Fish Passage Plan

Corps of Engineers Projects

CENWD-PDW-R

US Army Corps of Engineers®
Northwestern Division

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Top Photo: Ice Harbor Dam North Shore Fishway and Spillway with RSW in Bay 2 (Scott Thoren, COE-NWW).
Bottom Photo: Bonneville Dam Powerhouse Two and Corner Collector (Dennis Schwartz, COE-NWP).

2012 Fish Passage Plan
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Section 1 Overview

1. Fish Passage Plan

1.1. Background

The Fish Passage Plan (FPP) is developed annually by the U.S. Army Corps of Engineers (Corps) in coordination with the region's federal and state fish agencies, Indian tribes, the Bonneville Power Administration (BPA), and other regional partners through the Corps' Fish Passage Operations and Maintenance (FPOM) coordination team. The FPP describes year-round operation and maintenance (O&M) activities at Corps mainstem hydroelectric projects in the Federal Columbia River Power System (FCRPS) that are coordinated through FPOM so as to protect and enhance anadromous and resident fish species listed as endangered or threatened under the Endangered Species Act (ESA), as well as other resident and migratory fish species (e.g., lamprey, sturgeon). The FPP guides Corps actions in regard to providing fish protection and passage at the eight Corps projects on the mainstem lower Columbia and lower Snake rivers, and at Chief Joseph Dam on the upper Columbia River. Other Corps documents and agreements related to fish passage at these projects are consistent with the FPP.

The FPP is drafted in accordance with the ESA Section 7 Biological Opinion (BiOp) by NOAA Fisheries on the effects of operating the FCRPS on ESA-listed anadromous fish species, issued May 5, 2008, and titled "*Consultation on Remand for Operation of the Federal Columbia River Power System, 11 Bureau of Reclamation Projects in the Columbia Basin and ESA Section 10(a)(I)(A) Permit for Juvenile Fish Transportation Program (Revised and reissued pursuant to court order, NWF v. NMFS, Civ. No. CV 01-640-RE (D. Oregon))*". On May 20, 2010, NOAA Fisheries issued a Supplemental FCRPS BiOp which integrated the entire 2008 FCRPS BiOp and its Reasonable and Prudent Alternative (RPA) with new information and an Adaptive Management Integration Plan (AMIP). The Corps prepared a Record of Consultation and Statement of Decision (ROCASOD) in response to both the 2008 and 2010 NOAA Fisheries BiOps. The Corps also prepared a ROCASOD in response to the US Fish & Wildlife Service (USFWS) BiOp issued in 2000 and supplemented in 2006 on the effects of operating the FCRPS on ESA-listed resident fish species. The ROCASODs document the Corps' decision to implement the actions recommended in the BiOps and associated RPAs so that the FCRPS is operated consistent with the ESA in a manner that protects and enhances ESA-listed fish species, as well as other regionally important fish species. The FCRPS BiOps, decision documents and other related information can be found on the following website: http://www.salmonrecovery.gov

The FPP is defined in NOAA Fisheries' 2008 BiOp RPA as part of the hydropower strategy of operating and maintaining fish passage facilities at Corps mainstem projects in order to maintain biological performance. Key elements of the FPP include:

- Operate according to project-specific criteria and dates to operate and maintain fish facilities, turbine operating priorities, and spill patterns;
- Operate according to fish transportation criteria;
- Maintain turbine operations within the 1% of best efficiency range;
- Maintain spillway discharge levels and dates to provide project spill for fish passage;
- Implement TDG monitoring plan;

- Operate according to protocols for fish trapping and handling;
- Take advantage of low river conditions, low reservoir elevations or periods outside the juvenile migration season to accomplish repairs, maintenance, or inspections so there is little or no effect on juvenile fish;
- Coordinate routine and non-routine maintenance that affects fish operations or structures to eliminate and/or minimize fish operation impacts;
- Schedule routine maintenance during non-fish passage periods;
- Conduct non-routine maintenance activities as needed; and
- Coordinate criteria changes and emergency operations with FPOM.

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 NOAA Fisheries and 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 as described in Section 5.2 below.

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

1.2. Emergency Deviations from the Fish Passage Plan

River operations emergencies may occur which require projects to deviate temporarily from the FPP. To the extent practicable, these operations will be coordinated with fish agencies and tribes and conducted in a manner to avoid or minimize fish impacts. Normally, coordination occurs prior to an action; however, if an emergency situation requires immediate attention, coordination will be completed as soon as practicable afterwards. See Section 5.2 for more detail.

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 an 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 the 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 generation, and implementation of the Juvenile Fish Transportation Plan (JFTP; see Appendix B).

1.4. Spill at Corps Mainstem Projects

Corps mainstem projects will provide spill for juvenile fish passage in accordance with NOAA Fisheries 2008 FCRPS BiOp RPA Table 2: "Initial Voluntary Spill Operations at Columbia and Snake River Dams".

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 2008/2010 NOAA Fisheries FCRPS BiOp calls for spill levels to benefit fish (fish spill) that results in TDG levels higher than 110% (Appendix D). State waivers from Oregon and Washington allow the FCRPS projects to exceed the 110% standard so long as forebays do not exceed 115% and tailwaters do not exceed 120% TDG levels due to voluntary spill provided for anadromous fish passage.

Spring freshet river flows above the generation capacity of the FCRPS projects has occurred in the past, causing levels of involuntary spill that exceed the 115% and 120% TDG limits. Furthermore, implementation of requests for additional fish spill 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 greater volumes of spill from Chief Joseph Dam (Appendix D). This spill management action is intended to reduce TDG downstream of those projects and is not a fish passage operation.

1.6. System Load Shaping

BPA coordinated the development of guidelines of system load shaping that avoid or minimize impacts on fish (Appendix C). The guidelines define how BPA requests hydropower load so that the Corps can operate 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 Fish Operations Plan (FOP - Appendix E), the 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 the Fish Passage Plan Sections 2 through 9 (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 the JFTP, including deviation from the plan described in Appendix B, will be coordinated through TMT and NOAA Fisheries.

1.8. Lamprey Passage

The Fish Accords signed in May 2008 address actions to protect Pacific lamprey. The goals of the Pacific lamprey passage program are to improve both juvenile and adult lamprey passage through the FCRPS. Guidance for project operations to improve passage conditions for adult and juvenile lamprey are addressed in FPOM and specific 2012 operations for juvenile and adult lamprey will be defined in the appropriate project sections of the 2012 FPP. In-season conflicts between operations for listed species and Pacific lamprey not addressed in the FPP may be reviewed by FPOM and/or TMT.

2. Fish Passage Facilities Inspection and Reporting Criteria

Sections 2 through 9 of the FPP are project-specific and include detailed inspection and reporting criteria for fish passage facilities at Corps projects on the lower Snake and lower Columbia Rivers (Figure OVE-1). An example of a typical fish passage system is illustrated in Figure OVE-2. 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.

2.1. Annual Reporting

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 and compiles this information 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 operated 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.

2.2. Reporting of Excursions 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 BiOp. If unforeseen circumstances arise that preclude BPA or the Corps from notifying the 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 TMT as soon as practicable.

3. 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.

4. Turbine Dewatering Procedure at Dworshak Dam

The Corps has coordinated and adopted a procedure to dewater turbine draft tubes for maintenance at Dworshak Dam (Appendix I). 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.

5. 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. The 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-wide 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 advice 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. See Section 5.3 for TMT coordination procedures.

District biologists and RCC biologists attend monthly FPOM meetings dealing with project-specific issues below (see Section 5.2 for FPOM coordination procedures):

- Consider recommendations from affected interests.
- Provide updates on construction, operations and maintenance, research, and other topics.
- Develop criteria for the annual FPP.
- Coordinate fish passage issues that may require deviation from FPP criteria.

5.1. Agency Responsibilities

5.1.1. 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.

5.1.2. Fishery 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.

5.1.3. 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.

5.1.4. Mid-Columbia Public Utility Districts

a) 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.

5.2. FPOM Coordination

Project operations and maintenance activities are coordinated with the Region through FPOM, pursuant to actions defined in the 2008/2010 NOAA Fisheries FCRPS BiOp (RPA No. 32). The FPP is effective year-round and revisions are coordinated through FPOM, which includes representatives from the Corps, NOAA Fisheries, USFWS, BPA, state fish agencies (OR, WA, ID), 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 throughout the year 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 the 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's annual *Water Management Plan*.

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 resolved 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, project personnel will communicate their needs to a District biologist (or other appropriate personnel). The District biologist will then provide essential information to the fish agencies, tribes, and other affected interests via FPOM by submitting a Memorandum of Coordination[1] (MOC). If necessary, the District biologist will follow up with telephone calls to appropriate FPOM representatives and/or an email. Information for planned activities should be provided at least two weeks in advance to FPOM representatives for review. For O&M activities that are not anticipated but are not considered an emergency (e.g., equipment failures), information should be provided to FPOM 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, in person, or by phone. All responses will be documented on the MOC, and then the final MOC will be distributed to FPOM and filed for future reference. A District biologist will forward the decision to project personnel, and if necessary, 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:

- Doug Baus, Lisa Wright (Corps, Reservoir Control Center, Northwestern Division)
- Bernard Klatte*, Tammy Mackey, Robert Stansell (Corps, Operations Division, Portland District)
- Mike Langeslay (Corps, Planning, Programs, and Project Management Division, Portland District)
- Ann Setter, John Bailey, Greg Moody (Corps, Operations Division, Walla Walla District)
- Marvin Shutters (Corps, Planning, Programs, and Project Management Division, Walla Walla District)
- Scott Bettin, Jason Sweet (BPA)
- Gary Fredricks, Bill Hevlin, Paul Wagner (NOAA Fisheries)
- David Wills (USFWS)
- Tom Lorz (CRITFC)
- Rick Kruger (ODFW)
- Ann Stephenson, Steven Richards (WDFW)
- Russ Kiefer (IDFG)
- Dave Benner (Fish Passage Center)

*-FPOM chair

[1] A template for the Memorandum of Coordination (MOC) is included at the end of this section.

5.3. TMT Coordination

Actions that may impact fish system-wide will be coordinated and documented through the TMT forum. 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. TMT Guidelines are posted at: www.nwd-wc.usace.army.mil/tmt/documents/wmp/2007/guidelines.pdf

5.4. Day-to-Day Coordination of FCRPS

Procedures described in the annual *Water Management Plan* will be used for fish operations. Coordination for system and project operations for flow augmentation and recommended reservoir 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.

5.4.1. Fish Spill Management

The Corps will implement fish spill provisions described in Appendix E: Water Management Plan, 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.

5.4.2. Special Operations – Requests and Recommendations Related to Fish and/or 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. Preferably, 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.

5.4.3. Special Operations – Other 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.

5.4.4. 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 ESA-listed or non-listed fish.

OFFICIAL COORDINATION REQUEST FOR
NON-ROUTINE OPERATIONS AND MAINTENANCE

COORDINATION TITLE- *(filled in by NWP or NWW OD Bio)*

COORDINATION DATE-

PROJECT-

RESPONSE DATE-

Description of the problem

Type of outage required

Impact on facility operation

Dates of impacts/repairs

Length of time for repairs

Expected impacts on fish passage

Comments from agencies

Final results

Please email or call with questions or concerns.

Thank you,

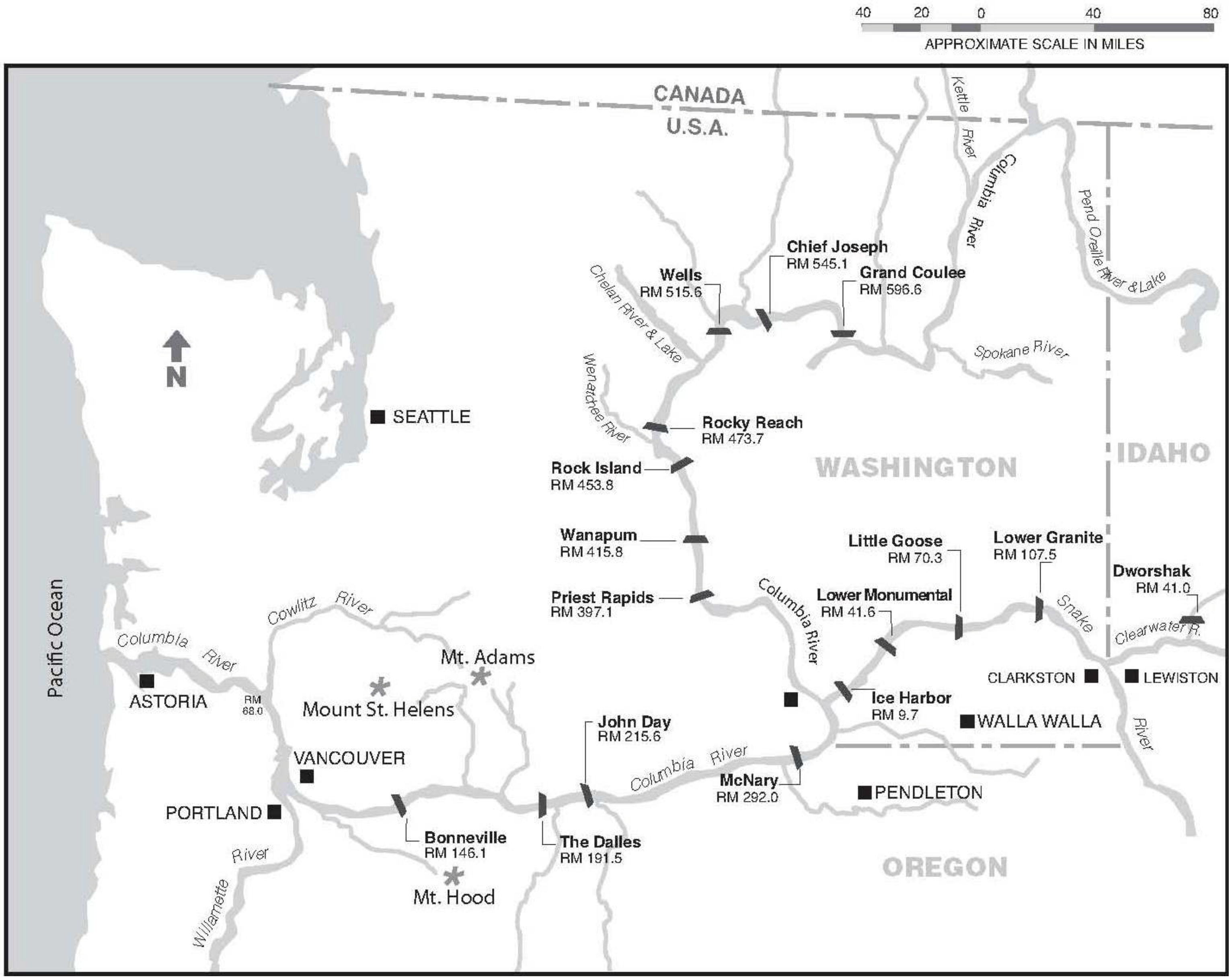

Figure OVE- 1. Map of the Federal Columbia River Power System (FCRPS).

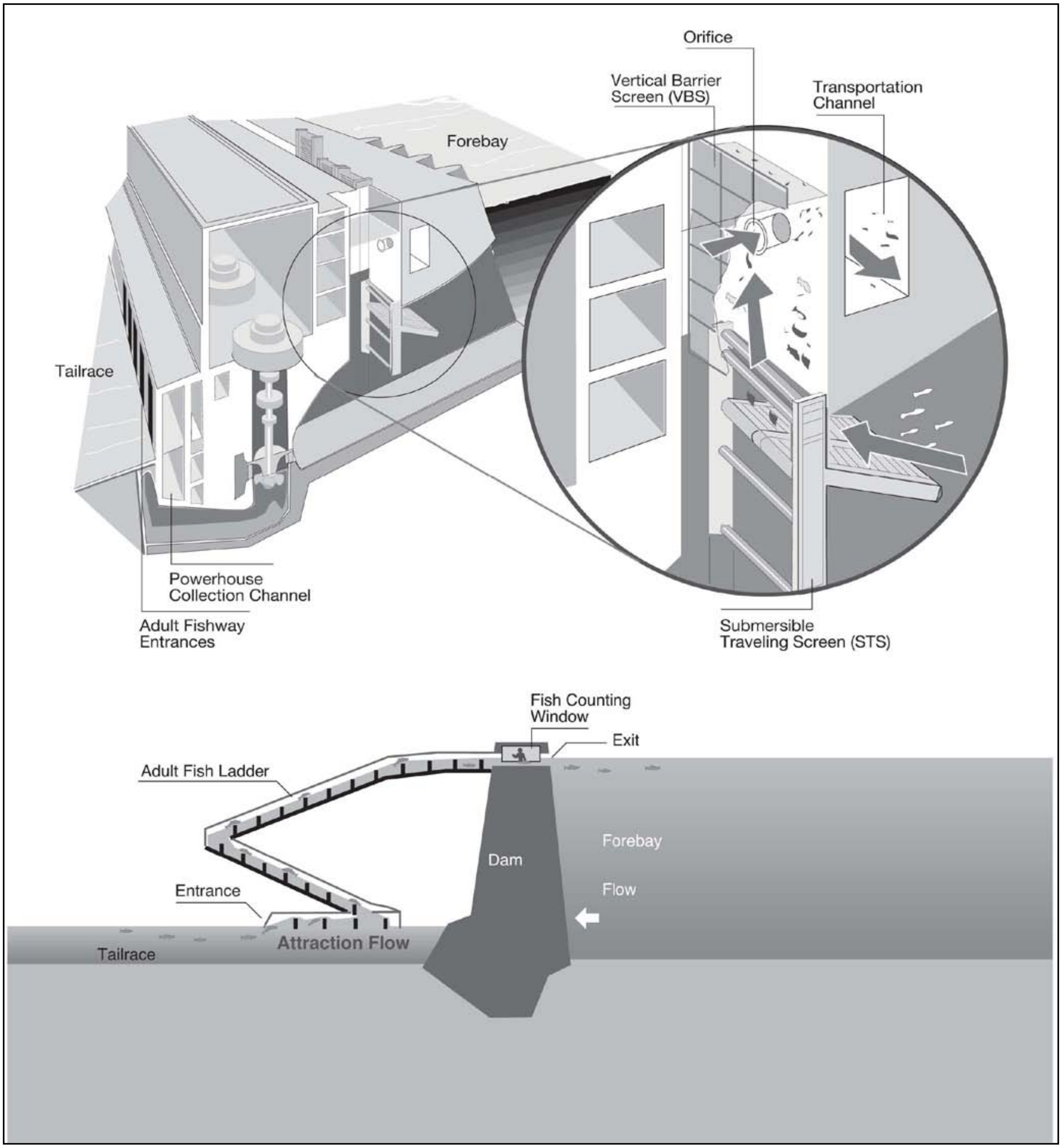

Figure OVE- 2. Generalized example of fish passage structures at a hydroelectric facility.

Section 2 – Bonneville Dam
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Section 2 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 routes at the Bonneville Dam Powerhouse One (PH1) consist of an ice and trash sluiceway (ITS) and minimum gap runner (MGR) turbines.

1.1.2. Facilities Description - Powerhouse Two (PH2). Juvenile fish passage facilities at the Bonneville Dam Powerhouse Two (PH2) 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 PH2 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 PH2. The associated flume extends several hundred feet west on the south side of the PH2 tailrace and empties at the tip of Cascades Island.

1.1.3. Juvenile Migration Timing. The juvenile fish migration season occurs from March 1 through November 30. **Table BON-2** shows 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 the end of February to minimize the impact on downstream migrants. These activities will be coordinated to minimize potential impacts on juvenile migrants that may be present at that time.

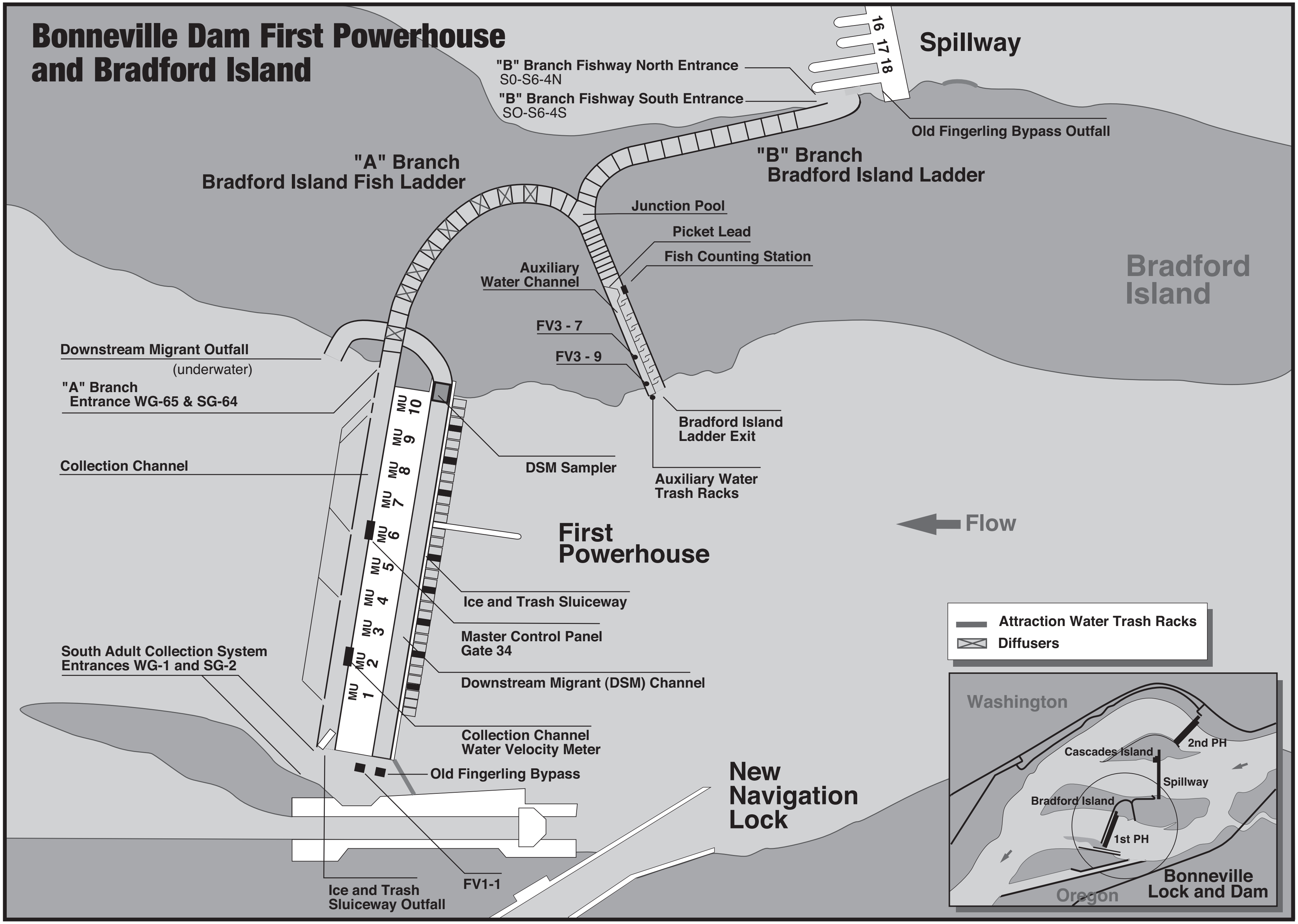

Figure BON-1. Bonneville Dam Powerhouse One and Bradford Island Fish Ladder.

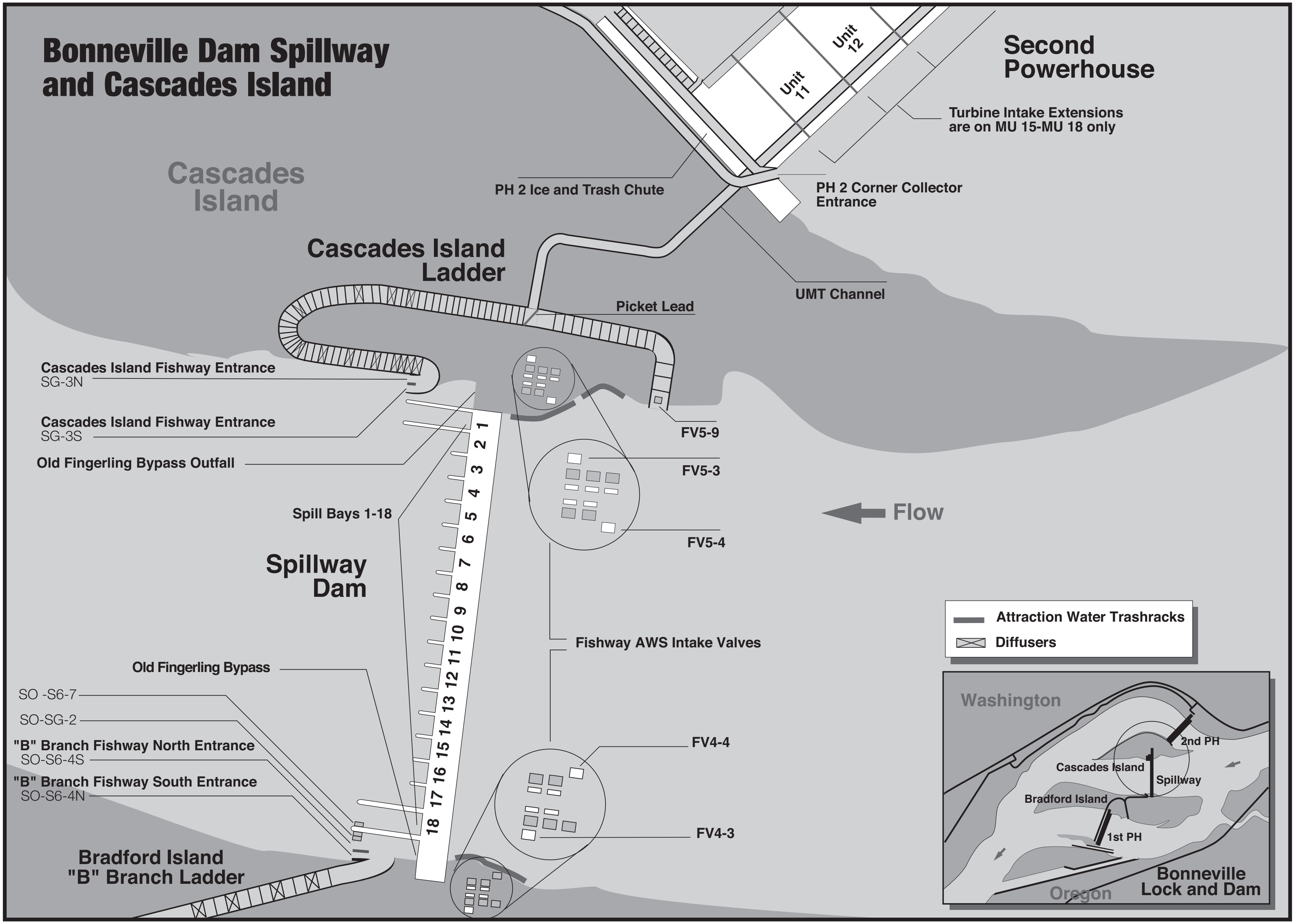

Figure BON-2. Bonneville Dam Spillway, Cascades Island Fish Ladder and Upstream Migrant Transportation (UMT) Channel.

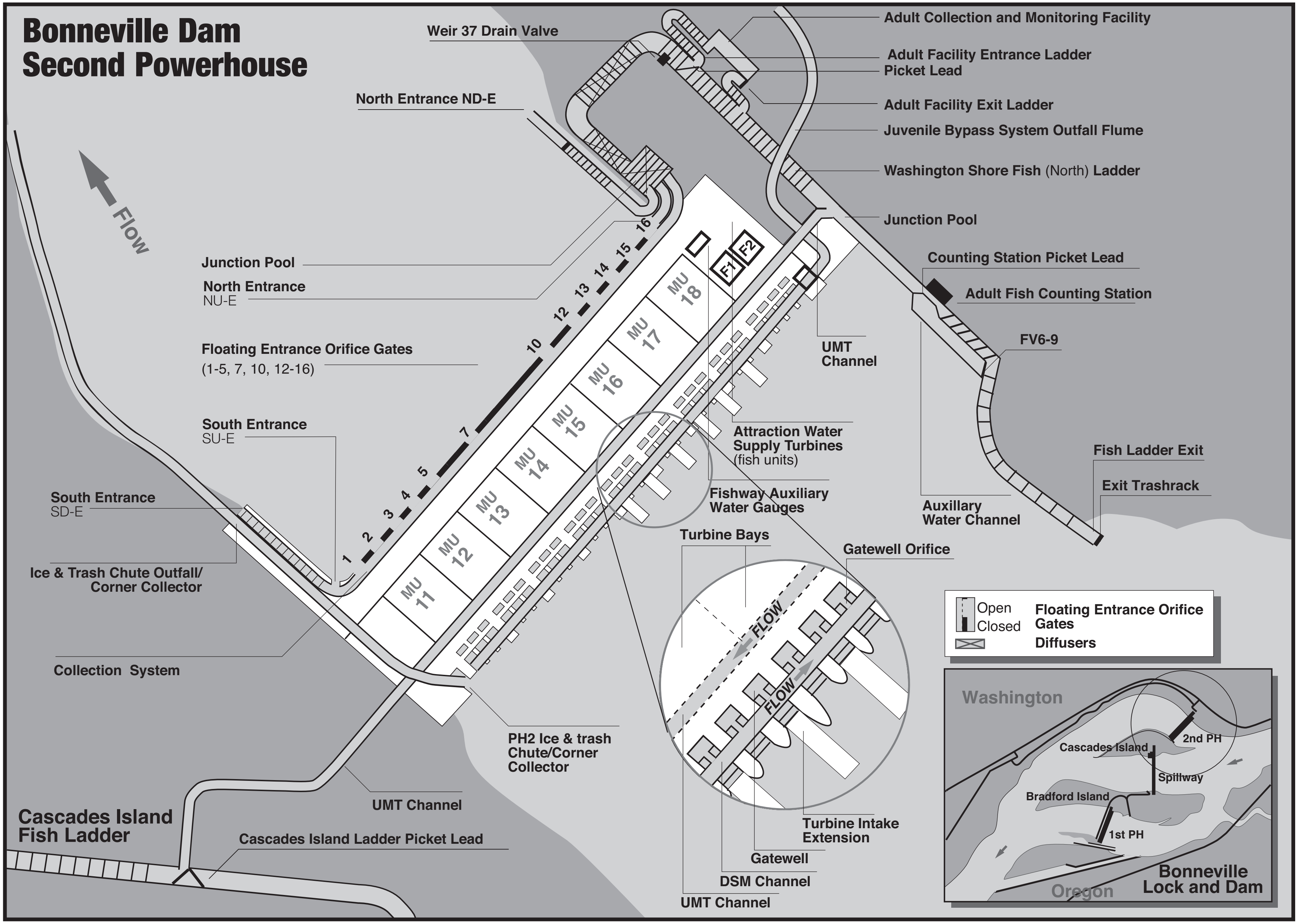

Figure BON-3. Bonneville Dam Powerhouse Two and Washington Shore (WS) North Fish Ladder.

