Real-time monitoring, to ascertain how project releases affect water quality relative to ESA Biological Opinion measures and existing state and tribal dissolved gas standards;
3) Trend monitoring, to identify long-term changes in basin wide dissolved gas saturation levels resulting from water management decisions; and
4) Model refinement, to enhance predictive capability of existing models used to evaluate management objectives.

Portland, Seattle and Walla Walla Districts have direct responsibilities for TDG monitoring at their respective projects, including data collection, transmission, and analysis and reporting. The Division's Reservoir Control Center (RCC) will coordinate this activity with the Districts and other State and Federal agencies and private parties as needed to insure the information received meet all real-time operational and regulatory requirements. Districts and Division roles and functions are described in more detail in later sections of this document.

The Corps considers TDG monitoring a high priority activity with considerable potential for adversely affecting reservoir operations and ongoing regional efforts to protect aquatic biota. It will make all reasonable efforts toward achieving at least a data quality and reliability level comparable to that provided in previous years.

Furthermore, the Corps believes it is important to maintain a two-way communication between those conducting the monitoring and the users of monitoring information. These interactions give decision-makers and managers an understanding of the limitations of monitoring and, at the same time, provide the technical staff with an understanding of what questions should be answered. Therefore, comments and recommendations received from users were and continue to be very useful in establishing monitoring program priorities and defining areas requiring special attention.

3.0 DISTRICTS/DIVISION RESPONSIBILITIES

3.1 Portland, Seattle and Walla Walla Districts Functions

Portland, Seattle and Walla Walla Districts will perform all the activities required at their TDG monitoring sites. Data will be collected and transmitted from those sites systematically and without interruption to the Columbia River Operational and Hydromet Management System (CROHMS) operational database (data can be accessed from the Dataquery website at:: http://www.nwd-wc.usace.army.mil/perl/dataquery.pl). Some of the gauges will record year round while others will be seasonal (see Table 4 at the end of this appendix). For seasonal gauges, TDG data may be collected outside of the prescribed time periods. The amount of data collected outside the time period will depend upon when the gauge is initiated (gauges are often installed several weeks prior to the initiation date to ensure for reliable data at the start of the season) and when the gauge is removed at the end of the season (some gauges are left in intentionally to monitor special operations or unusual environmental conditions and some are left in well past the end of the season simply due to unavailability of technicians to remove the gauge). However, data acquired outside of the specified season may not be reliable because maintenance of these gauges outside of the season is often limited.

District responsibilities include but are not limited the following tasks:

- Assist the Division office in the preparation of the annual Plan of Action For Dissolved Gas Monitoring and schedule for gauge installation
- procuring data collection/transmission instruments
- preparing and awarding equipment and service contracts
- performing initial instrument installation and testing
- setting up and removal of permanent monitoring installations, if requested
- evaluate existing stations to ensure that measured TDG levels are representative of true river conditions
- collecting and transmitting TDG data to CROHMS
- reviewing data for early detection of instrument malfunction
- conducting periodic calibration, service and maintenance calls.
- providing emergency service calls as needed and/or when so notified

- performing special TDG measurements, if needed
- keeping records of instrument calibration and/or adjustments
- retrieving, servicing, and storing instruments at the end of the season
- providing final data corrections to the Division office
- preparing an annual activity report
- document and report QA/QC performance

All three Districts will also be responsible for (1) preparing an annual report on instrument performances, and (2) providing the necessary material including test and data analyses, charts, maps, etc. for incorporation in the Corps' Annual TDG Report, which will be finalized by the Division. Additional monitoring at selected locations may be required on an "as needed" basis and depending upon available funding. Dissemination of data to outside users will remain a Division responsibility to avoid duplication and uncoordinated service.

To better understand the physical process of dissolved gas distribution across the reservoirs and its dissipation along the various pools, selected transect studies will continue to be conducted on an as-needed/as-funded basis. An additional objective for this activity is to be able to define how representative readings from current monitoring sites really are with respect to the entire river reach.

3.2 Division's Functions

The Division will be responsible for overall coordination of the TDG monitoring program with the Districts, other State and Federal agencies and cooperating parties. The Team Leader of the Water Quality Unit, CENWD-PDW-R, is the designated TDG Division Program Coordinator reporting through the chain of command through Chief, Reservoir Control Center and Chief, Columbia Basin Water Management Division to the Directorate of Programs.

The Division TDG Program Coordinator will provide overall guidance to District counterparts to ensure that the monitoring program is carried out in accordance with the plan outlined in this document, including close adherence to a general schedule and operating QA/QC protocols. The Program Coordinator will be the main point of contact for all technical issues related to the TDG monitoring at Corps projects, will refer problems of common regional interest to relevant forums such as the Regional Forum Water Quality Team (WQT) for peer review and open discussion, and will facilitate final decision-making on technical issues based on all relevant input from interested parties.

The Division TDG Program Coordinator will coordinate with District counterparts in late January or early February to discuss and firm up a detailed implementation plan and schedule for the current year. Discussion will cover monitoring sites, equipment, data collection and transmission procedures, service and maintenance, budget, communication needs, etc. A set of specific performance measures will be jointly prepared as a basis for reviewing and monitoring District performances. A post-season review meeting will be held annually to provide a critique of the operations and identify areas needing changes and/or improvements.

4.0 2008 ACTION PLAN

The 2008 Action Plan consists of the following eight phases observed in previous years, plus fall-winter monitoring. These phases are as follows:

(1) Program start-up;
(2) Instrument Installation;
(3) In-season Monitoring and Problem Fixing;

(4) Instrument Removal and Storage;
(5) Fall-Winter Monitoring;
(6) Data Compilation, Analysis and Storage;
(7) Program Evaluation and Report; and
(8) Special Field Studies

The Plan of Action for all three Districts during the spring and summer spill seasons is identical to the one in 2007. This is in accordance with the United States District Court order issued on February 25th, 2008 with regards to 2008 FCRPS operations.

4.1 Phase 1: Program Start-Up

After the monitoring plan has been coordinated with the Regional Forum Water Quality Team, responsible parties (See Table 3 at the end of this appendix) will coordinate the details of the plan of action in late January or early February. This will ensure a good mutual understanding of the most current objectives of the dissolved gas monitoring program, including data to be collected, instrument location, procedures to be used, special requirements, etc.

All three Districts will ensure that adequate funding is available for 2008 monitoring activities. Portland District, having decided to continue to use the service of the USGS (Portland Office) in 2008, will prepare the necessary contracts to secure those services and provide for rental and associated maintenance of the USGS's Sutron data collection platforms (DCP's). Walla Walla District will again be using the services of the USGS (Pasco Office) in 2008; will also prepare the necessary contracts to secure those services. Seattle will issue a solicitation for total dissolved gas monitoring services in 2008 and will prepare the necessary contracts to secure those services. All maintenance and service contracts should be completed at least two weeks before the instruments are installed in the field. Where applicable, the Districts will ensure that real estate agreements and right of entry are finalized between the landowners and the Corps. All paper work for outside contracting will be completed no later than 31 January (subject to funding constraints and availability).

To date, the Districts have been initiating the necessary contracts to continue operation and maintenance of the FMS's through the 2007-2008 fall-winter monitoring season and the 2008 spring/summer monitoring season. Districts and Northwestern Division have finalized the current QA/QC protocols. Thermistor strings that monitor temperature at several depths throughout the year and report data hourly have been placed in Dworshak Reservoir, Lower Granite Reservoir, Lake Bryan (Little Goose Reservoir), Lake Herbert G. West (Lower Monumental Reservoir), Lake Sacajawea (Ice Harbor Reservoir), and Lake Wallula (McNary Reservoir).

Discussions between Districts, division and contractors are expected to continue through February, at which time a final plan of action will be produced. It is also understood that the following entities will continue to operate their monitoring instruments in 2008:

- U.S. Bureau of Reclamation, below Hungry Horse, at the International Boundary and above and below Grand Coulee Dam;
- Mid-Columbia PUDs (Douglas, Chelan and Grant Counties), above and below all five PUD dams on the Columbia River; and
- Idaho Power Company, in the Hells Canyon area (as part of its Federal Energy Regulatory Commission's license renewal requirement).

4.2 Phase 2: Instrument Installation

Instruments to be installed and their assigned locations are listed in Table 1 and shown in Figure 1 at the end of this document. Some of them are already in place for the 2007-2008 fall-winter monitoring. The Corps network will essentially remain the same as in 2007.

All instruments are scheduled to be in place and duly connected to their Sutron, Zeno, or Geomation DCP's no later than 1 April for all stations except the stations downstream of Bonneville dam (Camas-Washougal, Cascades Island, and Warrendale) which will need to be activated earlier to be consistent with the Oregon TDG rule modification issued to the U.S. Fish and Wildlife Service in conjunction with the Spring Creek hatchery release. The Warrendale gauge will be kept active until late May to facilitate monitoring of TDG impacts on chum redds below Bonneville dam.

Corps stations that remain in service during the 2007-2008 fall-winter season will continue their operation with minimum interruption into the spring, following the necessary instrument service and maintenance check-up and site equipment (piping) upgrades. These stations include the tailwater monitor at each Lower Columbia and Lower Snake River project.

An assessment of monitoring site integrity will be conducted; any damages that may have occurred over the fall-winter will be fixed before proceeding on to calibration and testing. Selected project personnel may be requested to assist on this task as needed.

4.3 Phase 3: In-season Monitoring and Problem Fixing

Actual data collection and transmission will begin in early March at the monitoring stations below Bonneville Dam in conjunction with the Spring Creek Hatchery release. Otherwise, the data collection and transmission will begin no later than 1 April for the entire monitoring network.. The exact starting date will be coordinated with the Corps' Reservoir Control Center (CENWD-PDW-R), project biologists and cooperating agencies, based on run-off, spill, and fish migration conditions.

The following data will be collected approximately every hour:

- Water Temperature (°C)
- Barometric Pressure (mm of Hg)
- Total Dissolved Gas Pressure (mm of Hg)
- Gauge depth (feet)

Data will be collected at least hourly and transmitted at least every four hours. If feasible, the previous 12 hours of data will also be sent to improve the capability of retrieving any data that may have been lost during the preceding transmission. For Portland, Seattle (see below), and Walla Walla Districts, data transmission will be done via the GOES Satellite, to the Corps' ground-receive station in Portland. After decoding, all data will be stored in the CROHMS database. Per their contracts with Portland and Walla Walla Districts, the USGS is planning to have the satellite data going into CROHMS and ADAPS (the USGS's internal Automated Data Processing System) simultaneously to allow for some pre-screening. Data transmission at Libby and Albeni Falls (gauges operated by the Seattle District) will be done via radio to the NWS HEC-DSS database and the data sent via file transfer protocol (ftp) to the CROHMS database.

Given their direct relevance to fish mortality, the first three parameters (Temperature, Barometric Pressure, and TDG) will be collected on a first priority basis.

Daily reports summarizing TDG and related information will be posted on the Technical Management Team's (TMT) home page. Information provided on the homepage will include some or all of the following data:

- Station Identifier
- Date and Time of the Probe Readings

- Water Temperature, °C
- Barometric Pressure, mm of Hg
- TDG Pressure, mm of Hg
- Calculated TDG Saturation Percent (%)
- Project Hourly Spill, Kcfs (QS)
- Project Total Hourly Outflow (Total River Flow), Kcfs (QR)
- Probe depth, ft
- Calculated Compensation Depth, ft

The Reservoir Control Center staff will perform reconciliation of data received to CROHMS based on input from the field before the data are permanently stored in the Corps' Water Quality Data Base. Additional data posting in the TMT home page will continue.

4.3.1 Data Quality Process

The Final UPA and the 2004 BiOp stipulate that the "Action Agencies shall monitor the effects of TDG." Additional detail provided in the Data Quality Criteria report includes a discussion of Quality Control and Quality Assurance including redundant and backup monitoring, bi-weekly calibration, and spot-checking of monitoring equipment. In an effort to address these concerns the US Army Corps of Engineers has established Data Quality Criteria for the fixed monitoring stations at its projects. These Data Quality Criteria describe the accuracy, precision and completeness of the data needed at each station. The fixed monitoring stations will be assessed at the end of the monitoring season against these criteria and a performance report will be created. These reports will be included in the annual Total Dissolved Gas and Water Temperature Report. Adjustments will be made to the individual fixed monitoring stations that do not perform to the objectives described.

As a general overview, the Data Quality criteria for fixed monitoring stations (FMS) include having two dedicated TDG probes for each site, which provides redundancy instead of redundant stations. The "extra" TDG probe for each site is lab calibrated before its regular rotation into the field. For Portland and Walla Walla District gauges, this rotation will occur once every three weeks during the spill season and monthly during the fall-winter months. For Seattle District, this rotation will occur bi-monthly during the spill season. Seattle District does not operate their TDG gauges during the fall-winter months. Once it is deployed, it is again calibrated and/or checked. The data from the FMS operated by the Portland and Walla Walla Districts is sent to USGS and USACE-NWD. The USGS reviews this data and performs corrections. The Seattle District reviews and corrects their data. There is a goal of 95% data completeness.

4.3.1.1 Data Quality Criteria

The proposed data quality criteria for fixed monitoring station cover three main parts:

A. **Calibration Protocols:** laboratory and field calibrations
B. **Reviewing Data Quality:** data quality checks and dealing with suspect data
C. **Completeness of Data**

The items are described as following:

A. Calibration Protocols

There are two general types of calibrations performed on Fixed monitoring stations (FMS): lab calibrations and field calibration.

1. Laboratory Calibration
   There are four data quality criteria associated with laboratory calibration, including *i)* calibration of the secondary TDG standard, *ii)* the secondary barometric pressure standard, *iii*) the field instrument TDG sensor, and *iv*) secondary standard thermistor. Each is described as follows:

i. Calibration of Secondary TDG Standard
Calibrate the TDG sensor at two points using the primary National Institute of Standards and Technology (NIST) standard. The TDG pressure must be +/- 2 mm Hg at both pressures; otherwise the secondary standard is recalibrated. Pressures at which the sensor is calibrated must bracket the expected range of field measurements. An index of primary and secondary standards is shown below.

PARAMETER	PRIMARY STANDARD	SECONDARY STANDARD
Temperature	NIST traceable thermometer	Multi-parameter probe
Barometer Pressure	NIST traceable barometer or digital pressure gauge.	Hand held barometer
Total Gas Pressure	Digital pressure gauge calibrated to NIST	TDG Probe

ii. Calibration of Secondary Barometric Pressure Standard
Calibrate the secondary standard barometer at ambient barometric pressure to the NIST standard. The barometer must be +/- 1 mm Hg of the primary standard (NIST certified instrument) otherwise the secondary standard is recalibrated.

iii. Calibration of Field Instrument TDG sensor
The two point TDG sensor calibration must agree within +/- 2 mmHg at both pressures, otherwise the sensor is recalibrated. Pressures at which the sensor is calibrated must bracket the expected range of field measurements.

iv. Calibration of Secondary Standard Thermistor
The instrument's thermistor must agree within +/- 0.2°C with the primary NIST standard. This variance will be monitored and if the probe performs outside this range, it will be returned to the manufacturer for maintenance. A check or verification still constitutes a calibration and should be documented in records.

2. Field Calibration
   There are two data quality criteria associated with field calibration: Calibrations and Performance checks. Calibrations include two fixed points and two point TDG sensor calibration.

i. Calibrations

- Two Fixed Points: In order to reduce TDG calibration variability, two fixed points should be chosen and incorporated in the TDG calibration protocol. For example, calibrate the first point to ambient barometric pressure, and the second point to 200 mmHg over barometric pressure. The calibrated range for this example brackets 100-126 % TDG saturation. This ensures the same calibration curve is established each time for every instrument.

- Two Point TDG Sensor Calibration: Following the designated deployment period for a particular gauge, a two point TDG sensor calibration must agree within +/- 4 mmHg at both pressures. Pressures at which the sensor is calibrated must bracket the expected range of field measurements. If the pressure is not +/- 4 mmHg of the standard, the data will considered "suspect" and handled as described in "Reviewing Data Quality".

ii. Performance checks (Portland and Seattle Districts)
There are four data quality criteria associated with performance checks: TDG pressure compared to secondary standard; standby probes deployed; thermistor compared to secondary standard; and field barometer compared to secondary standard. Each is described as follows:

- TDG Pressure Compared to Secondary Standard: After the deployment period, prior to removal of the field instrument, the TDG pressure will be compared to the secondary standard. The actual decision point regarding adjusting the data would be in the lab following the two point TDG sensor calibration described in field instrument post calibration. The field comparison actually involves sampling precision and should not be used as a decision point for shifting data.

- Standby Probe Deployed: During initial deployment of a new TDG probe, after sufficient time for equilibration (up to one hour), the TDG pressure must be +/- 10 mmHg of the secondary standard otherwise another (standby) probe is deployed.

- Thermistor Compared to Secondary Standard: During initial deployment of the new instrument, the thermistor will be +/- 0.4°C of the secondary standard, corrected for calibration, or the instrument will be replaced with a standby.

- Field Barometer Compared to Secondary Standard: At each visit the field barometer reading should the same as the secondary standard or the field barometer will be calibrated.

iii. Performance checks (Walla Walla District)
There are three data quality criteria associated with performance checks: TDG pressure and water temperature compared to a replacement sonde (which is considered a secondary standard) and field barometer compared to a secondary standard. Each is described as follows:

- TDG Pressure Compared to Replacement Sonde: After the deployment period, the TDG pressure will be compared to that of the replacement sonde. Comparisons are made using one of two methods: 1) the replacement sonde will be deployed nearby the in-place field sonde if possible or 2) the field sonde will be removed from the deployment tube and both it and the replacement sonde will be tied together and deployed for comparison. After sufficient time for equilibration, the TDG pressures must be +/- 10 mmHg of each other, otherwise another replacement sonde is deployed for comparison. After the comparisons are made, the field sonde is removed and the replacement sonde is deployed.

- Thermistor Compared to Replacement Sonde: Thermistors will be +/- 0.4°C of each other, corrected for calibration, otherwise another replacement sonde is deployed for comparison.

The sensor must be deployed to a depth where the compensation depth is sufficient to accommodate the change in pressure relative to the atmosphere, otherwise the TDG measurements may be underestimated. If the site does not accommodate maintaining the probe at greater than the compensation depth for more than 95% of the measuring cycle, investigations will begin to re-locate the fixed monitoring station.

3. Repair of Malfunctioning Gauges:

The Corps, or their contractors, will have an adequate inventory of spare instruments that will be maintained to ensure that at least one backup monitor will be made available for deployment as necessary. A malfunctioning instrument will generally be repaired within 24 to 48 hours from the time that the malfunction has been detected, depending on the remoteness of the instrument location and TDG conditions. A gauge malfunction that occurs during the weekend may require a longer response time depending upon when the detection of the malfunction has occurred and availability of capable technician/equipment). High priority will be placed on fixing a faulty instrument when TDG are or expected to be in excess of the current state standards.

Corps staff and/or contractors will maintain TDG instruments. Instruments needing repairs that are beyond the staff's capability will be shipped to the manufacturer. In-house water quality and information management will do repairs of communication network systems. USGS Stennis Center (MS) staff will handle Service and repairs of the Sutron DCPs. Service and repairs of the Zeno DCPs will be performed by a contractor.

To help reduce response time in determining whether an emergency field visit is needed, the following decision-making procedure was developed by the WQT:

- No emergency trips are made for the parameter of temperature.

- For gas and barometric pressure, if more than 25% of the hourly values are missing, then an emergency trip is needed.

- If the difference in values between two consecutive stations is larger than 20 mm Hg for gas pressure, or 14 mm Hg for barometric pressure, then an emergency trip is triggered. This criterion does not apply if:
    a. there is a transient "spike" for a parameter.
    b. if the higher-than-expected gas pressure value is associated with spill operations.

- If gas parameters at a station do not fall within any of the Corps Engineering Research and Development Laboratory (ERDC) generated/RCC generated gas production curves, are not caused from operational or structural changes, and these data persist for over 48 hours, then an emergency visit is triggered.

If there is uncertainty with an abnormal reading at a fixed monitoring station that is expected to persist for more than 48 hours, the COE will notify a WQT chairperson as soon as possible via email. The WQT should develop a recommendation to TMT, and to IT if necessary. If the COE plans to change fish passage actions because of the uncertainty, it should notify both the TMT & WQT members of the proposed change. TMT members will determine whether or not a meeting or conference call is needed and advise the COE of this need. The COE will then convene a TMT meeting, if requested to do so. If an abnormal reading at the gas monitoring station persists for more than 48 hours, the Corps will adopt the 2000 Plan of Action language on the subject. According to the May 2, 2000 letter from the Corps to NMFS, "If the WQT chairs determine a water quality issue exists, the issue will be framed by the WQT and forwarded from the chairs of the WQT to the chair of TMT or IT, as appropriate. Each state's fishery and water quality agencies and tribes will work together prior to any TMT meeting on this issue to balance and assure consistency of the proposed actions with fishery management requirements and state water quality standards."

B. Reviewing Data Quality

The data from the fixed monitoring stations will be sent to the USACE-NWD's CROHMS database which stores the raw data. At the same time, data from the FMS operated by the Portland and Walla Walla Districts is sent to the USGS's ADAP database. The USGS performs the review, correction and deletion process described below on ADAP's data, thus storing corrected data.

1. Reviewing Data

Once data are received, one or more of the following review processes occur:

- **Visually look at the tables of data**: There are certain signs in the data that may indicate mechanical problems. An instance, when the TDG pressure rises to 1,000 mmHg suddenly, and remains at that level, there may be a membrane tear. If there are extreme changes in any parameter, this shows that the data is erroneous.

- **A data checklist is completed.** The data quality checklist shown below provides an example of questions that can be used to assist in identifying problems with data.

- **Review graphs of the data.** Creating graphs of the data can show unusual spikes in a parameter and draw attention to potentially erroneous data quickly. Spikes in graphed data can suggest further investigation may be necessary. For instance, a sudden rise of 5^{o} C in one hour stands out and is suspect. Figure 2 is an example of what is currently used.

2. Dealing with Suspect Data

Once suspect data are identified, one of the following actions can be taken:

- **Correct the data:** If there is a constant amount of shift or a continual drift, the data can be corrected using the USGS NWIS software. This is not usually the case. Sensor drift can be handled using a linearly prorated correction.

- **Delete the data:** If there appears to be no means of correcting the data, then it is deleted from the USGS ADAPS database and they inform the Corps of the erroneous data. The Corps can then decide what to do with the erroneous data.

If data recorded by the fixed sensors are different from those recorded during the calibration procedure, appropriate correction will be made to the current as well as past data already stored in CROHMS as soon as possible. Data corrections will be provided to the USACE-NWD on an on-going basis so that they can be incorporated into the database.

C. Completeness of Data:

Completeness of data includes method of calculation and the data quality criteria goal.

1. Completeness Calculation

The calculation of data set completeness is based on temperature and %TDG, which encompasses barometric pressure and TDG pressure. Data completeness is not based on the completeness of one parameter but of an entire suite.

2. Completeness Goal

Data collected at each site will be 95% of the data that could have been collected during the defined monitoring period. Only "verified" data will be considered to be part of the 95% and any suspect data will have been deleted.

4.4 Phase 4: Instrument Removal and Storage

The seasonal water quality monitors will be removed shortly after the end of the monitoring season (31 August) by Corps staff or the USGS, except for those that are slated for continued fall-winter monitoring. Those removed will be serviced by the maintenance and service contractors and stored at a convenient location until the beginning of the next monitoring season. A selected number of monitors and spare DCPs will be available for off-season special monitoring activities upon request. Seattle District owns its Sutron and Geomation DCPs, and maintains and stores them as needed.

4.5 Phase 5: Fall-Winter Monitoring.

Fall-Winter monitoring of TDG will be consistent with what was recommended in the TDG TMDL's for the Lower Columbia and the Lower Snake rivers. A TDG monitor will be installed in the tailraces of each project.

4.6 Phase 6: Data Compilation, Analysis and Storage

Time and resource permitting, Corps staff and contractors will fill data gaps, perform statistical analyses, and develop trends and relationships between spill and TDG saturation. Efforts will be made to use the SYSTDG model, and finding ways to facilitate and/or improve user access to the TDG and TDG-related database. The SYSTDG model (developed by ERDC) will be available for in-season gas production predictions and screening. Data collected at and transmitted from all network stations will be ultimately stored at CENWD-CM-WR-N, where they can be accessed through a data management system such as HEC-DSS or download the information from the TMT website.

4.7 Phase 7: Program Evaluation and Summary Report

An annual report will be prepared after the end of the normal (spring and summer) monitoring season to summarize the yearly highlights of the TDG monitoring program. Preparation for the annual report will begin with a post-season review, with participation by the Northwest Division Office, the three Corps Districts, the Bureau of Reclamation, the Mid-Columbia PUD's, and the Regional Forum WQT. The report will include a general program evaluation of the adequacy and timeliness of the information received from the field, and how that information is used to help control TDG supersaturation and high water temperature in the Columbia River basin. Information on the performance of the instruments (including accuracy, precision and bias associated with each parameter) and the nature and extent of instrument failures will be documented. This summary should include statistics on data confidence limits. Division staff will prepare the Annual TDG Monitoring Report based on field input, other material provided by each District, and recommendations by the WQT. This report will also contain suggestions and recommendations to improve the quality of the data during the FY2006 monitoring program.

4.8 Phase 8: Special Field Studies

As provided for in Phase 3, additional monitoring of dissolved gas saturation will be conducted on an as-needed basis.

5.0 COOPERATION WITH PARTICIPATING AGENCIES

The Bureau of Reclamation, Douglas County PUD, Chelan County PUD, and Grant County PUDs currently monitor for total dissolved gases at their mainstem projects and have maintained a cooperative effort with the Corps in collecting and reporting total dissolved gas and related water quality parameters. It is expected that this cooperation will extend through the 2008 spill season. Idaho Power Company is believed to have been collecting some TDG information in the Hells Canyon Complex for use in numerical modeling for FERC re-licensing efforts. However, this information has not been as widely disseminated as the data from the rest of the TDG monitoring network. The following is a summary of the action plans for the cooperating agencies.

Bureau of Reclamation. Bureau of Reclamation TDG monitoring will continue at International Boundary and the Grand Coulee forebay and tailrace, and the Hungry Horse sites in 2008. Hourly data transmission to CROHMS will continue via the GOES satellite.

Douglas County PUD. TDG monitoring will continue at the forebay and tailrace of Wells Dam in 2008. Hourly data from both of these stations will continue to be sent to the Corps.

Chelan County PUD. Chelan County PUD will continue to monitor TDG in the forebays and tailraces of Rocky Reach and Rock Island dams in 2008. Hourly data from these four stations will continue to be posted in the Corps of Engineers' CROHMS database.

Public Utility District No. 2 of Grant County (Grant PUD). Grant PUD currently operates and maintains four fixed-site water quality monitoring stations that monitor depth (m), barometric pressure (mmHg), total dissolved gas (TDG; percent saturation), temperature (°C), dissolved oxygen (DO; mg/L), pH (units), and turbidity (NTU). Depth, barometric pressure, TDG, and temperature are monitored on an hourly basis throughout the year, while DO, pH, and turbidity are monitored on a bi-weekly basis throughout the year. Fixed site monitors are located midway across the river channel in the forebay and tailrace of each dam.

Each fixed site water quality monitoring station is equipped with a Hydrolab Corporation Model DS4A®, DS4® or Minisonde® multi-probe enclosed in a submerged conduit. Multi-probes are connected to an automated system that allows Grand PUD to monitor depth, barometric pressure, temperature, and TDG on an hourly basis (year-round). A barometer is located at each fixed site and provides the atmospheric pressure readings necessary to correct the partial pressure readings taken by the Hydrolab multi-probes. Data is collected and recorded onto a Sutron 8210 DCP at the top of the hour. A PCBase2 operating system transmits hourly water quality data via radio/antenna links to a PC at each dam. Data is transferred from the PC to an Access database from which daily reports can be generated and distributed. Grab-sample readings of pH, turbidity, and DO are taken during each bi-weekly calibration throughout the year.

Multi-probe calibration and maintenance for fixed monitoring sites follow established guidelines by U.S. Geological Survey (personal communication with Dwight Tanner) and Hydrolab Corporation. Fixed site multi-probes are exchanged bi-weekly (year-round) with a previously calibrated (12-72 hours) probe. Calibration is conducted in a controlled laboratory environment using certified equipment and recommended standard solutions. A secondary probe (QA) is deployed at each site for quality assurance/quality control (QA/QC) during maintenance and calibration. The QA probe is used to monitor probe sensor deviation and suggest future deployment or recalibration maintenance, and to collect grab sample readings of pH, turbidity, and DO Grant PUD currently posts total dissolved gas, temperature, discharge (kcfs), spill (kcfs) and spill percentage (%) data to its web-site: (www.gcpud.org/stewardship/waterquality.htm) on a daily basis. The data is generally posted by 12:00 pm each day for the previous day (1-day lag during weekdays and a 3-day lag over weekends). The one-day lag-time is necessary to conduct a QA/QC on all water quality data. Specific details of Grand PUD's fixed site water quality monitors, maintenance and calibration procedures, and quality assurance methods can be reviewed in Grant PUD's Final License Application, License Technical Appendix E-3.F (Duvall and Dresser 2003)..

Table 1: 2008 Dissolved Gas Monitoring Network

STATION NAME	STATION CODE	OWNER [d,e,f]	DATES OF OPERATION	CALIBRATION FREQUENCY	
				FALL-WINTER [a]	SPRING-SUMMER [b]
Albeni Falls Forebay	ALFI	USACE-NWS	April 1 – September 15	N/A	2 Weeks
Albeni Falls Tailwater	ALQI	USACE-NWS	April 1 – September 15	N/A	2 Weeks
Anatone	ANQW	USACE-NWW	April 1 – August 31	N/A	3 Weeks
Bonneville Forebay	BON	USACE-NWP	April 1 – August 31	N/A	3 Weeks
Boundary	CIBW	USBR	Year Round	Monthly	2 Weeks
Camas-Washougal	CWMW	USACE-NWP	April 1 – August 31	N/A	3 Weeks
Cascades Island	CCIW	USACE-NWP	March 1 – August 31	N/A	3 Weeks
Chief Joseph Forebay	CHJ	USACE-NWS	April 1 – September 15	N/A	2 Weeks
Chief Joseph Tailwater	CHQW	USACE-NWS	April 1 – September 15	N/A	2 Weeks
Dworshak Tailwater	DWQI	USACE-NWW	Year Round	Monthly	3 Weeks
Grand Coulee Forebay	FDRW	USBR	Year Round	Monthly	2 Weeks
Grand Coulee Tailwater	GCGW	USBR	Year Round	Monthly	2 Weeks
Hungry Horse Tailwater	HGHM	USBR	April 1 – September 30	N/A	2 Weeks
Ice Harbor Forebay	IHRA	USACE-NWW	April 1 – August 31	N/A	3 Weeks
Ice Harbor Tailwater	IDSW	USACE-NWW	Year Round	Monthly	3 Weeks
John Day Forebay	JDY	USACE-NWP	April 1 – August 31	N/A	3 Weeks
John Day Tailwater	JHAW	USACE-NWP	Year Round	Monthly	3 Weeks
Lewiston	LEWI	USACE-NWW	April 1 – August 31	N/A	3 Weeks
Libby Tailwater	LBQM	USACE-NWS	April 1 – September 15	N/A	2 Weeks
Little Goose Forebay	LGSA	USACE-NWW	April 1 – August 31	N/A	3 Weeks
Little Goose Tailwater	LGSW	USACE-NWW	Year Round	Monthly	3 Weeks
Lower Granite Forebay	LWG	USACE-NWW	April 1 – August 31	N/A	3 Weeks
Lower Granite Tailwater	LGNW	USACE-NWW	Year Round	Monthly	3 Weeks
Lower Monumental Forebay	LMNA	USACE-NWW	April 1 – August 31	N/A	3 Weeks

STATION NAME	STATION CODE	OWNER [a,b,c]	DATES OF OPERATION	CALIBRATION FREQUENCY FALL-WINTER [d]	CALIBRATION FREQUENCY SPRING-SUMMER [e]
Lower Monumental Tailwater	LMNW	USACE-NWW	Year Round	Monthly	3 Weeks
McNary Forebay	MCNA	USACE-NWW	April 1 – August 31	N/A	3 Weeks
McNary Tailwater	MCPW	USACE-NWW	Year Round	Monthly	3 Weeks
Pasco	PAQW	USACE-NWW	April 1 – August 31	N/A	3 Weeks
Peck	PAQW	USACE-NWW	April 1 – August 31	N/A	3 Weeks
Priest Rapids Forebay	PRD	Grant County PUD	Year Round	2 Weeks	2 Weeks
Priest Rapids Tailwater	PRXW	Grant County PUD	Year Round	2 Weeks	2 Weeks
Rock Island Forebay	RIS	Chelan County PUD	April 1 – August 31	N/A	Monthly
Rock Island Tailwater	RIGW	Chelan County PUD	April 1 – August 31	N/A	Monthly
Rocky Reach Forebay	RRH	Chelan County PUD	April 1 – August 31	N/A	Monthly
Rocky Reach Tailwater	RRDW	Chelan County PUD	April 1 – August 31	N/A	Monthly
The Dalles Forebay	TDA	USACE-NWP	April 1 – August 31	N/A	3 Weeks
The Dalles Tailwater	TDDO	USACE-NWP	Year Round	Monthly	3 Weeks
Wanapum Forebay	WAN	Grant County PUD	Year Round	2 Weeks	2 Weeks
Wanapum Tailwater	WANW	Grant County PUD	Year Round	2 Weeks	2 Weeks
Warrendale	WRNO	USACE-NWP	September 1 – May 31	Monthly	3 Weeks [f]
Wells Forebay	WEL	Douglas County PUD	April 1 – August 31	N/A	Monthly
Wells Tailwater	WELW	Douglas County PUD	April 1 – August 31	N/A	Monthly

a. USACE = U.S. Army Corps of Engineers (NWP = Portland District, NWS = Seattle District, NWW = Walla Walla District)
b. USBR = U.S. Bureau of Reclamation
c. Data for all TDG monitoring stations is available at; http://www.nwd-wc.usace.army.mil/tmt/
d. For the purposes of Corps of Engineers TDG monitoring, "Fall-Winter Season" is defined as September 1 through March 31. For the purposes of Bureau of Reclamation TDG monitoring, "Fall-Winter Season" is defined as October 1 through March 31.
e. For the purposes of Corps of Engineers TDG monitoring, "Spring-Summer Season" is defined as April 1 through August 31. For the purposes of Bureau of Reclamation TDG monitoring, "Spring-Summer Season" is defined as April 1 through September 30.
f. The Warrendale TDG monitor will be recalibrated every three weeks from March 1 through May 31.

Table 2. List of Contact Persons in 2008

Project	Name	Position	Phone #	E-Mail
Internat'l Bndry., Hungry Horse, Grand Coulee	Norbert Cannon	Chemist	(208) 334-1540	ncannon@pn.usbr.gov
	Bryan Horsburgh	Water Quality Regional Coordinator	(208) 378-5035	bhorsburgh@pn.usbr.gov
	Jim Doty	Hydromet Data Transmission	(208) 378-5272	jdoty@pn.usbr.gov
Chief Joseph, Albeni Falls, Libby	Kent Easthouse	Oversight	(206) 764-6926	Kent.b.easthouse@usace.army.mil
	Ray Strode	Trouble-shooting	(206) 764-3529	ray.strode@usace.army.mil
Wells (Douglas)	Rick Klinge	Coordinator	(509) 884-7191	rklinge@dcpud.org
Rocky Reach and Rock Island (Chelan County PUD)	Waikele (Kelee) Hampton	Coordinator	(509) 663-8121 x 4627	waikele@chelanpud.org
	Mike Blalock	Data Manager	(509) 669-1732	
Priest Rapids and Wanapum (Grant County PUD)	Ross Hendrick	Limnologist	(509) 754-5088 Ext. 2468	rhendr1@gcpud.org
	Tom Dresser	Manager of Fish, Wildlife, and Water Quality Program	(509) 754-5088 Ext. 2312	tdresse@gcpud.org
Dworshak, Low. Granite, Little Goose, Low. Monumental, Ice Harbor, McNary, Pasco, Anatone	Steve Juul	Coordinator	(509) 527-7281	steve.t.juul@usace.army.mil
	Russ Heaton	Oversight	(509) 527-7282	russ.d.heaton@usace.army.mil
	Greg Ruppert	USGS/ Oversight	(509) 527-2571	gruppert@usgs.gov
John Day, The Dalles, Bonneville, Warrendale, Skamania, Camas	Jim Britton	Coordinator	(503) 808-4888	james.l.britton@usace.army.mil
	Joe Rinella	USGS/ Contract Coordinator	(503) 251-3278	jrinella@usgs.gov
	Dwight Tanner	USGS/ Oversight	(503) 251-3289	dqtanner@usgs.gov
COE Northwest Division Program Coordination	Jim Adams	Coordinator	(503) 808-3938	james.r.adams@usace.army.mil
	Laura Hamilton	Oversight	(503) 808-3939	laura.j.hamilton@usace.army.mil
	Tina Lundell	Data Manager	(503) 808-3937	Tina.m.lundell@usace.army.mil