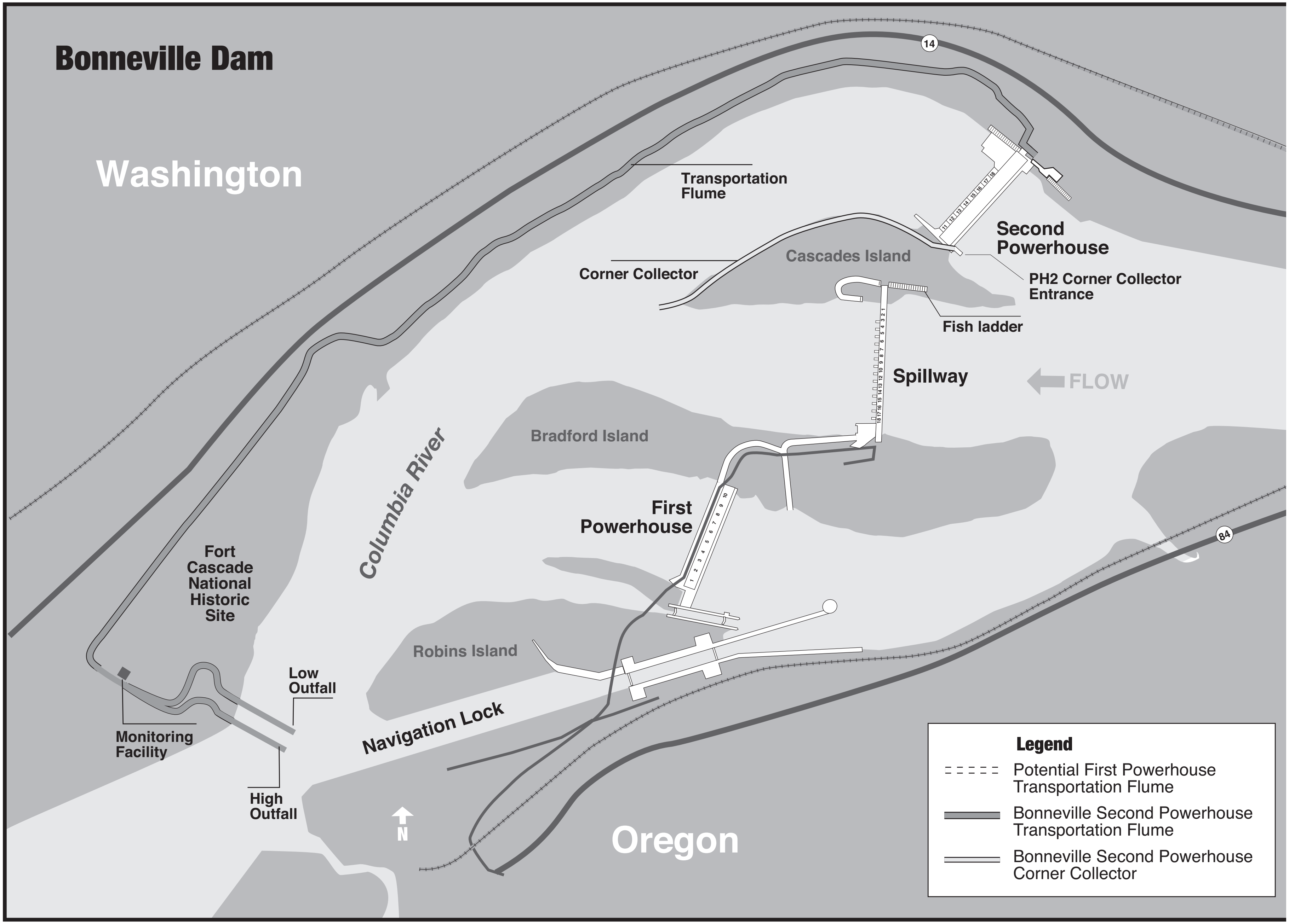

Figure BON-4. Bonneville Dam Juvenile Salmonid Passage System, including Powerhouse Two Bypass Flume, Juvenile Monitoring Facility, Outfall and Corner Collector.

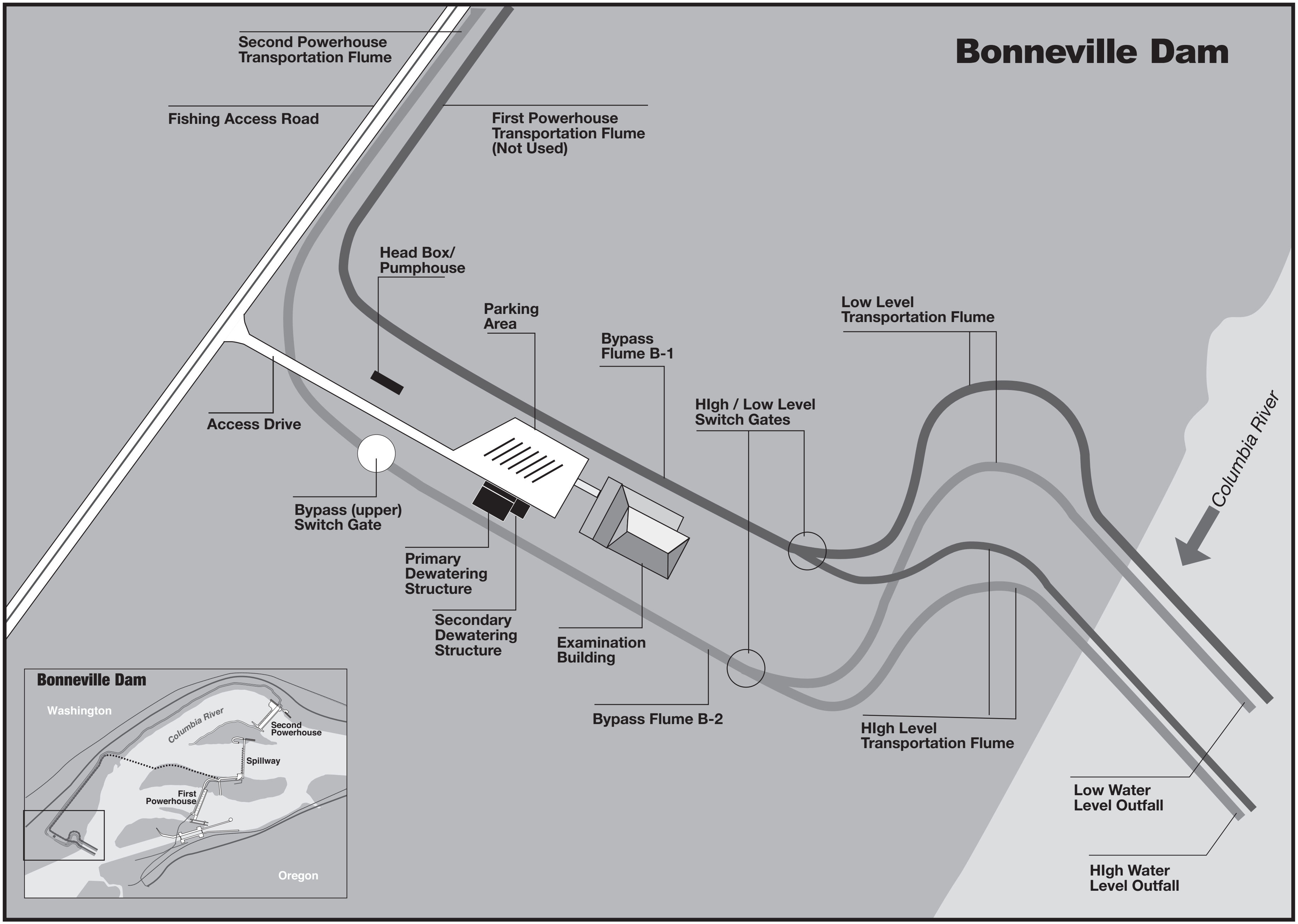

Figure BON-5. Bonneville Dam Juvenile Monitoring Facility and Outfall Flumes.

Table BON-1. Dates of Project Operations for Fish Purposes at Bonneville Dam for the 2012 Fish Passage Season and 2012-2013 Winter Maintenance Period.

Task Name	Start	Finish	Reference
2012 FISH PASSAGE SEASON	**3/1/12**	**11/30/12**	
Juvenile Fish Passage Season	3/1/12	11/30/12	BON 2.4.1.2
Adult Fish Passage Season	3/1/12	11/30/12	BON 2.5.1.2
2012-2013 WINTER MAINTENANCE PERIOD	**12/1/12**	**2/28/13**	
Winter Maintenance Adult Fish Facilities	12/1/12	2/28/13	BON 2.5.1.1
Winter Maintenance Juvenile Fish Facilities	12/1/12	2/28/13	BON 2.4.1.1
Adult Fish Counting (year-round)	**3/1/12**	**2/28/13**	**BON Table BON-3**
Video Count 0400 - 2000 PST	3/1/12	3/31/12	
Visual Count 0500 - 2100 DST	4/1/12	10/31/12	
Video Night Lamprey Count 2100 - 0500 DST	6/1/12	9/30/12	
Video Count 0400 - 2000 PST	11/1/12	2/28/13	
1% Constraints (year-round)	**3/1/12**	**2/28/13**	**BON 5.3**
1% soft constraint	3/1/12	3/31/12	
1% hard constraint	4/1/12	10/31/12	
1% soft constraint	11/1/12	2/28/13	
TDG Monitoring (year-round)	**3/1/12**	**2/28/13**	**App D Table 1**
TDG Monitoring - Tailrace	3/1/12	5/31/12	WRNO
TDG Monitoring - Forebay	4/1/12	8/31/12	BON
TDG Monitoring - Tailrace	9/1/12	2/28/13	WRNO
Weekly Reports (year-round)	3/1/12	2/28/13	BON 3.3.1
Operation of Ice & Trash Sluiceway (year-round)	3/1/12	2/28/13	BON 1.2.1.1
PH2 Screens Installed	3/1/12	12/15/12	BON 2.4.2.2.a
Avian Abatement in Place	3/1/12	12/1/12	BON 2.4.1.1 c
Steelhead Kelt Downstream Passage Study	3/1/12	11/30/12	App A BON 2.2
Operate Avian Cannons	3/1/12	11/1/12	BON 2.4.2.5.a.5
Active Pinniped Hazing	3/1/12	5/31/12	App A BON
Sea Lion Predation Study	3/1/12	5/31/12	App A BON 2.5
Spillbays 1 & 18 - Gates Open 6"	3/1/12	4/10/12	BON 2.2.3.1
Spillway Debris Removal Operation	3/1/12	3/31/12	App A BON 1.2
Active Avian Hazing	4/1/12	7/30/12	
Operate PH2 Corner Collector (B2CC)	4/10/12	8/31/12	BON 2.4.2.3
Spring Spill for Fish Passage	4/10/12	6/15/12	App E
Adult Pacific Lamprey Passage Study	6/1/12	10/31/12	App A BON 2.3
BiOp Performance Standard Compliance Testing (summer test approx. dates)	6/1/12	7/15/12	App A BON 2.1, App E
Summer Spill for Fish Passage	6/16/12	8/31/12	App E
Spillbays 1 & 18 - Gates Open 6"	9/1/12	11/30/12	BON 2.2.3.1
Annual Report (for Dec 1, 2011 - Nov 30, 2012)	1/31/13	1/31/13	BON 3.3.4

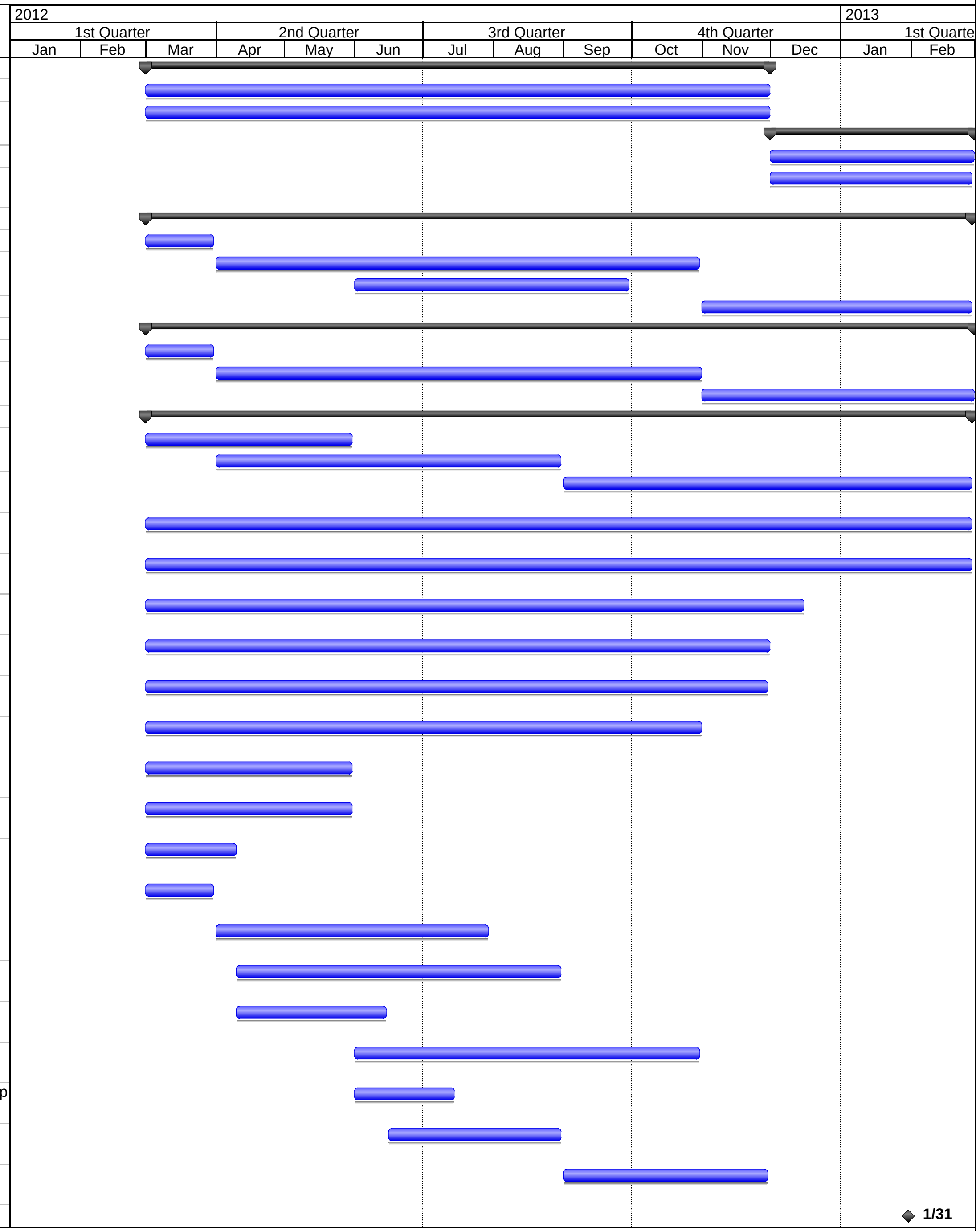

Table BON- 2. Bonneville Dam 10-Year Juvenile Salmonid Passage Data (2002-2011).

Yearling Chinook				
	10 %	50%	90 %	# of Days
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 07	May 25	37
2006	Apr 16	May 9	May 21	36
2007	Apr 20	May 11	May 23	34
2008	Apr 20	May 12	May 27	38
2009	Apr 19	May 11	May 26	38
2010	Apr 27	May 13	Jun 01	36
2011	Apr 17	May 10	May 18	32
MEDIAN	**Apr 19**	**May 11**	**May 26**	**38**
MIN	**Apr 16**	**May 04**	**May 18**	**32**
MAX	**Apr 27**	**May 18**	**Jun 01**	**44**

Subyearling Chinook ("Brights" only*)				
	10 %	50%	90 %	# of Days
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
2008	Jun 22	Jul 06	Jul 23	32
2009	Jun 20	Jun 30	Jul 19	30
2010	Jun 19	Jul 05	Jul 20	32
2011	Jun 24	Jul 14	Aug 02	40
MEDIAN	**Jun 19**	**Jul 02**	**Jul 20**	**32**
MIN	**Jun 10**	**Jun 28**	**Jul 14**	**30**
MAX	**Jun 24**	**Jul 14**	**Aug 02**	**70**

Unclipped Steelhead				
	10 %	50%	90 %	# of Days
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
2008	May 5	May 14	May 30	26
2009	Apr 30	May 13	May 29	30
2010	May 01	May 14	Jun 01	32
2011	Apr 23	May 15	May 31	39
MEDIAN	**Apr 29**	**May 14**	**May 31**	**33**
MIN	**Apr 17**	**May 07**	**May 29**	**26**
MAX	**May 05**	**May 27**	**Jun 09**	**45**

Clipped Steelhead				
	10 %	50%	90 %	# of Days
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
2008	May 07	May 13	May 25	19
2009	May 04	May 13	May 26	23
2010	May 06	May 14	Jun 07	33
2011	Apr 24	May 12	May 29	36
MEDIAN	**May 03**	**May 14**	**May 29**	**28**
MIN	**Apr 24**	**May 08**	**May 25**	**19**
MAX	**May 08**	**May 30**	**Jun 11**	**41**

Coho				
	10 %	50%	90 %	# of Days
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
2008	May 01	May 18	May 30	30
2009	Apr 29	May 22	Jun 01	35
2010	Apr 24	May 14	Jun 05	43
2011	Apr 11	May 14	May 24	44
MEDIAN	**Apr 26**	**May 15**	**May 30**	**35**
MIN	**Apr 11**	**May 05**	**May 24**	**20**
MAX	**May 06**	**May 22**	**Jun 09**	**44**

Sockeye (Wild & Hatchery)				
	10 %	50%	90 %	# of Days
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 01	18
2006	May 10	May 19	May 31	22
2007	May 16	May 25	Jun 07	23
2008	May 24	May 29	Jun 08	16
2009	May 15	May 26	Jun 05	22
2010	May 19	Jun 01	Jun 10	23
2011	May 04	May 17	Jun 04	32
MEDIAN	**May 15**	**May 24**	**Jun 06**	**23**
MIN	**May 04**	**May 17**	**May 31**	**16**
MAX	**May 24**	**Jun 01**	**Jun 15**	**34**

* Includes upriver brights only to exclude 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. Bradford Island Fishway (Figure BON-1) is formed by the Powerhouse One (PH1) collection channel and Bradford Island A-branch ladder that join the south spillway ladder entrance and B-branch ladder at the Bradford Island ladder junction pool. The Ice and Trash Sluiceway (ITS) is also used for adult passage throughout the year. The system consists of 3 automated chain gates and 27 manual chain gates.

1.2.1.2. Washington Shore Fishway (Figure BON-2) is formed by the Powerhouse Two (PH2) collection channel and north and south monoliths that join the Washington Shore (North) ladder and the Cascades Island (north spillway) ladder at the upstream migrant transportation (UMT) channel.

1.2.1.3. The Bradford Island, Cascades Island and Washington Shore fishways have counting stations. The Washington Shore ladder also has an adult fish facility (AFF). 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 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, but do not appear on the Corps daily website total due to relative infrequency of passage. These data are posted in the Miscellaneous Fish Counts report during the passage season (updated periodically during the season) found on the Corps' web site, and summarized in the Annual Fish Passage Report.

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

Table BON- 3. Adult Fish Counting Schedule at Bonneville Dam.

Count Period	Counting Method and Hours
January 1 through March 31	Video 0400–2000 hours (PST)
April 1 through October 31	Visual 0500–2100 hours (DST)
June 1 through September 30	Night Video Lamprey count 2100–0500 hours (DST)
November 1 through December 31	Video 0400–2000 hours (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 the impact on upstream migrants and to minimize adult fall chinook and steelhead fallback.

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 count periods and peak adult fish passage timing through 2011. **Table BON-4** includes count periods and the earliest and latest peaks of migration for each species (except shad) at Bonneville Dam. 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 1999-2011 and peak lamprey migration timing for years 2000-2011 appears in this table.

Table BON- 4. Adult Count Periods and Peak Migration Timing at Bonneville Dam (based on 1938-2011 fish count data).

Species	Count Period	Earliest Peak	Latest Peak
Spring Chinook	3/14 – 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	10/11
Lamprey*	3/15 – 11/15	6/20	7/18

*Peak winter steelhead migration timing based on data from 1999-2010 and peak lamprey migration timing based on data from 2001-2011.

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-14**. If a turbine is out of service, use the next turbine in the priority list.

2.1.2. When adult and jack salmonid counts equal or exceed 30,000 fish per 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 and jack salmonid counts equal or exceed 25,000 fish per 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 adult and jack salmon counts fall below 20,000 fish.

2.1.2.1. Turbine units at PH1 should be operated at the mid or upper 1% range whenever possible, during the split flows operation.

2.1.2.2. Turbine units at PH2 should be operated at the mid to lower 1% range whenever possible, during the split flows operation.

2.1.2.3. Split flow operations, prior to the end of summer spill, may only occur if flows exceed 120K.

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 Fish Operations Plan (**Appendix E**) for more information.

2.2.1. General. Only one spill schedule will be used at Bonneville Dam (**Table BON-17**).

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) super-saturation. 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. Minimum spill level is 50 kcfs from April 10 through August 31 to provide acceptable conditions for juvenile fish tailrace egress. However, under extreme low flow conditions, lower spill levels may be considered and coordinated through the TMT. There is no minimum spill level from September 1 through April 9. For spill specific information see Appendix E: Operations Related to Project Spill for Fish Passage.

2.2.3. Adult Fish. To reduce adult fallback from June 16 through August, whenever PH1 is in operation, daytime spill will be limited to 100 kcfs or less (**see also 2.2.2**). Normally, this restriction will be from 1 hour before sunrise to ½ hour after sunset (**Table BON-5**). During that portion of the sockeye run that occurs from June 16 through July 15, the cap will apply until 1 hour after sunset only when PH1 is in operation.

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 Dam.

Date Range	Daytime Spill Hours	
	Begin	End
Jan 01 – Jan 19	0700	1730
Jan 20 – Feb 14	0630	1800
Feb 15 – Mar 01	0600	1830
Mar 02 – Apr 02	0600	1930
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 March 1 for Cascades Island station 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 (PH1) Operating Criteria

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

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

b. The ice and trash sluiceway (ITS) operations after November 30 are detailed in section **2.5.1.1.m.**

c. 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 (Juvenile 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. At the ITS, set chain gate 1A at 71' msl and 1B at 73' msl. Ensure gates 3B, 6C, and 10B are operating according to **Table BON-6**.

Table BON- 6. Chain Gate Elevations (feet) at Bonneville Dam Powerhouse One ITS.

Forebay Elevation (ft)	PH1 ITS Chain Gates 3B	6C	10B	Forebay Elevation (ft)	PH1 ITS Chain Gates 3B	6C	10B
<72	70.00	70.00	70.00	**75**	71.75	72.25	73.00
72	70.00	70.00	70.00	**76**	73.50	73.50	74.00
73	70.00	70.25	70.75	**77**	75.00	75.00	75.00
74	70.75	71.50	71.75	**>77**	75.00	75.00	75.00

2.4.2. Powerhouse Two (PH2) 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. The PH2 Downstream Migrant (DSM2) channel 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.

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 (Adult Fish Passage Season).

a. Juvenile fish protection devices (STS, etc.) will be in place prior to the juvenile fish passage season. 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. Check more often during times of overwhelming debris, as described in **section 2.4.2.2.j.**

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 and record reading at least 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 Section 4 Fish Facilities Maintenance. In the event of overwhelming debris (as defined below) follow the procedures outlined below. Monitor gatewell drawdown daily.

1. TIE Crane in Service

A. VBSs will be cleaned by installing the spare VBS in the back slot, pulling the main VBS up and spray it off with a fire hose, then replace back in slot and pull spare (reverse order).

B. If the VBS drawdown criteria of <1.1’ CANNOT be maintained during the day due to debris, the spare VBS will not be installed in the back slot and the gatewells will not be dipped. The Project will pull the main screen, spray it off with a fire hose, and then re-install.

C. If the VBS drawdown criteria of <1.5' over a 12 hour period CANNOT be maintained due to debris, even after performing the above operations, then the STSs will be pulled out until the screen re-installation criteria (see 2.4.2.2.j.3) have been met.

D. Once the screens have been removed, these units should operate only as necessary to maintain TDG levels below dissolved gas cap limits.

2. TIE Crane OOS- use gantry crane

A. If the Gantry Crane is used to pull the main VBS, the spare VBS will not be installed in the back slot.

B. If the VBS drawdown criteria of <1.5' over a 12 hour period CANNOT be maintained due to debris, even after performing the above operations, then the STSs will be pulled out until the screen re-installation criteria (see **2.4.2.2.j.3**) have been met.

C. Once the screens have been removed, these units should be operated only as necessary to maintain TDG levels below dissolved gas cap limits.

3. SCREEN RE-INSTALLATION CRITERIA: Once flows drop below 300 kcfs and water clarity is 4' or greater, the Project will install STSs in the highest priority unit available. When VBS drawdown for that unit remains below 1.1' for 24 hours, the Project will re-install the remaining STSs. The reinstallation process may occur before or after the above criteria are reached at the discretion of the Project Biologist followed by a discussion with FPOM.

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 non-operational 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.

3. Coordinate gatewell cleaning with smolt monitoring personnel operating downstream juvenile sampling facilities.

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.

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.

2.4.2.3. Powerhouse Two Corner Collector (B2CC) Operation. Operate the B2CC during spill season. Open and close the B2CC within one hour of the start and end of spill season, respectively.

a. Beginning on March 01, JMF personnel will enumerate steelhead kelt at the JMF adult/debris separator. If 2 kelts per day are observed at the JMF separators for 2 consecutive days for a cumulative total of 20 kelts, JMF personnel will notify the Control Room and Project Fisheries, and the B2CC will be opened within 1 hour.

2.4.2.4. DSM2 Channel Operation.

a. Screen cleaners. The primary screen cleaner will be the airburst system. The system may be set to cycle every 20, 60, or 180 minutes, depending on debris loads.

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.

Table BON- 7. Regulating Orifice Control at Bonneville Dam DSM2.

Orifice	FB ≤ 71.5'	FB ≤ 72.5'	FB ≤ 73.5'	FB ≤ 74.5'	FB ≤ 75.5'	FB ≤ 76.5'
11A-S	Open	Open	Open	Open	Open	
11B-S	Open	Open	Open	Open		
11C-S	Open	Open	Open	Open		
12A-S	Open	Open	Open			
12B-S	Open	Open	Open			
12C-S	Open	Open				
13A-S	Open	Open				
13B-S	Open	Open				
13C-S	Open					
14A-S	Open					
14B-S	Open					
14C-S	Open					

2.4.2.5. Juvenile Monitoring Facility (JMF).

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 November 1. 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 ladder 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-14** 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. See section **2.2.3.1** and **Table BON-5** for operating criteria at spillbays 1 and 18.

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. Except when closed to facilitate maintenance activities, the PH1 ITS gates 1A, 1B, 3B, 6C, and 10B should remain open from December 01 through the end of February. This operation is intended to facilitate steelhead kelt passage.

1. Set chain gate 1A at 71' msl and 1B at 73' msl. Ensure gates 3B, 6C, and 10B are operating according to **Table BON-6**.

2. From December 15 through the end of February the Project may close the ITS endgate or ITS gates to facilitate winter maintenance (including researcher equipment O&M) in the PH1 forebay. Closures may not exceed six hours per day unless otherwise coordinated with FPOM.

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 non-shad passage season (<5,000 shad per day/ per count station) and 1.3' +/- 0.1' during the shad passage season (> or = 5,000 shad per day/ per count station).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-13** 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 PH1 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. All equipment should be maintained and in good condition. The counting window and backboard should be cleaned as needed to maintain good visibility.

> **1.** The crowder will be closed so that the count slot width is no less than 18 inches. This will usually occur during high turbidity conditions to maintain count accuracy. All equipment will be maintained in good condition. The counting window and backboard will be cleaned as needed to maintain good visibility.