Figure 1: 2008 Dissolved Gas Monitoring

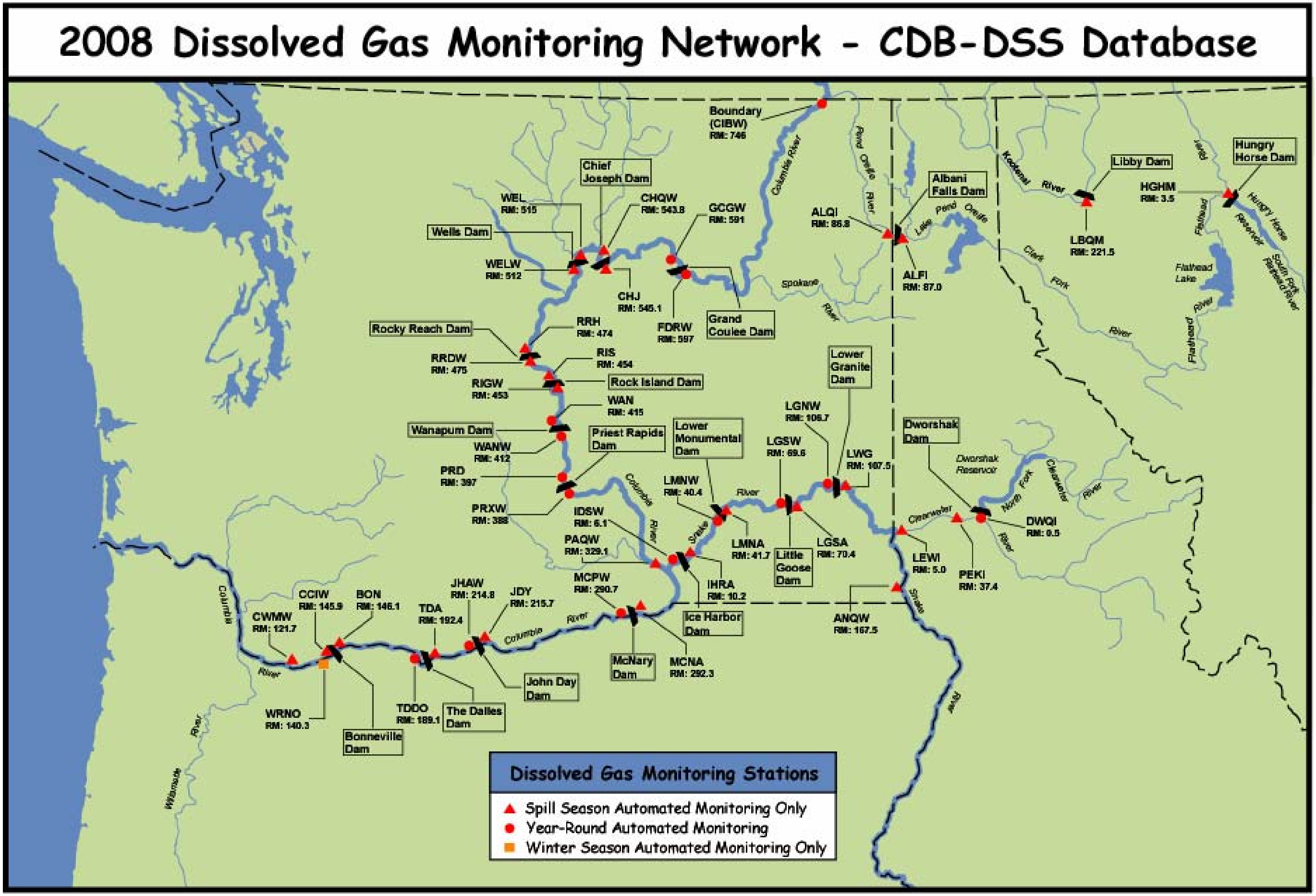
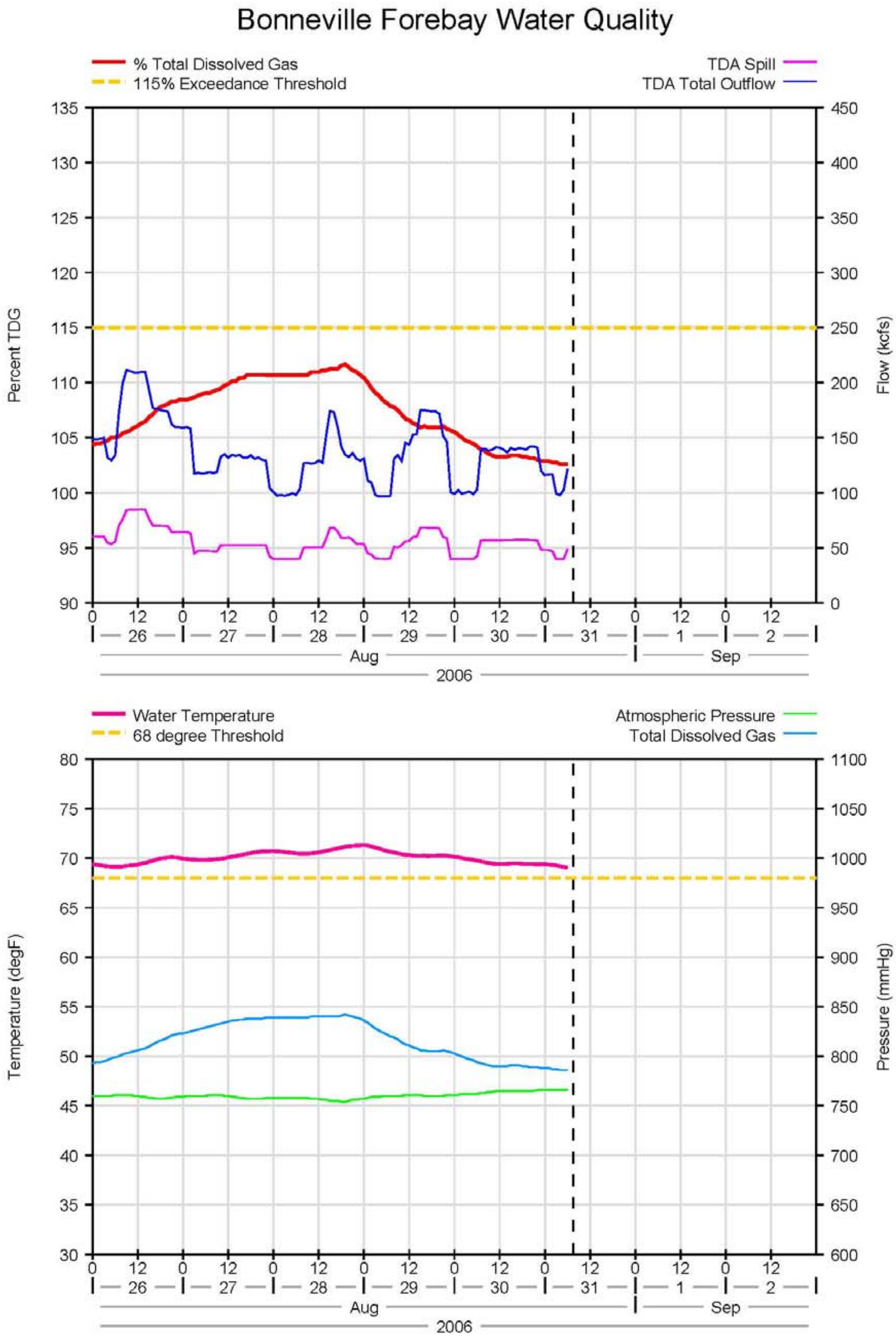


Figure 2: Graphs for Data Review



APPENDIX E

OPERATIONS RELATED TO PROJECT SPILL FOR FISH PASSAGE

2008 FISH OPERATIONS PLAN

CENWD-PDD February 8, 2008

2008 Fish Operations Plan

BACKGROUND

The 2008 Fish Operations Plan (FOP) describes actions by the U.S. Army Corps of Engineers (Corps) to implement project operations for fish passage at its Federal Columbia River Power System (FCRPS) dams during the April – August 2008 fish migration season. This plan adopts the project operations contained in the 2007 FOP, as incorporated in the Court's May 23, 2007 Opinion and Order, through August 31, and modified through consensus during the 2007 migration season. Consistent with the 2004 Biological Opinion adaptive management strategy, water management and project operations for fish passage not addressed in this FOP will be consistent with the operations considered in the 2004 Biological Opinion and in particular, the 2008 Water Management Plan and 2008 Fish Passage Plan (FPP). Additionally, this plan incorporates operational adjustments necessary to perform essential research and to accommodate the installation or adjustment of surface bypass structures subsequent to the 2007 migration season. The structural modifications necessitating changes in operations are: (1) installation of a removable spillway weir (RSW) at Lower Monumental Dam; (2) installation of two prototype temporary spillway weirs (TSWs) at John Day Dam; and, (3) moving one of the two TSWs at McNary Dam to a different spill bay. In addition, the FOP describes operations during low flow periods and load swing hours which occurred in 2007 and were reported to the court. The following is a detailed description of the fish passage operations for the 2008 migration season.

SPRING SPILL OPERATIONS

Lower Snake River - spring spill will occur from April 3, 2008 through June 20, 2008 at Lower Granite, Little Goose, Lower Monumental, and Ice Harbor dams.

Lower Columbia River - spring spill will occur from April 10, 2008 through June 30, 2008 at McNary, John Day, and The Dalles dams and from April 10, 2008 through June 20, 2008 at Bonneville Dam.

Table 1 below summarizes spring spill and transport operations planned for each mainstem dam.

As in 2007, the Corps will manage spill levels to the total dissolved gas (TDG) saturation levels of 120% in the project tailrace and 115% in the forebay of the next project downstream, referred to as "gas caps" in this document. The project spill discharge level needed to meet but not exceed the gas caps is referred to as the "spill cap". Therefore, the spill cap is the maximum flow rate a project can spill for fish passage that does not exceed the gas caps. The gas caps (120% tailrace and 115% forebay) do not change for dams providing spill for fish passage in the spring and summer. Spill caps, on the other hand, may vary daily depending on flow, temperature, and other environmental conditions.

Table 1. Spring 2008 project spill levels and transport criteria.

Spring 2008

	Planned Operations for Spring 2008 (Day/Night)	Comments
Transport	**Initiate transport at Lower Granite Dam between April 20 – May 1 with staggered transport start dates at Little Goose and Lower Monumental. Criteria for start date and stagger days will be provided to TMT *1**	**Same as 2007**
Lower Granite	**20kcfs / 20kcfs**	**Same as 2007**
Little Goose	**30%/30% Allow for 14 days night Gas Cap spill within the last week of April – second week of May (April 22 – May 15)*. Dates of actual night time spill to be determined by salmon managers within the window of time identified above**	**Same as 2007**
Lower Monumental	**gas cap / gas cap (approximately 27 kcfs day/ night)**	**Same as 2007 test program (24 hr gas cap spill), with RSW installed**
Ice Harbor	**30%/30% vs 45kcfs/gas cap**	**Same as 2007**
McNary	**40%/40% (April 10 – June 30)**	**Same as 2007 for continued prototype temporary spillway weir (TSW) tests**
John Day	**0 / 60% on non-test days; 30%/30% or ~40%/40% on test days (~April 20 – June 20)**	**Same as 2007 on non-test days. TSW tests with 24 hour spill planned for 2008**
The Dalles	**40%/40%**	**Same as 2007**
Bonneville	**100kcfs/100kcfs**	**Same as 2007**

*1 Initiation of Transport

* The timing of the 14 days of spill to nighttime gas cap levels will be determined in-season through the TMT processes and is intended to coincide with the peak of the wild spring yearling Chinook migration at Little Goose Dam within the window specified.

SUMMER SPILL OPERATIONS

Lower Snake River - summer spill will occur from June 21, 2008 through August 31, 2008 at Lower Granite, Little Goose, Lower Monumental, and Ice Harbor dams.

Lower Columbia River -summer spill will occur from July 1, 2008 through August 31, 2008 at McNary, John Day, and The Dalles dams and from June 21, 2008 through August 31, 2008 at Bonneville Dam.

Table 2 below summarizes summer spill operations planned for each mainstem dam.

As in 2007, the Corps will manage spill levels to the TDG saturation levels of 120% in the project tailrace and 115% in the forebay of the next project downstream, referred to as “gas caps” in this document. The project spill discharge level needed to meet but not exceed the gas caps is referred to as the “spill cap”. Therefore, the spill cap is the maximum flow rate a project can spill for fish passage that does not exceed the gas caps. The gas caps (120% tailrace and 115% forebay) do not change for dams providing spill for fish passage in the spring and summer. Spill caps, on the other hand, may vary daily depending on flow, temperature, and other environmental conditions.

Table 2. Summer 2008 project spill levels.

Summer 2008

Project	Planned Operations for Summer 2008 (Day/Night)	Comments
Lower Granite	**18 kcfs / 18 kcfs**	**Same as 2007**
Little Goose	**30% / 30%**	**Same as 2007**
Lower Monumental	**17 kcfs / 17 kcfs**	**Same as 2007**
Ice Harbor	**30%/30% vs 45kcfs/gas cap**	**Same as 2007 test program**
McNary	**40%/40% vs 60%/60%**	**Same as 2007 test program**
John Day	**30% / 30% on non-test days; 30%/30% or ~40%/40% on test days (~June 21 – July 20)**	**Same as 2007 on non-test days. TSW tests with 24 hour spill planned for 2008**
The Dalles	**40%/40%**	**Same as 2007**
Bonneville	**85 or 75kcfs / gas cap (approximately 120 kcfs at night)**	**Same as 2007 test program**

General Guidance for 2008 Fish Operations

For planning purposes, the Corps’ 2008 FOP operations for fish passage assume “average” run-off conditions. However, actual run-off conditions may be higher or lower than average, requiring adjustments in spill levels (kcfs discharge rates, spill percentages, or spill caps) to avoid or minimize poor juvenile or adult fish passage conditions or powerhouse constraints.

Therefore, actual spill levels may vary from the tables above. In addition, spill levels may require adjustments for the following reasons:

- TDG is managed daily in response to changing conditions. Adjustments will be made to manage the spill operation consistent with the states' 2007 TDG saturation limits of 120% tailrace and 115% forebay for fish passage.
- Power system and other project emergencies, including unplanned/unanticipated facility maintenance or outages, may necessitate temporary adjustments in accordance with established protocols.

The following sections describe the processes for spill management during high and low runoff conditions, TDG management, spillway operation, minimum generation, specific spring and summer operations for fish passage for each mainstem project, juvenile fish transportation program operations, protocols for emergencies, and reporting.

Spill Management

The Corps will initiate spill at 0001 hours, or shortly after midnight, at each of the projects on the start dates specified above. Spill caps will be established at the specified amounts and will continue unless conditions require changing to maintain TDG within the states' 2007 limits of 120% in the tailwater of a dam and 115% in the forebay of the next project downstream (and at Camas/Washougal). Spill will terminate at 2359 hours, or shortly before midnight, at each project on the end dates specified above.

The spill rates represented in Tables 1 and 2 assume average runoff conditions; however, actual conditions may require adjustments to these spill rates. Actual spill rates may increase above the specified rates for several reasons:

1. high runoff conditions where flows exceed the powerhouse hydraulic capacity with the specified spill rates;
2. generation unit outages that reduce powerhouse capacity;
3. power system or other emergencies that reduce powerhouse discharges; and,
4. a lack of power load resulting in an increase in the rate of spill.

Spill below the specified rates could occur during low runoff conditions when meeting minimum generation levels at a project requires reducing spill rates. This would most likely occur in late July and August. Minimum generation and spill rates are included below in the project specific information. Spill also may be reduced to accommodate navigation issues or other exigencies.

To make adjustments in response to changes in conditions, the Corps will utilize the existing Regional Forum committees. Changes in spill rates when flow conditions are higher or lower than anticipated will be coordinated through the regional forum Technical Management Team (TMT). This could include potential issues and adjustments to the juvenile fish transportation program. Spill patterns and biological test issues that have not been coordinated to date will be coordinated through the Corps' Anadromous Fish Evaluation Program (AFEP) subcommittees, which include the Studies Review Work Group (SRWG), Fish Facility Design Review Work Group (FFDRWG), and Fish Passage Operations and Maintenance Coordination Team (FPOM).

Total Dissolved Gas Management

In order to manage gas cap spill rates consistent with the states' 120%/115% TDG limits for fish passage spill used in 2007, the Corps' Reservoir Control Center (RCC) establishes the spill caps for each project on the lower Columbia and Snake rivers on a daily basis throughout the fish passage season. These spill caps are set so that resultant TDG percent saturation levels are not expected to exceed the 120%/115% TDG limits, measured as an average of the highest 12 hourly readings each day as was done in 2007. Within any given day, some hours of measured TDG levels may be higher or lower than the gas caps due to changing environmental conditions (wind, air temperature, etc). The process of establishing daily spill caps entails reviewing existing hourly data at each dam (including flow, spill, temperature, and TDG levels) and taking into consideration a number of forecast conditions (including total flow, flow through the powerhouse, wind and temperature forecast, etc.). This information is used as input into the SYSTDG (System TDG) modeling tool. The SYSTDG model estimates TDG levels in the rivers several days into the future and is a tool integral to daily decision-making when establishing spill caps at individual dams.

SYSTDG output is used to guide decisions to establish spill caps at each dam to avoid exceedances of the gas caps. However, during the spring freshet when flows are expected to be greater than hydraulic capacity with the specified spill rates at the dams, or if a lack of power load results in an increase in the spill rate, the Corps will attempt to minimize TDG on a system-wide basis. In this case, spill caps are also developed for 125%, 130%, or 135% saturation to minimize TDG throughout the system.

Spill caps set by RCC in daily spill priority requests will be met at the projects by using the spill pattern in the appropriate FPP spill table which most closely corresponds to the requested spill, either over or under the spill request. Spill caps will be adjusted on a daily basis as needed to avoid exceeding the gas caps. Operations to manage TDG will continue to be coordinated through the TMT.

Spillway Operations

Actual hourly spill quantities at dams will be slightly greater or less than shown in Tables 1 and 2. The Action Agencies will meet the requested spill levels to the extent possible, as described in Table 3. However, actual spill levels depend on the precision of spill gate settings, flow variations in real time, varying project head (the elevation difference between a project's forebay and tailwater), and other factors. Operations considerations are as follows:

Spill discharge rates: Due to limits in the precision of spill gates and control devices, short term flow variations, and head changes, it is not possible to discharge exactly the spill rates stated in the Tables 1 and 2, or as stated in RCC spill requests to projects that call for specific spill discharges. Therefore, spillway gates are opened to the settings in FPP spill pattern tables which provide discharges that are the closest to the agreed upon spill discharge rate. The spill rates in Table 3 coincide with specific gate settings in the FPP spill tables. Actual spill may be higher or lower than the identified spill rate.

Spill percentages: Spill percentages are considered target spill levels. The project control room operator and BPA duty scheduler calculate spill rates to attempt to be within +/- 1% of the target percentage for the following hour (Table 3). These percentages may not be attained due to low flow conditions, periods of minimum generation, when spill caps limit spill amounts, when spill is curtailed for navigation safety, and other circumstances. Operators and schedulers will review the percentages achieved during the day and adjust spill rates in later hours, with the objective of ending the day with a day average spill that achieves the target.

Minimum Generation

The Corps has identified minimum generation flows derived from FPP tables which specify turbine operation within the 1% of best efficiency range. These figures are approximations and do not account for varying head or other small adjustments that may result in variations in the reported minimum generation flow and spill amount. Conditions that may result in minor variations include:

1. Varying pool elevation: as reservoirs fluctuate within the operating range, flow rates through the generating unit change.
2. Generating unit governor "dead band": the governor controls the number of megawatts the unit should generate and cannot precisely control a unit; variations can be +/- 1% to 2% of generation.
3. System disturbances: once the generator is online and connected to the grid, it responds to changes in system voltage and frequency. These changes may cause the unit to increase flow and generation slightly within an hour.
4. Individual units may behave slightly differently or have unit specific constraints.
5. Generation control systems regulate megawatts (MW) generation only, and not flow through turbines.

All of the lower Snake River powerhouses may be required to keep one generating unit on line at all times for power system reliability. During low flows, one generator is run at the bottom of the 1% of best efficiency range. All of the Snake River plants have 2 “families” of turbines with slightly different capacities. In most cases one of the smaller units, with somewhat less generation and flow, will be online during these times. At the Snake River dams, the smaller units are generally numbered 1 – 3 and are the first priority for operation during the fish passage season. However, if smaller units are unavailable, one of the larger units may be used. Further, at Lower Monumental, generating unit 1, which is the first priority unit during fish passage, is damaged and cannot operate at the low end of the design range. However, because this unit is a fish passage priority TMT may recommend use of this unit, which will result in higher turbine discharge rates than shown in the Lower Monumental Summer Operation Considerations section below. In addition, Ice Harbor units cannot be operated at the lower end of the 1% of best efficiency range. These units experience cavitation at a generation level somewhat higher than the lower 1% limit, which damages the turbine and can be detrimental to fish. Therefore, Ice Harbor units will operate at their lower cavitation limits, as in 2007.

Table 3. Comparison of 2008 spill levels in Tables 1 and 2 with operational spill levels at mainstem dams.

Season/Project	2008 Spill Levels in Tables 1 and 2	2008 Operational Spill Levels	Comments
Spring			
Lower Granite	20 kcfs day/night	20.4 kcfs	Will fluctuate due to project head changes
Little Goose	30% day/night	30% +/- 1% hourly; 14 nights at spill cap	Target* 30% as a day average; meet nightly spill cap for 14 nights
Lower Monumental	27 kcfs day/night (gas cap)	spill cap day/night	Meet spill cap daily
Ice Harbor	30% day/night vs. 45 kcfs day / gas cap night	30% +/- 1% hourly; 45.6 kcfs day / spill cap night	Target 30% as a day average; 45.6 kcfs will fluctuate due to head changes; meet nightly spill cap
McNary	40% day/night	40% +/- 1% hourly	Target 40% as a day average
John Day	0 day / 60% night (non-test dates); 30% & ~40% day/night (test dates)	60%, 30%, ~40% +/- 1% hourly	Target percentages as a nightly or day average
The Dalles	40% day/night	40% +/- 1% hourly	Target 40% as a day average
Bonneville	100 kcfs day/night	100 kcfs	Will fluctuate due to head changes
Summer			
Lower Granite	18 kcfs day/night	18.6 kcfs	Will fluctuate due to head changes
Little Goose	30% day/night	30% +/- 1% hourly	Target 30% as a day average
Lower Monumental	17 kcfs day/night	17.1 kcfs	Will fluctuate due to head changes
Ice Harbor	30% day/night vs. 45 kcfs day / gas cap night	30% +/- 1% hourly; 45.6 kcfs day / spill cap night	Target 30% as a day average; 45.6 kcfs will fluctuate due to head changes; meet nightly spill cap
McNary	40% day/night vs. 60% day/night	40% +/- 1% hourly; 60% +/- 1% hourly	Target 40% or 60% as a day average
John Day	30% day/night	30% +/- 1% hourly	Target 30% as a day average
The Dalles	40% day/night	40% +/- 1% hourly	Target 40% as a day average
Bonneville	85 or 75 kcfs day / 120 kcfs night	85.3 or 74.6 kcfs day / spill cap night **	85.3 & 74.6 kcfs will fluctuate due to head changes; meet nightly spill cap

* Target: Make best effort to meet a specified spill level through frequent monitoring, projections, and spill adjustments within the defined range of variation. This will occur for each project through analysis and coordination between the Corps and BPA.

** The Bonneville Dam summer daytime spill discharge rate will be 85 kcfs until approximately July 20 for testing, then 75 kcfs through August 31.

Low Flow Operations

Low flow operations on Lower Snake projects are triggered when inflow is not sufficient to provide for both minimum generation and the planned spill levels. In these situations, the projects will operate one unit at minimum generation and spill the remainder of flow coming into the project. As flows transition from higher flows to low flows, there may be situations when flows recede at a higher rate than forecasted. In addition, inflows provided by nonfederal projects upstream are variable and uncertain. The combination of these factors may result in instances where unanticipated changes to inflow result in forebay elevations dropping to the low end of the Minimum Operating Pool (MOP). Since these projects have limited operating flexibility, maintaining minimum generation and the target spill may not be possible on every hour.

Also during these low flow operations, additional flow that is passed through a dam as the result of navigational lockages becomes more apparent. This is because the volume of water needed to empty the navigation lock during periods of low flow is a greater percentage of the total flow than it had been earlier in the season. As a result, the official recorded spill percent through the spillway appears to be reduced since it does not include this volume of water needed to empty the navigation lock.

Dates to start transporting fish at the Snake collector projects will be advanced if the spring seasonal flows at Lower Granite Dam are projected to be less than 70 kcfs. In that case, transportation will begin on April 20 at all three Snake collector projects instead of a staggered start as planned when seasonal flows are expected to be 70 kcfs or higher. Transportation operations and research are described in the "Juvenile Fish Transportation Program Operations" section on pages 24 – 26 of this document. Spill for fish passage will be provided under all flow conditions.

Operations during Load Swing Hours

Project operations during load swing hours may result in not meeting hourly spill, mostly at McNary, John Day, and The Dalles dams. This occurs because projects must be available to respond to within-hour load variability to satisfy North American Electric Reliability Council (NERC) reserve requirements ("on response"). During periods of rapidly changing loads, projects on response may have significant changes in turbine discharge within the hour. Under normal conditions, within-hour load changes occur mostly on hours immediately preceding and after the peak load hours, while spill quantity remains the same within the hour, however, sometimes several hours after peak load hours the project may still be decreasing total outflow and generation faster than the corresponding spill decreases causing the percent spill to be slightly higher. These hours are referred to as "load swing hours." Due to the high variability of within-hour load, these load swing hours may have a greater instance of reporting actual spill percentages that vary more than the +/- 1% requirement than other hours. On the days this occurred in 2007, the day or night-time average spill was within the FOP level of +/- 1% of the target spill.

<u>Spring and Summer Operations for Fish Passage by Project</u>

The following describes the spring and summer operations by project. Included in the description is planned research as considered in the 2004 Biological Opinion. The Corps, and the regional agencies and Tribes are interested in the continuation of project research studies under the Corps' AFEP. These studies have undergone review by the regional agencies and Tribes. The studies are intended to provide further information on project survival and assist the region in making decisions on future operations and configuration actions to improve fish passage at the Lower Snake and Columbia River dams.

Lower Granite

Spring Spill Operations April 3 – June 20, 2008: 20 kcfs (including approximately 6 kcfs from the RSW and 14 kcfs from the training spill) 24 hours/day with the Removable Spillway Weir (RSW) operating. See Table 3 for operational spill levels.

Changes in Operations for Research Purposes:

- <u>Spring research operations</u>: Normal spring spill patterns and rates as described in the FPP will be used. There will be no specific spill variations for testing.

Operation considerations:

- Unit 2 will be out of service until late September 2008. The powerhouse will operate with no more than 5 units on during the spring and summer spill seasons. A contract for fire protection installation will take one unit at a time out of service, starting in July and continuing through the summer.
- With one unit out of service, powerhouse capacity is about 85 kcfs. If total river discharge is greater than approximately 105 kcfs, then spillway discharge will be forced above RSW spill + training spill levels. This involuntary spill could result in gas cap exceedances. Lack of power load also could cause involuntary spill at higher total river discharges.
- Unit outages will occur for required maintenance activities. The outage schedule for the project is shown in Appendix 2. Dates are subject to change.

Summer Spill Operations June 21 – August 31, 2008: 18 kcfs (including approximately 6 kcfs from the RSW and 12 kcfs from the training spill) 24 hours/day with the RSW operating. See Table 3 for operational spill levels.

Changes in Operations for Research Purposes:

- <u>Summer research operations</u>: Normal summer spill patterns and rates as described in the FPP will be used. There will be no specific spill variations for testing.

Operation considerations:

- o Minimum spill: During periods of low flow before the spring freshet and during the summer period, there may be periods where spill quantities are limited so that tailrace conditions are not advantageous to fish passage. If such low runoff conditions occur, alternative spill operations at the dam will be coordinated through the TMT.
- o Minimum generation: The minimum generation amount represents the operation of one unit at the lower end of its 1% efficiency range and is needed for power system reliability. This generation will be controlled to approximately 81 – 83 MW at units 1 – 3, the priority fish units. If these units are not available, the larger units 4 – 6 will be run at 96 - 100 MW. This will result in turbine flows of approximately 11 kcfs – 12 kcfs at units 1 – 3 and 12.5 kcfs - 13.5 kcfs at units 4 - 6. There may be slight variations in the generation due to power system fluctuations. Also, the outflow will fluctuate because of changing head at the dam. This condition may occur in early spring before the freshet and during the late summer period with low flow conditions.
- o Unit outages will occur for required maintenance activities. The outage schedule for the project is shown in Appendix 2. Dates are subject to change.

Little Goose

Spring Spill Operations April 3 – June 20, 2008: 30% spill 24 hours/day. In addition, allow for 14 nights of spill up to gas cap spill rates between April 22 and May 15. Nighttime spill hours are 1800 – 0600. See Table 3 for operational spill levels.

Changes in Operations for Research Purposes:

- Spill duration for testing: Adult passage will be studied throughout the spring spill period.

- Spring research operations: 30% spill 24 hour/day. Bulk and uniform spill patterns (2 or 3 patterns) will be tested. Final test conditions will be coordinated through the SRWG.

- Objectives of the biological test: The primary objectives of the spring and summer test will be to inform decisions on TSW placement and operation in 2009 to provide effective juvenile fish passage while allowing adult fish to pass. Radio tagged adult fish will be tracked in the tailrace and into the fishway under the various spill operations. No juvenile survival studies are planned for Little Goose during spring or summer 2008.

- Spill pattern during the biological test: The test spill patterns will be developed through ERDC modeling and in coordination with SRWG.

Operation considerations:

- In the 2005 summer spill period, adult passage was blocked when daytime spill levels exceeded 30%. Also, adult passage was impaired in May 2007 with a bulk spill pattern. The study is designed to determine the hydraulics causing the blockages. In order to discern cause of the poor adult passage conditions it is necessary to monitor fish during both good and poor passage conditions. Slower fish passage may occur a couple days each week. In-season reporting will allow treatments to be adjusted through SRWG and TMT adaptive management processes to meet the study objectives or to ensure good adult passage is maintained in the course of the season.
- In both spring and summer, day average flows in the lower Snake River near 30 kcfs can result in incompatible operations with Lower Monumental Dam and cause spill quantity fluctuations.
- Unit outages will occur for required maintenance activities. The outage schedule for the project is shown in Appendix 2. Dates are subject to change.
- The powerhouse capacity with all six units in service operating within 1% best efficiency is approximately 107 kcfs. However, Unit 6 is currently forced out of service with a ground fault. Indications are that the unit will remain out of service through the spring season. With 5 units operating, powerhouse turbine capacity within the 1% of best efficiency range is about 88 kcfs. If the total river discharge is greater than approximately 115 kcfs, then spillway discharge will be forced above the planned operation of 30% spill.
- Nighttime spill up to gas cap rates will be provided for 14 days between April 22 and May 15. The spill is intended to coincide with peak passage periods for wild yearling Chinook. The 14 spill days do not have to be consecutive. Actual dates will be determined through coordination with TMT.

Summer Spill Operations June 21 – August 31, 2008: 30% spill 24 hours/day. See Table 3 for operational spill levels.

Changes in Operations for Research Purposes:

- Spill duration for testing: Adult passage will be studied throughout the summer spill period.

- Summer research operations: 30% spill 24 hour/day. The spill patterns used in the spring will be continued in the summer. Final test conditions will be coordinated through the SRWG.

- Objectives of the biological test: The primary objectives of the spring and summer test will be to inform decisions on TSW placement and operation in 2009 to provide effective juvenile fish passage while allowing adult fish to pass. Radio tagged adult fish will be tracked in the tailrace and into the fishway under the various spill operations. No juvenile passage studies are planned for Little Goose during spring or summer in 2008.

- Spill pattern during the biological test: The test spill patterns will be developed through ERDC modeling and in coordination with SRWG.

Operation considerations:

  - Unit outages will occur for required maintenance activities. The outage schedule for the project is shown in Appendix 2. Dates are subject to change.
  - Minimum spill: During periods of low flow before the spring freshet and during the late summer period, there may be periods where spill quantities are so low that it creates tailrace conditions not advantageous to fish passage. If such flow conditions occur, alternative operations at the dam will be coordinated through the TMT.
  - Minimum generation: The minimum generation amount represents the operation of one unit at the lower end of its 1% efficiency range and is needed for power system reliability. This generation will be controlled to approximately 81 – 83 MW at units 1 – 3, the priority fish units. If these units are not available, the larger units 4 – 6 will be run at 100 - 104 MW. This should result in turbine flows of 11 kcfs – 12 kcfs at units 1 – 3 and 13 kcfs – 14 kcfs at units 4 – 6. There may be slight variations in the generation due to power system fluctuations. Also, the outflow will fluctuate because of changing head at the dam. This situation may occur in early spring before the freshet and during the late summer period with low flow conditions.

Once the operations for research are completed, the spill patterns will return to normal operation as described in the FPP and to the spill levels as shown in the tables above.

Lower Monumental

Spring Spill Operations April 3 – June 20, 2008: Spill to the spill cap 24 hours/day. The estimated spring spill cap rate is 27 kcfs. See Table 3 for operational spill levels.

Changes in Operations for Research Purposes:

- Spill duration for testing: Approximately May 1 – May 31. The dates of testing will be dependent on the size of fish and fish availability. Final dates for testing will be coordinated through the SRWG.

- Spring research operations: A two treatment test will be conducted, utilizing the bulk spill pattern from 2006-2007 versus the 2003 uniform (flat) pattern modified for the RSW in spill bay 8. Pattern changes will occur at 0600. However, if the runoff forecast is high, a one treatment study would be conducted as the higher the spill levels the more similar the two patterns become.

- Objectives of the biological test: The objectives of the study are to assess passage distribution and efficiency metrics, forebay retention, tailrace egress, and survival for yearling Chinook, and steelhead for two spill pattern treatments, a bulk spill pattern and a uniform pattern with the RSW. This will be the first year of testing of the RSW at Lower Monumental Dam.

- Spill pattern during the biological test: Spill patterns will be verified through ERDC modeling and SRWG coordination.

Operation considerations:

- In the spring and summer, day average flows near 30 kcfs results in incompatible operations with Little Goose Dam and results in spill quantity fluctuation.
- The Lower Monumental spill cap is affected by Little Goose Dam operations. Therefore, spill discharge could be lower than 27 kcfs.
- The removable spillway weir (RSW) was installed in October 2007 and will be tested in 2008.
- Spill will be reduced or stopped as needed to allow safe operation of fish transportation barges near collection facilities downstream of the project. Spill changes will be minimized in order to reduce effects on spill research.
- Operating units within the 1% of best efficiency range yields up to 19 kcfs per unit at each of the 6 units for a maximum hydraulic capacity of approximately 114 kcfs. The expected spill cap is 27 kcfs. Therefore, if total river discharge is greater than 141 kcfs the gas cap will be exceeded. Either lack of power load or unit outages can also cause forced spill above spill cap rates at higher total river discharges.
- Unit outages will occur for required maintenance activities. The outage schedule for the project is shown in Appendix 2. Dates are subject to change.

During non-test periods, the spill patterns will return to normal operation as described in the FPP and to the spill levels as shown in the tables above.

Summer Spill Operations June 21 – August 31, 2008: Spill 17 kcfs 24 hours per day, subject to gas cap limits. See Table 3 for operational spill levels.

Changes in Operations for Research Purposes:

- Spill duration for testing: June 21 – mid-July, or possibly earlier. The dates of testing will be dependent on the availability of Subyearling Chinook of sufficient size for tagging. Final dates for testing will be coordinated through the FFDRWG.

- Summer research operations: 17 kcfs 24 hours per day with one spill pattern treatment. The spill pattern will be the pattern used in 2006 and coordinated through SRWG. The 2007 pattern for navigation appeared to have lower fish survival than in 2006.

- Objectives of the biological test: Estimate passage distribution and survival for subyearling fall Chinook salmon under two spill pattern treatments.

- Spill pattern during the biological test: FPP spill patterns will be provided in February.

Operation considerations:

  - As in the spring, the summer spill caps may be affected by Little Goose operations.
  - Minimum spill: During periods of low flow before the spring freshet and during the summer period, there may be periods when spill quantities are limited so that tailrace conditions are not advantageous to fish passage. This is interpreted to be a minimum of spill through the RSW only (6.8 kcfs with the reservoir operating at MOP). If such a low flow condition occurs, alternative operations at the dam will be coordinated through the TMT.
  - Minimum generation: The minimum generation amount represents the operation of one unit at the lower end of its 1% of best efficiency range and is needed for power system reliability. This generation will be controlled to approximately 81 – 83 MW at units 2 – 3, the priority fish units. If these units are not available, the larger units 4 – 6 will be run at 104 - 106 MW on units 4 – 6, or 126 – 129 MW on unit 1 which has welded fixed blades. This will result in turbine flows of approximately 11 kcfs – 14 kcfs at units 2 – 6 and 17 kcfs – 19 kcfs if unit 1 is used. There may be slight variations in the generation due to power system fluctuations. Also, the outflow will fluctuate because of changing head at the dam. This limit may occur in early spring before the freshet and during the late summer period with low flow conditions.
  - Unit outages will occur for required maintenance activities. The outage schedule for the project is shown in Appendix 2. Dates are subject to change.
  - A spill pattern or spill operation which will not adversely affect barge traffic and juvenile fall Chinook survival is still in development. During 2007 a spill pattern was developed with the assistance of the tow boat operators. However, survival of fall Chinook during 2007 was lower than that observed in 2006. A period of no spill during the time when barges approach the lock may be the best solution to balancing the needs of barge traffic and fish operations.

Ice Harbor

Spring Spill Operations April 3 – June 20, 2008: Alternate between 45 kcfs day/spill cap night and 30% 24 hours per day with the RSW operating, following a test schedule similar to that used in 2007. Nighttime spill hours are 1800 – 0500. See Table 3 for operational spill levels.

Changes in Operations for Research Purposes:

- Spring research operations: Normal spring spill patterns and rates as described in the FPP will be used. Radio tagged fish will be monitored to evaluate spill and project survival for two test conditions (single release model). Dates for 30% spill 24 hours per day will follow a schedule similar to that used in 2007, alternating every 2 days with 45 kcfs day / spill cap night in a randomized block design. This will start May 2 and continue through July 16. Spill will be 45 kcfs day / spill cap night before May 2 and after July 16. Both spill operations will have the RSW operating.

- Objectives of the biological test: The primary objective of the test is to determine spill and project survival under two spill conditions for yearling Chinook and steelhead.

- Spill pattern: FPP spill patterns will be used (FPP Tables IHR-9 and IHR-10).

Operation considerations:

- Powerhouse capacity at Ice Harbor is approximately 94 kcfs with all 6 units operating, while spill cap rates are about 100 kcfs. If total river flows exceed about 194 kcfs, TDG levels may exceed the limits set by the states of Oregon and Washington.
- Minimum generation or higher powerhouse operation will occur at all times during both the spring and summer fish spill seasons in 2008. This is due to a transformer failure at BPA's Sacajawea transmission facility near the project. Mobile capacitor groups will be installed at BPA's Franklin transmission facility to partially resolve power system issues. In addition, continuous generation is required at Ice Harbor Dam for power system stability and reliability.
- Unit outages will occur for required maintenance activities. The outage schedule for the project is shown in Appendix 2. Dates are subject to change.

Summer Spill Operations June 21 – August 31, 2008: Alternate between 45 kcfs day/spill cap night and 30% 24 hours per day with the RSW operating through July 16, then spill 45 kcfs day / spill cap night through August 31. See Table 3 for operational spill levels.

Changes in Operations for Research Purposes:

- Summer research operations: Continue 30% spill vs. 45 kcfs day / spill cap night through July 16, following a test schedule similar to that used in 2007. Both operations will have the RSW operating.

- Objectives of the biological test: The primary objective of the test is to determine spill and project survival under two spill conditions for subyearling Chinook.

- Spill pattern during the biological test: FPP spill patterns will be used (FPP Tables IHR-9 and IHR-10, same as spring).

Operation considerations:

  - Minimum spill: During periods of low flow before the spring freshet and during the summer period, there may be periods where spill quantities are limited so that tailrace conditions are not advantageous to fish passage. The minimum spill for Ice Harbor Dam is 15.2 kcfs, which includes providing spill through the RSW and training spill to ensure good tailrace egress conditions. If such a low flow condition occurs, alternative operations at the dam will be coordinated through the TMT.
  - Minimum generation: The minimum generation amount represents the operation of one unit at the lower cavitation limit. The cavitation limit is within the 1% of best efficiency range. This generation will be controlled to approximately 65 – 70 MW at units 1 and 3, the priority fish units. If these units are not available, the larger units 4 – 6 will be run at 80 – 81 MW. This will result in turbine flows of approximately 9 kcfs – 10 kcfs at units 1 – 3 and 11 kcfs – 12 kcfs at units 4 – 6. Unit 2 has been modified by fixing the blades in a single position to eliminate an oil leak. As a result, its MW output and kcfs discharge at the low end of 1% will be higher than the other 5 units. Unit 2 is the last priority unit to operate and therefore is unlikely to operate to meet minimum generation. There may be slight variations in the generation due to power system fluctuations. Also, the outflow will fluctuate because of changing head at the dam. This limit may occur in early spring before the freshet and during the late summer period with low flow conditions.
  - Unit outages will occur for required maintenance activities. The outage schedule for the project is shown in Appendix 2. Dates are subject to change.

McNary

Spring Spill Operations April 10 – June 30, 2008: 40% spill 24 hours/day. See Table 3 for operational spill levels.

Changes in Operations for Research Purposes:

- Spill duration for testing: Approximately April 20 to early June (tentative). The dates of testing will be dependent on the size of fish, fish availability, and the number of treatments needed for testing. Final dates for testing will be coordinated through the SRWG.

- Spring research operations: 40% spill 24 hours/day for the second year of prototype Temporary Spillway Weir (TSW) testing. One project spill configuration will be tested. Final test conditions will be coordinated through the SRWG.

- Objectives of the biological test:

  - Estimate passage and survival rates of yearling Chinook salmon under a single treatment of project operations.
  - Estimate passage and survival rates of juvenile steelhead under a single treatment of project operations.
  - Characterize juvenile salmon behavior in the forebay of McNary Dam under a single treatment of project operations.

- Spill pattern: As outlined in an addendum to the FPP. The Corps' Walla Walla District coordinated with regional fishery managers and evaluated new spill patterns with general model observations. Test spill patterns are provided in Appendix 1.

Operation considerations:

  - TSW1 is placed in spill bay 19 (relocated from spill bay 22) while TSW2 remains in spill bay 20 for 2008 testing. This configuration was regionally reviewed and supported.
  - During the periods when total river discharge exceeds approximately 320 kcfs, involuntary spill in excess of the states' TDG limits for fish passage, may occur.
  - In addition, low power demand may also necessitate involuntary spill during any given spill treatment at total river discharges of less than 320 kcfs.
  - Unit outages will occur for required maintenance activities. The outage schedule for the project is shown in Appendix 2. Dates are subject to change.

Once research spill operations are completed, the spill pattern will return to normal operation as described in the FPP (Table MCN-6).

Summer Spill Operations July 1 – August 31, 2008: 40% spill vs. 60% spill 24 hours/day. Spill conditions will be alternated every two days. Spill changes will occur at 0600. See Table 3 for operational spill levels.

Changes in Operations for Research Purposes:

- Spill duration for testing: approximately June 15 through July 25 (tentative). The dates of testing will be dependent on the size of fish, fish availability, and the number of treatments needed for testing. Final dates for testing will be coordinated through the SRWG.

- Summer research operations: 40% spill 24 hours/day vs. 60% spill 24 hours/day. Continue to evaluate TSW performance. The spill will be alternated in two day blocks which will be randomized during testing.