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 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.

2.5.2.1. 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**).

2.5.2.2. 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. SO-SG-4N and SO-SG-4S shall be closed at all tailwater elevations. When the tailwater is below 9', sluice gates SW-SG-3N, SW-SG-3S, shall be open. When the tailwater is between 9' and 17', sluice gate SW-SG-3N shall close. When the tailwater exceeds 17', sluice gates SW-SG-3N and SW-SG-3S shall be closed.

Table BON- 8. Diffuser Operating Ranges at Bonneville Dam Bradford Island B-Branch.

Diffuser	Operating Range (feet)	Diffuser	Operating Range (feet)	Diffuser	Operating Range (feet)
FG3-18	>34	FG3-23	>19	FG3-28	<25
FG3-19	>31	FG3-24	>16	FG3-29	Manual open
FG3-20	>28	FG3-25	13'-34	FG3-30	Manual open
FG3-21	>25	FG3-26	12'-31	FG3-31	>25
FG3-22	>22	FG3-27	10.5-28	FG3-32	>26
				FG3-33	>27

Table BON- 9. Diffuser Operating Ranges at Bonneville Dam Cascades Island.

Diffuser	Operating Range (feet)	Diffuser	Operating Range (feet)	Diffuser	Operating Range (feet)
FG6-5	>31	FG6-10	>17	FG6-15	Manual open
FG6-6	>29	FG6-11	>14	FG6-16	Manual open
FG6-7	>25	FG6-12	>11	FG6-17	Manual open
FG6-8	>23	FG6-13	>10	FG6-18	>12
FG6-9	>20	FG6-14	>9	FG6-19	>15
				FG6-20	>19

2.5.3. Powerhouse One (PH1).

2.5.3.1. Weir Gates. The PH1 weir gates will be operated as shown in **Table BON-10.**

a. 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'.

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

Table BON- 10. Weir Gate Requirements at Bonneville Dam Powerhouse One.

Weir Gate	Submergence Requirement (feet)	Differential Requirement (feet)	Sill Elevation (feet)
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'

2.5.3.2. Control of Fish Valve FV1-1.

a. 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.

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

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

2.5.3.4. Control of A-Branch Diffusion Gates FG3-3 through FG3-9. Bradford Island A-branch diffusers are open according to the pattern in **Table BON-11**.

Table BON- 11. Diffuser Operating Ranges at Bonneville Dam Bradford Island A-branch.

Diffuser	Operating Range – Tailwater Elevation (feet)	Dead Bands (feet)
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

2.5.3.5. Powerhouse One Collection Channel Diffusers. Diffuser valves are operated according to the pattern in **Table BON-12**.

Table BON- 12. Open Adult Fish Collection Channel Diffuser Valves at Bonneville Dam Powerhouse One. ***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

2.5.4. Powerhouse Two (PH2).

a. During daytime spill hours (see Table BON-5), 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 PH2 floating gate fishway entrances.

c. Lamprey Operations, June 1 - August 31: During nighttime spill hours (see Table BON-5), reduce fish unit output to operate all north (NUE and NDE) and south (SUE and SDE) entrances at 0.5' of entrance head. To ensure proper function of the fish units, B2 fish unit output can be further reduced or placed on standby to float debris as necessary between 2200-0400.

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. 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. AWS closures (i.e. cleaning times).
f. When trapping is occurring in the AFF.
g. Any 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 name of the reporter 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.

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

3.3.4.2. 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.

3.3.4.3. 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, 3, 11, and 18 out of service, when practicable.

c. Whenever practicable, except during split flows operation, do not take any other PH2 units out of service from June 21 through September 15, to minimize PH1 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.

4.2.2.1. 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 the coordination form):

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.

4.2.2.2. 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). PH1 juvenile passage routes consist of the ITS and MGR turbines. The DSM is no longer in service.

f. Powerhouse Two (PH2). 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 PH2. 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 ASAP 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 (PH1). 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 (PH2).

1. If either or both 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-13**, Emergency Operations for Bonneville PH2 AWS Systems Operations or until a fishway head of 1’ is achieved.

2. Table Bon-13 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. **Table BON-13** 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.

3. If both 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 modified powerhouse priority operations.

4. PH2 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- 13. Emergency Operations for Bonneville Dam Powerhouse Two Auxiliary Water Supply.

Tailwater Elevation (ft)	Turbine (MW)	Turbine Q (cfs)	*****************CLOSED****************			
			Floating Orifices	South "B" Diffusers	PH "C" Diffusers	Main Entrances
8	13.90	2,950	All	B3-8	C1-5	None
9	13.95	3,010	All	B3-8	C1-5	None
10	14.05	3,090	All	B3-8	C1-5	None
11	14.15	3,165	All	B3-8	C1-5	None
12	14.20	3,230	All	B3-8	C1-5	None
13	14.40	3,340	All	B3-8	C1-5	None
14	14.40	3,400	All	B3-8	C1-5	None
15	14.60	3,520	All	B3-8	C1-5	None
16	14.30	3,515	All	B3-8	C1-5	None
17	14.20	3,560	All	B3-8	C1-5	None
18	14.00	3,575	All	B5-8	None	NU-E
19	13.60	3,535	All	B5-8	None	NU-E
20	13.30	3,520	All	B4-8	None	NU-E
21	13.00	3,510	All	B4-8	None	NU-E
22	12.70	3,505	All	B4-8	None	NU-E
23	12.40	3,505	All	B4-8	None	NU-E
24	12.20	3,535	All	B4-8	None	NU-E
25	11.60	3,535	All	B4-8	None	NU-E
26	11.10	3,365	All	B4-8	None	NU-E
27	10.60	3,285	All	B4-8	None	NU-E
28	10.00	3,160	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.

5.1. Powerhouse priority is detailed in **Table BON-14.** When splitting flows, as directed in section **2.1.2,** the top two available priority units for PH1 will be operated first followed by normal unit priority at PH2. If there is a need for more units, and all available units at PH2 are in operation, proceed with the normal unit priority for PH1**.**

5.2. Turbine units at PH1 will operate within 1% of best efficiency and within cavitation limits at various head ranges as shown in **Table BON-15**.

5.2.1. Turbine units at PH2 will operate at the mid to lower 1% range (unless total dissolved gas waivers are exceeded in the tailrace) of best efficiency and within cavitation limits at various head ranges as shown in **Table BON-16**.

5.3. Turbines will be operated within +/-1% of best turbine efficiency from April 1 through October 31 (as specified in the BPA load shaping guidelines), except as outlined in **Appendix C**.

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.

Table BON- 14. Turbine Unit Operating Priorities at Bonneville Dam (Units 1-18).

PERIOD	PRIORITY *
Adult Fish Ladders in service PH1 Adult Fish Ladder out of service	PH2 Priority: 11,18,12,17,13,14,15,16, 1,10,3,6,2,4,5,8,7,9
PH2 Adult Fish Ladder out of service	PH1 Priority: 1,10,3,6,2,4,5,8,7,9 11,18,12,17,13,14,15,16,
Split Flows (all units available)	1,10,11,18,12,17,13,14,15,16,3,6,2,4,5,8,7,9
PH1 Unit priority	1,10,3,6,2,4,5,8,7,9
PH2 Unit priority	11,18,12,17,13,14,15,16

* Changes in unit priorities may occur and will be authorized in RCC teletypes as needed.

5.4.1. When PH1 is operating, Unit 1 provides important attraction flow for adult fish, and it helps move juvenile fish downstream. To maintain the priority importance of Unit 1 when PH1 must be used, 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.

5.4.3. Units may be operationally tested for up to 30 minutes before going into maintenance status by running the unit at speed no load and various loads within the 1% criteria to allow pre-maintenance measurements and testing AND TO ALLOW ALL FISH TO MOVE THROUGH THE UNIT. Units may be operationally tested after maintenance or repair while remaining in maintenance or forced outage status. Operational testing may consist of running the unit for up to a cumulative time of 30 minutes (within 1% criteria) before it is returned to operational status. Operational testing OF UNIT UNDER MAINTENANCE is in addition to a unit in run status (E.G. MINIMUM GENERATION) required for power plant reliability. Operational testing may deviate from fish priority units and may require water that would otherwise be used for spill if the running unit for reliability is at its 1% minimum load. Water will be used from the

powerhouse allocation if possible, and water diverted from spill for operational testing will be minimized to that necessary to maintain and assure generation system reliability.

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).

5.6. From December 1 through April 30, priority turbine units will be scheduled for any necessary extended outages. Priority units are 1, 3, 11, and 18. During this time, non-priority units should not be scheduled for routine or extended outages if the outage will delay or conflict with maintenance on a priority unit.

5.7. Turbines which have been idle/out of service for more than 12 hours will be started by slow rolling the unit after manually tipping turbine blades from flat to steep and back to flat.

5.8. During high head events (such as a higher than normal forebay) the top priority unit at PH1 may be operated, when necessary, to keep PH2 units within the 1% efficiency range.

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 <u>Fish Recovery Plans</u> 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 ensure 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 depth of 1" - 2" will be maintained in 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 - 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. Project Fisheries will assist directly in fish rescue operations, provide technical guidance to ensure fish safety, and ensure that rescue equipment and personnel are available if needed.

6.5. Turbines.

6.5.1. From December 1 through April 30, priority turbine units will be scheduled for any necessary extended outages. Priority units are 1, 3, 11, and 18. During this time, non-priority units should not be scheduled for routine or extended outages if the outage will delay or conflict with maintenance on a priority unit.

6.5.2. Turbines which have been idle/out of service will be started by slow rolling the unit after manually tipping turbine blades from flat to steep and back to flat.

6.5.3. 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.

6.5.4. 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. Bottom tail logs should be placed first.

6.5.5. If a turbine unit draft tube is to be dewatered and the turbine unit has been idle, it will be operated when possible at full load for a minimum of one hour, four hours preferred. Stop logs will then be placed immediately. It is recommended adjacent units be operated a minimum of one hour, four hours preferred, to flush fish prior to placing tail logs in the unit to be OOS. It is also recommended that units located adjacent to OOS units not be voluntarily taken out of service until the adjacent units return to service.

6.5.6. 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.

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

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

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

6.5.10. 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 PH1, the corner collector at PH2, 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 (contact information is available in the Control Room):

1. Ben Hausmann, Supervisory Fishery Biologist
2. Jon Rerecich, Fishery Biologist
3. Andrew Traylor, Fishery Biologist
4. Bern Klatte, Fisheries Section Supervisor, or Tammy Mackey, Fishery Biologist

9. Endnotes. (Not applicable to this Project)

Table BON- 15. Turbine Operating Ranges Within 1% of Best Efficiency for Bonneville Dam Powerhouse One MGR Units 1-10. [*]

Head (feet)	Powerhouse One (Units 1-10)			
	Lower Limit		Upper Limit	
	(MW)	(cfs)	(MW)	(cfs)
38	20.7	7,204	25.6	8,918
39	21.3	7,202	26.3	8,886
40	21.9	7,199	26.9	8,854
41	22.5	7,201	28.0	8,969
42	23.1	7,202	29.1	9,077
43	23.6	7,203	30.1	9,180
44	24.2	7,203	31.2	9,278
45	24.8	7,203	32.3	9,370
46	25.4	7,210	33.2	9,416
47	26.0	7,217	34.1	9,459
48	26.6	7,223	35.0	9,500
49	27.3	7,229	36.0	9,539
50	27.9	7,234	36.9	9,575
51	28.5	7,241	37.8	9,618
52	29.1	7,248	38.4	9,577
53	29.7	7,254	39.0	9,537
54	30.3	7,260	39.7	9,499
55	30.9	7,266	41.6	9,768
56	31.5	7,269	42.5	9,808
57	32.1	7,272	43.4	9,846
58	32.7	7,274	44.4	9,883
59	33.3	7,277	45.3	9,918
60	33.8	7,279	46.3	9,952
61	34.5	7,296	46.9	9,930
62	35.1	7,311	47.6	9,909
63	35.8	7,326	48.3	9,889
64	36.5	7,340	49.0	9,868
65	37.1	7,354	49.7	9,849
66	37.6	7,341	50.6	9,876
67	38.1	7,329	51.4	9,902
68	38.6	7,317	52.3	9,928
69	39.0	7,305	53.2	9,954
70	39.5	7,294	54.1	9,979

[*] Table based on data provided by HDC, June 2000 (Table BON-15 revised 2009: removed reference to STSs only).

Table BON- 16. Turbine Operating Ranges Within 1% of Best Efficiency for Bonneville Dam Powerhouse Two Units 11-18, with/without STSs. *

Head (feet)	Powerhouse Two (units 11-18)							
	With STS				Without STS			
	Lower Limit		Upper Limit		Lower Limit		Upper Limit	
	(MW)	(cfs)	(MW)	(cfs)	(MW)	(cfs)	(MW)	(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

* Table based on data provided by HDC, January 2001 (Table BON-16 revised 2006).

Table BON- 17 (page 1 of 9). Spill Patterns for Bonneville Dam. (Flow calculations updated in 2007.)

Bonneville Dam Spillway Bay Number																		1 Stop = ½ ft	FB = 74.0 ft
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18		
Spill Gate Vertical Opening (feet)																		# Gate Stops	Total Spill (kcfs)
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

Bonneville Dam Spillway Bay Number																		1 Stop = ½ ft	FB = 74.0 ft
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18		
Spill Gate Vertical Opening (feet)																		# Gate Stops	Total Spill (kcfs)
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
2	2	2	0	2	0	0	2	0	2	0	0	2	2	0	2	2	2	44	49
2	2	2	0	2	0	0	2	0	2	0	0	2	2	0	2	2.5	2	45	50
2	2.5	2	0	2	0	0	2	0	2	0	0	2	2	0	2	2.5	2	46	52
2	2.5	2	0	2	0	0	2	0	2	0	0	2	2	0	2.5	2.5	2	47	53
2	2	2	0	2	0	2	2	0	2	0	0	2	2	0	2	2	2	48	54
2	2	2	0	2	0	2	2	0	2	0	0	2	2	0	2	2.5	2	49	55
2	2.5	2	0	2	0	2	2	0	2	0	0	2	2	0	2	2.5	2	50	56
2	2.5	2	0	2	0	2	2	0	2	0	0	2	2	0	2.5	2.5	2	51	57
2	2	2	0	2	0	2	2	0	2	2	0	2	2	0	2	2	2	52	58
2	2	2	0	2	0	2	2	0	2	2	0	2	2	0	2	2.5	2	53	59
2	2.5	2	0	2	0	2	2	0	2	2	0	2	2	0	2	2.5	2	54	61
2	2.5	2	0	2	0	2	2	0	2	2	0	2	2	0	2.5	2.5	2	55	62
2	2	2	2	2	0	2	2	0	2	2	0	2	2	0	2	2	2	56	63
2	2	2	2	2	0	2	2	0	2	2	0	2	2	0	2	2.5	2	57	64
2	2.5	2	2	2	0	2	2	0	2	2	0	2	2	0	2	2.5	2	58	65
2	2.5	2	2	2	0	2	2	0	2	2	0	2	2	0	2.5	2.5	2	59	66
2	2	2	2	2	0	2	2	0	2	2	0	2	2	2	2	2	2	60	67
2	2	2	2	2	0	2	2	0	2	2	0	2	2	2	2	2.5	2	61	68
2	2.5	2	2	2	0	2	2	0	2	2	0	2	2	2	2	2.5	2	62	70
2	2.5	2	2	2	0	2	2	0	2	2	0	2	2	2	2.5	2.5	2	63	71
2	2	2	2	2	2	2	2	0	2	2	0	2	2	2	2	2	2	64	72
2	2	2	2	2	2	2	2	0	2	2	0	2	2	2	2	2.5	2	65	73
2	2.5	2	2	2	2	2	2	0	2	2	0	2	2	2	2	2.5	2	66	74
2	2.5	2	2	2	2	2	2	0	2	2	0	2	2	2	2.5	2.5	2	67	75
2	2	2	2	2	2	2	2	0	2	2	2	2	2	2	2	2	2	68	76
2	2	2	2	2	2	2	2	0	2	2	2	2	2	2	2	2.5	2	69	77
2	2.5	2	2	2	2	2	2	0	2	2	2	2	2	2	2	2.5	2	70	78
2	2.5	2	2	2	2	2	2	0	2	2	2	2	2	2	2.5	2.5	2	71	80

Bonneville Dam Spillway Bay Number																		1 Stop = ½ ft	FB = 74.0 ft
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18		
Spill Gate Vertical Opening (feet)																		# Gate Stops	Total Spill (kcfs)
2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	72	81
2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2.5	2	73	82
2	2.5	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2.5	2	74	83
2	2.5	2	2	2	2	2	2	2	2	2	2	2	2	2	2.5	2.5	2	75	84
2	2.5	2.5	2	2	2	2	2	2	2	2	2	2	2	2	2.5	2.5	2	76	85
2	2.5	2.5	2	2	2	2	2	2	2	2	2	2	2	2	2.5	2.5	2.5	77	86
2.5	2.5	2.5	2	2	2	2	2	2	2	2	2	2	2	2	2.5	2.5	2.5	78	87
2.5	2.5	2.5	2	2	2	2	2	2	2	2	2	2	2	2	2.5	3	2.5	79	88
2.5	3	2.5	2	2	2	2	2	2	2	2	2	2	2	2	2.5	3	2.5	80	89
2.5	3	2.5	2	2	2	2	2	2	2	2	2	2	2	2	2.5	3	3	81	90
3	3	2.5	2	2	2	2	2	2	2	2	2	2	2	2	2.5	3	3	82	91
3	3	2.5	2	2	2	2	2	2	2	2	2	2	2	2	3	3	3	83	92
3	3	3	2	2	2	2	2	2	2	2	2	2	2	2	3	3	3	84	94
3	3	3	2	2	2	2	2	2	2	2	2	2	2	2.5	3	3	3	85	95
3	3	3	2.5	2	2	2	2	2	2	2	2	2	2	2.5	3	3	3	86	96
3	3	3	2.5	2	2	2	2	2	2	2	2	2	2.5	2.5	3	3	3	87	97
3	3	3	2.5	2.5	2	2	2	2	2	2	2	2	2.5	2.5	3	3	3	88	98
3	3	3	2.5	2.5	2	2	2	2	2	2	2.5	2	2.5	2.5	3	3	3	89	99
3	3	3	2.5	2.5	2	2	2	2.5	2	2	2.5	2	2.5	2.5	3	3	3	90	100
3	3	3	2.5	2.5	2.5	2	2	2.5	2	2	2.5	2	2.5	2.5	3	3	3	91	101
3	3	3	2.5	2.5	2.5	2.5	2.5	2	2	2	2.5	2.5	2.5	2.5	3	3	3	93	103
3	3	3	2.5	3	2.5	2.5	2.5	2	2	2	2.5	2.5	2.5	3	3	3	3	95	105
3	3	3	3	3	2.5	2.5	2.5	2	2	2	2.5	2.5	2.5	3	3.5	3	3	97	107
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	110
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

Bonneville Dam Spillway Bay Number																		1 Stop = ½ ft	FB = 74.0 ft
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	# Gate Stops	Total Spill (kcfs)
Spill Gate Vertical Opening (feet)																			
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
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

Bonneville Dam Spillway Bay Number																		1 Stop = ½ ft	FB = 74.0 ft
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	# Gate Stops	Total Spill (kcfs)
Spill Gate Vertical Opening (feet)																			
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

Bonneville Dam Spillway Bay Number																		1 Stop = ½ ft	FB = 74.0 ft
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**		
Spill Gate Vertical Opening (feet)																		**# Gate Stops**	**Total Spill (kcfs)**
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
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

Bonneville Dam Spillway Bay Number																		1 Stop = ½ ft	FB = 74.0 ft
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18		
Spill Gate Vertical Opening (feet)																		# Gate Stops	Total Spill (kcfs)
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
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

Bonneville Dam Spillway Bay Number 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	1 Stop = ½ ft	FB = 74.0 ft
Spill Gate Vertical Opening (feet)																		# Gate Stops	Total Spill (kcfs)
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

Bonneville Dam Spillway Bay Number																		1 Stop = ½ ft	FB = 74.0 ft
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18		
Spill Gate Vertical Opening (feet)																		# Gate Stops	Total Spill (kcfs)
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
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
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Section 3 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 & 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 & 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 2001 to 2011. 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 salmon, steelhead, and lamprey are normally counted from April 1 through October 31 (**Table TDA-1**), and these data appear daily on the Corps adult count website. Migration timing data for these species appear in **Table TDA-2**. Sturgeon and bull trout are also counted and recorded on the WDFW fish counters' daily summary sheet comments section, but do not appear on the Corps daily website total due to relative infrequency of passage. These data are posted in the Miscellaneous Fish Counts report during the passage season (updated periodically during the season) found on the Corps' web site, and summarized in the Annual Fish Passage Report.

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.

Count Period	Counting Method and Hours
March 1 through March 31	Video 0600–1800 hours (PST)
April 1 through October 31	Visual 0500–2100 hours (DST)
July 1 through September 30	Night Video Lamprey count 2100–0500 hours (DST)
November 1 through end of February	Video 0500–2100 hours (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 counting periods and peak fish passage timing through 2011. 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 2000-2011 appears in this table.

Table TDA- 2. Adult Count Periods and Peak Migration Timing at The Dalles Dam (based on fish count data for years 1957-2011).

Species	Count Period	Earliest Peak	Latest Peak
Spring Chinook	2/20 – 6/3	4/13	5/13
Summer Chinook	6/4 – 8/3	6/6	8/1
Fall Chinook	8/4 – 12/7	9/2	9/23
Sockeye	2/20 – 12/7	6/20	7/10
Steelhead	2/20 – 12/7	7/9	9/23
Coho	2/20 – 12/7	9/3	10/25
Lamprey*	2/20 – 12/7	7/12	8/1

*****Peak lamprey migration timing based on lamprey count data for years 2000-2011.

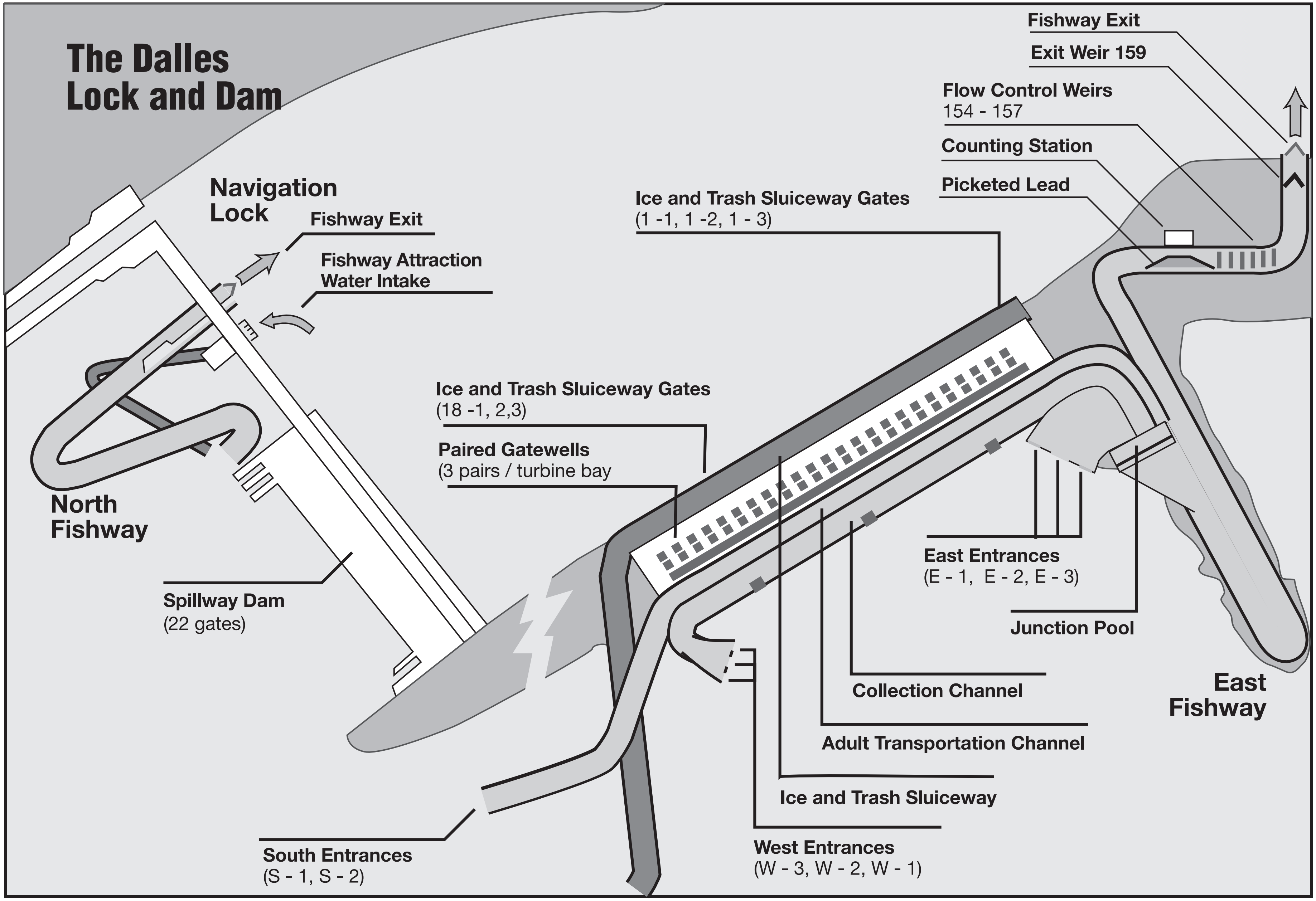


Figure TDA - 1. The Dalles Dam.

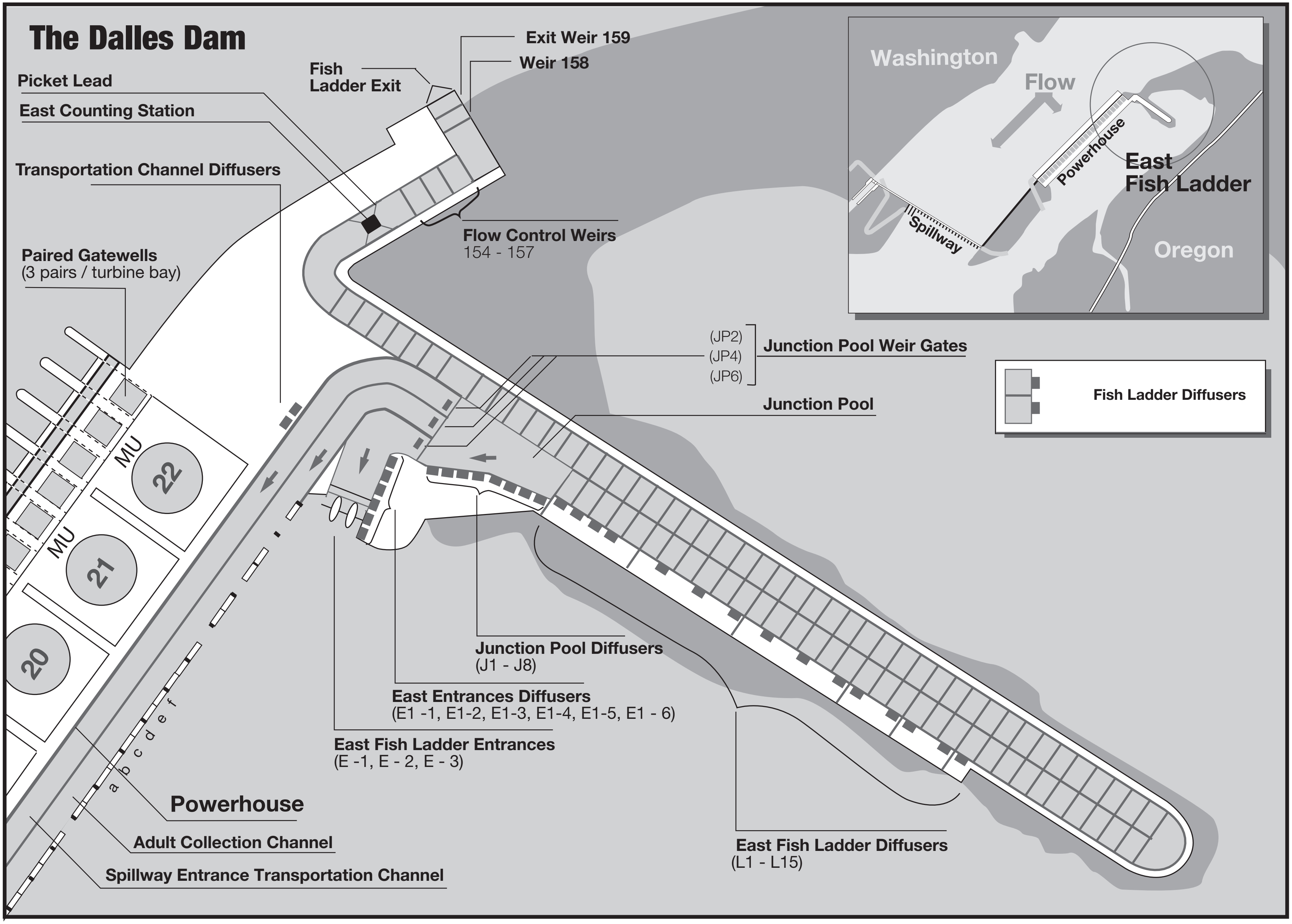


Figure TDA - 2. The Dalles Dam East Fish Ladder.