- Objectives of the biological test:

  - Estimate passage and survival rates of subyearling fall Chinook salmon under two treatments of project operations.

  - Characterize juvenile salmon behavior in the forebay of McNary Dam under two treatments of project operations.

- Spill pattern during the biological test: Spill pattern details were identified using the general model at ERDC by USACE Walla Walla District staff and representatives of the regional fisheries agencies and tribes. Test spill patterns are provided in Appendix 1. A single spill pattern will be tested at the 40% and 60% spill levels, using the 2006 spill pattern modified for placement of the TSWs in spill bays 19 and 20.

Operation considerations:

- Spill will be curtailed as needed to allow safe operation of fish transportation barges near collection facilities downstream of the project. Spill changes will be minimized in order to reduce effects on spill research. Specifically, the spillway, including TSWs in spill bays 19 and 20, will be closed while barges are crossing the tailrace (15 – 30 minutes per crossing). Gate hoists at spill bays 19 and 20 will be modified to allow closure with TSWs in place.
- Minimum generation: A minimum powerhouse discharge of 50 kcfs is required at all times to meet minimum generation requirements. The lower Columbia River dams provide some of the required generation capacity reserves for the power system. Due to this requirement and the constant fluctuations in power demands throughout the day, the 50 kcfs flow cannot be maintained precisely on an hourly basis. The flow may increase by as much as 10 kcfs for short periods. Therefore, the minimum generation flow should meet or exceed 50 kcfs for all hours.
- If total river discharge drops below about 90 kcfs, 40% spill treatments may be reduced to maintain 50 kcfs powerhouse discharge. Similarly, if total river discharge drops below about 135 kcfs, 60% spill treatments may be reduced to maintain a 50 kcfs powerhouse discharge.
- Minimum spill: During periods of low flow before the spring freshet and during the summer period, there may be periods where spill quantities are limited so that tailrace conditions are not advantageous to fish passage. If such a low flow condition occurs, alternative operations at the dam will be coordinated through the TMT.

- o Unit outages will occur for required maintenance activities. The outage schedule for the project is shown in Appendix 2. Dates are subject to change.

Once research spill operations are completed, the spill pattern will return to normal operation as described in the FPP (Table MCN-6).

John Day

Spring Spill Operations April 10 – June 30, 2008: 0 kcfs spill day/60% spill night. Nighttime spill hours are 1800 – 0600 from April 10 through May 14 and 1900 – 0600 May 15 through June 30. See Table 3 for operational spill levels.

Changes in Operations for Research Purposes:

- Spill duration for prototype TSW testing: Testing in late April through early June. The dates of testing will be dependent on the size of fish, fish availability, and the number of treatments needed for testing. Final dates for testing will be coordinated through the SRWG.

- Spring research operations: Two prototype TSWs that pass about 10 kcfs spill each will be installed in spill bays 18 and 19. Training spill patterns to support the TSW jets and provide good downstream egress for juvenile salmonids are currently being developed by modeling at ERDC and coordination with regional agencies. Two spill levels will be tested to provide spill / TSW efficiency curves. These data will be used to design surface flow outlet and tailrace improvements at John Day Dam.

- Objectives of the biological test: The objectives of the study are to assess passage distribution and efficiency metrics, forebay retention, tailrace egress, and survival for yearling Chinook, and juvenile steelhead for two spill treatments. Also, prior to the smolt migration, a direct survival and injury test using balloon-tagged fish will be conducted.

- Spill pattern during biological test: 10 – 20 April, prior to the test, same as 2007 FOP except the spill pattern will be modified to use spill bays 1 – 17 only. Spill bays 18 and 19 will have the TSWs installed, which are not easily opened and closed. During 20 April to June 20, spill patterns for 30% and ~40% spill will be developed at ERDC in coordination with regional agencies.

Operation considerations:

- o The hydraulic capacity for John Day is approximately 272 kcfs with all 16 units operating. If total river discharge exceeds this level, involuntary spill will occur during the daytime.
- o If total river flow exceeds approximately 400 kcfs at night, 60% night spill levels would be 160 kcfs which may exceed TDG levels.
- o Unit outages will occur for required maintenance activities. The outage schedule for the project is shown in Appendix 2. Dates are subject to change.

Summer Spill Operations July 1 – August 31, 2008: 30% spill 24 hours/day. See Table 3 for operational spill levels.

Changes in Operations for Research Purposes:

- Spill duration for testing: June 21 to approximately July 20. The dates of testing will be dependent on the size of fish, fish availability, and the number of treatments needed for testing. Final dates for testing will be coordinated through the SRWG.

- Summer research operations: Two training spill percentages, 30% and approximately 40%, will be tested.

- Objectives of the biological test: The objectives of the study are to assess passage distribution and efficiency metrics, forebay retention, tailrace egress, and survival will be estimated for subyearling fall Chinook.

- Spill pattern during the biological test: Spill patterns for 30% and ~40% spill will be developed at ERDC in coordination with regional agencies. Outside the test period, spill patterns described in the FPP with two TSWs in place will be used.

Operation considerations:

  - Minimum spill: During periods of low flow before the spring freshet and during the summer period, there may be periods where spill quantities are limited so that tailrace conditions are not advantageous to fish passage. If such a low flow condition occurs, alternative operations at the dam will be coordinated through the TMT.
  - Minimum generation: A minimum powerhouse discharge of 50 kcfs is required at all times to meet minimum generation requirements. The lower Columbia River dams provide some of the required generation capacity reserves for the power system. Due to this requirement and the constant fluctuations in power demands throughout the day, the 50 kcfs flow cannot be maintained precisely on an hourly basis. The flow may increase by as much as 10 kcfs for short periods. Therefore, the minimum generation flow should meet or exceed 50 kcfs for all hours.
  - Unit outages will occur for required maintenance activities. The outage schedule for the project is shown in Appendix 2. Dates are subject to change.
  - If river flows drop below about 75 kcfs then spill may need to drop below 30% spill in order to maintain station service and power system needs.

The Dalles

Spring Spill Operations April 10 – June 30, 2008: 40% spill 24 hours/day. See Table 3 for operational spill levels.

Changes in Operations for Research Purposes:

- Spill pattern during the biological test: No research is planned for 2008. The FPP spill patterns will be used. Spill patterns for high flows (450 kcfs or higher) are provided in Appendix 1.

Operation considerations:

- Spillway wire ropes at The Dalles Dam were replaced on Bays 1-9 in 2006. These bays are fully operational in 2008. Spill bays 10 – 22 can be operated in emergencies according to the table in Appendix 1.
- When high river flows exceed those shown in the table below such that available bays 1 – 9 cannot maintain 40% spill, FPOM and TMT will discuss the preferred spill pattern and rate. The project may maintain 40% spill of the total river flow and depart from the spill pattern, or spill less than 40% of the total river flow using a pattern other than that shown in the FPP. At no time is spill recommend on the south side of the spillway (Bays 14-22) as this creates a poor tailrace egress condition for spillway-passed fish.
- Unit outages will occur for required maintenance activities. The outage schedule for the project is shown in Appendix 2. Dates are subject to change.

Summer Spill Operations July 1 – August 31, 2008: 40% spill 24 hours/day. See Table 3 for operational spill levels.

Changes in Operations for Research Purposes:

- Spill pattern during the biological test: No research is planned for 2008. The FPP spill patterns will be used.

Operation considerations:

- When high river flows exceed those shown in the table above such that available bays 1 – 9 cannot maintain 40% spill, FPOM and TMT will discuss the preferred spill pattern and rate. The project may maintain 40% spill of the total river flow and depart from the spill pattern, or spill less than 40% of the total river flow using a pattern other than that shown in the FPP. At no time is spill recommend on the south side of the spillway (Bays 14-22) as this creates a poor tailrace egress condition for spillway-passed fish.

- o Minimum generation: A minimum powerhouse discharge of 50 kcfs is required at all times to meet minimum generation requirements. The lower Columbia River dams provide some of the required generation capacity reserves for the power system. Due to this requirement and the constant fluctuations in power demands throughout the day, the 50 kcfs flow cannot be maintained precisely on an hourly basis. The flow may increase by as much as 10 kcfs for short periods. Therefore, the minimum generation flow should meet or exceed 50 kcfs for all hours.
- o Unit outages will occur for required maintenance activities. The outage schedule for the project is shown in Appendix 2. Dates are subject to change.
- o If river flows drop below about 90 kcfs then spill may need to drop below 40% spill in order to maintain station service and power system needs.

Bonneville

Spring Spill Operations April 10 – June 20, 2008: 100 kcfs spill 24 hours/day. See Table 3 for operational spill levels.

Changes in Operations for Research Purposes:

- <u>Spill duration for testing</u>: Approximately April 26 – June 7. The dates of testing will be dependent on the size of fish and fish availability. Final dates for testing will be coordinated through the SRWG.

- <u>Spring research operations</u>: 100 kcfs spill 24 hours/day.

- <u>Objectives of the biological test</u>: Estimate survival of yearling Chinook passing through the dam and spillway. Focus will be on new spill patterns to improve project spill survival.

- <u>Spill pattern during the biological test</u>: Spill patterns in the FPP will be used.

Operation considerations:

- o Minimum spill discharge rate is 50 kcfs. This is to provide acceptable juvenile fish egress conditions in the tailrace.
- o At spring flows less than 135 kcfs, spill will be less than 100 kcfs to maintain minimum powerhouse generation of 30 kcfs plus fish ladder and facility spill (e.g. corner collector).
- o Unit outages will occur for required maintenance activities. The outage schedule for the project is shown in Appendix 2. Dates are subject to change.
- o Actual spill levels at Bonneville Dam may range from 1 to 3 kcfs lower or higher than specified in the 2008 FOP. A number of factors influence this including hydraulic efficiency, exact gate opening calibration, spillway gate hoist cable stretch due to temperature changes, and forebay elevation (a higher forebay results in a greater volume of spill since more water can pass under the spill gate).

- The second powerhouse corner collector (5 kcfs discharge) will operate from early March to August 31, 2008. The March start date will be set to accommodate a passage study for migrating steelhead kelts and a potential passage study of juvenile fish released from the Spring Creek National Fish Hatchery. A 2-hour outage will occur the week of April 7 to remove research equipment.
- A 1-hour outage at spill bay 9 may occur monthly during the spill season to facilitate the use of Ground Penetrating Sonar (GPS) to measure and track erosion at spill bay 9 from inside the spillway inspection gallery. GPS data will be evaluated by Corps Portland District engineers to determine if a full spillway outage is required for a hydrographic survey. Such an outage occurred in 2007, but may not be needed in 2008 if GPS provides adequate monitoring data. The Corps will coordinate this work through FFDRWG, FPOM, and TMT.

Summer Spill Operations June 21 through August 31, 2008: 85 kcfs day from June 21 through approximately July 20, then 75 kcfs day for the remainder of the season through August 31. Spill to the spill cap at night. The estimated summer spill cap rate is 120 kcfs. Daytime spill hours change periodically and are defined in FPP Table BON-6. See Table 3 for operational spill levels.

Changes in Operations for Research Purposes:

- <u>Spill duration for testing</u>: June 21 through approximately July 20. Continue tests of new spill patterns in the summer. Final dates for testing will be coordinated through the SRWG.

- <u>Summer research operations</u>: Daytime spill will be 85 kcfs until the end of the summer test, approximately July 20, after which the daytime spill will be 75 kcfs through August 31. Spill to the spill cap at night.

- <u>Objectives of the biological test</u>: Estimate survival of subyearling Chinook passing through the dam and spillway. Focus will be on new spill patterns to improve project spill survival.

- <u>Spill Patterns for summer operations:</u> Spill patterns in the FPP will be used.

Operation considerations:

- Minimum generation: A minimum powerhouse discharge of 30 kcfs is required at all times to meet minimum generation requirements. The lower Columbia River dams provide some of the required generation capacity reserves for the power system. Due to this requirement and the constant fluctuations in power demands throughout the day, the 30 kcfs flow cannot be maintained precisely on an hourly basis. The flow may increase by as much as 10 kcfs for short periods. Therefore, the minimum generation flow should meet or exceed 30 kcfs for all hours.

- Unit outages will occur for required maintenance activities. The outage schedule for the project is shown in Appendix 2. Dates are subject to change.
- Minimum spill discharge level is 50 kcfs. This is to provide acceptable juvenile fish egress conditions in the tailrace.

- Actual spill levels at Bonneville Dam may range from 1 to 3 kcfs lower or higher than specified in the 2008 FOP. A number of factors influence this including hydraulic efficiency, exact gate opening calibration, spillway gate hoist cable stretch due to temperature changes, and forebay elevation (a higher forebay results in a greater volume of spill since more water can pass under the spill gate).
- The second powerhouse corner collector (5 kcfs discharge) will operate from early March until August 31.
- A full spillway outage may occur for several hours (up to 8 hours) in July 2008 for a hydrographic survey in the tailrace to measure erosion at spill bay 9. This survey may not be needed if the monthly GPS data are adequate to monitor spillway erosion. The Corps will coordinate this work through FFDRWG, FPOM, and TMT.

Juvenile Fish Transportation Program Operations

As noted above, the Corps' planned fish operations assume average runoff conditions. Based on collaborative discussion with the regional agencies and tribes, and as agreed to in 2007, the following explains the juvenile fish transportation program under all runoff conditions. The lower Snake River projects are described first, followed by McNary project operations. Detailed descriptions of project and transport facility operations to implement the program are contained in FPP Appendix B.

Lower Snake River Dams - Operation and Timing:

If the Snake River projected seasonal average (April 3 – June 20) flow is greater than 70 kcfs, the Corps will initiate transportation at Lower Granite Dam no earlier than April 20 and no later than May 1. The seasonal average flow projection will be based on the Corps' STP model and the April final water supply forecast for Lower Granite. The actual start date in 2008 will be determined through coordination with TMT as informed by the in-season river condition (e.g. river flow and temperature) and the status of the juvenile Chinook and steelhead runs (e.g. percentage of runs having passed the project). Also if the projected flow is greater than 70 kcfs, transportation will start 8 days and 11 days after the Lower Granite Dam start date for Little Goose and Lower Monumental dams, respectively. The actual start dates at Little Goose and Lower Monumental dams will be further considered through the TMT process, depending on in-season river conditions and the status of the juvenile Chinook and steelhead runs.

a. Lower Granite: All ESBSs will be installed by March 25 and juvenile fish will be bypassed via normal separator operations and routed to the mid-river release outfall. All juvenile fish collected will be interrogated for PIT tags and normal 24-hour sampling for the Smolt Monitoring Program will take place.

b. Little Goose and Lower Monumental: All ESBSs and STSs will be installed by April 1 and juvenile fish will be bypassed via normal separator operations and fish will be routed to normal facility bypass outfalls. All juvenile fish will be interrogated for PIT tags and limited sampling may take place every 3 to 5 days to monitor fish condition. A full sample may be performed every other day to monitor species composition to help inform a decision on initiating transportation at these projects. At Lower Monumental, daily smolt monitoring will occur beginning April 1 and 100 steelhead will be PIT-tagged to assess avian prey selection. Also, study fish will be collected at Little Goose for the Lower Monumental passage and survival study.

In exceptionally low water years, when the projected seasonal average flow is less than 70 kcfs, the Corps will begin transportation on April 20 at all three Snake collector projects. Spill for fish passage will occur under all flow conditions.

April 20 – June 20: The collection of fish at lower Snake River projects for transportation will commence at 0700 hours on the agreed to start dates. Barging of fish will begin the following day and collected juvenile fish will be barged from each facility on a daily or every-other-day basis (depending on the number of fish) throughout the spring. Transport operations will be carried out concurrent with spill operations at each project and in accordance with all relevant FPP operating criteria.

June 21 – August 15: Transportation of juvenile fish from all three Snake River transport projects will continue on an every-other-day basis from June 21 through August 15, via barges.

August 16 – August 31: After August 15, trucks will be used for transporting juvenile fish from the Snake River collector projects on an every-other-day basis through August 31.

September 1 – Completion: Transportation of juvenile fish via trucks on an every-other-day basis will continue through October 31, 2008 at Lower Granite and Little Goose dams. At Lower Monumental Dam, transportation of fish via every-other-day trucking will continue through September 30, 2008.

McNary Dam - Operation and Timing:

Spring: Juvenile fish collected at McNary during the spring, April 1 through June 20, will be bypassed to the river. The normal operation will be to bypass fish through the full flow bypass pipe, which has interrogation capability to monitor for PIT tags. Every other day, however, in order to sample fish for the Smolt Monitoring Program, fish will be routed through the separator, interrogated for PIT tags, and then bypassed to the river.

Summer: When river conditions are determined to no longer be “spring like” as defined in the FPP and discussed at TMT, transportation of juvenile fish will begin if it does not significantly conflict with TSW operations. Collected juvenile fish will be barged every other day through August 16 unless they have been marked for in-river passage research. From August 16 through September 30, transportation will occur via trucks.

Other Planned Research

Juvenile Fish Transportation Research at Lower Granite Dam (three studies):

1. A study will be conducted to determine seasonal effects of transporting fish from the Snake River to optimize a transportation strategy. At Lower Granite, fish will be collected for this study starting on April 6, with marking beginning on April 7, 2008. Depending on the number of fish available, fish will be collected 1-2 days with tagging occurring on the day following collection. A barge will leave each Thursday morning with all fish collected during the previous 1-3 days. By barging all fish (minus the in-river group) during 1 to 3 days of collection, barge densities will be maintained at a level similar to what would occur under normal transport operations that time of year. This pattern will occur in the weeks preceding general transportation and will be incorporated into general transportation once that operation begins. The desired transported sample size is 6,000 wild Chinook and 6,000 wild steelhead weekly for approximately eight weeks.

2. A study to evaluate alternative barge release sites below Bonneville Dam has been underway for three years and will continue in 2008. The first barge for this study is tentatively scheduled to depart on April 21, and tagging of fish at Lower Granite on April 20 following collection on April 18 – 19.

3. A study will be conducted to evaluate latent mortality associated with passage through Snake River dams. The goal of this study is to determine whether migration through Snake River dams and reservoirs causes extra mortality in Snake River yearling (spring/summer) Chinook salmon smolts. Specifically, the study will determine if life-cycle survival downstream from McNary Dam is significantly higher for yearling hatchery Chinook salmon released into the Ice Harbor Dam tailrace than for counterparts which must pass three additional dams and reservoirs after release into the Lower Granite Dam tailrace. Fish will be collected at Lower Granite Dam beginning 20 April 2008 with the goal of tagging approximately 120,000 smolts, about 2/3 of which will be released into the tailrace of Lower Granite Dam, and 1/3 transported by truck and released in the tailrace of Ice Harbor Dam.

Avian Predation at Lower Monumental Dam:

A study will be conducted to evaluate the impacts of avian predation on salmonid smolts from the Columbia and Snake rivers. The study will determine how various biotic and abiotic factors are associated with differences in steelhead smolt vulnerability to predation by Crescent Island terns and Foundation Island cormorants. The study requests PIT tagging both hatchery and wild steelhead collected in the smolt monitoring sample at Lower Monumental and Ice Harbor dams, beginning April 1 and continuing through July. The recorded condition of a fish will be attached to a specific tag code and vulnerability to avian predation will be evaluated using PIT tag recovery data collected from the avian bird colonies. The study needs a minimum sample of 100 fish each day that are collected for condition by the smolt monitoring program.

Navigation Safety

Short-term adjustments in spill patterns or reductions in spill discharge rates may be required for navigation safety, primarily at the lower Snake projects but may also be necessary at the lower Columbia projects. This includes both commercial tows and fish barges.

Emergency Protocols

The Corps and Bureau of Reclamation will operate the projects in emergency situations in accordance with the Water Management Plan (WMP) Emergency Protocols (WMP Appendix 1). The Protocols define emergency conditions and situations that may arise while operating the FCRPS, and the immediate actions that may be taken in the face of the emergency. The Corps, BPA, and the Bureau of Reclamation are revising the Emergency Protocols in coordination with TMT. The most recent version of the Emergency Protocols is located at: http://www.nwd-wc.usace.army.mil/tmt/documents/wmp/2008/0926Ap1EmerActPlandrft.pdf

Reporting

The Corps will prepare monthly (April – August) reports on the implementation of 2008 fish passage operations. The reports will include the following information:

- the hourly flow through the powerhouse;
- the hourly flow over the spillway compared to the spill target for that hour; and,
- the resultant 12-hour average TDG for the tailwater at each project and for the next project's forebay downstream.

The reports will also provide information on substantial issues that arise as a result of the spill program (e.g. Little Goose adult passage issues in 2005 and 2007). The reports also will address any emergency situations that arise.

The Corps will continue to provide the following data to the public regarding project flow, spill rate, TDG level, and water temperature.

- Flow and spill quantity data for the lower Snake and Columbia River dams are posted to the following website every hour: http://www.nwd-wc.usace.army.mil/report/projdata.htm

- Water Quality: TDG and water temperature data are posted to the following website every six hours: http://www.nwd-wc.usace.army.mil/report/total.html These data are received via satellite from fixed monitoring sites in the Columbia and Snake rivers every six hours, and placed on a Corps public website upon receipt. Using the hourly TDG readings for each station in the lower Snake and Columbia rivers, the Corps calculates the highest 12-hour average TDG for each station. These averages are reported at: http://www.nwd-wc.usace.army.mil/ftppub/water_quality/12hr/html/

Appendix 1

Test Spill Patterns

Special spill patterns for 2008 tests and high flow conditions are provided for Little Goose, Lower Monumental, McNary, John Day, and The Dalles dams.

Little Goose Dam:

The Corps will provide updated patterns for 30% tests.

Lower Monumental Dam:

The Corps will provide updated patterns for TSW tests.

McNary Dam:

The Corps will provide updated patterns for TSW tests.

John Day Dam:

The Corps will provide spill patterns for TSW testing.

The Dalles Dam:

The Dalles Dam, Special and Emergency Spill Operations, 2008 (and beyond). A total river volume greater than 450,000 cfs is possible that would require additional spillway flows. With Bays 10 – 23 out-of-service, the table below shows the special and emergency spill operations that are recommended at TDA in 2008 to safely accommodate higher flows.

Spill condition	Bays in use	Gate Opening (ft)	Spillway Q (cfs)	Powerhouse Q (cfs)	Total Q (cfs)
Normal, 40% BiOp	1-6 + 7-9	14 + 12	180,000	270,000	450,000
Special spill	1-9	14	189,000	270,000	459,000
	1-6 + 7-9	15 + 14	198,000	270,000	468,000
	1-9	15	202,500	270,000	472,500
	1-6 + 7 -9	16 + 15	211,500	270,000	481,500
	1-9	16	216,000	270,000	486,000
	Continue sequence	Continue sequence			
	1-9	30	405,000	270,000	**675,000***
Emergency spill	1-9 + 14	30	450,000	270,000	720,000
	1-9 + 14-15	30	495,000	270,000	765,000
	1-9 + 14-16	30	540,000	270,000	810,000
	1-9 + 14-17	30	585,000	270,000	855,000
	Continue sequence to Bay 21	Max. of 30' opening			
	1-9 + 14-21	30	765,000	270,000	1,035,000
	1-9 + 12 + 14-21	30	810,000	270,000	1,080,000
	1-9 + 12+ 14-22	30	855,000	270,000	1,125,000
	1-9 + 12+ 14-23	30	900,000	270,000	1,170,000
	1-10+ 12 + 14-23	30	945,000	270,000	1,215,000
	1-12 + 14-23	30	990,000	270,000	1,260,000
	1-23	30	1,035,000	270,000	1,305,000

* Project discharge level at which the Corps may declare an emergency operation at The Dalles Dam to open spill bays 14 – 23.

Appendix 2

Schedule of Major Unit Outages

The following major outages are scheduled for the period April 1 through September 30, 2008. This schedule is based on the best information available at this time, but circumstances may arise which will necessitate adjustments to the schedule. It does not show all outages; shorter maintenance outages take place throughout the year. This schedule shows outages of longer duration with possible significant impacts to fish operations.

1. The schedule shown is for the four Lower Snake and four Lower Columbia projects for the period April 1 through September 30, 2008.

2. Where the description under the "Reason" column is preceded by an "F", this represents a forced outage. Estimated return to service dates are given and are the best guess at this time. Usually, the extent of the damage is not fully known.

3. Outage plans are not fully developed at this time. Some major work will depend on contracts which are not in place yet.

Project	Unit	Capacity (MW)	Out of Service Date		Return to Service Date		Reason
LWG	2	155	01/17/2006	0700	09/29/2008	2359	Liner Cavitation & Generator Rewind - Turbine Rehab/Testing
LWG	2	155	6/23/2008	0600	7/5/2008	1700	Main unit CO2 Fire Protection
LWG	4	155	07/07/2008	0600	07/31/2008	1700	Annual/PSS Install/Fire Protection
LWG	1	155	7/21/2008	0600	8/1/2008	1700	Main unit CO2 Fire Protection
LWG	5	155	08/04/2008	600	8/29/2008	1700	Annual/PSS Install/Fire Protection
LWG	3	155	08/04/2008	0600	12/19/2008	1700	Cavitation Repair/Air Cooler Replacement/Annual

LWG	6	155	09/02/2008	0700	09/26/2008	1700	Annual/PSS/Fire Protection
LWG	One	155	09/22/2008	0600	9/30/2008	1700	Commission New PSSs, Unit 4-6, One at a time
LGS*	6	155	12/11/2007	1500	10/1/2008	1700	F- Water leak caused field ground
LGS*	6	155	09/01/2008	0700	02/28/2009	1700	Spillway Deflector Ins. (Out as Needed)
LMN	1-6	930	09/08/2008	0700	09/08/2008	0800	Line Outage to take T1 OOS (Placeholder)
LMN	1-4	620	09/08/2008	0800	09/11/2008	1700	T1 Disconnect Work
LMN	1-6	930	09/11/2008	1700	09/11/2008	1800	Return T1 to service
IHR	6	127	10/01/2007	0000	3/28/2008	1700	F - HIgh gas readings
IHR	One	127	07/01/2008	0630	09/01/2008	1700	Main Unit Strainers
IHR	3	103	07/08/2008	0630	09/04/2008	1700	Overhaul
IHR	3-4	230	07/14/2008	0630	07/17/2008	1700	Doble Test TW 3, 4 Line 2
MCN	7	80	07/07/2008	0600	08/01/2008	1700	ETBOC
MCN	5	80	07/07/2008	0600	09/19/2008	1700	9-Yr Overhaul
MCN	1-2	160	08/04/2008	0600	08/06/2008	1700	T1 Doble Testing
MCN	5	80	08/04/2008	0600	08/29/2008	1700	ETBOC
MCN	8	80	09/02/2008	0600	09/26/2008	1700	ETBOC/Annual and Oil Indication
MCN	One	80	09/02/2008	1000	09/02/2008	1300	ESBS Insp
MCN	Three	240	09/08/2008	0600	09/13/2008	1700	Diving for Fish Studies
MCN	One	62	09/09/2008	1000	09/09/2008	1300	ESBS Inspections
MCN	4	80	09/15/2008	0600	09/19/2008	1700	Annual and Oil Indication
MCN	5-6	160	09/16/2008	0600	09/18/2008	1700	T3 Doble Testing
MCN	6	80	09/22/2008	0600	12/12/2008	1700	9-Yr Overhaul

MCN	11	80	09/29/2008	0600	10/24/2008	1700	ETBOC
JDA	16	155	04/16/2006	1630	02/29/2008	1700	F - kaplan linkage
JDA	10	155	05/25/2007	1730	02/29/2008	1600	F - field Ground/6 Year Overhaul
JDA	1,3	310	07/28/2008	0600	09/04/2008	1700	Overhaul
JDA	13-16	620	09/08/2008	0600	09/11/2008	1400	T4 Doble
JDA	9-10	310	09/15/2008	0600	10/23/2008	1400	Overhaul
JDA	5-8	620	10/20/2008	0600	10/23/2008	1400	T2 Doble
TDA	4	90	03/24/2008	0630	05/22/2008	1700	Cavitation Repair
TDA	22	100	05/27/2008	0630	07/31/2008	1700	5-Yr/Blade Cavitation, Seals/ Servo Motors
BON	8	60	09/12/2006	0750	05/15/2008	1600	Turbine Rehab
BON	7	60	06/04/2007	0750	12/25/2008	1700	Rehab Turbine, Stator
BON	1	48	10/23/2007	1551	02/14/2008	1600	F - Governor problems. wicket gate
BON	15	76	11/25/2007	2315	03/31/2008	1600	F - Rotor Pole Failure
BON	One	76	01/17/2008	1701	07/09/2008	1700	Excitor Repl - units 11-18, one unit at a time
BON	One	76	1/1/ 2008	0700	05/01/2008	1700	Fish guidance exclusion mods.
BON	3	56	04/14/2008	0700	05/30/2008	1700	PH 1 Unit five year o/haul, turbine obstructions
BON	9	60	07/01/2008	0700	12/20/2009	1700	U9 - Turbine rehab - Generator Rewind
BON	1	48	07/12/2008	0000	08/20/2008	1700	Five year o/haul, turbine obstruction, 300 G ins
BON	15	76	07/28/2008	0700	09/25/2008	1700	Cavitation repair
BON	Two	152	07/29/2008	0000	07/29/2008	1800	Collection Channel Dive, Brush Rigging, F1 & F2
BON	Four	304	08/04/2008	0000	08/07/2008	1700	T11 Bi/Annual Maint., Us 11 & 12 Annual, Install T11 Fault gas monitor, install sync PTs

BON	Four	304	08/11/2008	0000	08/14/2008	1700	T11 Bi/Annual Maint., Us 16 & 18 Annual, Install T12 Fault gas monitor, install sync PTs
BON	17	76	09/08/2008	0000	10/30/2008	1700	4 year overhaul

* Little Goose Dam: In addition to the Unit 6 outage, one unit at a time will be taken out of service for annual maintenance, starting July 28, 2008. Each outage will last approximately 3 weeks.

APPENDIX F

GUIDELINES FOR DEWATERING AND FISH HANDLING PLANS

Guidelines for Dewatering and Fish Handling (Salvage) Plans

Each Corps of Engineers mainstem project on the Columbia and Snake Rivers has dewatering and fish handling plans which cover the dewatering of various project facilities which may contain fish at the time of dewatering. The plans contain procedures for any handling or salvaging of fish within a facility or project area when it is dewatered. All dewatering and fish handling plans should be reviewed and revised where appropriate to reflect any new information and guidelines listed below. The plans shall be reviewed by the Fish Passage O&M Coordination Team.

Coordination: The dewatering and fish handling (salvage) plan for each project shall include coordination procedures for planned and emergency fish salvage activities. The project fishery biologist shall coordinate all fish salvage activities with project and District personnel.

Fish Salvage Briefing: The plans shall include a requirement that a fish salvage briefing for **all participants** involved in a dewatering activity be held prior to each dewatering activity. The briefings should lay out responsibilities for each participant in the dewatering activity. All emergency fish salvage operations will be coordinated and overseen by the project fishery biologist or fisheries staff if possible.

Personnel: The dewatering plans shall specify the number and specialization of personnel required for each type of dewatering activity. Personnel for fish salvage include the project fishery biologist, fisheries staff, crane operators, riggers, winch operators, forklift operators, and maintenance workers. To minimize fish stress and mortality, adequate personnel must be available for fish salvage activities.

Facilities and Dewatering Procedures: The salvage plans shall be project specific and shall contain step by step dewatering and fish salvaging procedures for all facilities and project features which may contain fish. The most common areas include adult fish ladders and collection channels, juvenile bypass systems, juvenile fish sampling facilities, turbines scroll cases and draft tubes, gatewell slots, and navigation locks. Individual projects may have other facilities or features that contain fish. The plans shall specify how the facility is to be dewatered and where and how fish are to be salvaged. Each project shall have designated release sites for the various types of fish expected to be encountered during each dewatering activity.

Fish Handling Equipment: The plans shall specify all fish handling equipment required for handling fish during each type of dewatering activity. Typical fish salvage equipment includes gloves, hand held fish nets, seines, fish buckets, gatewell dip baskets, and fish transportation tanks and vehicles. All equipment should be in good condition and pre-positioned before dewatering begins.

Support Equipment: The plans shall include a detailed listing of all support equipment required for each dewatering activity. This should include items such as hard-hats, boots, safety harnesses, flashlights, portable radios, ladders, cranes, man-baskets, pumps, forklifts, and any other equipment required for a dewatering activity. The plans shall specify where equipment is required for use during a dewatering, where certain equipment should be pre-positioned before work begins, and the heavy equipment needed for fish salvage activities.

Fish Safety Pools: The fish salvage plans shall identify the areas in each facility which pond enough water to hold fish temporarily. The plan shall specify whether the safety pools are usually maintained by leakage or a controlled water flow. The plans shall specify how long and under what conditions each safety pool can be used to hold fish safely. If the there is the potential for the safety pools to freeze over or loose their water source, the fish should be evacuated as soon as possible.

Fish Handling Procedures/Practices: The plans shall include procedures to minimize fish mortality and stress. The primary fish handling objective will be to collect and transport fish to release sites with minimal stress and without injury or mortality to any fish. Plans shall specify the details of all fish handling activities including how to crown and handle fish within each facility, specifics on the number of fish which can be hauled or transported in containers or transport tanks at varying water temperatures, and how and where to release fish at each project.

Fish Handling Guidelines: General fish handling guidelines which should be reflected in fish handling/salvage plans are detailed here. Adult salmonids and other large adult fish should be salvaged first. Netting of fish should be minimized whenever possible. Fish should not be crowded in the holding containers. Fish will be less stressed in larger containers (300 gallons or larger preferred), in colder water, and with supplemental oxygen or aeration. If fish are transported in warmer water (>65^{o} F), fewer fish should be transported in a container and holding times should be shorter. All fish will be returned to the river as soon as possible at specified, predetermined release sites. Fish should not be held in holding tanks or containers for more than two hours under any circumstances. Fish should be released from the holding tanks into the river as soon as the fish salvage operation stops for any reason. Fish should be carefully released into the tailwater or forebay with a short vertical drop to the river. Fish release slides are desirable. The water temperature in the transport tank should be monitored. The water temperature in the transport or holding tanks will not be more than 2^{o} F different from the river water. Fish should be removed prior to debris removal if possible.

Fish Salvage Report: The fish salvage plan should include a report form for the fish salvage operations. These forms should be completed for all fish salvage activities and kept permanently on file at each project.

APPENDIX G

PROTOCOLS FOR ADULT FISH TRAPPING OPERATION AT BONNEVILLE, ICE HARBOR, AND LOWER GRANITE DAMS

Protocols for Adult Fish Facility Trapping Operations
Bonneville Dam

The following protocols will be implemented by agencies conducting research in the Bonneville Dam second powerhouse Adult Fish Facility (AFF). These protocols were coordinated with fish agencies and tribes through the Fish Passage Operation and Maintenance Coordination Team (FPOM). The purpose of these protocols is to provide measures to limit mortality resulting from stress when handling fish.

1. General facility protocols.

- **1.1.** Users must have appropriate documentation for conducting research at the dam (See _Guide for Researchers at Bonneville Dam_). This includes valid state and federal permits that cover all listed species passing the project during the trapping period and users shall comply with all fish handling conditions in the permits. **Note: If permit conditions are more restrictive than the following protocols, users must follow permit conditions.**
- **1.2.** The Corps reserves the right to terminate trapping operations at any time.
- **1.3.** Users will be trained in the proper operation of the AFF to insure fish and personnel safety. Users may request training through the Project Biologists.
- **1.4.** Bridge crane certification is required prior to operating the overhead crane. Training will not be provided by the Corps of Engineers.
- **1.5.** Hard hats, long pants or raingear, steel-toed shoes or rubber boots are to be worn at all times. Shorts, tennis shoes, or sandals will not be permitted in the lab.
- **1.6.** Water temperatures should be observed upon arrival and periodically during the day.
- **1.7.** Personnel conducting research are required to be present in the AFF to divert desired fish into the anesthetic tank using the flume swing gates. While the AFF is in operation, flumes shall be open and a researcher must be on-site.
- **1.8.** Undesired fish will be bypassed to the return pool.
- **1.9.** The brail pool shall remain in the lowered position except during winter activities.
- **1.10.** Researchers shall perform no maintenance on Corps owned/installed equipment. Nets may be mended as necessary.
- **1.11.** Qualified users may lower the main ladder picket leads and downstream exit bulkhead when they arrive, and must raise the picket leads and downstream exit bulkhead when they are completed for the day.
- **1.12.** Users will be permitted to operate valves 10 and 11 to control flow down the flumes at their discretion and to operate the raw water booster pump. Users may operate valve 12 to provide flow in the holding pool and valve 15 to drain water at the return pool.
- **1.13.** Users must use a cotton mesh net, large enough to safely handle the largest fish passing the project during the trapping period.
- **1.14.** Fish greater than 100 cm in length **will not** be diverted into the anesthetic tank. These fish will be allowed to return to the ladder untouched.

2. Notification and Documentation

- **2.1.** Users will notify the control room when they set up and close down the lab.
- **2.2.** Users will record the times picket leads are lowered and raised and which agency they are representing on the sheet provided by the project biologists.
- **2.3.** Anytime lamprey are held overnight in the AFF, researchers will notify Project Fisheries and the Control Room.

2.4. Any and all mortalities must be immediately reported to a Project Biologist. The Project Biologist will examine the mortality and take any photos.

2.4.1. The researcher shall give a detailed report including:

A. Species
B. Origin
C. Length
D. Weight
E. Marks and injuries.
F. Cause and time of death
G. Future preventative measures.

2.4.2. All mortalities are included in the Project Fisheries weekly report and the reports are submitted to FPOM.

3. Trapping protocols when fish ladder water temperatures are <70°F.

3.1. There will be no time restriction for trapping operations.

3.2. There will be no more than four chinook, or four steelhead, or four sockeye, or any combination of four adult salmonids allowed in the anesthetic tank at any one time. This assumes that users can effectively track the length of time fish stay in the anesthetic tank.

3.3. There will be no more than one adult salmonid allowed in the small recovery tank at any one time. The brail pool is the primary and preferred recovery area.

3.4. Water in the anesthetic tank will be replaced at least two times per day. Water temperatures in the anesthetic tank will be maintained within 2°F of the fish ladder water temperature. **Note: If anesthetic tank water temperature exceeds 70°F, criteria in section 4 will go into effect.**

3.5. Water in the small recovery tank will be running continuously to allow a constant exchange of water through the tank.

3.6. Personnel shall ensure fish are sampled as quickly as possible. It is recommended that it take no longer than 25 minutes to transition the fish from entry into the anesthetic tank to release back into the return ladder or transportation tank.

3.7. Personnel shall ensure that fish are fully recovered from anesthetization prior to release into the return ladder. Fish may volitionally leave the brail pool when they are ready.

3.8. When trapping is completed for the day, users will properly shut down the lab.

3.9. No more than two picket leads will be down while trapping activities are in operation. Additional leads may be requested through the Project Biologists.

3.10. Project biologists retain the authority to raise additional picket leads depending on fish densities and ladder conditions.

4. Trapping protocols when fish ladder water temperatures are >70°F.

4.1. Trapping will not occur when fish ladder water temperatures meet or exceed 70°F as measured in the brail pool. The only exception is for <u>US v Oregon</u> requirements.

4.1.1. Project Biologists will use the Corps temperature probe reading as the official temperature.

4.1.2. Temperatures are both instantaneous readings and 0000 to 2400 daily averages.

4.1.3. Project biologists will collect temperature data weekly from the data logger in the exit ladder. Daily checks may be requested when temperatures approach 70°F.

4.2. Sampling will be permitted 1-day per week from 0600- 1000 when water temperatures exceed 70°F to allow for mandatory steelhead sampling.

4.3. There will be no lamprey trapping or testing, unless previously coordinated with FPOM.

- **4.4.** There will be no more than three adult salmonids in the anesthetic tank at a time. This assumes users can effectively track the length of time fish stay in the anesthetic tank.
- **4.5.** The brail pool is the primary and preferred recovery pool.
- **4.6.** The small recovery tank will only be used in emergencies. If used, there will be no more than one adult salmonid allowed in the small recovery tank at any one time.
- **4.7.** If used, water in the small recovery tank will be running continuously allowing a constant exchange of water through the tank.
- **4.8.** Assure oxygen levels are maintained at saturation in the anesthetic and recovery tanks. There will be no depression in oxygen levels in the anesthetic or recovery tanks. To assure this, water in the anesthetic tank will be replaced at least every three hours.
- **4.9.** Maintain the anesthetic and recovery tank water temperatures 1-2°F lower than the ladder water temperature. If ice is used to cool the anesthetic or recovery tank water, the ice should be from river water or from an un-chlorinated water source. Do not exceed a 2°F difference between the anesthetic or recovery tank water and fish ladder water.
- **4.10.** Personnel shall ensure fish are sampled as quickly as possible. It is recommended that it take no longer than 25 minutes to transition the fish from entry into the anesthetic tank to release back into the return ladder or transportation tank.
- **4.11.** Personnel shall ensure fish are fully recovered from anesthetization prior to release. Fish may volitionally leave the brail pool when they are ready.
- **4.12.** Project biologists retain the authority to raise additional picket leads depending on fish densities and ladder conditions.
- **4.13.** This operation will remain in effect until daily average water temperatures drop to 69.5°F.