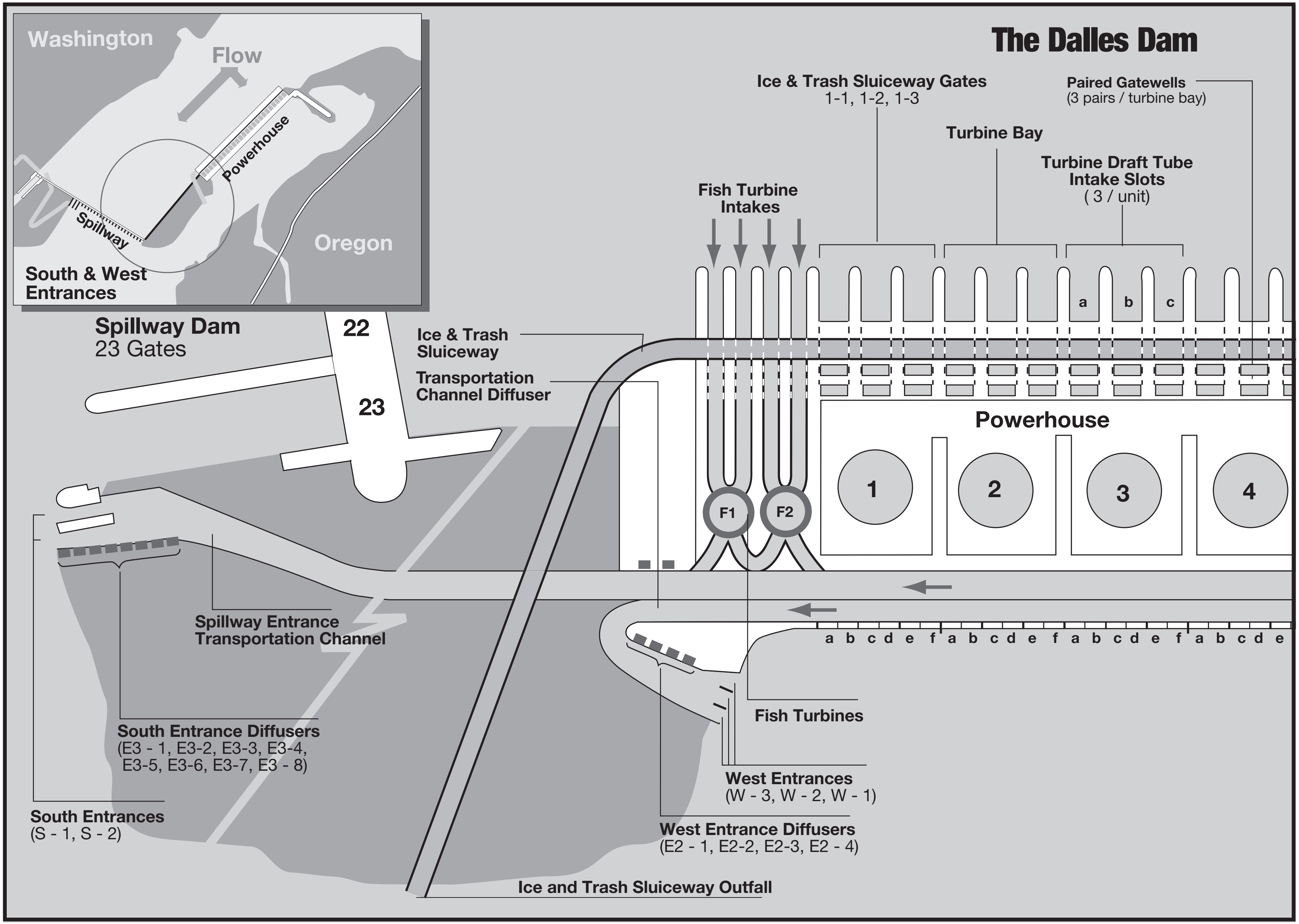


Figure TDA - 3. The Dalles Dam South and West Fish Ladder Entrances.

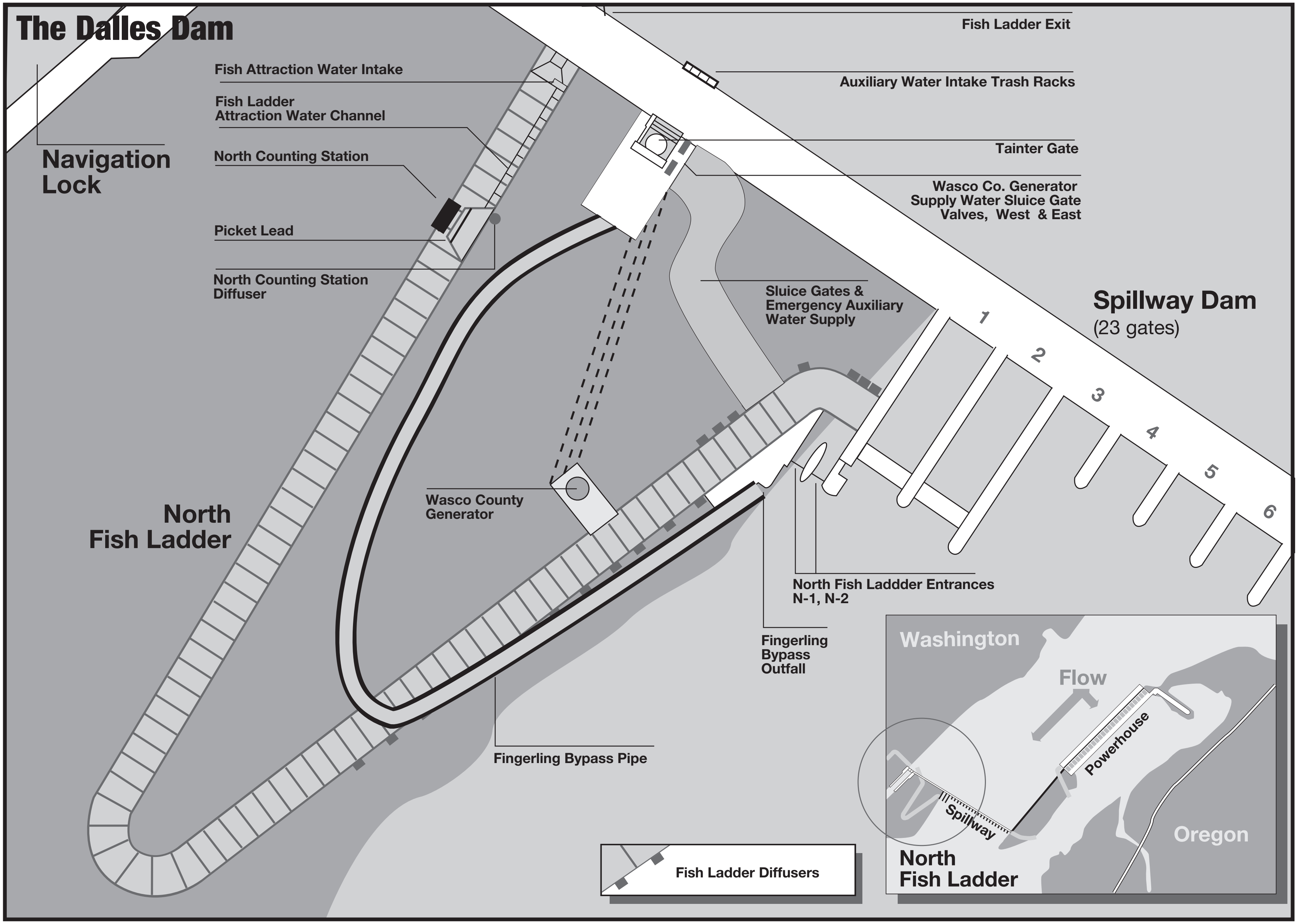
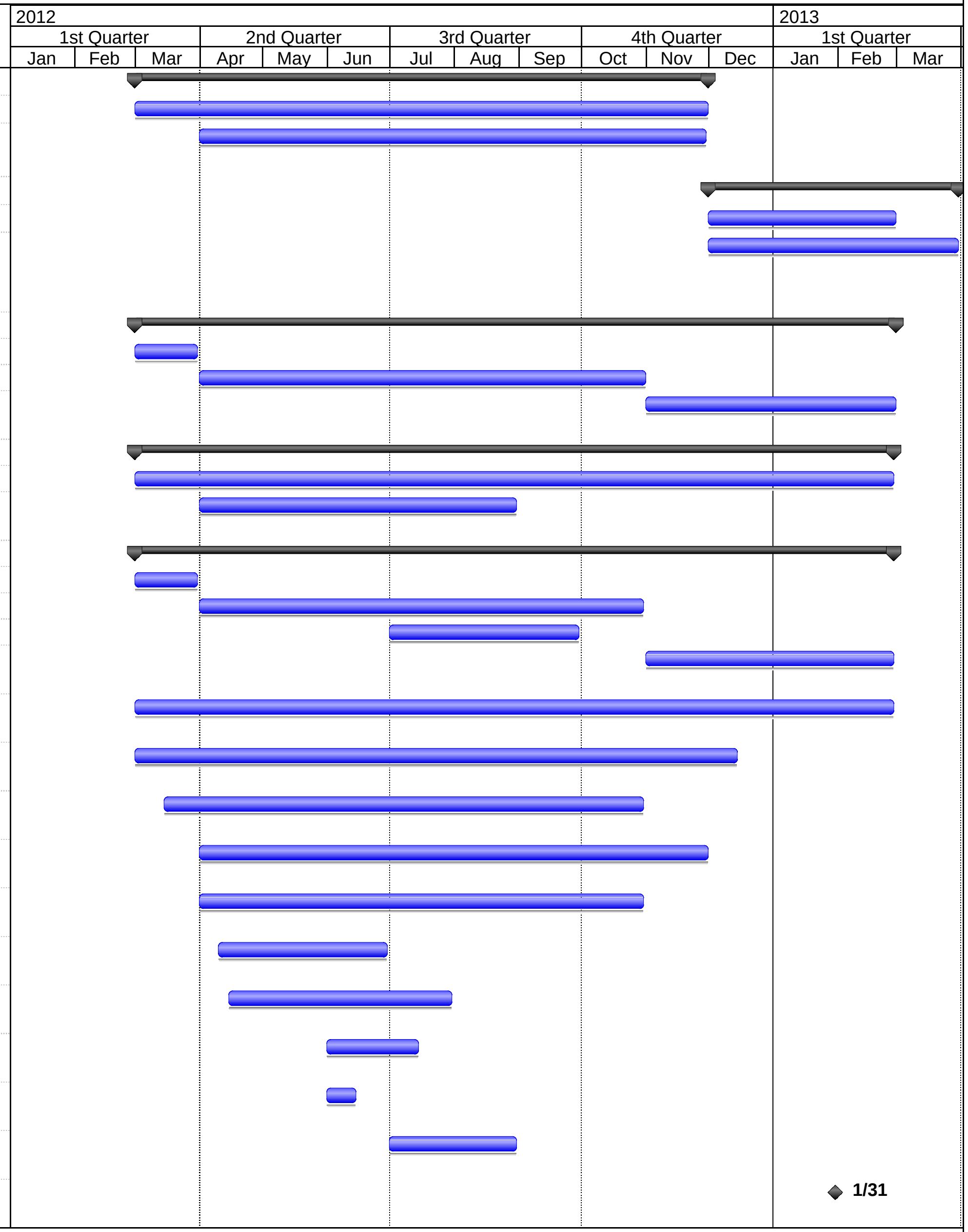


Figure TDA - 4. The Dalles Dam North Fish Ladder and Spillway.

Table TDA-3. Dates of Project Operations for Fish Purposes at The Dalles Dam for the 2012 Fish Passage Season and 2012-2013 Winter Maintenance Period.

Task Name	Start	Finish	Reference
2012 FISH PASSAGE SEASON	**3/1/12**	**11/30/12**	
Adult Fish Passage Season	3/1/12	11/30/12	TDA 2.5.1.2
Juvenile Fish Passage Season	4/1/12	11/30/12	TDA 2.4.1.2
2012-2013 WINTER MAINTENANCE PERIOD	**12/1/12**	**3/31/13**	
Winter Maintenance Adult Fish Facilities	12/1/12	2/28/13	TDA 2.5.1.1
Winter Maintenance Juvenile Fish Facilities	12/1/12	3/31/13	TDA 2.4.1.1
1% Constraints	**3/1/12**	**2/28/13**	**TDA 5.4**
1% soft constraint	3/1/12	3/31/12	
1% hard constraint	4/1/12	10/31/12	
1% soft constraint	11/1/12	2/28/13	
TDG Monitoring	**3/1/12**	**2/28/13**	**Appendix D Table 1**
TDG Monitoring - Tailrace	3/1/12	2/28/13	TDDO
TDG Monitoring - Forebay	4/1/12	8/31/12	TDA
Adult Fish Counting	**3/1/12**	**2/28/13**	**TDA Table TDA-1**
Video Count 0600-1700 PST	3/1/12	3/31/12	
Visual Count 0500-2100 DST	4/1/12	10/31/12	
Night Video Lamprey Count 2100-0500 DST	7/1/12	9/30/12	
Video Count 0500-2100 PST	11/1/12	2/28/13	
Weekly Reports (year-round)	3/1/12	2/28/13	TDA 3.3.1
Operate Ice & Trash Sluiceway	3/1/12	12/15/12	TDA 2.4.1.2 e
Kelt Passage Study	3/15/12	10/31/12	App A TDA 2.4
Avian Abatement in Place	4/1/12	12/1/12	TDA 2.4.1.1 e
Adult Lamprey Study	4/1/12	10/31/12	App A TDA 2.1
Spring Spill for Fish Passage	4/10/12	6/30/12	App E
Active Avian Hazing	4/15/12	7/31/12	
BiOp Performance Standard Testing (approximate dates)	6/1/12	7/15/12	App A TDA 2.3, App E
Rake Trash Racks	6/1/12	6/15/12	TDA 2.4.1.2 a
Summer Spill for Fish Passage	7/1/12	8/31/12	App E
Annual Report (for Dec 1, 2011 - Nov 30, 2012)	1/31/13	1/31/13	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, below, 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. Additionally, a 12-hour trend for entrance differential and weir depth will be monitored daily from the data logging system to track operational changes. Results will be reported in the weekly status report.

2.2. Spill Management. See the Fish Operations Plan (**Appendix E**) for more information. A summary of the spill patterns is provided in Table TDA-6.

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 & 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 mid-April through July 31. However, there will be no avian abatement measures, other than avian lines, performed from August through May each year.

f. December 1 through December 15, see **2.5.1.1.f and 2.5.1.1.g** for Ice & Trash Sluiceway (ITS) operations for adult fallback and steelhead kelts.

g. December 16 through February 28 discontinue operation of the ITS on a 24-hour basis. Close endgate, and open sluice gates 1-1 and 17-3 to allow fish egress from the ITS when equalized with the forebay.

2.4.1.2. April 1 through November 30 (Juvenile 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'. Inspect unit 3 (or any other unit 1-5 which minimizes fish impacts), 8 and 18 by ROV between June 1 and June 15 to determine if there is debris buildup on the trashracks. If so, trashracks will be raked. 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. Clean gatewells before the gatewell water surface becomes 50% covered with debris. If due to the volume of debris, it is not possible to keep the gatewell surfaces at least 50% 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 ITS gates 1-1, 1-2, and 1-3 over operating Main Unit (MU) 1; sluiceway gate 8-3 over operating MU 8; and sluiceway gates 18-2 and 18-3 over operating MU 18. If any these MUs are out of service, operate the next available MU and associated gates adjacent to the unit (i.e., if MU-1 is OOS, then operate MU-2 w/gates; if MU-18 is OOS, then operate MU-17 w/gates or MU-19 w/gates). The ITS will be operated on a 24-hour basis April 1 through December 15.

f. When units are being dewatered, leave endgate open and close sluice gates to expose gatewell orifices, and then install orifice blocker. After orifice-sealing devices are installed, sluice gates should be returned to the open position. Installation time should be approximately 30 minutes.

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-6** 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.

e. 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.

f. December 1 through December 15, open ITS gates 1-2 and 1-3 over operating MU 1, and gates 18-1 and 18-2 over operating MU 18. If either of these MUs is out of service, operate the next available MU and associated adjacent gates (i.e., if MU-1 is OOS, then operate MU-2 w/gates; if MU-18 is OOS, then operate MU-17 w/gates or MU-19 w/gates). The ITS will be operated on a 24-hour basis December 1 through December 15. *This operation will be implemented on a trial basis and considered for longer term implementation pending review at the comprehensive check-in in 2013.*

g. December 16 through February 28, discontinue operation of the ITS on a 24-hour basis. Close endgate and open sluice gates 1-1 and 18-3 to allow fish egress from the ITS when equalized with the forebay.

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

a. All Adult Facilities.

1. Water depth over fish ladder weirs: 1.0' +/- 0.1'. During the shad passage season (> 5,000 shad/count station/day/at Bonneville Dam): 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°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. Fishway channel water velocities will be measured three times weekly, daily preferred, during adult fish passage (Mar 1 – Dec 1) part of the fishway inspection program. Floats will be timed through all fishway channels that are supplemented by auxiliary water. Results will be provided in the project weekly fishway status report.

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 cleaned and/or 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. The current fish counting program is conducted 16 hours per day, from April through October (see **Table TDA-1**). Count station crowders shall remain in the operating position while visual counting and/or videotaping is being conducted.

A. 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.

B. 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.

C. Project biologists, FFU, and the WDFW fish count supervisor shall coordinate to achieve optimum count slot passage and/or count accuracy conditions.

D. If counting is temporarily discontinued due to unscheduled events, the crowder shall be fully opened.

E. The crowder may remain in operating position during the counters' hourly ten-minute break period.

9. March 1 through March 31, open ITS gates 1-2 and 1-3 over operating MU 1, and gates 18-1 and 18-2 over operating MU 18. If either of these MUs is out of service, operate the next available MU and associated adjacent gates (i.e., if MU-1 is OOS, operate MU-2 w/gates; if MU-18 is OOS, operate MU-17 w/gates or MU-19 w/gates). The ITS will be operated on a 24-hour basis March 1 through March 31. *This operation will be implemented on a trial basis and considered for longer term implementation pending review at the comprehensive check-in in 2013.*

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 will 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.

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 in 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. 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. AWS closures (i.e. cleaning times);
f. Any 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 reporter 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.

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

3.3.4.2. 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.

3.3.4.3. 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. The zebra mussel monitoring program will continue. This includes veliger 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.

4.2. Juvenile Fish Passage Facilities.

4.2.1. Routine Maintenance.

4.2.1.1. Collection and Transportation Systems. The Dalles Dam Ice & 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 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 is a regular and recurring process that requires units to be shut down for extended periods (see **Appendix F. 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, 8, and 18 (during Ice & 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 Operations Project Manager has the authority to initiate work prior to notifying CENWP-OD when delay of work will result in unsafe situations for people, property, or fish. Information required by CENWP-OD includes: (see also **Overview** for the coordination form).

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. Collection and Transportation Systems. The Ice & 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.

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.

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. 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. Close entrance weir S1.

3. Raise entrance weir E2 and E3 to 8' depth.

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. Through the juvenile fish passage season, April 1 through November 30, *and* from March 1 through March 31 and December 1 through December 15 to aid adult steelhead fallbacks or kelts, 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 adult fish passage conditions while meeting transmission line needs, the main powerhouse turbine units will operate in the priority outlined in Table TDA-4 below.

Table TDA- 4. Turbine Unit Operating Priorities at The Dalles Dam.

PERIOD	PRIORITY
Fish Passage Season: April 1 through November 30	1 and/or 2, 3 and/or 4, 8, 18*
If additional units needed, operate one unit from each block moving west to east.	block 5-8, block 9-12, block 13-16, block 17-22
If additional units still needed, operate one unit from each block moving west to east.	block 5-8, block 9-12, block 13-16, block 17-22
December 1 through December 15	1 and/or 2, 18†
December 16 through February 28	1-22 in any order
March 1 through March 31	1 and/or 2, 3 and/or 4, 8, 18†

*During fish passage season – Unit 1 and/or 2, Unit 3 or 4, Units under open sluice gates 1,8,18
† During the March and December operation for adult steelhead fallbacks and kelt passage – Unit 1 and/or 2 and Unit 18 must be operated under at least 2 open sluice gates per unit

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-5.**

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.

5.6. Units may be operationally tested for up to 30 minutes before going into maintenance status by running the unit at speed no load and various loads within the 1% criteria to allow pre-maintenance measurements and testing AND TO ALLOW ALL FISH TO MOVE THROUGH THE UNIT. Units may be operationally tested after maintenance or repair while remaining in maintenance or forced outage status. Operational testing may consist of running the unit for up to a cumulative time of 30 minutes (within 1% criteria) before it is returned to operational status. Operational testing OF UNIT UNDER MAINTENANCE is in addition to a unit in run status (E.G. MINIMUM GENERATION) required for power plant reliability. Operational testing may deviate from fish priority units and may require water that would otherwise be used for spill if the running unit for reliability is at its 1% minimum load. Water will be used from the

powerhouse allocation if possible, and water diverted from spill for operational testing will be minimized to that necessary to maintain and assure generation system reliability.

5.7. To reduce the chance of debris washing onto the tail log sill during tail log installation in units 19 - 22, fish unit loading may be reduced to about 8 MW for 30 to 60 minutes; and entrance weir E1 may be closed for the same duration of time.

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. If the turbine unit draft tube is dewatered, operate unit with full load for a minimum 15 minutes prior to immediately installing tail logs. If not possible to load, run unit at speed-no-load for minimum 15 minutes. 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. Bern Klatte (503-808-4318) or Tammy Mackey (503-961-5733).

9. Endnotes. (Not applicable to this Project)

Table TDA- 5. Turbine Unit Operating Ranges Within 1% of Best Efficiency for The Dalles Dam Units 1-14 and Units 15-22.

Head (feet)	Units 1-14				Units 15-22			
	Lower Limit		Upper Limit		Lower Limit		Upper Limit	
	MW	cfs	MW	cfs	MW	cfs	MW	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: Table is based on information provided by HDC in 2001 and 2002 (Table TDA-5 revised 2006).

Table TDA- 6. Spill Pattern for Juvenile Fish Passage at The Dalles Dam (see notes next page).

Discharge Distribution Patterns																										40% Spill				
Spillway Bay Number																								Total	Total	Total	Range of Flow		Range of %Spill	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	counts	Feet	Spill	River	Low	High	High	Low
vertical gate opening (ft.)																								(ft)	(cfs)	cfs				
						4	4																44	8	12,000	62,000	62,000	62,737	19.4%	19.1%
						4.5	4.5																49	9	13,473	63,473	62,737	64,207	21.5%	21.0%
						5	5																54	10	14,940	64,940	64,207	65,671	23.3%	22.7%
						5.5	5.5																58	11	16,401	66,401	65,671	67,129	25.0%	24.4%
						6	6																63	12	17,856	67,856	67,129	68,581	26.6%	26.0%
						6.5	6.5																68	13	19,305	69,305	68,581	70,027	28.1%	27.6%
						7	7																73	14	20,748	70,748	70,027	71,467	29.6%	29.0%
						7.5	7.5																78	15	22,185	72,185	71,467	72,901	31.0%	30.4%
						8	8																82	16	23,616	73,616	72,901	74,329	32.4%	31.8%
						8.5	8.5																87	17	25,041	75,041	74,329	75,751	33.7%	33.1%
						9	9																92	18	26,460	76,460	75,751	77,167	34.9%	34.3%
						9.5	9.5																96	19	27,873	77,873	77,167	78,577	36.1%	35.5%
						10	10																101	20	29,280	79,280	78,577	79,981	37.3%	36.6%
						10.5	10.5																105	21	30,681	80,681	79,981	81,379	38.4%	37.7%
						11	11																110	22	32,076	82,076	81,379	82,771	39.4%	38.8%
						11.5	11.5																114	23	33,465	83,465	82,771	85,293	40.4%	39.2%
						12	12																119	24	34,848	87,120	85,293	88,560	40.9%	39.3%
		4	4	4	4	4	4																44	24	36,000	90,000	88,560	92,212	40.7%	39.0%
		4.2	4.2	4.2	4.2	4.2	4.2																46	25.2	37,770	94,424	92,212	97,736	41.0%	38.6%
		4.5	4.5	4.5	4.5	4.5	4.5																49	27	40,419	101,048	97,736	103,024	41.4%	39.2%
	4	4	4	4	4	4	4																44	28	42,000	105,000	103,024	107,581	40.8%	39.0%
	4.2	4.2	4.2	4.2	4.2	4.2	4.2																46	29.4	44,065	110,162	107,581	114,025	41.0%	38.6%
	4.5	4.5	4.5	4.5	4.5	4.5	4.5																49	31.5	47,156	117,889	114,025	118,944	41.4%	39.6%
4	4	4	4	4	4	4	4																44	32	48,000	120,000	118,944	122,950	40.4%	39.0%
4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2																46	33.6	50,360	125,899	122,950	130,315	41.0%	38.6%
4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5																49	36	53,892	134,730	130,315	137,668	41.4%	39.1%
4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7																51	37.6	56,242	140,605	137,668	145,003	40.9%	38.8%
5	5	5	5	5	5	5	5																54	40	59,760	149,400	145,003	152,326	41.2%	39.2%
5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2																56	41.6	62,100	155,251	152,326	159,631	40.8%	38.9%
5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5																58	44	65,604	164,010	159,631	166,924	41.1%	39.3%
5.7	5.7	5.7	5.7	5.7	5.7	5.7	5.7																60	45.6	67,935	169,837	166,924	174,199	40.7%	39.0%
6	6	6	6	6	6	6	6																63	48	71,424	178,560	174,199	181,462	41.0%	39.4%
6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2																65	49.6	73,745	184,363	181,462	188,707	40.6%	39.1%
6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5																68	52	77,220	193,050	188,707	195,940	40.9%	39.4%
6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7																70	53.6	79,532	198,829	195,940	203,155	40.6%	39.1%
7	7	7	7	7	7	7	7																73	56	82,992	207,480	203,155	210,358	40.9%	39.5%
7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.2																75	57.6	85,294	213,235	210,358	217,543	40.5%	39.2%
7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5																78	60	88,740	221,850	217,543	224,716	40.8%	39.5%
7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7																80	61.6	91,032	227,581	224,716	231,871	40.5%	39.3%
8	8	8	8	8	8	8	8																82	64	94,464	236,160	231,871	239,014	40.7%	39.5%
8.2	8.2	8.2	8.2	8.2	8.2	8.2	8.2																84	65.6	96,747	241,867	239,014	246,139	40.5%	39.3%
8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5																87	68	100,164	250,410	246,139	253,252	40.7%	39.6%
8.7	8.7	8.7	8.7	8.7	8.7	8.7	8.7																89	69.6	102,437	256,093	253,252	260,347	40.4%	39.3%
9	9	9	9	9	9	9	9																92	72	105,840	264,600	260,347	267,430	40.7%	39.6%
9.2	9.2	9.2	9.2	9.2	9.2	9.2	9.2																94	73.6	108,104	270,259	267,430	274,495	40.4%	39.4%
9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5																96	76	111,492	278,730	274,495	285,765	40.6%	39.0%
10	10	10	10	10	10	10	10																101	80	117,120	292,800	285,765	299,805	41.0%	39.1%
10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5																105	84	122,724	306,810	299,805	313,785	40.9%	39.1%
11	11	11	11	11	11	11	11																110	88	128,304	320,760	313,785	327,705	40.9%	39.2%
11.5	11.5	11.5	11.5	11.5	11.5	11.5	11.5																114	92	133,860	334,650	327,705	341,565	40.8%	39.2%
12	12	12	12	12	12	12	12																119	96	139,392	348,480	341,565	355,365	40.8%	39.2%
12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5																123	100	144,900	362,250	355,365	369,105	40.8%	39.3%
13	13	13	13	13	13	13	13																128	104	150,384	375,960	369,105	382,785	40.7%	39.3%
13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5																132	108	155,844	389,610	382,785	396,405	40.7%	39.3%
14	14	14	14	14	14	14	14																137	112	161,280	403,200	396,405	420,090	40.7%	38.4%
14	14	14	14	12	12	12	12	11																115	166,980	436,980				
14	14	14	14	14	14	12	12	12																120	174,240	444,240				
14	14	14	14	14	14	14	14	12																124	178,560	448,560				
14	14	14	14	14	14	12	12	12			12													132	191,664	461,664				
14	14	14	14	14	14	12	12	12			12		12											144	209,088	479,088				
14	14	14	14	14	14	12	12	12			12		12	12										156	226,512	496,512				
14	14	14	14	14	14	12	12	12			12		12	12		12								168	243,936	513,936				
14	14	14	14	14	14	12	12	12			12		12	12		12			12					180	261,360	531,360				
14	14	14	14	14	14	12	12	12			12		12	12		12			12	12				192	278,784	548,784				
14	14	14	14	14	14	12	12	12			12		12	12		12			12	12	4			196	284,592	554,592				
14	14	14	14	14	14	12	12	12			12		12	12		12			12	12	6			198	287,496	557,496				
14	14	14	14	14	14	14	14	14			14		14	14		14			14	14	7			217	312,480	582,480				
14	15	15	15	15	15	15	15	15			15		15	15		15			15	15	7			231	331,254	601,254				
14	16	16	16	16	16	16	16	16			16		16	16		16			16	16	8			246	351,288	621,288				
14	17	17	17	17	17	17	17	17			17		17	17		17			17	17	8			260	369,720	639,720				
15	18	18	18	18	18	18	18	18			18		18	18		18			18	18	9			276	390,816	660,816				
18	18	18	18	18	18	18	18	18			18		18	18		18			18	18	18			288	407,808	677,808				

The spill pattern in **Table TDA-6** was last revised on April 20, 2011.