5. Winter trapping protocols, from December 01 through March 14. The purpose of these protocols is to provide measures to limit passage delay, and stress from overcrowding in the brail pool. Personnel conducting research during this time are not required to be present in the AFF. Users are allowed to activate the flume swing gates to divert all fish into the brail pool.

- **5.1.** Fish will not be permitted to remain in the brail pool longer than 24 hours. It is recommended that handling of fish occurs daily by 1800 hours. This assures that if fish are sampled at the end of the day, most of the fish captured are only held from the morning until afternoon since passage at night is minimal, thus reducing delay.
- **5.2.** During sampling, the brail pool should be raised and one adult salmonid netted, via a sanctuary net, and placed into the anesthetic tank at a time. After removing fish from the brail pool into the anesthetic tank, the brail pool will be lowered back to its full depth.
- **5.3.** There will be no more than three adult salmonids in the anesthetic tank at a time. This assumes users can effectively track the length of time fish are in the anesthetic tank.
- **5.4.** There will be no more than two adult salmonids in the recovery tank at a time.
- **5.5.** Water in the recovery tank will be running continuously, allowing a constant exchange of water through the tank.
- **5.6.** Personnel shall ensure fish are sampled as quickly as possible. It is recommended that it take no longer than 25 minutes to transition the fish from entry into the anesthetic tank to release back into the return ladder or transportation tank.
- **5.7.** Personnel shall ensure fish are fully recovered from anesthesia prior to release.
- **5.8.** If daily sampling is not to occur within 24 hours, the main ladder picket leads and downstream exit gate will be raised. The lab will be properly returned to bypass mode.

Protocols for Adult Fish Trapping Operations
Ice Harbor Dam

1. **General.** Personnel conducting research at the adult fish trapping facility at Ice Harbor Dam will implement the following protocols. These protocols were coordinated with fisheries agencies and tribes through the Fish Passage Operations and Maintenance Coordination Team (FPOM).

2. **Administrative requirements.** All researchers and managers working at the facility will adhere to the following requirements.
   - **a.** The facility will not be operated unless there is an approved Corps-funded research project that requires its use, or the user has a letter from the Corps that permits use of the facility. Users not funded by the Corps should request permission to use the trap by sending a letter to: Chief, Operations Division, U.S. Army Corps of Engineers, 201 North Third Avenue, Walla Walla, WA 99362. Appropriate authorizations from the relevant federal and state fishery agencies, as indicated in paragraph b below, should be included with the letter. Upon approval of the user's request, the Corps will provide copies of the user's letter and authorizations to the Corps' project biologist at Ice Harbor Dam.
   - **b.** Users must have the proper federal authorization (e.g. ESA Section 10 permit) from the U.S. Fish and Wildlife Service and/or NOAA Fisheries if their activity may or will affect listed species, as well as any required state authorization from the Washington Department of Fish and Wildlife for listed or unlisted species. **Note: If federal or state fishery agency requirements are more restrictive than the following protocols, users must follow the fishery agency requirements.**
   - **c.** Hard hats will be worn if so required by the Corps' Operations Manager at Ice Harbor (509-543-3256).
   - **d.** Long pants are to be worn at all times.
   - **e.** Steel-toed shoes or steel-toed rubber boots are to be worn at all times.
   - **f.** <u>Notification Required For Work During Regular Business Hours (Monday through Thursday, 0630 to 1700 hours)</u>. Users will notify the project biologist when they arrive on site and when they depart (509-543-3208). If users supply the project biologist with a season schedule, it will not be necessary to notify project biologist upon arrival and departure.
   - **g.** <u>Notification Required For Work During All Other Hours (Monday through Thursday, 1700 to 0630 hours, or anytime from Friday through Sunday)</u>. If users are on site during times other than regular business hours, specific notification procedures must be worked out with the Operations Manager at Ice Harbor <u>in advance</u>. Users <u>may</u> be required to contact the control room (509-543-3231) upon arrival and departure.
   - **h.** Users must present a safety plan to the project biologist, who can provide guidance for developing the plan.

3. **Trapping protocols during the fish passage season (March 1 through December 15) when fish ladder water temperatures are less than 70°F.** Since the trap is operated manually, personnel conducting research are required to be present at the facility to divert desired fish.
   a. The trap will be tested for proper operation before trapping begins. After each day's use the trap will be promptly removed from the water by suspending it in its guides, or by completely removing it from the fish ladder.
   b. Trapping operations can take place between 0600 and 1200 hours, for up to 4 hours per day or until the designated number of desired fish are obtained, whichever occurs first. During the summer months, the period from 0600 to 1000 hours is preferred. The trap shall not be in the water for more than 4 hours.
   c. Netting of fish is not recommended. If transfer of fish is necessary, fish should stay in water at all times through the use of a water-filled bag, sanctuary net, or other means. The device used should be large enough to safely handle the largest fish.
   d. Non-target fish will be released to the ladder.
   e. **Oxygen levels** in fish handling tanks will be maintained at saturation by replacing the water and providing aeration as necessary.
   f. **Water temperatures** in fish handling tanks will be maintained within 2°F of the fish ladder water temperature but less than 70°F.
   g. Personnel shall sample fish as quickly as possible. It should require no longer than 25 minutes to transition the fish from entry into the anesthetic tank to release back into the ladder or transportation tank.
   h. Fish must be adequately recovered from anesthetization prior to the next step in the handling process, whether placed in the ladder or transported.

4. **Trapping protocols during the fish passage season (March 1 through December 15) when fish ladder water temperatures are 70°F to 72°F.** The trap may be operated when water temperatures are within the range of 70°F to 72°F, provided that researchers closely adhere to the restrictions below. **Trapping operations will not be allowed, and trapping must cease immediately, if fish ladder water temperatures exceed 72°F.** Due to the narrow temperature range involved, researchers must use reliable digital thermometers.
   a. Researchers must notify the Corps project biologist in advance when trapping is to occur in this temperature range. The project biologist will occasionally monitor trapping operations.
   b. The trap will be tested for proper operation before trapping begins. After each day's use the trap will be promptly removed from the water by suspending it in its guides, or by completely removing it from the fish ladder.
   c. Trapping operations can take place between 0600 and 1200 hours, for up to 4 hours per day or until the designated number of desired fish are obtained, whichever occurs first. During the summer months, the period from 0600 to 1000 hours is preferred. The trap shall not be in the water for more than 4 hours.
   d. Trapping operations may take place up to 4 days per week.

- **e.** Netting of fish is not recommended. If transfer of fish is necessary, fish should stay in water at all times through the use of a water-filled bag, sanctuary net, or other means. The device used should be large enough to safely handle the largest fish.
- **f.** Non-target fish will be released to ladder.
- **g.** **Oxygen levels** in fish handling tanks will be maintained at saturation by replacing the water and providing aeration as necessary.
- **h.** **Water temperature** in the anesthetic tank will be maintained 1-2°F lower than the ladder water temperature. If ice is used, the ice should be from river water or from an un-chlorinated water source. If practical, water temperature in the recovery tank should also be maintained 1-2°F lower than the ladder water temperature; otherwise flow-through water should be running continuously.
- **i.** Personnel shall sample fish as quickly as possible. It should require no longer than 25 minutes to transition the fish from entry into the anesthetic tank to release back into the ladder or transportation tank.
- **j.** Fish must be adequately recovered from anesthetization prior to the next step in the handling process, whether placed in the ladder or transported.

Protocols for Adult Fish Trapping Operations
Lower Granite Dam

1. **General.** Personnel conducting research at the adult fish trapping facility at Lower Granite Dam will implement the following protocols. These protocols were coordinated with fisheries agencies and tribes through the Fish Passage Operations and Maintenance Coordination Team (FPOM).

2. **Administrative requirements.** NOAA Fisheries is the primary user of the facility and employs personnel that are permanently based there. These and all other researchers and managers working at the facility will adhere to the following requirements.
    - **a.** The facility will not be operated unless there is an approved Corps-funded research project that requires its use, or the user has a letter from the Corps that permits use of the facility. Users not funded by the Corps should request permission to use the trap by sending a letter to: Chief, Operations Division, U.S. Army Corps of Engineers, 201 North Third Avenue, Walla Walla, WA 99362. Appropriate authorizations from the relevant federal and state fishery agencies, as indicated in paragraph b below, should be included with the letter. Upon approval of the user's request, the Corps will provide copies of the user's letter and authorizations to the Corps' project biologist at Lower Granite Dam.
    - **b.** Users must have the proper federal authorization (e.g. ESA Section 10 permit) from the U.S. Fish and Wildlife Service and/or NOAA Fisheries if their activity may or will affect listed species, as well as any required state authorization from the Washington Department of Fish and Wildlife for listed or unlisted species. **Note: If federal or state fishery agency requirements are more restrictive than the following protocols, users must follow the fishery agency requirements.**
    - **c.** Hard hats will be worn if so required by the Corps' Operations Manager at Lower Granite (509-843-1493 x258).
    - **d.** Long pants are to be worn at all times.
    - **e.** Steel-toed shoes or steel-toed rubber boots are to be worn at all times.
    - **f.** <u>Notification Required For Work During Regular Business Hours (Monday through Thursday, 0630 to 1700 hours)</u>. Users will notify the project biologist when they arrive on site and when they depart (509-843-1493 x263 or x264). If users supply the project biologist with a season schedule, it will not be necessary to notify project biologist upon arrival and departure.
    - **g.** <u>Notification Required For Work During All Other Hours (Monday through Thursday, 1700 to 0630 hours, or anytime from Friday through Sunday)</u>. If users are on site during times other than regular business hours, specific notification procedures must be worked out with the Operations Manager at Lower Granite <u>in advance</u>. Users <u>may</u> be required to contact the control room (509-843-1493 x231) upon arrival and departure.

h. Users must present a safety plan to the project biologist, who can provide guidance for developing the plan.

3. Trapping protocols during the fish passage season (March 1 through December 15) when fish ladder water temperatures are less than 70°F. During the years just prior to 2003 the trap was operated automatically, 24 hours per day, during much of the fish passage season. Personnel conducting research during this time were therefore not always required to be present at the facility to divert desired fish. Automatic operation and the temporary absence of on-site personnel can continue as required. However, PIT tag detectors were installed in the upper end of the fish ladder in early 2003. As a result, the new detectors will collect PIT tag data normally collected at the trap. It is therefore anticipated that trap operation will be minimized in future years.

a. During lengthy periods of non-use (two days or more), the facility shall be dewatered or the water supply will be shut down. Since the facility obtains water from the fish ladder, this action will avoid out-of-criteria water flows in the ladder. If freezing weather may cause damage during such a non-use period, the facility will be dewatered.

b. There will be no time-of-day restrictions for trapping operations.

c. Adult fish generally do not need to be netted due to the layout of the facility. Netting of fish is not recommended. If transfer of fish is necessary, fish should stay in water at all times through the use of a water-filled bag, sanctuary net, or other means. The device used should be large enough to safely handle the largest fish.

d. Non-target fish will be released to the return pool.

e. There will be no more than 12 adult salmonids allowed in the anesthetic tank at any one time. This assumes that users can effectively track the length of time fish stay in the anesthetic tank.

f. There will be no more than 12 adult salmonids allowed in the recovery tank at any one time.

g. **Oxygen levels** in fish handling tanks will be maintained at saturation by replacing the water and providing aeration as necessary.

h. **Water temperatures** in fish handling tanks will be maintained within 2°F of the fish ladder water temperature but less than 70°F.

i. Personnel shall sample fish as quickly as possible. It should require no longer than 25 minutes to transition the fish from entry into the anesthetic tank to release back into the return ladder or transportation tank.

j. Fish must be adequately recovered from anesthetization prior to the next step in the handling process, whether placed in the return ladder or transported. In the case of the return ladder, full recovery is not desirable because fish may jump onto a grating.

k. Fish must be released or transported from the trap within four days.

l. Researchers and managers conducting studies or obtaining broodstock are responsible for ensuring the wellbeing of their fish at all times. Twenty-four hour monitoring by personnel on-site is advised but not required.

4. **Trapping protocols during the fish passage season (March 1 through December 15) when fish ladder water temperatures are 70°F to 72°F.** The trap may be operated when water temperatures are within the range of 70°F to 72°F, provided that researchers closely adhere to the restrictions below. **Trapping operations will not be allowed, and trapping must cease immediately, if fish ladder water temperatures exceed 72°F.** Due to the narrow temperature range involved, researchers must use reliable digital thermometers.
    - **a.** Researchers must notify the Corps project biologist in advance when trapping is to occur in this temperature range. The project biologist will occasionally monitor trapping operations.
    - **b.** During lengthy periods of non-use (two days or more), the facility shall be dewatered or the water supply will be shut down. Since the facility obtains water from the fish ladder, this action will avoid out-of-criteria water flows in the ladder.
    - **c.** Trapping operations can take place between 0600 and 1200 hours, for up to 4 hours per day or until the designated number of desired fish are obtained, whichever occurs first. During the summer months, the period from 0600 to 1000 hours is preferred.
    - **d.** Trapping operations may take place up to 4 days per week.
    - **e.** Adult fish generally do not need to be netted due to the layout of the facility. Netting of fish is not recommended. If transfer of fish is necessary, fish should stay in water at all times through the use of a water-filled bag, sanctuary net, or other means. The device used should be large enough to safely handle the largest fish.
    - **f.** Non-target fish will be released to the return pool.
    - **g.** There will be no more than 3 adult salmonids allowed in the anesthetic tank at any one time. This assumes that users can effectively track the length of time fish stay in the anesthetic tank.
    - **h.** There will be no more than 3 adult salmonids allowed in the recovery tank at any one time.
    - **i.** **Oxygen levels** in fish handling tanks will be maintained at saturation by replacing the water and providing aeration as necessary.
    - **j.** **Water temperature** in the anesthetic tank will be maintained 1-2°F lower than the ladder water temperature. If ice is used, the ice should be from river water or from an un-chlorinated water source. If practical, water temperature in the recovery tank should also be maintained 1-2°F lower than the ladder water temperature; otherwise flow-through water should be running continuously.
    - **k.** Personnel shall sample fish as quickly as possible. It should require no longer than 25 minutes to transition the fish from entry into the anesthetic tank to release back into the return ladder or transportation tank.
    - **l.** Fish must be adequately recovered from anesthetization prior to the next step in the handling process, whether placed in the return ladder or transported. In the case of the return ladder, full recovery is not desirable because fish may jump onto a grating.

m. Fish must be released or transported from the holding tanks as soon as possible, preferably by 1000 hours the following day but no later than 1700 hours the following day. This provision applies to all situations but mostly involves fish held for hatchery broodstock.

n. Researchers and managers conducting studies or obtaining broodstock are responsible for ensuring the wellbeing of their fish at all times. Twenty-four hour monitoring by personnel on-site is advised but not required.

APPENDIX H

TURBINE DEWATERING PROCEDURE

FOR CHIEF JOSEPH DAM

DEPARTMENT OF THE ARMY
CHIEF JOSEPH DAM PROJECT OFFICE, CORPS OF ENGINEERS

SEATTLE DISTRICT
BRIDGEPORT, WASHINGTON 98813

CENWS-OD-CJ 13 Aug 02

EFFECTIVE UNTIL SUPERSEDED OR RESCINDED

PROJECT STANDING OPERATING PROCEDURE NO. 406

CHIEF JOSEPH DAM

SUBJECT: Fish Protection Procedures for Turbine Maintenance

To: Operations, Maintenance, and Resource Management Sections

Purpose: Outline key criteria and operational constraints intended to protect, and provide for the recovery of, any fish, which may become trapped in generator draft tubes at the Chief Joseph Dam Project.

1. This procedure provides a general outline of the dewatering process itself, and includes details for only those constraints specifically intended to promote fish survival. It is not intended to address the details of personnel safety policy or procedures, or any detailed operational instructions for the actual dewatering process. Personnel safety provisions are detailed in the appropriate activity hazard analyses. Details of the operational steps for dewatering are covered by separate Operating Procedures and, to some extent, may be dictated by circumstances unique to each dewatering. However, all dewatering efforts will adhere to the fish protection provisions outlined in this procedure.

2. Hydroelectric turbines and water passages must be inspected and serviced periodically. This requires draining the water passages between the intake bulkhead gates and the tailrace stoplogs. After the water reaches tail water level, the remaining water is drained to an dewatering sump and then pumped out into the river. Any fish trapped in the draft tube area must be removed before being stranded or lost through drains. It is therefore desirable to minimize numbers of fish involved in the draining process and then to quickly salvage any fish that may have been trapped.

3. Natural Resource Management section personnel will carry out fish protection and recovery operations with the help of maintenance personnel. During the dewatering process they will be present at the draft tube entry door, and will direct and monitor it through the final stages of the draft tube dewatering.

4. The Project's Natural Resource Management personnel will direct and coordinate the fish protection procedures and the recovery and release process. The Maintenance and Operations

Sections will provide Natural Resource Management advance notice of planned unit dewatering as soon as possible prior to the date of dewatering. Natural Resource Management personnel will conduct meetings and briefings as necessary to ensure all dewatering team members are familiar with the required fish recovery process.

5. Natural Resource Management personnel will coordinate with the National Marine Fisheries Service, Hydro Program Office, 503-231-6855, gary.fredricks@noaa.gov, to provide notification at least two weeks, if possible, in advance of any maintenance requiring dewatering or otherwise potentially affecting fish. In addition, the Fish Passage Operations and Maintenance Group will be notified with an annual schedule, contact USACE Portland District Office, Operations Div., 503-808-4304.

6. Several hours before the unit is to be dewatered the Operations Section will contact BPA to get final approval for the outage and make sure all the clearance tags are ready to be placed. Early on the day of the dewatering, the mechanics and operators will coordinate to lower the intake service gate and/or install the intake bulkhead. This will isolate the intake water passage from the forebay.

7. Operators will prepare to drain the water out of the penstock down to tailrace water elevation while mechanics prepare to install the intake bulkhead and tailrace stoplogs. The mechanics will place the tailrace stoplogs as soon as possible after the unit is flushed out. This entire process from flushing remaining water out of the penstock through complete installation of bulkheads and stoplogs should be completed within 3 hours, barring complications.

8. Operators will open the draft tube dewatering valve and start draining the draft tube to the dewatering sump. At the same time the sump dewatering pump or pumps will be started but the dewatering sump will not be allowed to go below an elevation of 733 feet above sea level. The draft tube is drained by gravity to this dewatering sump, so by restricting the dewatering sump to a minimum elevation of 733 feet, the draft tube is also restricted to this minimum elevation. The bottom of the draft tube is at an elevation of 725 feet above sea level, so this leaves a large area of water eight feet deep for any trapped fish. The water level in the draft tube will be monitored remotely from this dewatering sump. At no time will the water level in the dewatering sump drop below 733 feet without all aspects of the fish recovery plan in place including recovery devices, insulated transport device, etc. Project personnel will have the dip net, lifting sling, insulated fish carrying tank, and all required safety equipment at the unit during the final dewatering process. Fish can survive four days in the draft tube at a water level of 733 feet and above.

9. For safety reasons, the draft tube entry door will not be opened until confirmation that the tailrace stoplogs are sealed, i.e.: the water level is verified to be below the draft tube man door petcock and a maximum of one dewatering pump is maintaining the water level in the sump. Once Operations has declared a satisfactory seal has been achieved, the mechanics will then open the draft tube access door. General Maintenance personnel will either install safety gear at this time for access to the bottom of the draft tube, or, if the suspended work platform is to be required during this unit outage, it will be installed first. Once the draft tube door is open, the work platform can be installed when necessary and the water level in the draft tube can be monitored from the draft tube man door.