Note 1: There is a 50 kcfs minimum generation powerhouse requirement. Thus 40% spill is not achievable until total river flow is ≥84 kcfs. At total river flow <84 kcfs, spill all flow that is above the powerhouse minimum generation requirement.

Note 2: Uniform spill patterns are critical to increasing juvenile fish survival through the tailrace. To accomplish the flat spill pattern, fixed amounts of spill will occur that result in hourly spill percentages within the ranges shown in the table above.

Note 3: The highlighted columns are spillbays that are operationally restricted because of structural or wire rope issues. Highlighted bays will be used only if needed for dam safety.

Note 4: If total river flow is between 90-150 kcfs, the spill percentage could range from 38.6% - 41.4%.

Note 5: If total river flow is between 150-300 kcfs, the spill percentage could range from 38.9% - 41.2%.

Note 6: If total river flow is between 300-420 kcfs, the spill percentage could range from 38.4% and 41.0%.

Note 7: If gate openings greater than shown in the table are needed, to the extent feasible, incrementally increase the gate openings.

Note 8: If available gates are fully open and additional spill is needed to limit surcharge of the reservoir, use spillbays 10, 11, 13, 16, 18, 19 and 23 (in that priority order), fully utilizing each spillbay as needed before moving to the next.

Section 4 – John Day Dam
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Section 4 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 2,000 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.

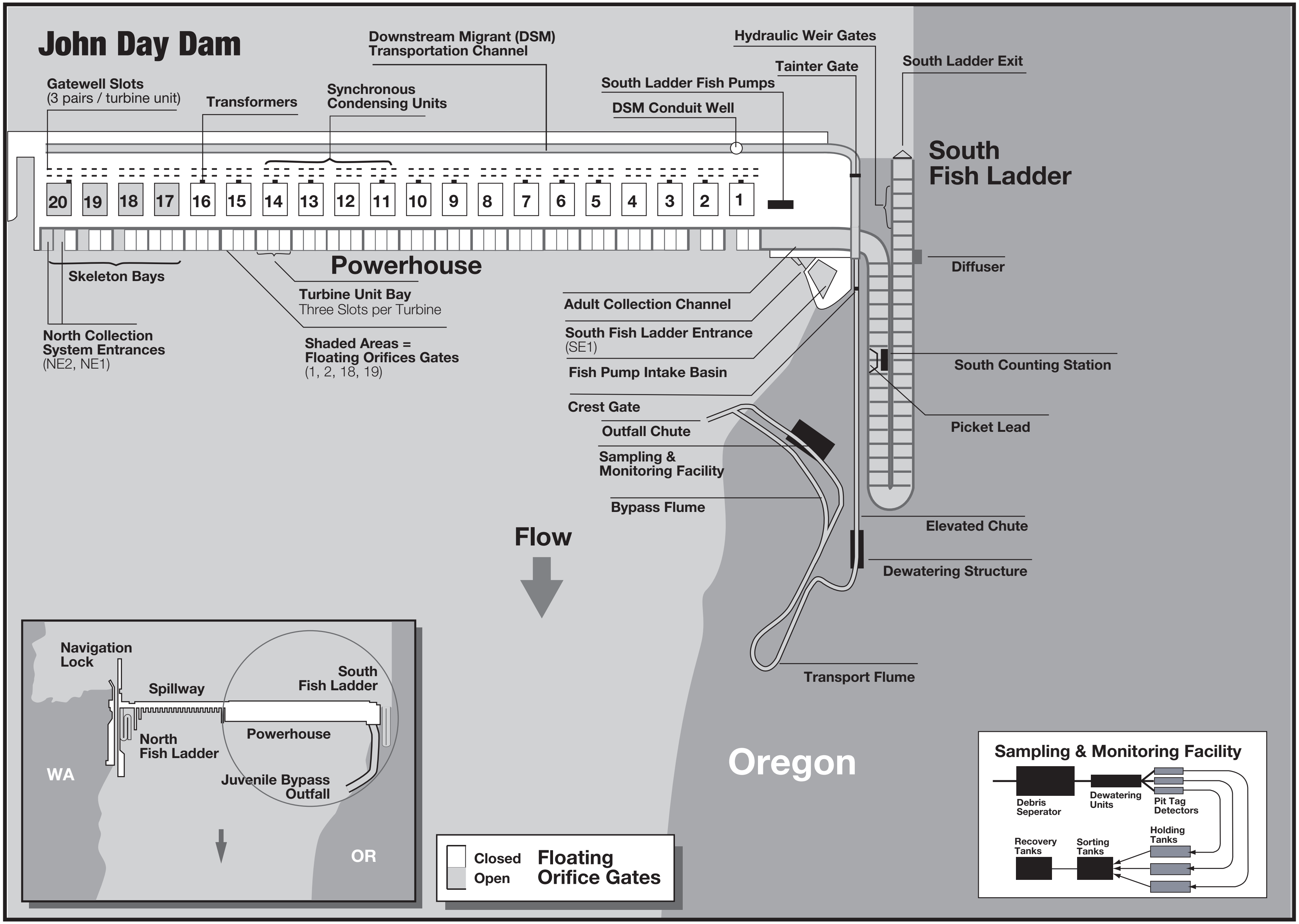

Figure JDA-1. John Day Dam South Fish Ladder, Powerhouse Collection System, and Juvenile Fish Bypass System.

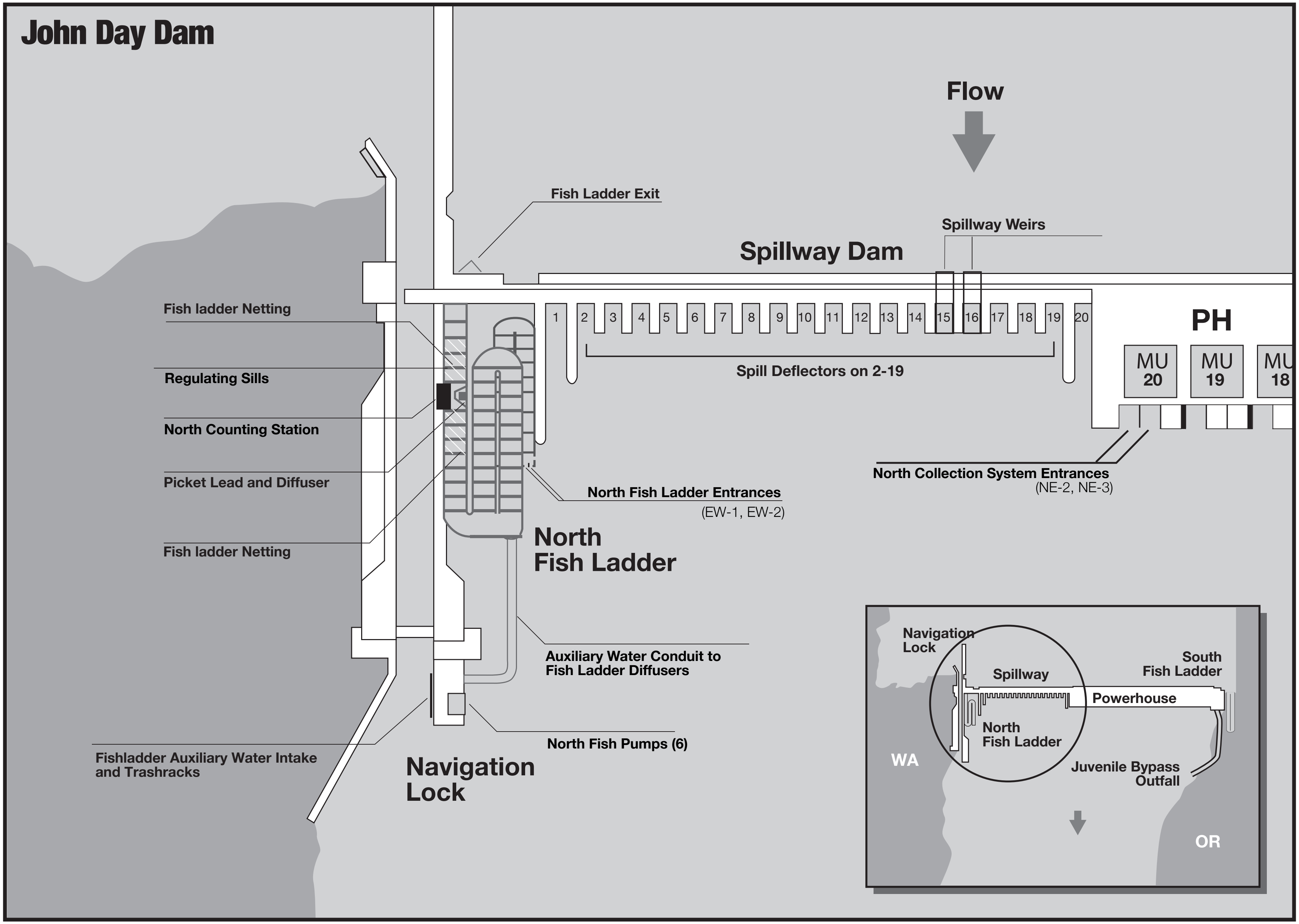

Figure JDA-2. John Day Dam Spillway and North Fish Ladder.

Table JDA-1. Dates of Project Operations for Fish Purposes at John Day Dam for 2012 Fish Passage Season and 2012-2013 Winter Maintenance Period.

Task Name	Start	Finish	Reference
2012 FISH PASSAGE SEASON	**3/1/12**	**11/30/12**	
Adult Fish Passage Season	3/1/12	11/30/12	JDA 2.5.1.2
Juvenile Fish Passage Season	4/1/12	11/30/12	JDA 2.4.1.2
2012-2013 WINTER MAINTENANCE PERIOD	**12/1/12**	**3/31/13**	
Winter Maintenance Adult Fish Facilities	12/1/12	2/28/13	JDA 1.2.2.2
Winter Maintenance Juvenile Fish Facilities	12/1/12	3/31/13	JDA 2.4.1.1
1% Constraints	**3/1/12**	**2/28/13**	**JDA 5.1**
1% soft constraint	3/1/12	3/31/12	
1% hard constraint	4/1/12	10/31/12	
1% soft constraint	11/1/12	2/28/13	
TDG Monitoring	**3/1/12**	**2/28/13**	**App D Table 1**
TDG Monitoring - Tailrace (year-round)	3/1/12	2/28/13	JHAW
TDG Monitoring - Forebay	4/1/12	8/31/12	JDY
Weekly Reports (year-round)	3/1/12	2/28/13	JDA 3.3.1
Adult Fish Counting	**4/1/12**	**10/31/12**	**JDA Table JDA-3**
Visual 0500-2100 DST	4/1/12	10/31/12	
Night Video Lamprey Count 2100-0500 DST	7/1/12	9/30/12	
Juvenile Fish Bypass System Operation	4/1/12	12/15/12	JDA 2.4.1.2
Submersible Traveling Screens Installed	4/1/12	12/15/12	JDA 2.4.1.2
Avian Abatement in Place	4/1/12	12/1/12	JDA 2.4.1.1 j
Adult Lamprey Study	4/1/12	10/31/12	App A JDA 2.1
Special Unit Raking	4/1/12	7/1/12	JDA 2.4.1.2 b
Active Avian Hazing	4/15/12	7/31/12	JDA 2.4.1.2.j
BiOp Performance Standard Testing (dates approximate)	4/21/12	7/15/12	App A JDA 2.3, App E
Research Equipment Maintenance Operations	5/1/12	7/31/12	App A JDA 2.4
Spill through Bay 2	9/1/12	11/30/12	JDA 2.2
Annual Report (for Dec 1, 2011 - Nov 30, 2012)	1/31/13	1/31/13	JTDA 3.3.4

2012: 1st Quarter (Jan, Feb, Mar), 2nd Quarter (Apr, May, Jun), 3rd Quarter (Jul, Aug, Sep), 4th Quarter (Oct, Nov, Dec); 2013: 1st Quarter (Jan, Feb, Mar)

1/31

Table JDA- 2. John Day Dam 10-Year Juvenile Salmonid Passage Data (2002-2011).

Yearling Chinook	10 %	50%	90 %	# of Days
2002	May 01	May 17	Jun 01	32
2003	May 03	May 19	Jun 02	31
2004	Apr 28	May 16	May 30	33
2005	Apr 25	May 12	May 22	28
2006	Apr 25	May 11	May 24	30
2007	May 02	May 13	May 25	24
2008	May 04	May 22	Jun 01	29
2009	Apr 27	May 17	Jun 01	36
2010	May 01	May 18	Jun 06	37
2011	May 02	May 17	May 28	27
MEDIAN	**Apr 29**	**May 16**	**May 31**	**33**
MIN	**Apr 20**	**May 09**	**May 22**	**24**
MAX	**May 06**	**May 27**	**Jun 20**	**46**

Subyearling Chinook*	10 %	50%	90 %	# of Days
2002	Jun 20	Jun 30	Jul 20	31
2003	Jun 06	Jun 27	Jul 30	55
2004	Jun 14	Jun 28	Jul 23	40
2005	Jun 19	Jul 05	Jul 27	39
2006	Jun 14	Jul 03	Jul 18	35
2007	Jun 25	Jul 08	Jul 17	23
2008	Jun 24	Jul 09	Aug 05	43
2009	Jun 17	Jul 01	Jul 17	31
2010	Jun 14	Jul 01	Jul 20	37
2011	Jun 16	Jul 14	Aug 3	49
MEDIAN*	**Jun 16**	**Jun 29**	**Jul 28**	**43**
MIN*	**Jun 06**	**Jun 27**	**Jul 20**	**23**
MAX*	**Jun 27**	**Jul 30**	**Aug 22**	**59**

Unclipped Steelhead	10 %	50%	90 %	# of Days
2002	Apr 19	May 19	Jun 08	51
2003	Apr 30	May 28	Jun 04	36
2004	Apr 30	May 23	Jun 02	34
2005	May 01	May 14	May 24	24
2006	Apr 24	May 13	May 29	36
2007	Apr 29	May 13	May 28	30
2008	May 06	May 21	Jun 01	27
2009	Apr 26	May 11	May 28	33
2010	Apr 27	May 12	Jun 08	43
2011	Apr 25	May 19	May 31	37
MEDIAN	**Apr 28**	**May 16**	**May 31**	**35**
MIN	**Apr 19**	**May 11**	**May 24**	**24**
MAX	**May 06**	**May 28**	**Jun 08**	**51**

Clipped Steelhead	10 %	50%	90 %	# of Days
2002	Apr 24	May 14	Jun 06	44
2003	May 02	May 29	Jun 04	34
2004	May 07	May 20	May 29	23
2005	May 04	May 19	May 26	23
2006	Apr 28	May 10	May 29	32
2007	May 04	May 12	May 26	23
2008	May 07	May 16	May 30	24
2009	Apr 29	May 10	May 27	29
2010	May 03	May 11	Jun 09	38
2011	Apr 19	May 19	May 30	42
MEDIAN	**May 02**	**May 15**	**May 29**	**28**
MIN	**Apr 19**	**May 10**	**May 26**	**23**
MAX	**May 07**	**May 29**	**Jun 9**	**44**

Coho	10 %	50%	90 %	# of Days
2002	May 07	Jun 01	Jun 12	37
2003	May 09	May 30	Jun 08	31
2004	May 12	May 27	Jun 12	32
2005	May 05	May 16	Jun 03	30
2006	May 10	May 26	Jun 12	27
2007	May 05	May 16	Jun 04	31
2008	May 11	May 25	Jun 06	27
2009	May 16	May 29	Jun 13	29
2010	May 09	Jun 03	Jun 16	39
2011	May 10	May 23	Jun 06	28
MEDIAN	**May 09**	**May 26**	**Jun 07**	**30**
MIN	**May 05**	**May 16**	**Jun 03**	**24**
MAX	**May 16**	**Jun 03**	**Jun 16**	**90**

Sockeye (Wild + Hatchery)	10 %	50%	90 %	# of Days
2002	May 09	May 21	Jun 02	25
2003	May 10	May 19	Jun 02	24
2004	May 20	Jun 01	Jun 12	24
2005	May 16	May 21	May 31	16
2006	May 07	May 20	May 30	24
2007	May 09	May 25	Jun 07	30
2008	May 22	May 29	Jun 06	16
2009	May 10	May 25	Jun 07	29
2010	May 11	May 29	Jun 09	30
2011	May 10	May 22	Jun 02	24
MEDIAN	**May 10**	**May 23**	**Jun 04**	**26**
MIN	**May 07**	**May 19**	**May 30**	**16**
MAX	**May 22**	**Jun 01**	**Jun 12**	**41**

* Subyearling Chinook median, min and max values based on data from 1998-2005. Data from 2006-2011 were not included due to potential bias from missed sample days resulting from the implementation of sampling protocols during periods of high water temperature (Appendix K).

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, lamprey) are typically counted from April 1 through October 31 (**Table JDA-3**), and count data appear daily 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, but do not appear on the Corps daily website total due to relative infrequency of passage. These data are posted in the Miscellaneous Fish Counts report during the passage season (updated periodically during the season) found on the Corps' web site and summarized in the Annual Fish Passage Report.

Table JDA- 3. Adult Fish Counting Schedule at John Day Dam.

Count Period	Counting Method and Hours
April 1 through October 31	Visual 0500–2100 hours (DST)
July 1 through September 30	Night Video Lamprey count 2100–0500 hours (DST)

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 count periods and peak passage timing through 2011. 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 2000-2011 appears in this table.

Table JDA- 4. Adult Count Periods and Peak Migration Timing at John Day Dam (based on fish count data from years 1968-2011).

Species	Count Period	Earliest Peak	Latest Peak
Spring Chinook	2/20 – 6/5	4/14	5/22
Summer Chinook	6/6 – 8/5	6/7	8/2
Fall Chinook	8/6 – 12/7	9/2	9/25
Steelhead	2/20 – 12/7	8/25	10/6
Sockeye	2/20 – 12/7	6/21	7/10
Coho	2/20 – 12/7	9/4	10/26
Lamprey*	2/20 – 12/7	7/16	8/12

***Peak lamprey migration timing based on lamprey count data for years 2000-2011.**

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 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 (e.g., TMT, FPOM, FFDRWG). Minimum spill level is 30% from April 10 through August 31.

2.3. Total Dissolved Gas (TDG) Management and Control. Total dissolved gas (TDG) levels at JDA 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 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 mid-April – July 31. However, there will be no avian abatement measures, other than avian lines, performed from August through mid-April 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 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 SMF Operation and Maintenance Manual.)

2.4.1.2. April 1 through November 30 (Juvenile 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 50% covered with debris. If, due to the volume of debris, it is not possible to keep the gatewell surfaces at least 50% 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 de-barking 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 SMF.

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. April 1 – September 15: the SMF will be monitored 24-hours per day, 7 days per week 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).

9. 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.

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

11. 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.

12. During any high debris loading periods (likely during spring run off) additional personnel may be required to keep the 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.

13. 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.

f. Outage periods will be minimized to the extent practicable. Only one ladder may be out of service or operating out of standard operating criteria at any one time, unless specifically coordinated.

2.5.1.2. March 1 through November 30 (Adult 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 at Bonneville Dam, 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°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. Fishway channel water velocities will be measured thrice weekly, daily preferred, during adult fish passage (Mar 1 – Dec 1) part of the fishway inspection program. Floats will be timed through all fishway channels that are supplemented by auxiliary water. Results will be provided in the project weekly fishway status report.

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. Instruments will be cleaned and/or recalibrated when necessary as soon as practicable.

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).

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, 19) and open associated auxiliary water diffusers (see also **2.5.1.2.a.4.**). During the fish turbine #3 overhaul, planned for 2011-2012, 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. 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. AWS closures (i.e. cleaning times);
f. Any 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 reporter 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.

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

3.3.4.2. 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.

3.3.4.3. 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 (see also **Overview** for the coordination form):

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 (STS). 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 50% covered with debris. If due to the volume of debris it is not possible to keep the gatewell surfaces at least 50% 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.

c. From September 15 through the end of February, spillbay gate 2 may be closed for up to one work day for maintenance activities. During the outage, spill gate 3 will be opened to provide attraction flow.

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 (section 5. Dewatering Plans).

4.3.1.3. Adult Fish Ladders and Counting Stations. Adult fish ladders will be dewatered once per year during the winter maintenance period. Unless specially coordinated, only one ladder will be dewatered at a time, with the other ladder 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 3.3.1.). 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 4.2.2).

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.

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

- **A.** SE-1 will be open with the weir crest 6' below the tailwater surface.
- **B.** Close NE1 and NE2.
- **C.** Cross channel bulkheads will be placed in the powerhouse collection channel between units 2 and 3.
- **D.** 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 Priorities at John Day Dam.

Season	Time of Day	Unit Operating Priority*
Fish Passage Season *without* TSWs[1]	24 hours / day	1-4 in any order, then 5-16 in any order.
Fish Passage Season *with* TSWs[1]	24 hours / day	5,1,3,16,14,12,10,8,15,2,11,7,4,13,9,6
Winter Maintenance Season	24 hours / day	any unit

*When a main unit is not available, the paired "sister unit" will be used to comply with the requested priority.

5.1. Guidelines for operating units within the 1% turbine efficiency range at various heads are shown in **Tables JDA-6** to **JDA-**7. 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.

[1] Temporary spillway weirs (TSWs) are installed at John Day, McNary and Little Goose dams. TSWs are differentiated from Removable Spillway Weirs (RSWs, installed at Lower Granite, Lower Monumental and Ice Harbor dams) by the ability to install, uninstall and move TSWs between spillbays using the project's gantry crane.

Table JDA- 6. Turbine Operating Ranges Within 1% of Best Efficiency at John Day Dam.

Head (feet)	With STSs Installed *				With ESBSs Installed **			
	Lower Limit		Upper Limit		Lower Limit		Upper Limit	
	(MW)	(cfs)	(MW)	(cfs)	(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	69.6	11,396	111.5	18,269
86	72.9	11,692	134.7	21,593	70.3	11,381	113.7	18,402
87	73.7	11,676	137.5	21,770	71.1	11,366	115.9	18,531
88	74.5	11,661	140.2	21,942	71.9	11,351	118.1	18,657
89	75.3	11,646	143.0	22,110	72.6	11,336	120.3	18,779
90	76.1	11,632	145.8	22,274	73.4	11,322	122.5	18,898
91	77.0	11,622	146.9	22,164	74.3	11,313	122.9	18,717
92	77.9	11,613	148.0	22,057	75.1	11,304	123.2	18,540
93	78.8	11,604	149.1	21,951	76.0	11,295	123.6	18,367
94	79.7	11,595	150.2	21,848	76.9	11,285	123.9	18,197
95	80.6	11,585	151.3	21,746	77.7	11,276	124.3	18,031
96	81.7	11,604	151.6	21,532	78.8	11,294	124.4	17,841
97	82.8	11,623	151.8	21,323	79.8	11,312	124.6	17,654
98	83.8	11,640	152.1	21,118	80.9	11,329	124.7	17,472
99	84.9	11,657	152.4	20,917	81.9	11,346	124.8	17,293
100	86.0	11,674	152.7	20,720	82.9	11,361	125.0	17,117
101	86.9	11,675	154.9	20,800	83.8	11,363	126.6	17,163
102	87.9	11,677	155.2	20,613	84.7	11,364	128.3	17,207
103	88.8	11,678	155.2	20,378	85.6	11,365	129.9	17,250
104	89.7	11,679	155.2	20,149	86.5	11,367	131.6	17,293
105	90.6	11,680	155.2	19,923	87.4	11,367	133.2	17,334
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				

* 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.

** 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- 7. Turbine Operating Ranges Within 1% of Best Efficiency with No Screens Installed at John Day Dam.

Head (Feet)	Lower Generator Limits (No Screens)		Upper Generator Limits (No Screens)	
	(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.

5.3. Units may be operationally tested for up to 30 minutes before going into maintenance status by running the unit at speed no load and various loads within the 1% criteria to allow pre-maintenance measurements and testing AND TO ALLOW ALL FISH TO MOVE THROUGH THE UNIT. Units may be operationally tested after maintenance or repair while remaining in maintenance or forced outage status. Operational testing may consist of running the unit for up to a cumulative time of 30 minutes (within 1% criteria) before it is returned to operational status. Operational testing OF UNIT UNDER MAINTENANCE is in addition to a unit in run status (E.G. MINIMUM GENERATION) required for power plant reliability. Operational testing may deviate from fish priority units and may require water that would otherwise be used for spill if the running unit for reliability is at its 1% minimum load. Water will be used from the

powerhouse allocation if possible, and water diverted from spill for operational testing will be minimized to that necessary to maintain and assure generation system reliability.

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. When draining the juvenile bypass channel, it is typical to flush the channel with only bay 16 bypass orifices open. Bay 16 gatewells will be dipped in advance to minimize the number of fish contained in this flushing water during fish passage season.

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 dewatered, operate unit with full load for a minimum 15 minutes prior to immediately installing tail logs. If not possible to load, run unit at speed-no-load for minimum 15 minutes. 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 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.** Miro Zyndol - (541) 506-7860 or (541) 980-9958. Home # available in Control Room.
>
> **2**. Bern Klatte (503) 808-4318 or Tammy Mackey (503) 961-5733.

9. Endnotes.

9.1. 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.

9.2. 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.

9.3. 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.

9.4. 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- 8. John Day Dam Spill Pattern with Temporary Spillway Weirs (TSWs).