10. When satisfied all fish recovery preparations are in place, the designated Natural Resource Management Section person will authorize the Maintenance Section clearance holder to request the water level in the draft tube be lowered below the 733-foot elevation to a level that allows for safe entry into the draft tube. Upon authorization, the Maintenance Section clearance holder will request the Chief Operator lower the water level in the sump/draft tube below an elevation of 733 feet. Upon receiving the clearance holder's request to go below 733 feet, the Chief Operator shall contact the designated Natural Resource Management Section person to confirm that all fish recovery preparations are complete, and lowering the water level below 733 feet is authorized. After receiving this confirmation, the Chief Operator will authorize journeymen operators to operate the sump as required to control the water level in the draft tube as requested by the designated Natural Resource Management Section person. Once the level in the sump drops below 733 feet, the designated Natural Resource Management Section person will visually monitor the draft tube water level.

11. When the water is down to a level where entry is safe, approximately two to four feet in depth, personnel will enter the draft tube through the draft tube access door at 747-foot level to inspect for trapped fish. Any live fish will be netted out with a dip net and placed in a rubber-lifting sling that is sized to hold the fish and water. The sling will then be lifted vertically to the 747-foot level and then to the 785-foot level generator floor through a series of hatches and stairways. This should take less than five minutes, during which time the fish will be in water. They will be placed in a large insulated fish carrying tank full of river water located on a cart which will be transported to the freight elevator, from which it will be loaded into a truck for eventual release of fish at the downstream boat ramp, using a flume if necessary. The fish will be handled only once during the netting process. At all other times the fish will be kept in water.

12. When the designated Natural Resource Management Section person has determined that either there are no fish in the draft tube or that all the fish have been safely removed, he will notify the Chief Operator that all fish recovery operations are complete. He will also notify the clearance holder that all fish protection restrictions on water levels in the draft tube and dewatering sump have been released.

13. Other considerations for fish protection include the following:

a. Tailrace logs have structural cross-members that form shelves, which may trap fish. These will be screened off as the bulkheads are removed for maintenance in 2002, but will be inspected for fish as applicable prior to screen installation.

b. Work windows intended to minimize likelihood of trapping endangered species will be investigated, although BPA power demands somewhat limit the timing of unit outages. Initially, avoidance of the month of October is suggested; adjustments may be considered according to experience.

c. Units 1 through 16 have floor drains with a grate with 2.5 inch spacing. It is possible for fish smaller than about ten inches to slip through these draft tube floor drains before they can be salvaged. Units 17 through 27 have side drains with small grate spacing. If necessary, smaller-mesh grating will be added or substituted on the floor drains to prevent entrapment of fish.

14. Equipment required for performing this procedure:

a. Two water hoses to supply water to gallery tank as well as transport tank..

b. Waders.

d. Two 5 gallon buckets to fill water tanks.

e. Large dip nets.

f. Fish bags/large fish stretcher.

g. Rope access ladder and anchors.

h. Rope to assist in hauling fish up ladder.

i. Life vests.

j. Safety belts, 1 per person; also anchored rope or cable for attachment to safety belt during entry and exit.

k. Dollies, one for gallery fish tank and one for transport tank used to take fish up the elevator.

l. Truck with fish transport tank (and possibly flume), to be procured as necessary.

15. Personnel required for performing this procedure:

a. Biologist or other trained personnel to advise on fish handling.

b. Personnel to net and transport fish in draft tube. Fish removal from draft tube requires a minimum of two people, however, three are preferred.

MARK C. JENSON, P. E.
Operations Project Manager

CJD FLOW DEFLECTOR CONSTRUCTION SPECIFICATIONS: (Provided By J. Laufle 2006)

1 Fish Salvage Operations
The contractor shall provide 5 working days notice prior to initial dewatering of each work area to allow for a Government Fisheries Biologist to be on site to perform fish salvage operations. During dewatering, if fish become trapped within the work area, the Contractor shall stop dewatering activities at a time directed by the Government Fisheries Biologist to allow the trapped fish to be removed from the work area. Removal of trapped fish will require the use of on-site equipment provided by the contractor to access the bottom of the dewatering caisson (e.g. ladder) and to lift a tank or sling containing fish and water out of the dewatering caisson and to place it into the river (e.g. crane or pulley system). Government personnel will capture and remove the trapped fish, following which the Contractor may resume dewatering activities.

2 Bubble Curtain
To exclude fish from work areas and to attenuate potentially harmful underwater vibrations, the Contractor shall design, furnish, install, and operate a bubble curtain to help minimize impacts of work on fish. The bubble curtain shall consist of one or more air compressors and air distribution piping. The distribution piping shall have a pipe installed on the river bottom and encircling the work area. The distribution pipe shall have holes drilled at 6 inches on center maximum along the top side of the pipe. The system shall be designed to provide a minimum of 0.25 cfm of air from each hole in the pipe. The pipe shall be weighted sufficiently to maintain its position on the river bottom and to maintain the upward orientation of the holes. The bubble curtain shall be operated whenever the dewatering caissons are being placed to begin work on a new flow deflector. The bubble curtain may be removed upon successful sealing of the dewatering caisson. In addition, a bubble curtain must be used during any pile driving activities, and may be required during drilling activities. Use of the bubble curtain may be required during any activities that are identified as having the potential to cause harm to fish.

The Contractor may propose the use of a proven alternative method to the Contracting Officer. Any alternative method must be approved by the Contracting Officer.

Note that the contractor was allowed to elect to use strobes instead of a bubble curtain, and has also employed a diver to sweep the area enclosed by the cofferdam prior to sealing.

APPENDIX I

LIST OF ACRONYMS

ACRONYMS	
ADCP	Acoustic Doppler Current Profiler
ADV	Acoustic Doppler Velocimeter
AFF	Adult Fish Facility
AFEP	Anadromous Fish Evaluation Program
AWS	Auxiliary Water Supply
BGS	Behavioral Guidance Structure
BI	Bradford Island
BON	Bonneville Lock and Dam
BPA	Bonneville Power Administration
BRZ	Boat Restricted Zone
CBFWA	Columbia Basin Fish and Wildlife Authority
CBTT	Columbia Basin Teletype
CENWP	Portland District
CENWW	Walla Walla District
CFS	Cubic Feet per Second
CI	Cascades Island
COE	Corps of Engineers
CRITFC	Columbia River Inter-Tribal Fish Commission
DSM	Downstream Migrant (channel)
E	East
EPA	Environmental Protection Agency
ERG	Emergency Relief Gate
ESA	Endangered Species Act
ESBS	Extended-Length Submersible Bar Screen
EW	East Weir
FDS	Fish/Debris Separator
FERL	Fish Engineering Research Laboratory
FFDRWG	Fish Facilities Design Review Work Group
FFU	Fisheries Field Unit
FG	Fish Gate
FGE	Fish Guidance Efficiency
FPC	Fish Passage Center
FPE	Fish Passage Efficiency
FPOM	Fish Passage O & M (Coordination Team)
FPP	Fish Passage Plan
fps	Feet Per Second
FV	Fish Valve
IHR	Ice Harbor Lock and Dam
IDFW	Idaho Department of Fish and Game
ISO	International Standardization Organization
JBS	Juvenile Bypass System
JDA	John Day Lock and Dam
JFTP	Juvenile Fish Transportation Plan
JMF	Juvenile Monitoring Facility (Bonneville)
JP	Junction Pool

ACRONYMS	
JSAT	Juvenile Salmon Acoustic Telemetry
Kcfs	Thousand cfs
LCRAS	Lower Columbia River Adult Study
LGS	Little Goose Lock and Dam
LWG	Lower Granite Lock and Dam
LMN	Lower Monumental Lock and Dam
MCN	McNary Lock and Dam
MOP	Minimum Operating Pool
MU	Main Unit
MW	Megawatts
N	North
NDE	North Downstream Entrance
NE	North Entrance
NFE	North Fishway Entrance
NFH	National Fish Hatchery
NMFS	National Marine Fisheries Service
NPE	North Powerhouse Entrance
NSE	North Shore Entrance
NUE	North Upstream Entrance
O&M	Operations and Maintenance
ODFW	Oregon Department Of Fish And Wildlife
OFC	Outlet Flow Control
OG	Orifice Gate
OOS	Out of Service
OPE	Orifice Passage Efficiency
PDS	Primary Dewatering Structure
PIES	Project Improvements for Endangered Species
PIT	Passive Integrated Transponder
PLC	Program Logic Controller
PSMFC	Pacific States Marine Fisheries Commission
PST	Pacific Standard Time
PUD	Public Utility District
RCC	Reservoir Control Center
RSW	Removable Spillway Weir
S	South
SBC	Surface Bypass Collector
SDE	South Downstream Entrance
SE	South Entrance
SFE	South Fishway Entrance
SG	Sluice Gate
SLED	Sea Lion Exclusion Device
SMF	Smolt Monitoring Facility
SO	Sluice Oregon
SPE	South Powerhouse Entrance
SPO	Special Project Operations

ACRONYMS	
SSE	South Shore Entrance
STS	Submersible Traveling Screen
SUE	South Upstream Entrance
SW	Sluice Washington
SWI	Simulated Wells Intake
TDA	The Dalles Lock and Dam
TDG	Total Dissolved Gas
TIE	Turbine Intake Extension
TMT	Technical Management Team
TSW	Temporary Spillway Weir
UMT	Upstream Migrant Transportation (channel)
USFWS	U.S. Fish and Wildlife Service
VBS	Vertical Barrier Screen
W	West
WDFW	Washington Department of Fish and Wildlife
WECC	Western Electricity Coordinating Council

APPENDIX J

PROTOCOLS FOR JUVENILE MONITORING FACILITY OPERATIONS AT BONNEVILLE DAM

Protocols for Juvenile Monitoring Facility Operations
Bonneville Dam

1. **General.** The following protocols will be implemented by agencies conducting research in the Bonneville Dam Powerhouse Two Juvenile Monitoring Facility (JMF). These protocols were coordinated with fish agencies and tribes through the Fish Passage Operation and Maintenance Coordination Team (FPOM). The purpose of these protocols is to provide precautionary measures to limit delayed mortality resulting from stress when handling fish.
    - **a.** Sample rates should not exceed 25% unless collecting fish for research when temperatures are less than 70°F.
    - **b.** Personnel conducting research or monitoring must be present at the facility to monitor the separator bars for debris and stranded fish.
    - **c.** The Corps reserves the right to terminate trapping operations at any time.

2. **General requirements for JMF users.** All personnel conducting research or monitoring in the JMF will implement the following requirements.
    - a. Users must have appropriate documentation for conducting research at the dam. (See *Guide for Researchers at Bonneville Dam*).
    - b. Users must have valid state and federal permits that cover all listed species passing the project during the trapping period and users shall comply with all fish handling conditions in the permit. **Note: If permit conditions are more restrictive than the following protocols, users must follow permit conditions.**
    - c. JMF personnel will be trained in the proper operation of the Juvenile Monitoring Facility to insure fish and personnel safety. Users may request training through the Project Biologists.
    - d. Hard hats are to be worn outside at all times.
    - e. Long pants or raingear are to be worn at all times. Shorts will not be permitted in the lab.
    - f. Steel-toed shoes or rubber boots are to be worn at all times. No tennis shoes or sandals will be permitted.
    - g. If users supply project biologists with a season schedule, it will not be necessary to notify project biologists upon arrival and departure.
    - h. Users may coordinate with smolt monitoring personnel regarding sample rates.
    - i. Users are permitted to routinely operate flushing valves, fish lifts, and release pipes/valves within the monitoring building.
    - j. Any modifications to the building or equipment will first be approved by Bonneville Project through Project Fisheries.
    - k. All anesthetic water is to empty into the sewage lift station after running through the activated charcoal filters.
    - l. Project Biologists will operate the upper switchgate at the start and end of each season. Users may operate the upper switchgate as necessary when separator bar monitoring is not available.

m. The lower switchgate is in automatic control. Users will monitor and report to Project biologists any problems with the lower switchgate.
    i. On seasonal ascending tailwater elevations, the transition from low to high outfall should be between tailwater elevations at the upper end of 16' to 18' range.
    ii. On seasonal descending tailwater elevations, the transition from high to low outfall should be between tailwater elevations at the lower end of 18' to 16' range.

n. Avian cannons will be operated 24 hours a day from March 1 through August 31.
    i. During August, avian cannons may be shut off if Project Biologists observe no predatory birds at the outfall and coordinate through FPOM.
    ii. If birds reappear at the outfall, cannon operation will resume and FPOM will be informed.
    iii. Project operators and mechanics are responsible for starting up and shutting down the avian cannons.

3. **Operation in sample mode (normally fish passage season)**

a. Smolt monitoring personnel will operate the sampling facility as part of the smolt monitoring program and to collect fish for regionally approved research.

b. Research updates and equipment or sampling trouble reports will go through the project biologists to the FPOM Coordination Team.

c. JMF personnel will monitor the JMF continuously while in sample mode. This is to ensure proper functioning and to provide quick response to an emergency while the JMF is in sample operation.

d. JMF personnel will perform a walk-through inspection of the entire facility (except the 2-mile transport flume) every two hours to ensure safe fish passage conditions.
    i. Particular attention will be paid to the following: dewatering facilities including the PDS, SDS, PDS screen cleaner system, adult transport flume, juvenile hopper, all valves and auxiliary water systems, flushing water systems and their perforated plates, all gates including switch and diverter gates, PIT tag detectors, and all monitoring building systems including holding tanks, valves, and conduits to prevent injury and/or mortality to passing fish.

e. JMF personnel will also observe video monitors at least every half hour or continually, and inspect manually every two hours or more frequently according to trash sweep operation or other debris potential.

f. JMF personnel shall monitor kelt passage over the separator.

g. When temperatures meet or exceed 70°F, modified index sampling may occur as coordinated through FPOM.
    i. Project Biologists will use the Corps temperature probe reading as the official temperature.

ii. For the 2008 season, Project Fisheries will be using the temperatures from http://www.nwd-wc.usace.army.mil/tmt/documents/ops/temp/200801.lcol.html to compare with the Project temperature probe. Maximum temperatures will be used.
iii. Project Biologists determine when temperature thresholds are met.
iv. Temperatures are taken in the general holding tank and are both instantaneous readings and 0000 to 2400 daily averages.
v. Daily average and/or instantaneous readings will trigger modified index sampling protocols.
vi. Normal sampling may resume when daily temperatures fall below 69.5°F.
vii. Sample sizes will be reduced to about 100 fish per day.
viii. The upper switchgate is the point at which flow will be diverted.

4. **Operation in bypass mode, or when PDS monitors are not present.**
   a. The upper switchgate will be in bypass mode.
   b. The Emergency fish release valve will be open.
   c. All rotating gates will be set to bypass.
   d. The bypass flume gate will be raised.
   e. Project Biologists will inspect the facility daily.

5. **System failures**
   a. Any system failure or abnormality will be reported to a project biologist immediately. If a project biologist is unavailable, the control room will be contacted at ext. 2221 or 2222.
   b. If a high or low water situation occurs in the PDS area-
      i. Contact the control room immediately.
      ii. Switch the upper switchgate to bypass mode until the problem is corrected.
      iii. Immediately open the emergency fish release valve
      iv. Raise bypass flume gate. **DO NOT ADJUST ANY WEIRS.**
   c. If a monitoring facility failure occurs,
      i. Open the emergency fish release valve.
      ii. Switch the upper switchgate to bypass mode until the problem is corrected.
      iii. Raise the bypass flume gate.
      iv. Begin fish salvage operations.
   d. If a lower switchgate failure occurs that results in releasing to the wrong high or low outfall and repairs can not be made within 24 hours, the special operation will be coordinated through FPOM.
   e. If a problem with either the 2 way or 3 way rotating gates (e.g. stuck open or partially open) is discovered, the response protocol should be as follows:
      i. Switch the upper switchgate to bypass.
      ii. Open the emergency fish release valve.

iii. Turn off the air to the rotating gate and manually rotate the half-round pipe section to the bypass position.

iv. Inspect the affected areas for stranded fish and return them to the flume. **Dead fish should be held in a bucket for processing by research personnel.**

v. Contact the project biologist, or if that is not possible, the control room operator. Project personnel will request maintenance crews. Repairs should commence within 4 hours of discovering the problem.

vi. Once all fish safety issues have been addressed and repair requests made, the problem should be thoroughly documented in writing and that information e-mailed to Project biologists prior to sending to other interested parties.

APPENDIX K

PROTOCOLS FOR SMOLT MONITORING FACILITY OPERATIONS AT THE JOHN DAY DAM

Protocols for Smolt Monitoring Facility Operations
John Day Dam

1. **General.** The following protocols will be implemented by agencies conducting research in the John Day Dam Smolt Monitoring Facility. These protocols were coordinated with fish agencies and tribes through the Fish Passage Operation and Maintenance Coordination Team (FPOM). The purpose of these protocols is to provide precautionary measures to limit delayed mortality resulting from stress when handling fish.
    - **a.** Sample rates should not exceed 25% unless collecting fish for research when temperatures are less than 70˚F.
    - **b.** The Corps reserves the right to terminate trapping operations at any time.

2. **General requirements for SMF users.** All personnel conducting research or monitoring in the SMF will implement the following requirements.
    - **a.** Users must have appropriate documentation for conducting research at the dam. (See Guide for Researchers at John Day Dam).
    - **b.** Users must have valid state and federal permits that cover all listed species passing the project during the trapping period and users shall comply with all fish handling conditions in the permit. **Note: If permit conditions are more restrictive than the following protocols, users must follow permit conditions.**
    - **c.** Hard hats are to be worn outside at all times.
    - **d.** Long pants or raingear are to be worn at all times. Shorts or sweats will not be permitted in the lab.
    - **e.** Steel-toed shoes or rubber boots are to be worn at all times. No tennis shoes or sandals will be permitted.
    - **f.** If users supply project biologists with a season schedule, it will not be necessary to notify project biologists upon arrival and departure.
    - **g.** Users may coordinate with smolt monitoring personnel regarding sample rates.
    - **h.** Users are permitted to routinely operate flushing valves and release pipes/valves within the monitoring building.
    - **i.** Any modifications to the building or equipment will first be approved by The Dalles/John Day/Willow Creek Project through Project Fisheries.
    - **j.** All anesthetic water is to empty into the activated charcoal filters tanks.

3. **Operation in sample mode (normally fish passage season)**
    - **a.** Smolt monitoring personnel will operate the sampling facility as part of the smolt monitoring program and to collect fish for regionally approved research.
    - **b.** Research updates and equipment or sampling trouble reports will go through the project biologists to the FPOM Coordination Team.
    - **c.** Sampling shall cease when temperatures meet or exceed 70°F.
        - **i.** Project Biologists will use the Corps temperature probe reading as the official temperature.

- **ii.** For the 2008 season, Project Fisheries will be using the temperatures from http://www.nwd-wc.usace.army.mil/tmt/documents/ops/temp/200801.lcol.html to compare with the Project temperature probe. Maximum temperatures will be used.
- **iii.** Project Biologists determine when temperature thresholds are met.
- **iv.** Temperatures are taken in the general holding tank and are both instantaneous readings and 0000 to 2400 daily averages.
- **v.** Sampling may resume when daily maximum temperatures fall below 69.5°F.
- **vi.** If there is a need to sample at temperatures above 70°F, coordination with FPOM will be initiated by the researcher.

d. When temperatures meet or exceed 70°F, the following sampling protocols will be implemented, following FPOM coordination.

- **i.** Condition sampling may occur twice a week. Mondays and Thursday are preferred.
- **ii.** The switchgate will be the point at which flow will be diverted.
- **iii.** Collection size will be reduced to 100 fish.
- **iv.** Fish will be collected and sampled between the hours of 0600-1200.

4. Operation in bypass mode.

- **a.** All rotating gates will be set to bypass.
- **b.** Project Biologists will inspect the facility every two hours.
- **c.** If the full-flow PIT tag detector is found to be effective the switch gate will be moved to bypass.

5. System failures

- **a.** Any system failure or abnormality will be reported to a project biologist immediately. If a project biologist is unavailable, the control room will be contacted at ext. 4211.
- **b.** If a problem with either the 2 way or 3 way rotating gates (e.g. stuck open or partially open) is discovered, the response protocol should be as follows:
  - **i.** Contact the project biologist, or if that is not possible, the control room operator. Project personnel (SMF Bio) will request maintenance crews. Repairs should commence within 4 hours of discovering the problem.
  - **ii.** Once all fish safety issues have been addressed and repair requests made, the problem should be thoroughly documented in writing and that information e-mailed to Project biologists prior to sending to other interested parties.