SPILLWAY BAY NUMBER																	TSW	TSW		Total	SPILL
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	STOPS	Kcfs
0	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	6.1	6.1	0.0	12.1	19.4
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6.1	6.1	**1.0**	13.1	21.0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6.1	6.1	**1.5**	13.6	21.8
0	**1**	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6.1	6.1	1.5	14.6	23.4
0	1	**1**	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6.1	6.1	1.5	15.6	25.0
0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	**1**	6.1	6.1	1.5	16.6	26.6
0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	**1**	1	6.1	6.1	1.5	17.6	28.2
0	1	1	0	0	0	0	0	0	0	0	0	0	0	**1**	1	1	6.1	6.1	1.5	18.6	29.8
0	1	1	0	0	0	0	0	0	0	0	0	0	**1**	1	1	1	6.1	6.1	1.5	19.6	31.4
0	1	1	0	0	0	0	0	0	0	0	0	**1**	1	1	1	1	6.1	6.1	1.5	20.6	33.0
0	1	1	0	0	0	0	0	0	0	0	**1**	1	1	1	1	1	6.1	6.1	1.5	21.6	34.6
0	1	1	0	0	0	0	0	0	0	**1**	1	1	1	1	1	1	6.1	6.1	1.5	22.6	36.2
0	1	1	0	0	0	0	0	0	**1**	1	1	1	1	1	1	1	6.1	6.1	1.5	23.6	37.8
0	1	1	0	0	0	0	0	**1**	1	1	1	1	1	1	1	1	6.1	6.1	1.5	24.6	39.4
0	1	1	0	0	0	0	**1**	1	1	1	1	1	1	1	1	1	6.1	6.1	1.5	25.6	41.0
0	1	1	0	0	0	**1**	1	1	1	1	1	1	1	1	1	1	6.1	6.1	1.5	26.6	42.6
0	1	1	**1**	0	0	1	1	1	1	1	1	1	1	1	1	1	6.1	6.1	1.5	27.6	44.2
0	1	1	1	0	0	1	1	1	1	1	1	1	1	1	1	**1.5**	6.1	6.1	1.5	28.1	45.0
0	**1.5**	1	1	0	0	1	1	1	1	1	1	1	1	1	1	1.5	6.1	6.1	1.5	28.6	45.8
0	1.5	**1.5**	1	0	0	1	1	1	1	1	1	1	1	1	1	1.5	6.1	6.1	1.5	29.1	46.6
0	1.5	1.5	1	**1**	0	1	1	1	1	1	1	1	1	1	1	1.5	6.1	6.1	1.5	30.1	48.2
0	1.5	1.5	1	1	0	1	1	1	1	1	1	1	1	1	**1.5**	1.5	6.1	6.1	1.5	30.6	49.0
0	1.5	1.5	**1.5**	1	0	1	1	1	1	1	1	1	1	1	1.5	1.5	6.1	6.1	1.5	31.1	49.8
0	1.5	1.5	1.5	1	0	1	1	1	1	1	1	1	1	1	1.5	1.5	6.1	6.1	**2.0**	31.6	50.6
0	1.5	1.5	1.5	1	0	1	1	1	1	1	1	1	1	1	1.5	**2**	6.1	6.1	2.0	32.1	51.4
0	1.5	1.5	1.5	1	**1**	1	1	1	1	1	1	1	1	1	1.5	2	6.1	6.1	2.0	33.1	53.0
0	1.5	1.5	1.5	**1.5**	1	1	1	1	1	1	1	1	1	1	1.5	2	6.1	6.1	2.0	33.6	53.8
0	**2**	1.5	**1**	1.5	1	1	1	**1.5**	1	1	1	1	1	1	1.5	2	6.1	6.1	2.0	34.1	54.6
0	2	1.5	1	1.5	1	**1.5**	1	1.5	1	1	1	1	1	1	1.5	2	6.1	6.1	2.0	34.6	55.4
0	2	1.5	1	1.5	1	1.5	1	1.5	1	1	1	1	1	**1.5**	1.5	2	6.1	6.1	2.0	35.1	56.2
0	2	1.5	1	1.5	1	1.5	1	1.5	1	1	1	1	1	1.5	**2**	2	6.1	6.1	2.0	35.6	57.0
0	**2.5**	1.5	1	1.5	1	1.5	1	1.5	1	1	1	1	1	1.5	2	2	6.1	6.1	2.0	36.1	57.8
0	2.5	1.5	1	1.5	1	1.5	1	1.5	**1.5**	1	1	1	1	1.5	2	2	6.1	6.1	2.0	36.6	58.6
0	2.5	1.5	1	1.5	1	1.5	**1.5**	1.5	1.5	1	1	1	1	1.5	2	2	6.1	6.1	2.0	37.1	59.4
0	2.5	1.5	1	1.5	1	1.5	1.5	1.5	1.5	1	1	1	**1.5**	1.5	2	2	6.1	6.1	2.0	37.6	60.2
0	2.5	1.5	1	1.5	1	1.5	1.5	**2**	1.5	1	1	1	1.5	1.5	2	2	6.1	6.1	2.0	38.1	61.0
0	2.5	1.5	1	1.5	**1.5**	1.5	1.5	2	1.5	1	1	1	1.5	1.5	2	2	6.1	6.1	2.0	38.6	61.8
0	2.5	1.5	1	1.5	1.5	1.5	1.5	2	1.5	1	1	**1.5**	1.5	1.5	2	2	6.1	6.1	2.0	39.1	62.6
0	2.5	1.5	1	1.5	1.5	1.5	1.5	2	1.5	1	**1.5**	1.5	1.5	1.5	2	2	6.1	6.1	2.0	39.6	63.4
0	2.5	1.5	1	1.5	1.5	**2**	1.5	2	1.5	1	1.5	1.5	1.5	1.5	2	2	6.1	6.1	2.0	40.1	64.2
0	2.5	1.5	1	1.5	1.5	2	1.5	2	1.5	1	1.5	1.5	1.5	1.5	2	**2.5**	6.1	6.1	2.0	40.6	65.0
0	2.5	1.5	1	1.5	1.5	2	1.5	2	1.5	1	1.5	1.5	1.5	**2**	2	2.5	6.1	6.1	2.0	41.1	65.8
0	2.5	1.5	1	1.5	1.5	2	1.5	2	1.5	**1.5**	1.5	1.5	1.5	2	2	2.5	6.1	6.1	2.0	41.6	66.6
0	2.5	1.5	**1.5**	1.5	1.5	2	1.5	2	1.5	1.5	1.5	1.5	1.5	2	2	2.5	6.1	6.1	2.0	42.1	67.4
0	2.5	1.5	1.5	1.5	1.5	2	**2**	2	1.5	1.5	1.5	1.5	1.5	2	2	2.5	6.1	6.1	2.0	42.6	68.2
0	2.5	1.5	1.5	1.5	1.5	2	2	2	1.5	1.5	1.5	1.5	**2**	2	2	2.5	6.1	6.1	2.0	43.1	69.0
0	2.5	1.5	1.5	1.5	1.5	2	2	2	1.5	1.5	1.5	1.5	2	2	**2.5**	2.5	6.1	6.1	2.0	43.6	69.8
0	2.5	**2**	1.5	1.5	1.5	2	2	2	1.5	1.5	1.5	1.5	2	2	2.5	2.5	6.1	6.1	2.0	44.1	70.6
0	2.5	2	1.5	1.5	1.5	2	2	2	1.5	1.5	1.5	1.5	2	2	2.5	2.5	6.1	6.1	**2.5**	44.6	71.4
0	2.5	2	1.5	1.5	1.5	2	2	2	1.5	1.5	1.5	**2**	2	2	2.5	2.5	6.1	6.1	2.5	45.1	72.2
0	**3**	2	1.5	1.5	1.5	2	2	2	1.5	1.5	1.5	2	2	2	2.5	2.5	6.1	6.1	2.5	45.6	73.0
0	3	2	1.5	**2**	1.5	2	2	2	1.5	1.5	1.5	2	2	2	2.5	2.5	6.1	6.1	2.5	46.1	73.8
0	3	2	1.5	2	1.5	2	2	2	1.5	1.5	**2**	2	2	2	2.5	2.5	6.1	6.1	2.5	46.6	74.6
0	3	2	1.5	2	1.5	2	2	2	**2**	1.5	2	2	2	2	2.5	2.5	6.1	6.1	2.5	47.1	75.4
0	3	2	1.5	2	1.5	2	2	2	2	**2**	2	2	2	2	2.5	2.5	6.1	6.1	2.5	47.6	76.2
0	3	2	1.5	2	**2**	2	2	2	2	2	2	2	2	2	2.5	2.5	6.1	6.1	2.5	48.1	77.0
0	3	2	1.5	2	2	**2.5**	2	2	2	2	2	2	2	2	2.5	2.5	6.1	6.1	2.5	48.6	77.8
0	3	2	**2**	2	2	2.5	2	2	2	2	2	2	2	2	2.5	2.5	6.1	6.1	2.5	49.1	78.6
0	3	**2.5**	2	2	2	2.5	2	2	2	2	2	2	2	2	2.5	2.5	6.1	6.1	2.5	49.6	79.4
0	3	2.5	2	2	**2.5**	2.5	2	2	2	2	2	2	2	2	2.5	2.5	6.1	6.1	2.5	50.1	80.2
0	**3.5**	2.5	2	2	2.5	2.5	2	2	2	2	2	2	2	2	2.5	2.5	6.1	6.1	2.5	50.6	81.0
0	3.5	2.5	2	2	2.5	2.5	2	2	2	2	2	2	2	**2.5**	2.5	2.5	6.1	6.1	2.5	51.1	81.8
0	3.5	2.5	2	2	2.5	2.5	**2.5**	2	2	2	2	2	2	2.5	2.5	2.5	6.1	6.1	2.5	51.6	82.6
0	3.5	2.5	2	2	2.5	2.5	2.5	2	2	2	2	2	**2.5**	2.5	2.5	2.5	6.1	6.1	2.5	52.1	83.4
0	3.5	2.5	**1.5**	2	2.5	2.5	2.5	**2.5**	2	2	2	**2.5**	2.5	2.5	2.5	2.5	6.1	6.1	2.5	52.6	84.2
0	3.5	2.5	1.5	2	2.5	2.5	2.5	2.5	**2.5**	2	2	2.5	2.5	2.5	2.5	2.5	6.1	6.1	2.5	53.1	85.0
0	3.5	2.5	1.5	2	2.5	2.5	2.5	2.5	2.5	2	2	2.5	2.5	2.5	**3**	2.5	6.1	6.1	2.5	53.6	85.8
0	3.5	2.5	1.5	2	2.5	2.5	2.5	2.5	2.5	2	2	2.5	2.5	**3**	3	2.5	6.1	6.1	2.5	54.1	86.6
0	3.5	2.5	1.5	2	2.5	2.5	2.5	2.5	2.5	2	**2.5**	2.5	2.5	3	3	2.5	6.1	6.1	2.5	54.6	87.4
0	3.5	**3**	1.5	2	2.5	2.5	2.5	2.5	2.5	2	2.5	2.5	2.5	3	3	2.5	6.1	6.1	2.5	55.1	88.2
0	3.5	3	1.5	2	2.5	2.5	2.5	2.5	2.5	2	2.5	2.5	**3**	3	3	2.5	6.1	6.1	2.5	55.6	89.0
0	3.5	3	1.5	2	2.5	**3**	2.5	2.5	2.5	2	2.5	2.5	3	3	3	2.5	6.1	6.1	2.5	56.1	89.8
0	3.5	3	1.5	2	2.5	3	2.5	2.5	2.5	**2.5**	2.5	2.5	3	3	3	2.5	6.1	6.1	2.5	56.6	90.6
0	3.5	3	**2**	2	2.5	3	2.5	2.5	2.5	2.5	2.5	2.5	3	3	3	2.5	6.1	6.1	2.5	57.1	91.4
0	3.5	3	2	2	2.5	3	2.5	2.5	2.5	2.5	2.5	2.5	3	3	3	**3**	6.1	6.1	2.5	57.6	92.2
0	3.5	3	2	**2.5**	2.5	3	2.5	2.5	2.5	2.5	2.5	2.5	3	3	3	3	6.1	6.1	2.5	58.1	93.0
0	3.5	3	2	2.5	2.5	3	2.5	2.5	2.5	2.5	2.5	2.5	3	3	**3.5**	3	6.1	6.1	2.5	58.6	93.8
0	3.5	**3.5**	2	2.5	2.5	3	2.5	2.5	2.5	2.5	2.5	2.5	3	3	3.5	3	6.1	6.1	2.5	59.1	94.6
0	3.5	3.5	2	2.5	2.5	3	**3**	2.5	2.5	2.5	2.5	2.5	3	3	3.5	3	6.1	6.1	2.5	59.6	95.4
0	3.5	3.5	2	2.5	2.5	3	3	2.5	2.5	2.5	2.5	2.5	3	3	3.5	**3.5**	6.1	6.1	2.5	60.1	96.2
0	3.5	3.5	2	**3**	2.5	3	3	2.5	2.5	2.5	2.5	2.5	3	3	3.5	3.5	6.1	6.1	2.5	60.6	97.0
0	3.5	3.5	**2.5**	3	2.5	3	3	2.5	2.5	2.5	2.5	2.5	3	3	3.5	3.5	6.1	6.1	2.5	61.1	97.8
0	3.5	3.5	2.5	3	2.5	3	3	2.5	2.5	2.5	**3**	2.5	3	3	3.5	3.5	6.1	6.1	2.5	61.6	98.6
0	3.5	3.5	2.5	3	2.5	3	3	**3**	2.5	2.5	3	2.5	3	3	3.5	3.5	6.1	6.1	2.5	62.1	99.4
0	3.5	3.5	2.5	3	2.5	3	3	3	**3**	2.5	3	2.5	3	3	3.5	3.5	6.1	6.1	2.5	62.6	100.2

SPILLWAY BAY NUMBER																	TSW	TSW		Total	SPILL
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	STOPS	Kcfs
0	3.5	3.5	2.5	3	2.5	3	3	3	3	2.5	3	**3**	3	3	3.5	3.5	6.1	6.1	2.5	63.1	101.0
0	3.5	3.5	2.5	**3.5**	2.5	3	3	3	3	2.5	3	3	3	3	3.5	3.5	6.1	6.1	2.5	63.6	101.8
0	3.5	3.5	**3**	3.5	2.5	3	3	3	3	2.5	3	3	3	3	3.5	3.5	6.1	6.1	2.5	64.1	102.6
0	3.5	3.5	3	3.5	2.5	3	3	3	3	2.5	3	3	3	3	3.5	**4**	6.1	6.1	2.5	64.6	103.4
0	3.5	3.5	3	3.5	2.5	3	3	3	3	2.5	3	3	3	**3.5**	3.5	4	6.1	6.1	2.5	65.1	104.2
0	**4**	3.5	3	3.5	2.5	3	3	3	3	2.5	3	3	3	3.5	3.5	4	6.1	6.1	2.5	65.6	105.0
0	4	3.5	3	3.5	2.5	3	3	3	3	**3**	3	3	3	3.5	3.5	4	6.1	6.1	2.5	66.1	105.8
0	4	3.5	3	3.5	**3**	3	3	3	3	3	3	3	3	3.5	3.5	4	6.1	6.1	2.5	66.6	106.6
0	4	3.5	3	3.5	3	3	3	3	3	3	3	3	3	3.5	**4**	4	6.1	6.1	2.5	67.1	107.4
0	4	3.5	3	3.5	3	3	3	3	3	3	3	3	**3.5**	3.5	4	4	6.1	6.1	2.5	67.6	108.2
0	4	**4**	3	3.5	3	3	3	3	3	3	3	3	3.5	3.5	4	4	6.1	6.1	2.5	68.1	109.0
0	4	4	3	3.5	3	3	3	3	3	3	**3.5**	3	3.5	3.5	4	4	6.1	6.1	2.5	68.6	109.8
0	4	4	3	3.5	3	**3.5**	3	3	3	3	3.5	3	3.5	3.5	4	4	6.1	6.1	2.5	69.1	110.6
0	4	4	3	3.5	3	3.5	3	3	3	**3.5**	3.5	3	3.5	3.5	4	4	6.1	6.1	2.5	69.6	111.4
0	4	4	3	3.5	3	3.5	3	3	3	3.5	3.5	**3.5**	3.5	3.5	4	4	6.1	6.1	2.5	70.1	112.2
0	4	4	3	3.5	**3.5**	3.5	3	3	3	3.5	3.5	3.5	3.5	3.5	4	4	6.1	6.1	2.5	70.6	113.0
0	4	4	3	3.5	3.5	3.5	3	**3.5**	3	3.5	3.5	3.5	3.5	3.5	4	4	6.1	6.1	2.5	71.1	113.8
0	4	4	3	3.5	3.5	3.5	3	3.5	3	3.5	3.5	3.5	3.5	3.5	4	**4.5**	6.1	6.1	2.5	71.6	114.6
0	4	4	3	3.5	3.5	3.5	3	3.5	3	3.5	3.5	3.5	3.5	3.5	4	4.5	6.1	6.1	**3.0**	72.1	115.4
0	4	4	3	3.5	3.5	3.5	3	3.5	3	3.5	3.5	3.5	3.5	**4**	4	4.5	6.1	6.1	3.0	72.6	116.2
0	4	4	**3.5**	3.5	3.5	3.5	3	3.5	3	3.5	3.5	3.5	3.5	4	4	4.5	6.1	6.1	3.0	73.1	117.0
0	4	4	3.5	3.5	3.5	3.5	**3.5**	3.5	3	3.5	3.5	3.5	3.5	4	4	4.5	6.1	6.1	3.0	73.6	117.8
0	4	4	3.5	3.5	3.5	3.5	3.5	3.5	**3.5**	3.5	3.5	3.5	3.5	4	4	4.5	6.1	6.1	3.0	74.1	118.6
0	4	4	3.5	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	6.1	6.1	3.0	74.6	119.4
0	4	4	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	**4**	4	4.5	4.5	6.1	6.1	3.0	75.1	120.2
0	4	**4.5**	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	4	4	4.5	4.5	6.1	6.1	3.0	75.6	121.0
0	4	4.5	3.5	**4**	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	4	4	4.5	4.5	6.1	6.1	3.0	76.1	121.8
0	4	4.5	3.5	4	3.5	3.5	3.5	3.5	3.5	3.5	**4**	3.5	4	4	4.5	4.5	6.1	6.1	3.0	76.6	122.6
0	4	4.5	3.5	4	3.5	**4**	3.5	3.5	3.5	3.5	4	3.5	4	4	4.5	4.5	6.1	6.1	3.0	77.1	123.4
0	4	4.5	3.5	4	3.5	4	3.5	3.5	3.5	**4**	4	3.5	4	4	4.5	4.5	6.1	6.1	3.0	77.6	124.2
0	4	4.5	3.5	4	3.5	4	3.5	3.5	3.5	4	4	**4**	4	4	4.5	4.5	6.1	6.1	3.0	78.1	125.0
0	4	4.5	3.5	4	**4**	4	3.5	3.5	3.5	4	4	4	4	4	4.5	4.5	6.1	6.1	3.0	78.6	125.8
0	4	4.5	3.5	4	4	4	3.5	**4**	3.5	4	4	4	4	4	4.5	4.5	6.1	6.1	3.0	79.1	126.6
0	4	4.5	3.5	4	4	4	3.5	4	3.5	4	4	4	4	4	4.5	**5**	6.1	6.1	3.0	79.6	127.4
0	4	4.5	3.5	4	4	4	3.5	4	3.5	4	4	4	4	4	4.5	5	6.1	6.1	**3.5**	80.1	128.2
0	4	4.5	3.5	4	4	4	3.5	4	3.5	4	4	4	4	**4.5**	4.5	5	6.1	6.1	3.5	80.6	129.0
0	4	4.5	**4**	4	4	4	3.5	4	3.5	4	4	4	4	4.5	4.5	5	6.1	6.1	3.5	81.1	129.8
0	4	4.5	4	4	4	4	**4**	4	3.5	4	4	4	4	4.5	4.5	5	6.1	6.1	3.5	81.6	130.6
0	4	4.5	4	4	4	4	4	4	**4**	4	4	4	4	4.5	4.5	5	6.1	6.1	3.5	82.1	131.4
0	4	4.5	4	4	4	4	4	4	4	4	4	4	4	4.5	**5**	5	6.1	6.1	3.5	82.6	132.2
0	4	4.5	4	4	4	4	4	4	4	4	4	4	**4.5**	4.5	5	5	6.1	6.1	3.5	83.1	133.0
0	4	**5**	4	4	4	4	4	4	4	4	4	4	4.5	4.5	5	5	6.1	6.1	3.5	83.6	133.8
0	4	5	4	**4.5**	4	4	4	4	4	4	4	4	4.5	4.5	5	5	6.1	6.1	3.5	84.1	134.6
0	4	5	4	4.5	4	4	4	4	4	4	**4.5**	4	4.5	4.5	5	5	6.1	6.1	3.5	84.6	135.4
0	4	5	4	4.5	4	**4.5**	4	4	4	4	4.5	4	4.5	4.5	5	5	6.1	6.1	3.5	85.1	136.2
0	4	5	4	4.5	4	4.5	4	4	4	**4.5**	4.5	4	4.5	4.5	5	5	6.1	6.1	3.5	85.6	137.0
0	4	5	4	4.5	4	4.5	4	4	4	4.5	4.5	**4.5**	4.5	4.5	5	5	6.1	6.1	3.5	86.1	137.8
0	4	5	4	4.5	**4.5**	4.5	4	4	4	4.5	4.5	4.5	4.5	4.5	5	5	6.1	6.1	3.5	86.6	138.6
0	4	5	4	4.5	4.5	4.5	4	**4.5**	4	4.5	4.5	4.5	4.5	4.5	5	5	6.1	6.1	3.5	87.1	139.4
0	4	5	4	4.5	4.5	4.5	4	4.5	4	4.5	4.5	4.5	4.5	4.5	5	**5.5**	6.1	6.1	3.5	87.6	140.2
0	4	5	4	4.5	4.5	4.5	4	4.5	4	4.5	4.5	4.5	4.5	4.5	5	5.5	6.1	6.1	**4.0**	88.1	141.0
0	4	5	4	4.5	4.5	4.5	4	4.5	4	4.5	4.5	4.5	4.5	**5**	5	5.5	6.1	6.1	4.0	88.6	141.8
0	4	5	**4.5**	4.5	4.5	4.5	4	4.5	4	4.5	4.5	4.5	4.5	5	5	5.5	6.1	6.1	4.0	89.1	142.6
0	4	5	4.5	4.5	4.5	4.5	**4.5**	4.5	4	4.5	4.5	4.5	4.5	5	5	5.5	6.1	6.1	4.0	89.6	143.4
0	4	5	4.5	4.5	4.5	4.5	4.5	4.5	**4.5**	4.5	4.5	4.5	4.5	5	5	5.5	6.1	6.1	4.0	90.1	144.2
0	4	5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	5	**5.5**	5.5	6.1	6.1	4.0	90.6	145.0
0	4	5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	**5**	5	5.5	5.5	6.1	6.1	4.0	91.1	145.8
0	4	**5.5**	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	5	5	5.5	5.5	6.1	6.1	4.0	91.6	146.6
0	4	5.5	4.5	**5**	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	5	5	5.5	5.5	6.1	6.1	4.0	92.1	147.4
0	4	5.5	4.5	5	4.5	4.5	4.5	4.5	4.5	4.5	**5**	4.5	5	5	5.5	5.5	6.1	6.1	4.0	92.6	148.2
0	4	5.5	4.5	5	4.5	**5**	4.5	4.5	4.5	4.5	5	4.5	5	5	5.5	5.5	6.1	6.1	4.0	93.1	149.0
0	4	5.5	4.5	5	4.5	5	4.5	4.5	4.5	**5**	5	4.5	5	5	5.5	5.5	6.1	6.1	4.0	93.6	149.8
0	4	5.5	4.5	5	4.5	5	4.5	4.5	4.5	5	5	**5**	5	5	5.5	5.5	6.1	6.1	4.0	94.1	150.6
0	4	5.5	4.5	5	**5**	5	4.5	4.5	4.5	5	5	5	5	5	5.5	5.5	6.1	6.1	4.0	94.6	151.4
0	4	5.5	4.5	5	5	5	4.5	**5**	4.5	5	5	5	5	5	5.5	5.5	6.1	6.1	4.0	95.1	152.2
0	4	5.5	4.5	5	5	5	4.5	5	4.5	5	5	5	5	5	5.5	**6**	6.1	6.1	4.0	95.6	153.0
0	4	5.5	4.5	5	5	5	4.5	5	4.5	5	5	5	5	5	5.5	6	6.1	6.1	**4.5**	96.1	153.8
0	4	5.5	4.5	5	5	5	4.5	5	4.5	5	5	5	5	**5.5**	5.5	6	6.1	6.1	4.5	96.6	154.6
0	4	5.5	**5**	5	5	5	4.5	5	4.5	5	5	5	5	5.5	5.5	6	6.1	6.1	4.5	97.1	155.4
0	4	5.5	5	5	5	5	**5**	5	4.5	5	5	5	5	5.5	5.5	6	6.1	6.1	4.5	97.6	156.2
0	4	5.5	5	5	5	5	5	5	**5**	5	5	5	5	5.5	5.5	6	6.1	6.1	4.5	98.1	157.0
0	4	5.5	5	5	5	5	5	5	5	5	5	5	5	5.5	**6**	6	6.1	6.1	4.5	98.6	157.8
0	4	5.5	5	5	5	5	5	5	5	5	5	5	**5.5**	5.5	6	6	6.1	6.1	4.5	99.1	158.6
0	4	**6**	5	5	5	5	5	5	5	5	5	5	5.5	5.5	6	6	6.1	6.1	4.5	99.6	159.4
0	4	6	5	**5.5**	5	5	5	5	5	5	5	5	5.5	5.5	6	6	6.1	6.1	4.5	100.1	160.2
0	4	6	5	5.5	5	5	5	5	5	5	**5.5**	5	5.5	5.5	6	6	6.1	6.1	4.5	100.6	161.0
0	4	6	5	5.5	5	**5.5**	5	5	5	5	5.5	5	5.5	5.5	6	6	6.1	6.1	4.5	101.1	161.8
0	4	6	5	5.5	5	5.5	5	5	5	**5.5**	5.5	5	5.5	5.5	6	6	6.1	6.1	4.5	101.6	162.6
0	4	6	5	5.5	5	5.5	5	5	5	5.5	5.5	**5.5**	5.5	5.5	6	6	6.1	6.1	4.5	102.1	163.4
0	4	6	5	5.5	**5.5**	5.5	5	5	5	5.5	5.5	5.5	5.5	5.5	6	6	6.1	6.1	4.5	102.6	164.2
0	4	6	5	5.5	5.5	5.5	5	**5.5**	5	5.5	5.5	5.5	5.5	5.5	6	6	6.1	6.1	4.5	103.1	165.0
0	4	6	5	5.5	5.5	5.5	5	5.5	5	5.5	5.5	5.5	5.5	5.5	6	**6.5**	6.1	6.1	4.5	103.6	165.8
0	4	6	5	5.5	5.5	5.5	5	5.5	5	5.5	5.5	5.5	5.5	5.5	6	6.5	6.1	6.1	**5.0**	104.1	166.6
0	4	6	5	5.5	5.5	5.5	5	5.5	5	5.5	5.5	5.5	5.5	**6**	6	6.5	6.1	6.1	5.0	104.6	167.4
0	4	6	**5.5**	5.5	5.5	5.5	5	5.5	5	5.5	5.5	5.5	5.5	6	6	6.5	6.1	6.1	5.0	105.1	168.2

SPILLWAY BAY NUMBER																	TSW	TSW		Total	SPILL
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	STOPS	Kcfs
0	4	6	5.5	5.5	5.5	5.5	**5.5**	5.5	5	5.5	5.5	5.5	5.5	6	6	6.5	6.1	6.1	5.0	105.6	169.0
0	4	6	5.5	5.5	5.5	5.5	5.5	5.5	**5.5**	5.5	5.5	5.5	5.5	6	6	6.5	6.1	6.1	5.0	106.1	169.8
0	4	6	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	6	**6.5**	6.5	6.1	6.1	5.0	106.6	170.6
0	4	6	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	**6**	6	6.5	6.5	6.1	6.1	5.0	107.1	171.4
0	4	6	5.5	**6**	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	6	6	6.5	6.5	6.1	6.1	5.0	107.6	172.2
0	4	6	5.5	6	5.5	5.5	5.5	5.5	5.5	5.5	**6**	5.5	6	6	6.5	6.5	6.1	6.1	5.0	108.1	173.0
0	4	6	5.5	6	5.5	**6**	5.5	5.5	5.5	5.5	6	5.5	6	6	6.5	6.5	6.1	6.1	5.0	108.6	173.8
0	4	6	5.5	6	5.5	6	5.5	5.5	5.5	**6**	6	5.5	6	6	6.5	6.5	6.1	6.1	5.0	109.1	174.6
0	4	6	5.5	6	5.5	6	5.5	5.5	5.5	6	6	**6**	6	6	6.5	6.5	6.1	6.1	5.0	109.6	175.4
0	4	6	5.5	6	**6**	6	5.5	5.5	5.5	6	6	6	6	6	6.5	6.5	6.1	6.1	5.0	110.1	176.2
0	4	6	5.5	6	6	6	5.5	**6**	5.5	6	6	6	6	6	6.5	6.5	6.1	6.1	5.0	110.6	177.0
0	4	6	5.5	6	6	6	5.5	6	5.5	6	6	6	6	6	6.5	**7**	6.1	6.1	5.0	111.1	177.8
0	4	6	5.5	6	6	6	5.5	6	5.5	6	6	6	6	6	6.5	7	6.1	6.1	**5.5**	111.6	178.6
0	4	6	5.5	6	6	6	5.5	6	5.5	6	6	6	6	**6.5**	6.5	7	6.1	6.1	5.5	112.1	179.4
0	4	6	**6**	6	6	6	5.5	6	5.5	6	6	6	6	6.5	6.5	7	6.1	6.1	5.5	112.6	180.2
0	4	6	6	6	6	6	**6**	6	5.5	6	6	6	6	6.5	6.5	7	6.1	6.1	5.5	113.1	181.0
0	4	6	6	6	6	6	6	6	**6**	6	6	6	6	6.5	6.5	7	6.1	6.1	5.5	113.6	181.8
0	4	6	6	6	6	6	6	6	6	6	6	6	6	6.5	**7**	7	6.1	6.1	5.5	114.1	182.6
0	4	6	6	6	6	6	6	6	6	6	6	6	**6.5**	6.5	7	7	6.1	6.1	5.5	114.6	183.4
0	4	6	6	**6.5**	6	6	6	6	6	6	6	6	6.5	6.5	7	7	6.1	6.1	5.5	115.1	184.2
0	4	6	6	6.5	6	6	6	6	6	6	**6.5**	6	6.5	6.5	7	7	6.1	6.1	5.5	115.6	185.0
0	4	6	6	6.5	6	**6.5**	6	6	6	6	6.5	6	6.5	6.5	7	7	6.1	6.1	5.5	116.1	185.8
0	4	6	6	6.5	6	6.5	6	6	6	**6.5**	6.5	6	6.5	6.5	7	7	6.1	6.1	5.5	116.6	186.6
0	4	6	6	6.5	6	6.5	6	6	6	6.5	6.5	**6.5**	6.5	6.5	7	7	6.1	6.1	5.5	117.1	187.4
0	4	6	6	6.5	**6.5**	6.5	6	6	6	6.5	6.5	6.5	6.5	6.5	7	7	6.1	6.1	5.5	117.6	188.2
0	4	6	6	6.5	6.5	6.5	6	**6.5**	6	6.5	6.5	6.5	6.5	6.5	7	7	6.1	6.1	5.5	118.1	189.0
0	4	6	6	6.5	6.5	6.5	6	6.5	6	6.5	6.5	6.5	6.5	6.5	7	**7.5**	6.1	6.1	5.5	118.6	189.8
0	4	6	6	6.5	6.5	6.5	6	6.5	6	6.5	6.5	6.5	6.5	6.5	7	7.5	6.1	6.1	**6.0**	119.1	190.6
0	4	6	6	6.5	6.5	6.5	6	6.5	6	6.5	6.5	6.5	6.5	**7**	7	7.5	6.1	6.1	6.0	119.6	191.4
0	4	6	**6.5**	6.5	6.5	6.5	6	6.5	6	6.5	6.5	6.5	6.5	7	7	7.5	6.1	6.1	6.0	120.1	192.2
0	4	6	6.5	6.5	6.5	6.5	**6.5**	6.5	6	6.5	6.5	6.5	6.5	7	7	7.5	6.1	6.1	6.0	120.6	193.0
0	4	6	6.5	6.5	6.5	6.5	6.5	6.5	**6.5**	6.5	6.5	6.5	6.5	7	7	7.5	6.1	6.1	6.0	121.1	193.8
0	4	6	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	7	**7.5**	7.5	6.1	6.1	6.0	121.6	194.6
0	4	6	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	**7**	7	7.5	7.5	6.1	6.1	6.0	122.1	195.4
0	4	6	6.5	**7**	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	7	7	7.5	7.5	6.1	6.1	6.0	122.6	196.2
0	4	6	6.5	7	6.5	6.5	6.5	6.5	6.5	6.5	**7**	6.5	7	7	7.5	7.5	6.1	6.1	6.0	123.1	197.0
0	4	6	6.5	7	6.5	**7**	6.5	6.5	6.5	6.5	7	6.5	7	7	7.5	7.5	6.1	6.1	6.0	123.6	197.8
0	4	6	6.5	7	6.5	7	6.5	6.5	6.5	**7**	7	6.5	7	7	7.5	7.5	6.1	6.1	6.0	124.1	198.6
0	4	6	6.5	7	6.5	7	6.5	6.5	6.5	7	7	**7**	7	7	7.5	7.5	6.1	6.1	6.0	124.6	199.4
0	4	6	6.5	7	**7**	7	6.5	6.5	6.5	7	7	7	7	7	7.5	7.5	6.1	6.1	6.0	125.1	200.2
0	4	6	6.5	7	7	7	6.5	**7**	6.5	7	7	7	7	7	7.5	7.5	6.1	6.1	6.0	125.6	201.0
0	4	6	6.5	7	7	7	6.5	7	6.5	7	7	7	7	7	7.5	**8**	6.1	6.1	6.0	126.1	201.8
0	4	6	6.5	7	7	7	6.5	7	6.5	7	7	7	7	7	7.5	8	6.1	6.1	**6.5**	126.6	202.6
0	4	6	6.5	7	7	7	6.5	7	6.5	7	7	7	7	**7.5**	7.5	8	6.1	6.1	6.5	127.1	203.4
0	4	6	**7**	7	7	7	6.5	7	6.5	7	7	7	7	7.5	7.5	8	6.1	6.1	6.5	127.6	204.2
0	4	6	7	7	7	7	**7**	7	6.5	7	7	7	7	7.5	7.5	8	6.1	6.1	6.5	128.1	205.0
0	4	6	7	7	7	7	7	7	**7**	7	7	7	7	7.5	7.5	8	6.1	6.1	6.5	128.6	205.8
0	4	6	7	7	7	7	7	7	7	7	7	7	7	7.5	**8**	8	6.1	6.1	6.5	129.1	206.6
0	4	6	7	7	7	7	7	7	7	7	7	7	**7.5**	7.5	8	8	6.1	6.1	6.5	129.6	207.4
0	4	6	7	**7.5**	7	7	7	7	7	7	7	7	7.5	7.5	8	8	6.1	6.1	6.5	130.1	208.2
0	4	6	7	7.5	7	7	7	7	7	7	**7.5**	7	7.5	7.5	8	8	6.1	6.1	6.5	130.6	209.0
0	4	6	7	7.5	7	**7.5**	7	7	7	7	7.5	7	7.5	7.5	8	8	6.1	6.1	6.5	131.1	209.8
0	4	6	7	7.5	7	7.5	7	7	7	**7.5**	7.5	7	7.5	7.5	8	8	6.1	6.1	6.5	131.6	210.6
0	4	6	7	7.5	7	7.5	7	7	7	7.5	7.5	**7.5**	7.5	7.5	8	8	6.1	6.1	6.5	132.1	211.4
0	4	6	7	7.5	**7.5**	7.5	7	7	7	7.5	7.5	7.5	7.5	7.5	8	8	6.1	6.1	6.5	132.6	212.2
0	4	6	7	7.5	7.5	7.5	7	**7.5**	7	7.5	7.5	7.5	7.5	7.5	8	8	6.1	6.1	6.5	133.1	213.0
0	4	6	7	7.5	7.5	7.5	7	7.5	7	7.5	7.5	7.5	7.5	7.5	8	**8.5**	6.1	6.1	6.5	133.6	213.8
0	4	6	7	7.5	7.5	7.5	7	7.5	7	7.5	7.5	7.5	7.5	7.5	8	8.5	6.1	6.1	**7.0**	134.1	214.6
0	4	6	7	7.5	7.5	7.5	7	7.5	7	7.5	7.5	7.5	7.5	**8**	8	8.5	6.1	6.1	7.0	134.6	215.4
0	4	6	**7.5**	7.5	7.5	7.5	7	7.5	7	7.5	7.5	7.5	7.5	8	8	8.5	6.1	6.1	7.0	135.1	216.2
0	4	6	7.5	7.5	7.5	7.5	**7.5**	7.5	7	7.5	7.5	7.5	7.5	8	8	8.5	6.1	6.1	7.0	135.6	217.0
0	4	6	7.5	7.5	7.5	7.5	7.5	7.5	**7.5**	7.5	7.5	7.5	7.5	8	8	8.5	6.1	6.1	7.0	136.1	217.8
0	4	6	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	8	**8.5**	8.5	6.1	6.1	7.0	136.6	218.6
0	4	6	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	**8**	8	8.5	8.5	6.1	6.1	7.0	137.1	219.4
0	4	6	7.5	**8**	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	8	8	8.5	8.5	6.1	6.1	7.0	137.6	220.2
0	4	6	7.5	8	7.5	7.5	7.5	7.5	7.5	7.5	**8**	7.5	8	8	8.5	8.5	6.1	6.1	7.0	138.1	221.0
0	4	6	7.5	8	7.5	**8**	7.5	7.5	7.5	7.5	8	7.5	8	8	8.5	8.5	6.1	6.1	7.0	138.6	221.8
0	4	6	7.5	8	7.5	8	7.5	7.5	7.5	**8**	8	7.5	8	8	8.5	8.5	6.1	6.1	7.0	139.1	222.6
0	4	6	7.5	8	7.5	8	7.5	7.5	7.5	8	8	**8**	8	8	8.5	8.5	6.1	6.1	7.0	139.6	223.4
0	4	6	7.5	8	**8**	8	7.5	7.5	7.5	8	8	8	8	8	8.5	8.5	6.1	6.1	7.0	140.1	224.2
0	4	6	7.5	8	8	8	7.5	**8**	7.5	8	8	8	8	8	8.5	8.5	6.1	6.1	7.0	140.6	225.0
0	4	6	7.5	8	8	8	7.5	8	7.5	8	8	8	8	8	8.5	**9**	6.1	6.1	7.0	141.1	225.8
0	4	6	7.5	8	8	8	7.5	8	7.5	8	8	8	8	8	8.5	9	6.1	6.1	**7.5**	141.6	226.6
0	4	6	7.5	8	8	8	7.5	8	7.5	8	8	8	8	**8.5**	8.5	9	6.1	6.1	7.5	142.1	227.4
0	4	6	**8**	8	8	8	7.5	8	7.5	8	8	8	8	8.5	8.5	9	6.1	6.1	7.5	142.6	228.2
0	4	6	8	8	8	8	**8**	8	7.5	8	8	8	8	8.5	8.5	9	6.1	6.1	7.5	143.1	229.0
0	4	6	8	8	8	8	8	8	**8**	8	8	8	8	8.5	8.5	9	6.1	6.1	7.5	143.6	229.8
0	4	6	8	8	8	8	8	8	8	8	8	8	8	8.5	**9**	9	6.1	6.1	7.5	144.1	230.6
0	4	6	8	8	8	8	8	8	8	8	8	8	**8.5**	8.5	9	9	6.1	6.1	7.5	144.6	231.4
0	4	6	8	**8.5**	8	8	8	8	8	8	8	8	8.5	8.5	9	9	6.1	6.1	7.5	145.1	232.2
0	4	6	8	8.5	8	8	8	8	8	8	**8.5**	8	8.5	8.5	9	9	6.1	6.1	7.5	145.6	233.0
0	4	6	8	8.5	8	**8.5**	8	8	8	8	8.5	8	8.5	8.5	9	9	6.1	6.1	7.5	146.1	233.8
0	4	6	8	8.5	8	8.5	8	8	8	**8.5**	8.5	8	8.5	8.5	9	9	6.1	6.1	7.5	146.6	234.6
0	4	6	8	8.5	8	8.5	8	8	8	8.5	8.5	**8.5**	8.5	8.5	9	9	6.1	6.1	7.5	147.1	235.4
0	4	6	8	8.5	**8.5**	8.5	8	8	8	8.5	8.5	8.5	8.5	8.5	9	9	6.1	6.1	7.5	147.6	236.2

SPILLWAY BAY NUMBER																	TSW	TSW		Total	SPILL
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	STOPS	Kcfs
0	4	6	8	8.5	8.5	8.5	8	**8.5**	8	8.5	8.5	8.5	8.5	8.5	9	9	6.1	6.1	7.5	148.1	237.0
0	4	6	8	8.5	8.5	8.5	8	8.5	8	8.5	8.5	8.5	8.5	8.5	9	**9.5**	6.1	6.1	7.5	148.6	237.8
0	4	6	8	8.5	8.5	8.5	8	8.5	8	8.5	8.5	8.5	8.5	8.5	9	9.5	6.1	6.1	**8.0**	149.1	238.6
0	4	6	8	8.5	8.5	8.5	8	8.5	8	8.5	8.5	8.5	8.5	**9**	9	9.5	6.1	6.1	8.0	149.6	239.4
0	4	6	8	8.5	8.5	8.5	**8.5**	8.5	8	8.5	8.5	8.5	8.5	9	9	9.5	6.1	6.1	8.0	150.1	240.2
0	4	6	8	8.5	8.5	8.5	8.5	8.5	**8.5**	8.5	8.5	8.5	8.5	9	9	9.5	6.1	6.1	8.0	150.6	241.0
0	4	6	8	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5	9	**9.5**	9.5	6.1	6.1	8.0	151.1	241.8
0	4	6	8	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5	**9**	9	9.5	9.5	6.1	6.1	8.0	151.6	242.6
0	4	6	8	**9**	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5	9	9	9.5	9.5	6.1	6.1	8.0	152.1	243.4
0	4	6	8	9	8.5	8.5	8.5	8.5	8.5	8.5	**9**	8.5	9	9	9.5	9.5	6.1	6.1	8.0	152.6	244.2
0	4	6	8	9	8.5	**9**	8.5	8.5	8.5	8.5	9	8.5	9	9	9.5	9.5	6.1	6.1	8.0	153.1	245.0
0	4	6	8	9	8.5	9	8.5	8.5	8.5	**9**	9	8.5	9	9	9.5	9.5	6.1	6.1	8.0	153.6	245.8
0	4	6	8	9	8.5	9	8.5	8.5	8.5	9	9	**9**	9	9	9.5	9.5	6.1	6.1	8.0	154.1	246.6
0	4	6	8	9	**9**	9	8.5	8.5	8.5	9	9	9	9	9	9.5	9.5	6.1	6.1	8.0	154.6	247.4
0	4	6	8	9	9	9	8.5	**9**	8.5	9	9	9	9	9	9.5	9.5	6.1	6.1	8.0	155.1	248.2
0	4	6	8	9	9	9	8.5	9	8.5	9	9	9	9	9	9.5	**10**	6.1	6.1	8.0	155.6	249.0
0	4	6	8	9	9	9	8.5	9	8.5	9	9	9	9	9	9.5	10	6.1	6.1	**8.5**	156.1	249.8
0	4	6	8	9	9	9	8.5	9	8.5	9	9	9	9	**9.5**	9.5	10	6.1	6.1	8.5	156.6	250.6
0	4	6	8	9	9	9	**9**	9	8.5	9	9	9	9	9.5	9.5	10	6.1	6.1	8.5	157.1	251.4
0	4	6	8	9	9	9	9	9	**9**	9	9	9	9	9.5	9.5	10	6.1	6.1	8.5	157.6	252.2
0	4	6	8	9	9	9	9	9	9	9	9	9	9	9.5	**10**	10	6.1	6.1	8.5	158.1	253.0
0	4	6	8	9	9	9	9	9	9	9	9	9	**9.5**	9.5	10	10	6.1	6.1	8.5	158.6	253.8
0	4	6	8	**9.5**	9	9	9	9	9	9	9	9	9.5	9.5	10	10	6.1	6.1	8.5	159.1	254.6
0	4	6	8	9.5	9	9	9	9	9	9	**9.5**	9	9.5	9.5	10	10	6.1	6.1	8.5	159.6	255.4
0	4	6	8	9.5	9	**9.5**	9	9	9	9	9.5	9	9.5	9.5	10	10	6.1	6.1	8.5	160.1	256.2
0	4	6	8	9.5	9	9.5	9	9	9	**9.5**	9.5	9	9.5	9.5	10	10	6.1	6.1	8.5	160.6	257.0
0	4	6	8	9.5	9	9.5	9	9	9	9.5	9.5	**9.5**	9.5	9.5	10	10	6.1	6.1	8.5	161.1	257.8
0	4	6	8	9.5	**9.5**	9.5	9	9	9	9.5	9.5	9.5	9.5	9.5	10	10	6.1	6.1	8.5	161.6	258.6
0	4	6	8	9.5	9.5	9.5	9	**9.5**	9	9.5	9.5	9.5	9.5	9.5	10	10	6.1	6.1	8.5	162.1	259.4
0	4	6	8	9.5	9.5	9.5	9	9.5	9	9.5	9.5	9.5	9.5	9.5	10	**10.5**	6.1	6.1	8.5	162.6	260.2
0	4	6	8	9.5	9.5	9.5	9	9.5	9	9.5	9.5	9.5	9.5	9.5	10	10.5	6.1	6.1	**9.0**	163.1	261.0
0	4	6	8	9.5	9.5	9.5	9	9.5	9	9.5	9.5	9.5	9.5	**10**	10	10.5	6.1	6.1	9.0	163.6	261.8
0	4	6	8	9.5	9.5	9.5	**9.5**	9.5	9	9.5	9.5	9.5	9.5	10	10	10.5	6.1	6.1	9.0	164.1	262.6
0	4	6	8	9.5	9.5	9.5	9.5	9.5	**9.5**	9.5	9.5	9.5	9.5	10	10	10.5	6.1	6.1	9.0	164.6	263.4
0	4	6	8	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5	10	**10.5**	10.5	6.1	6.1	9.0	165.1	264.2
0	4	6	8	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5	**10**	10	10.5	10.5	6.1	6.1	9.0	165.6	265.0
0	4	6	8	**10**	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5	10	10	10.5	10.5	6.1	6.1	9.0	166.1	265.8
0	4	6	8	10	9.5	9.5	9.5	9.5	9.5	9.5	**10**	9.5	10	10	10.5	10.5	6.1	6.1	9.0	166.6	266.6
0	4	6	8	10	9.5	**10**	9.5	9.5	9.5	9.5	10	9.5	10	10	10.5	10.5	6.1	6.1	9.0	167.1	267.4
0	4	6	8	10	9.5	10	9.5	9.5	9.5	**10**	10	9.5	10	10	10.5	10.5	6.1	6.1	9.0	167.6	268.2
0	4	6	8	10	9.5	10	9.5	9.5	9.5	10	10	**10**	10	10	10.5	10.5	6.1	6.1	9.0	168.1	269.0
0	4	6	8	10	**10**	10	9.5	9.5	9.5	10	10	10	10	10	10.5	10.5	6.1	6.1	9.0	168.6	269.8
0	4	6	8	10	10	10	9.5	**10**	9.5	10	10	10	10	10	10.5	10.5	6.1	6.1	9.0	169.1	270.6
0	4	6	8	10	10	10	9.5	10	9.5	10	10	10	10	10	10.5	**11**	6.1	6.1	9.0	169.6	271.4
0	4	6	8	10	10	10	9.5	10	9.5	10	10	10	10	10	10.5	11	6.1	6.1	**9.5**	170.1	272.2
0	4	6	8	10	10	10	9.5	10	9.5	10	10	10	10	**10.5**	10.5	11	6.1	6.1	9.5	170.6	273.0
0	4	6	8	10	10	10	**10**	10	9.5	10	10	10	10	10.5	10.5	11	6.1	6.1	9.5	171.1	273.8
0	4	6	8	10	10	10	10	10	**10**	10	10	10	10	10.5	10.5	11	6.1	6.1	9.5	171.6	274.6
0	4	6	8	10	10	10	10	10	10	10	10	10	10	10.5	**11**	11	6.1	6.1	9.5	172.1	275.4
0	4	6	8	10	10	10	10	10	10	10	10	10	**10.5**	10.5	11	11	6.1	6.1	9.5	172.6	276.2
0	4	6	8	**10.5**	10	10	10	10	10	10	10	10	10.5	10.5	11	11	6.1	6.1	9.5	173.1	277.0
0	4	6	8	10.5	10	10	10	10	10	10	**10.5**	10	10.5	10.5	11	11	6.1	6.1	9.5	173.6	277.8
0	4	6	8	10.5	10	**10.5**	10	10	10	10	10.5	10	10.5	10.5	11	11	6.1	6.1	9.5	174.1	278.6
0	4	6	8	10.5	10	10.5	10	10	10	**10.5**	10.5	10	10.5	10.5	11	11	6.1	6.1	9.5	174.6	279.4
0	4	6	8	10.5	10	10.5	10	10	10	10.5	10.5	**10.5**	10.5	10.5	11	11	6.1	6.1	9.5	175.1	280.2
0	4	6	8	10.5	**10.5**	10.5	10	10	10	10.5	10.5	10.5	10.5	10.5	11	11	6.1	6.1	9.5	175.6	281.0
0	4	6	8	10.5	10.5	10.5	10	**10.5**	10	10.5	10.5	10.5	10.5	10.5	11	11	6.1	6.1	9.5	176.1	281.8
0	4	6	8	10.5	10.5	10.5	10	10.5	10	10.5	10.5	10.5	10.5	10.5	11	**11.5**	6.1	6.1	9.5	176.6	282.6
0	4	6	8	10.5	10.5	10.5	10	10.5	10	10.5	10.5	10.5	10.5	10.5	11	11.5	6.1	6.1	**10.0**	177.1	283.4
0	4	6	8	10.5	10.5	10.5	10	10.5	10	10.5	10.5	10.5	10.5	**11**	11	11.5	6.1	6.1	10.0	177.6	284.2
0	4	6	8	10.5	10.5	10.5	**10.5**	10.5	10	10.5	10.5	10.5	10.5	11	11	11.5	6.1	6.1	10.0	178.1	285.0
0	4	6	8	10.5	10.5	10.5	10.5	10.5	**10.5**	10.5	10.5	10.5	10.5	11	11	11.5	6.1	6.1	10.0	178.6	285.8
0	4	6	8	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	11	**11.5**	11.5	6.1	6.1	10.0	179.1	286.6
0	4	6	8	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	**11**	11	11.5	11.5	6.1	6.1	10.0	179.6	287.4
0	4	6	8	**11**	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	11	11	11.5	11.5	6.1	6.1	10.0	180.1	288.2
0	4	6	8	11	10.5	10.5	10.5	10.5	10.5	10.5	**11**	10.5	11	11	11.5	11.5	6.1	6.1	10.0	180.6	289.0
0	4	6	8	11	10.5	**11**	10.5	10.5	10.5	10.5	11	10.5	11	11	11.5	11.5	6.1	6.1	10.0	181.1	289.8
0	4	6	8	11	10.5	11	10.5	10.5	10.5	**11**	11	10.5	11	11	11.5	11.5	6.1	6.1	10.0	181.6	290.6
0	4	6	8	11	10.5	11	10.5	10.5	10.5	11	11	**11**	11	11	11.5	11.5	6.1	6.1	10.0	182.1	291.4
0	4	6	8	11	**11**	11	10.5	10.5	10.5	11	11	11	11	11	11.5	11.5	6.1	6.1	10.0	182.6	292.2
0	4	6	8	11	11	11	10.5	**11**	10.5	11	11	11	11	11	11.5	11.5	6.1	6.1	10.0	183.1	293.0
0	4	6	8	11	11	11	10.5	11	10.5	11	11	11	11	11	11.5	**12**	6.1	6.1	10.0	183.6	293.8
0	4	6	8	11	11	11	10.5	11	10.5	11	11	11	11	11	11.5	12	6.1	6.1	**10.5**	184.1	294.6
0	4	6	8	11	11	11	10.5	11	10.5	11	11	11	11	**11.5**	11.5	12	6.1	6.1	10.5	184.6	295.4
0	4	6	8	11	11	11	**11**	11	10.5	11	11	11	11	11.5	11.5	12	6.1	6.1	10.5	185.1	296.2
0	4	6	8	11	11	11	11	11	**11**	11	11	11	11	11.5	11.5	12	6.1	6.1	10.5	185.6	297.0
0	4	6	8	11	11	11	11	11	11	11	11	11	11	11.5	**12**	12	6.1	6.1	10.5	186.1	297.8
0	4	6	8	11	11	11	11	11	11	11	11	11	**11.5**	11.5	12	12	6.1	6.1	10.5	186.6	298.6
0	4	6	8	**11.5**	11	11	11	11	11	11	11	11	11.5	11.5	12	12	6.1	6.1	10.5	187.1	299.4
0	4	6	8	11.5	11	11	11	11	11	11	**11.5**	11	11.5	11.5	12	12	6.1	6.1	10.5	187.6	300.2
0	4	6	8	11.5	11	**11.5**	11	11	11	11	11.5	11	11.5	11.5	12	12	6.1	6.1	10.5	188.1	301.0
0	4	6	8	11.5	11	11.5	11	11	11	**11.5**	11.5	11	11.5	11.5	12	12	6.1	6.1	10.5	188.6	301.8
0	4	6	8	11.5	11	11.5	11	11	11	11.5	11.5	**11.5**	11.5	11.5	12	12	6.1	6.1	10.5	189.1	302.6
0	4	6	8	11.5	**11.5**	11.5	11	11	11	11.5	11.5	11.5	11.5	11.5	12	12	6.1	6.1	10.5	189.6	303.4
0	4	6	8	11.5	11.5	11.5	11	**11.5**	11	11.5	11.5	11.5	11.5	11.5	12	12	6.1	6.1	10.5	190.1	304.2

SPILLWAY BAY NUMBER																	TSW	TSW		Total	SPILL	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	STOPS	Kcfs	
0	4	6	8	11.5	11.5	11.5	11	11.5	11	11.5	11.5	11.5	11.5	11.5	12	12	6.1	6.1	11.0	190.6	305.0	(1)
0	4	6	8	11.5	11.5	11.5	11.5	11.5	11	11.5	11.5	11.5	11.5	11.5	12	12	6.1	6.1	11.0	191.1	305.8	
0	4	6	8	11.5	11.5	11.5	11.5	11.5	11	11.5	11.5	11.5	12	11.5	12	12	6.1	6.1	11.0	191.6	306.6	
0	4	6	8	11.5	11.5	11.5	11.5	11.5	11	11.5	12	11.5	12	11.5	12	12	6.1	6.1	11.0	192.1	307.4	
0	4	6	8	11.5	11.5	11.5	11.5	11.5	11.5	11.5	12	11.5	12	11.5	12	12	6.1	6.1	11.0	192.6	308.2	
0	4	6	8	11.5	11.5	11.5	12	11.5	11.5	11.5	12	11.5	12	11.5	12	12	6.1	6.1	11.0	193.1	309.0	
0	4	6	8	11.5	12	11.5	12	11.5	11.5	11.5	12	11.5	12	11.5	12	12	6.1	6.1	11.0	193.6	309.8	
0	4	6	8	12	12	11.5	12	11.5	11.5	11.5	12	11.5	12	11.5	12	12	6.1	6.1	11.0	194.1	310.6	
0	4	6	8	12	12	11.5	12	11.5	11.5	11.5	12	11.5	12	12	12	12	6.1	6.1	11.0	194.6	311.4	
0	4	6	8	12	12	11.5	12	11.5	11.5	11.5	12	12	12	12	12	12	6.1	6.1	11.0	195.1	312.2	
0	4	6	8	12	12	11.5	12	11.5	11.5	12	12	12	12	12	12	12	6.1	6.1	11.0	195.6	313.0	
0	4	6	8	12	12	11.5	12	12	11.5	12	12	12	12	12	12	12	6.1	6.1	11.0	196.1	313.8	
0	4	6	8	12	12	12	12	12	11.5	12	12	12	12	12	12	12	6.1	6.1	11.0	196.6	314.6	
0	4	6	8	12	12	12	12	12	12	12	12	12	12	12	12	12	6.1	6.1	11.0	197.1	315.4	(2)
1	4	6	8	12	12	12	12	12	12	12	12	12	12	12	12	12	6.1	6.1	11.0	198.1	317.0	
2	4	6	8	12	12	12	12	12	12	12	12	12	12	12	12	12	6.1	6.1	11.0	199.1	318.6	
3	4	6	8	12	12	12	12	12	12	12	12	12	12	12	12	12	6.1	6.1	11.0	200.1	320.2	
3	4	6	9	12	12	12	12	12	12	12	12	12	12	12	12	12	6.1	6.1	11.0	201.1	321.8	
4	4	6	9	12	12	12	12	12	12	12	12	12	12	12	12	12	6.1	6.1	11.0	202.1	323.4	
4	5	6	9	12	12	12	12	12	12	12	12	12	12	12	12	12	6.1	6.1	11.0	203.1	325.0	
4	5	7	9	12	12	12	12	12	12	12	12	12	12	12	12	12	6.1	6.1	11.0	204.1	326.6	
4	5	7	10	12	12	12	12	12	12	12	12	12	12	12	12	12	6.1	6.1	11.0	205.1	328.2	
5	5	7	10	12	12	12	12	12	12	12	12	12	12	12	12	12	6.1	6.1	11.0	206.1	329.8	
5	6	7	10	12	12	12	12	12	12	12	12	12	12	12	12	12	6.1	6.1	11.0	207.1	331.4	
5	6	8	10	12	12	12	12	12	12	12	12	12	12	12	12	12	6.1	6.1	11.0	208.1	333.0	
5	6	8	11	12	12	12	12	12	12	12	12	12	12	12	12	12	6.1	6.1	11.0	209.1	334.6	
6	6	8	11	12	12	12	12	12	12	12	12	12	12	12	12	12	6.1	6.1	11.0	210.1	336.2	
6	7	8	11	12	12	12	12	12	12	12	12	12	12	12	12	12	6.1	6.1	11.0	211.1	337.8	
6	7	9	11	12	12	12	12	12	12	12	12	12	12	12	12	12	6.1	6.1	11.0	212.1	339.4	
6	7	9	12	12	12	12	12	12	12	12	12	12	12	12	12	12	6.1	6.1	11.0	213.1	341.0	
7	7	9	12	12	12	12	12	12	12	12	12	12	12	12	12	12	6.1	6.1	11.0	214.1	342.6	
7	8	9	12	12	12	12	12	12	12	12	12	12	12	12	12	12	6.1	6.1	11.0	215.1	344.2	
7	8	10	12	12	12	12	12	12	12	12	12	12	12	12	12	12	6.1	6.1	11.0	216.1	345.8	
8	8	10	12	12	12	12	12	12	12	12	12	12	12	12	12	12	6.1	6.1	11.0	217.1	347.4	
8	9	10	12	12	12	12	12	12	12	12	12	12	12	12	12	12	6.1	6.1	11.0	218.1	349.0	
8	9	11	12	12	12	12	12	12	12	12	12	12	12	12	12	12	6.1	6.1	11.0	219.1	350.6	
9	9	11	12	12	12	12	12	12	12	12	12	12	12	12	12	12	6.1	6.1	11.0	220.1	352.2	
9	10	11	12	12	12	12	12	12	12	12	12	12	12	12	12	12	6.1	6.1	11.0	221.1	353.8	
10	10	11	12	12	12	12	12	12	12	12	12	12	12	12	12	12	6.1	6.1	11.0	222.1	355.4	
10	11	11	12	12	12	12	12	12	12	12	12	12	12	12	12	12	6.1	6.1	11.0	223.1	357.0	
10	11	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	6.1	6.1	11.0	224.1	358.6	
11	11	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	6.1	6.1	11.0	225.1	360.2	(3)
11	11	13	12	12	12	12	12	12	12	12	12	12	12	12	12	12	6.1	6.1	11.0	226.1	361.8	
11	11	13	12	12	12	12	12	12	12	12	12	12	12	12	12	13	6.1	6.1	11.0	227.1	363.4	
11	11	13	13	12	12	12	12	12	12	12	12	12	12	12	12	13	6.1	6.1	11.0	228.1	365.0	
11	11	13	13	12	12	12	12	12	12	12	12	12	12	13	12	13	6.1	6.1	11.0	229.1	366.6	
11	11	13	13	13	12	12	12	12	12	12	12	12	12	13	12	13	6.1	6.1	11.0	230.1	368.2	
11	11	13	13	13	12	12	13	12	12	12	12	12	12	13	12	13	6.1	6.1	11.0	231.1	369.8	
11	11	13	13	13	12	12	13	12	13	12	12	12	12	13	12	13	6.1	6.1	11.0	232.1	371.4	
11	11	13	13	13	12	12	13	12	13	12	13	12	12	13	12	13	6.1	6.1	11.0	233.1	373.0	
11	11	13	13	13	13	12	13	12	13	12	13	12	12	13	12	13	6.1	6.1	11.0	234.1	374.6	
11	11	13	13	13	13	12	13	12	13	12	13	12	12	13	13	13	6.1	6.1	11.0	235.1	376.2	
11	11	13	13	13	13	13	13	12	13	12	13	12	12	13	13	13	6.1	6.1	11.0	236.1	377.8	
11	11	13	13	13	13	13	13	12	13	12	13	12	13	13	13	13	6.1	6.1	11.0	237.1	379.4	
11	11	13	13	13	13	13	13	13	13	12	13	12	13	13	13	13	6.1	6.1	11.0	238.1	381.0	
11	11	13	13	13	13	13	13	13	13	13	13	12	13	13	13	13	6.1	6.1	11.0	239.1	382.6	
11	11	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	6.1	6.1	11.0	240.1	384.2	
11	11	14	13	13	13	13	13	13	13	13	13	13	13	13	13	13	6.1	6.1	11.0	241.1	385.8	
11	11	14	13	13	13	13	13	13	13	13	13	13	13	13	13	14	6.1	6.1	11.0	242.1	387.4	
11	11	14	14	13	13	13	13	13	13	13	13	13	13	13	13	14	6.1	6.1	11.0	243.1	389.0	
11	11	14	14	13	13	13	13	13	13	13	13	13	13	14	13	14	6.1	6.1	11.0	244.1	390.6	
11	11	14	14	14	13	13	13	13	13	13	13	13	13	14	13	14	6.1	6.1	11.0	245.1	392.2	
11	11	14	14	14	13	13	14	13	13	13	13	13	13	14	13	14	6.1	6.1	11.0	246.1	393.8	
11	11	14	14	14	13	13	14	13	14	13	13	13	13	14	13	14	6.1	6.1	11.0	247.1	395.4	
11	11	14	14	14	13	13	14	13	14	13	14	13	13	14	13	14	6.1	6.1	11.0	248.1	397.0	
11	11	14	14	14	14	13	14	13	14	13	14	13	13	14	13	14	6.1	6.1	11.0	249.1	398.6	
11	11	14	14	14	14	13	14	13	14	13	14	13	13	14	14	14	6.1	6.1	11.0	250.1	400.2	
11	11	14	14	14	14	14	14	13	14	13	14	13	13	14	14	14	6.1	6.1	11.0	251.1	401.8	
11	11	14	14	14	14	14	14	13	14	13	14	13	14	14	14	14	6.1	6.1	11.0	252.1	403.4	
11	11	14	14	14	14	14	14	14	14	13	14	13	14	14	14	14	6.1	6.1	11.0	253.1	405.0	
11	11	14	14	14	14	14	14	14	14	14	14	13	14	14	14	14	6.1	6.1	11.0	254.1	406.6	
11	11	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	6.1	6.1	11.0	255.1	408.2	
11	11	15	14	14	14	14	14	14	14	14	14	14	14	14	14	14	6.1	6.1	11.0	256.1	409.8	
11	11	15	14	14	14	14	14	14	14	14	14	14	14	14	14	15	6.1	6.1	11.0	257.1	411.4	
11	11	15	15	14	14	14	14	14	14	14	14	14	14	14	14	15	6.1	6.1	11.0	258.1	413.0	
11	11	15	15	14	14	14	14	14	14	14	14	14	14	15	14	15	6.1	6.1	11.0	259.1	414.6	
11	11	15	15	15	14	14	14	14	14	14	14	14	14	15	14	15	6.1	6.1	11.0	260.1	416.2	
11	11	15	15	15	14	14	15	14	14	14	14	14	14	15	14	15	6.1	6.1	11.0	261.1	417.8	
11	11	15	15	15	14	14	15	14	15	14	14	14	14	15	14	15	6.1	6.1	11.0	262.1	419.4	
11	11	15	15	15	14	14	15	14	15	14	15	14	14	15	14	15	6.1	6.1	11.0	263.1	421.0	
11	11	15	15	15	15	14	15	14	15	14	15	14	14	15	14	15	6.1	6.1	11.0	264.1	422.6	
11	11	15	15	15	15	14	15	14	15	14	15	14	14	15	15	15	6.1	6.1	11.0	265.1	424.2	
11	11	15	15	15	15	15	15	14	15	14	15	14	14	15	15	15	6.1	6.1	11.0	266.1	425.8	
11	11	15	15	15	15	15	15	14	15	14	15	14	15	15	15	15	6.1	6.1	11.0	267.1	427.4	
11	11	15	15	15	15	15	15	15	15	14	15	14	15	15	15	15	6.1	6.1	11.0	268.1	429.0	

SPILLWAY BAY NUMBER																	TSW	TSW		Total	SPILL
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	STOPS	Kcfs
11	11	15	15	15	15	15	15	15	15	**15**	15	14	15	15	15	15	6.1	6.1	11.0	269.1	430.6
11	11	15	15	15	15	15	15	15	15	15	15	**15**	15	15	15	15	6.1	6.1	11.0	270.1	432.2
11	11	**16**	15	15	15	15	15	15	15	15	15	15	15	15	15	15	6.1	6.1	11.0	271.1	433.8
11	11	16	15	15	15	15	15	15	15	15	15	15	15	15	15	**16**	6.1	6.1	11.0	272.1	435.4
11	11	16	**16**	15	15	15	15	15	15	15	15	15	15	15	15	16	6.1	6.1	11.0	273.1	437.0
11	11	16	16	15	15	15	15	15	15	15	15	15	15	**16**	15	16	6.1	6.1	11.0	274.1	438.6
11	11	16	16	**16**	15	15	15	15	15	15	15	15	15	16	15	16	6.1	6.1	11.0	275.1	440.2
11	11	16	16	16	15	15	**16**	15	15	15	15	15	15	16	15	16	6.1	6.1	11.0	276.1	441.8
11	11	16	16	16	15	15	16	15	**16**	15	15	15	15	16	15	16	6.1	6.1	11.0	277.1	443.4
11	11	16	16	16	15	15	16	15	16	15	**16**	15	15	16	15	16	6.1	6.1	11.0	278.1	445.0
11	11	16	16	16	**16**	15	16	15	16	15	16	15	15	16	15	16	6.1	6.1	11.0	279.1	446.6
11	11	16	16	16	16	15	16	15	16	15	16	15	15	16	**16**	16	6.1	6.1	11.0	280.1	448.2
11	11	16	16	16	16	**16**	16	15	16	15	16	15	15	16	16	16	6.1	6.1	11.0	281.1	449.8
11	11	16	16	16	16	16	16	15	16	15	16	15	**16**	16	16	16	6.1	6.1	11.0	282.1	451.4
11	11	16	16	16	16	16	16	**16**	16	15	16	15	16	16	16	16	6.1	6.1	11.0	283.1	453.0
11	11	16	16	16	16	16	16	16	16	**16**	16	15	16	16	16	16	6.1	6.1	11.0	284.1	454.6
11	11	16	16	16	16	16	16	16	16	16	16	**16**	16	16	16	16	6.1	6.1	11.0	285.1	456.2
11	11	**17**	16	16	16	16	16	16	16	16	16	16	16	16	16	16	6.1	6.1	11.0	286.1	457.8
11	11	17	16	16	16	16	16	16	16	16	16	16	16	16	16	**17**	6.1	6.1	11.0	287.1	459.4
11	11	17	**17**	16	16	16	16	16	16	16	16	16	16	16	16	17	6.1	6.1	11.0	288.1	461.0
11	11	17	17	16	16	16	16	16	16	16	16	16	16	**17**	16	17	6.1	6.1	11.0	289.1	462.6
11	11	17	17	**17**	16	16	16	16	16	16	16	16	16	17	16	17	6.1	6.1	11.0	290.1	464.2
11	11	17	17	17	16	16	**17**	16	16	16	16	16	16	17	16	17	6.1	6.1	11.0	291.1	465.8
11	11	17	17	17	16	16	17	16	**17**	16	16	16	16	17	16	17	6.1	6.1	11.0	292.1	467.4
11	11	17	17	17	16	16	17	16	17	16	**17**	16	16	17	16	17	6.1	6.1	11.0	293.1	469.0
11	11	17	17	17	**17**	16	17	16	17	16	17	16	16	17	16	17	6.1	6.1	11.0	294.1	470.6
11	11	17	17	17	17	16	17	16	17	16	17	16	16	17	**17**	17	6.1	6.1	11.0	295.1	472.2
11	11	17	17	17	17	**17**	17	16	17	16	17	16	16	17	17	17	6.1	6.1	11.0	296.1	473.8
11	11	17	17	17	17	17	17	16	17	16	17	16	**17**	17	17	17	6.1	6.1	11.0	297.1	475.4
11	11	17	17	17	17	17	17	**17**	17	16	17	16	17	17	17	17	6.1	6.1	11.0	298.1	477.0
11	11	17	17	17	17	17	17	17	17	**17**	17	16	17	17	17	17	6.1	6.1	11.0	299.1	478.6
11	11	17	17	17	17	17	17	17	17	17	17	**17**	17	17	17	17	6.1	6.1	11.0	300.1	480.2
11	11	**18**	17	17	17	17	17	17	17	17	17	17	17	17	17	17	6.1	6.1	11.0	301.1	481.8
11	11	18	17	17	17	17	17	17	17	17	17	17	17	17	17	**18**	6.1	6.1	11.0	302.1	483.4
11	11	18	**18**	17	17	17	17	17	17	17	17	17	17	17	17	18	6.1	6.1	11.0	303.1	485.0
11	11	18	18	17	17	17	17	17	17	17	17	17	17	**18**	17	18	6.1	6.1	11.0	304.1	486.6
11	11	18	18	**18**	17	17	17	17	17	17	17	17	17	18	17	18	6.1	6.1	11.0	305.1	488.2
11	11	18	18	18	17	17	**18**	17	17	17	17	17	17	18	17	18	6.1	6.1	11.0	306.1	489.8
11	11	18	18	18	17	17	18	17	**18**	17	17	17	17	18	17	18	6.1	6.1	11.0	307.1	491.4
11	11	18	18	18	17	17	18	17	18	17	**18**	17	17	18	17	18	6.1	6.1	11.0	308.1	493.0
11	11	18	18	18	**18**	17	18	17	18	17	18	17	17	18	17	18	6.1	6.1	11.0	309.1	494.6
11	11	18	18	18	18	17	18	17	18	17	18	17	17	18	**18**	18	6.1	6.1	11.0	310.1	496.2
11	11	18	18	18	18	**18**	18	17	18	17	18	17	17	18	18	18	6.1	6.1	11.0	311.1	497.8
11	11	18	18	18	18	18	18	17	18	17	18	17	**18**	18	18	18	6.1	6.1	11.0	312.1	499.4
11	11	18	18	18	18	18	18	**18**	18	17	18	17	18	18	18	18	6.1	6.1	11.0	313.1	501.0
11	11	18	18	18	18	18	18	18	18	**18**	18	17	18	18	18	18	6.1	6.1	11.0	314.1	502.6
11	11	18	18	18	18	18	18	18	18	18	18	**18**	18	18	18	18	6.1	6.1	11.0	315.1	504.2
11	11	**19**	18	18	18	18	18	18	18	18	18	18	18	18	18	18	6.1	6.1	11.0	316.1	505.8
11	11	19	18	18	18	18	18	18	18	18	18	18	18	18	18	**19**	6.1	6.1	11.0	317.1	507.4
11	11	19	**19**	18	18	18	18	18	18	18	18	18	18	18	18	19	6.1	6.1	11.0	318.1	509.0
11	11	19	19	18	18	18	18	18	18	18	18	18	18	**19**	18	19	6.1	6.1	11.0	319.1	510.6
11	11	19	19	**19**	18	18	18	18	18	18	18	18	18	19	18	19	6.1	6.1	11.0	320.1	512.2
11	11	19	19	19	18	18	**19**	18	18	18	18	18	18	19	18	19	6.1	6.1	11.0	321.1	513.8
11	11	19	19	19	18	18	19	18	**19**	18	18	18	18	19	18	19	6.1	6.1	11.0	322.1	515.4
11	11	19	19	19	18	18	19	18	19	18	**19**	18	18	19	18	19	6.1	6.1	11.0	323.1	517.0
11	11	19	19	19	**19**	18	19	18	19	18	19	18	18	19	18	19	6.1	6.1	11.0	324.1	518.6
11	11	19	19	19	19	18	19	18	19	18	19	18	18	19	**19**	19	6.1	6.1	11.0	325.1	520.2
11	11	19	19	19	19	**19**	19	18	19	18	19	18	18	19	19	19	6.1	6.1	11.0	326.1	521.8
11	11	19	19	19	19	19	19	18	19	18	19	18	**19**	19	19	19	6.1	6.1	11.0	327.1	523.4
11	11	19	19	19	19	19	19	**19**	19	18	19	18	19	19	19	19	6.1	6.1	11.0	328.1	525.0
11	11	19	19	19	19	19	19	19	19	**19**	19	18	19	19	19	19	6.1	6.1	11.0	329.1	526.6
11	11	19	19	19	19	19	19	19	19	19	19	**19**	19	19	19	19	6.1	6.1	11.0	330.1	528.2
11	11	**20**	19	19	19	19	19	19	19	19	19	19	19	19	19	19	6.1	6.1	11.0	331.1	529.8
11	11	20	19	19	19	19	19	19	19	19	19	19	19	19	19	**20**	6.1	6.1	11.0	332.1	531.4
11	11	20	**20**	19	19	19	19	19	19	19	19	19	19	19	19	20	6.1	6.1	11.0	333.1	533.0
11	11	20	20	19	19	19	19	19	19	19	19	19	19	**20**	19	20	6.1	6.1	11.0	334.1	534.6
11	11	20	20	**20**	19	19	19	19	19	19	19	19	19	20	19	20	6.1	6.1	11.0	335.1	536.2
11	11	20	20	20	19	19	**20**	19	19	19	19	19	19	20	19	20	6.1	6.1	11.0	336.1	537.8
11	11	20	20	20	19	19	20	19	**20**	19	19	19	19	20	19	20	6.1	6.1	11.0	337.1	539.4
11	11	20	20	20	19	19	20	19	20	19	**20**	19	19	20	19	20	6.1	6.1	11.0	338.1	541.0
11	11	20	20	20	**20**	19	20	19	20	19	20	19	19	20	19	20	6.1	6.1	11.0	339.1	542.6
11	11	20	20	20	20	19	20	19	20	19	20	19	19	20	**20**	20	6.1	6.1	11.0	340.1	544.2
11	11	20	20	20	20	**20**	20	19	20	19	20	19	19	20	20	20	6.1	6.1	11.0	341.1	545.8
11	11	20	20	20	20	20	20	19	20	19	20	19	**20**	20	20	20	6.1	6.1	11.0	342.1	547.4
11	11	20	20	20	20	20	20	**20**	20	19	20	19	20	20	20	20	6.1	6.1	11.0	343.1	549.0
11	11	20	20	20	20	20	20	20	20	**20**	20	19	20	20	20	20	6.1	6.1	11.0	344.1	550.6
11	11	20	20	20	20	20	20	20	20	20	20	**20**	20	20	20	20	6.1	6.1	11.0	345.1	552.2
11	11	**21**	20	20	20	20	20	20	20	20	20	20	20	20	20	20	6.1	6.1	11.0	346.1	553.8
11	11	21	20	20	20	20	20	20	20	20	20	20	20	20	20	**21**	6.1	6.1	11.0	347.1	555.4
11	11	21	**21**	20	20	20	20	20	20	20	20	20	20	20	20	21	6.1	6.1	11.0	348.1	557.0
11	11	21	21	20	20	20	20	20	20	20	20	20	20	**21**	20	21	6.1	6.1	11.0	349.1	558.6
11	11	21	21	**21**	20	20	20	20	20	20	20	20	20	21	20	21	6.1	6.1	11.0	350.1	560.2
11	11	21	21	21	20	20	**21**	20	20	20	20	20	20	21	20	21	6.1	6.1	11.0	351.1	561.8
11	11	21	21	21	20	20	21	20	**21**	20	20	20	20	21	20	21	6.1	6.1	11.0	352.1	563.4
11	11	21	21	21	20	20	21	20	21	20	**21**	20	20	21	20	21	6.1	6.1	11.0	353.1	565.0

SPILLWAY BAY NUMBER																	TSW	TSW		Total	SPILL
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	STOPS	Kcfs
11	11	21	21	21	**21**	20	21	20	21	20	21	20	20	21	20	21	6.1	6.1	11.0	354.1	566.6
11	11	21	21	21	21	20	21	20	21	20	21	20	20	21	**21**	21	6.1	6.1	11.0	355.1	568.2
11	11	21	21	21	21	**21**	21	20	21	20	21	20	20	21	21	21	6.1	6.1	11.0	356.1	569.8
11	11	21	21	21	21	21	21	20	21	20	21	20	**21**	21	21	21	6.1	6.1	11.0	357.1	571.4
11	11	21	21	21	21	21	21	**21**	21	20	21	20	21	21	21	21	6.1	6.1	11.0	358.1	573.0
11	11	21	21	21	21	21	21	21	21	**21**	21	20	21	21	21	21	6.1	6.1	11.0	359.1	574.6
11	11	21	21	21	21	21	21	21	21	21	21	**21**	21	21	21	21	6.1	6.1	11.0	360.1	576.2
11	11	**22**	21	21	21	21	21	21	21	21	21	21	21	21	21	21	6.1	6.1	11.0	361.1	577.8
11	11	22	21	21	21	21	21	21	21	21	21	21	21	21	21	**22**	6.1	6.1	11.0	362.1	579.4
11	11	22	**22**	21	21	21	21	21	21	21	21	21	21	21	21	22	6.1	6.1	11.0	363.1	581.0
11	11	22	22	21	21	21	21	21	21	21	21	21	21	**22**	21	22	6.1	6.1	11.0	364.1	582.6
11	11	22	22	**22**	21	21	21	21	21	21	21	21	21	22	21	22	6.1	6.1	11.0	365.1	584.2
11	11	22	22	22	21	21	**22**	21	21	21	21	21	21	22	21	22	6.1	6.1	11.0	366.1	585.8
11	11	22	22	22	21	21	22	21	**22**	21	21	21	21	22	21	22	6.1	6.1	11.0	367.1	587.4
11	11	22	22	22	21	21	22	21	22	21	**22**	21	21	22	21	22	6.1	6.1	11.0	368.1	589.0
11	11	22	22	22	**22**	21	22	21	22	21	22	21	21	22	21	22	6.1	6.1	11.0	369.1	590.6
11	11	22	22	22	22	21	22	21	22	21	22	21	21	22	**22**	22	6.1	6.1	11.0	370.1	592.2
11	11	22	22	22	22	**22**	22	21	22	21	22	21	21	22	22	22	6.1	6.1	11.0	371.1	593.8
11	11	22	22	22	22	22	22	21	22	21	22	21	**22**	22	22	22	6.1	6.1	11.0	372.1	595.4
11	11	22	22	22	22	22	22	**22**	22	21	22	21	22	22	22	22	6.1	6.1	11.0	373.1	597.0
11	11	22	22	22	22	22	22	22	22	**22**	22	21	22	22	22	22	6.1	6.1	11.0	374.1	598.6
11	11	22	22	22	22	22	22	22	22	22	22	**22**	22	22	22	22	6.1	6.1	11.0	375.1	600.2 (4)

(1) Begin transition from Juvenile Pattern to flood pattern
(2) Gate 20 blocked at 10.3 ft opening
(3) Gate 1 blocked at 10.3 ft opening
(4) TSW does not affect spillway flood capacity until flows reach 1,492 kcfs. TSW removal is recommended before river levels exceed 685 kcfs.

Table JDA- 9. John Day Dam Spill Pattern with No Temporary Spillway Weirs (TSWs).

SPILLWAY BAY NUMBER																	TSW	TSW		Total	SPILL
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	STOPS	Kcfs
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
0	4	5	4	4	4	3	3	3	3	**3**	2	2	2	2	2	2				48	76.8
0	4	5	4	4	4	3	3	3	3	3	**3**	2	2	2	2	2				49	78.4
0	4	5	**5**	4	4	3	3	3	3	3	3	2	2	2	2	2				50	80.0
0	4	5	5	4	4	**4**	3	3	3	3	3	2	2	2	2	2				51	81.6
0	4	5	5	4	4	4	3	3	3	3	3	**3**	2	2	2	2				52	83.2
0	4	5	5	4	4	4	3	3	3	3	3	3	**3**	2	2	2				53	84.8
0	4	5	5	4	4	4	3	3	3	3	3	3	3	**3**	2	2				54	86.4
0	4	5	5	4	4	4	3	3	3	3	3	3	3	3	**3**	2				55	88.0
0	4	5	5	4	4	4	**4**	3	3	3	3	3	3	3	3	2				56	89.6
0	4	5	5	4	4	4	4	**4**	3	3	3	3	3	3	3	2				57	91.2
0	4	5	5	**5**	4	4	4	4	3	3	3	3	3	3	3	2				58	92.8
0	4	5	5	5	4	4	4	4	**4**	3	3	3	3	3	3	2				59	94.4
0	4	5	5	5	4	4	4	4	4	**4**	3	3	3	3	3	2				60	96.0
0	4	5	5	5	4	4	4	4	4	4	3	3	3	3	3	**3**				61	97.6
0	4	5	5	5	4	4	4	4	4	4	**4**	3	3	3	3	3				62	99.2
0	4	**4**	**4**	**4**	4	4	4	4	4	4	4	3	**4**	**4**	**4**	**4**				63	100.8
0	4	4	4	4	4	4	4	4	4	4	4	**4**	4	4	4	4				64	102.4
0	4	**5**	4	4	4	4	4	4	4	4	4	4	4	4	4	4				65	104.0
0	4	5	**5**	4	4	4	4	4	4	4	4	4	4	4	4	4				66	105.6
0	4	5	5	4	4	4	4	4	4	4	4	4	4	4	4	**5**				67	107.2
0	4	5	5	4	4	4	4	4	4	4	4	4	4	**5**	4	5				68	108.8
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0	4	5	5	5	5	5	5	4	5	4	5	4	**5**	5	5	5				76	121.6
0	4	5	5	5	5	5	5	**5**	5	4	5	4	5	5	5	5				77	123.2
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0	4	**6**	5	5	5	5	5	5	5	5	5	5	5	5	5	5				80	128.0
0	4	6	**6**	5	5	5	5	5	5	5	5	5	5	5	5	5				81	129.6
0	4	6	6	5	5	5	5	5	5	5	5	5	5	5	5	**6**				82	131.2
0	4	6	6	5	5	5	5	5	5	5	5	5	5	**6**	5	6				83	132.8
0	4	6	6	**6**	5	5	5	5	5	5	5	5	5	6	5	6				84	134.4
0	4	6	6	6	5	5	**6**	5	5	5	5	5	5	6	5	6				85	136.0
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0	4	6	6	6	5	5	6	5	6	5	**6**	5	5	6	5	6				87	139.2
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0	4	6	6	6	6	5	6	5	6	5	6	5	5	6	**6**	6				89	142.4
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SPILLWAY BAY NUMBER																	TSW	TSW		Total	SPILL
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0	4	6	6	6	6	6	6	6	6	6	6	5	6	6	6	6				93	148.8
0	4	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6				94	150.4
0	4	6	7	6	6	6	6	6	6	6	6	6	6	6	6	6				95	152.0
0	4	6	7	6	6	6	6	6	6	6	6	6	6	6	6	7				96	153.6
0	4	6	7	6	6	6	6	6	6	6	6	6	6	7	6	7				97	155.2
0	4	6	7	7	6	6	6	6	6	6	6	6	6	7	6	7				98	156.8
0	4	6	7	7	6	6	7	6	6	6	6	6	6	7	6	7				99	158.4
0	4	6	7	7	6	6	7	6	7	6	6	6	6	7	6	7				100	160.0
0	4	6	7	7	6	6	7	6	7	6	7	6	6	7	6	7				101	161.6
0	4	6	7	7	7	6	7	6	7	6	7	6	6	7	6	7				102	163.2
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0	4	6	7	7	7	7	7	6	7	6	7	6	6	7	7	7				104	166.4
0	4	6	7	7	7	7	7	6	7	6	7	6	7	7	7	7				105	168.0
0	4	6	7	7	7	7	7	7	7	6	7	6	7	7	7	7				106	169.6
0	4	6	7	7	7	7	7	7	7	7	7	6	7	7	7	7				107	171.2
0	4	6	7	7	7	7	7	7	7	7	7	7	7	7	7	7				108	172.8
0	4	6	8	7	7	7	7	7	7	7	7	7	7	7	7	7				109	174.4
0	4	6	8	7	7	7	7	7	7	7	7	7	7	7	7	8				110	176.0
0	4	6	8	7	7	7	7	7	7	7	7	7	7	8	7	8				111	177.6
0	4	6	8	8	7	7	7	7	7	7	7	7	7	8	7	8				112	179.2
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0	4	6	8	8	8	7	8	7	8	7	8	7	7	8	8	8				117	187.2
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0	4	6	8	8	8	8	8	8	8	7	8	7	8	8	8	8				120	192.0
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0	4	6	8	8	8	8	8	8	8	8	8	8	8	8	8	8				122	195.2
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0	4	6	8	9	8	8	9	8	9	8	8	8	8	9	8	9				127	203.2
0	4	6	8	9	8	8	9	8	9	8	9	8	8	9	8	9				128	204.8
0	4	6	8	9	9	8	9	8	9	8	9	8	8	9	8	9				129	206.4
0	4	6	8	9	9	8	9	8	9	8	9	8	8	9	9	9				130	208.0
0	4	6	8	9	9	9	9	8	9	8	9	8	8	9	9	9				131	209.6
0	4	6	8	9	9	9	9	8	9	8	9	8	9	9	9	9				132	211.2
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0	4	6	8	10	9	9	10	9	10	9	10	9	9	10	9	10				141	225.6
0	4	6	8	10	10	9	10	9	10	9	10	9	9	10	9	10				142	227.2
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0	4	6	8	10	10	10	10	9	10	9	10	9	10	10	10	10				145	232.0
0	4	6	8	10	10	10	10	10	10	9	10	9	10	10	10	10				146	233.6
0	4	6	8	10	10	10	10	10	10	10	10	9	10	10	10	10				147	235.2
0	4	6	8	10	10	10	10	10	10	10	10	10	10	10	10	10				148	236.8
0	4	6	8	10	10	10	10	10	10	10	10	10	10	10	10	11				149	238.4
0	4	6	8	10	10	10	10	10	10	10	10	10	10	11	10	11				150	240.0
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0	4	6	8	10	11	10	11	10	11	10	11	10	10	11	11	11				155	248.0
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0	4	6	8	10	11	11	11	11	11	11	11	11	11	11	11	11				160	256.0
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0	4	6	8	10	12	12	12	11	12	11	12	11	11	12	12	11				167	267.2
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0	4	6	8	10	12	12	12	12	12	12	12	12	12	13	12	11				172	275.2
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0	4	6	8	10	12	12	13	12	13	12	12	12	12	13	12	11				174	278.4
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SPILLWAY BAY NUMBER																	TSW	TSW		Total	SPILL	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	STOPS	Kcfs	
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0	4	6	8	10	12	**13**	13	12	13	12	13	12	12	13	13	11				177	283.2	
0	4	6	8	10	12	13	13	12	13	12	13	12	**13**	13	13	11				178	284.8	
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0	4	6	8	10	12	13	13	13	13	**13**	13	12	13	13	13	11				180	288.0	
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0	4	6	8	10	12	13	13	13	13	13	13	13	13	14	13	11				182	291.2	
0	4	6	8	10	12	13	**14**	13	13	13	13	13	13	14	13	11				183	292.8	
0	4	6	8	10	12	13	14	13	**14**	13	13	13	13	14	13	11				184	294.4	
0	4	6	8	10	12	13	14	13	14	13	**14**	13	13	14	13	11				185	296.0	
0	4	6	8	10	12	13	14	13	14	13	14	13	13	14	**14**	11				186	297.6	
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0	4	6	8	10	12	14	14	**14**	14	13	14	13	14	14	14	11				189	302.4	
0	4	6	8	10	12	14	14	14	14	**14**	14	13	14	14	14	11				190	304.0	
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0	4	6	8	10	12	14	14	14	14	14	14	14	14	15	14	11				192	307.2	
0	4	6	8	10	12	14	**15**	14	14	14	14	14	14	15	14	11				193	308.8	
0	4	6	8	10	12	14	15	14	**15**	14	14	14	14	15	14	11				194	310.4	
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0	4	6	8	10	12	14	16	16	16	16	16	**16**	16	16	16	11				209	334.4	(1)
0	4	6	8	10	12	**15**	16	16	16	16	16	16	16	16	16	11				210	336.0	
0	4	6	8	10	**13**	15	16	16	16	16	16	16	16	16	16	11				211	337.6	
0	4	6	8	**11**	13	15	16	16	16	16	16	16	16	16	16	11				212	339.2	
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0	4	**7**	9	11	13	15	16	16	16	16	16	16	16	16	16	11				214	342.4	
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1	5	**8**	10	12	14	16	16	16	16	16	16	16	16	16	16	11				221	353.6	
1	**6**	8	10	12	14	16	16	16	16	16	16	16	16	16	16	11				222	355.2	
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2	6	8	10	12	**15**	16	16	16	16	16	16	16	16	16	16	11				224	358.4	
2	6	8	10	**13**	15	16	16	16	16	16	16	16	16	16	16	11				225	360.0	
2	6	8	**11**	13	15	16	16	16	16	16	16	16	16	16	16	11				226	361.6	
2	6	**9**	11	13	15	16	16	16	16	16	16	16	16	16	16	11				227	363.2	
2	**7**	9	11	13	15	16	16	16	16	16	16	16	16	16	16	11				228	364.8	
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3	7	9	11	13	**16**	16	16	16	16	16	16	16	16	16	16	11				230	368.0	
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3	7	9	**12**	14	16	16	16	16	16	16	16	16	16	16	16	11				232	371.2	
3	7	**10**	12	14	16	16	16	16	16	16	16	16	16	16	16	11				233	372.8	
3	**8**	10	12	14	16	16	16	16	16	16	16	16	16	16	16	11				234	374.4	
4	8	10	12	14	16	16	16	16	16	16	16	16	16	16	16	11				235	376.0	
4	8	10	12	**15**	16	16	16	16	16	16	16	16	16	16	16	11				236	377.6	
4	8	10	**13**	15	16	16	16	16	16	16	16	16	16	16	16	11				237	379.2	
4	8	**11**	13	15	16	16	16	16	16	16	16	16	16	16	16	11				238	380.8	
4	**9**	11	13	15	16	16	16	16	16	16	16	16	16	16	16	11				239	382.4	
5	9	11	13	15	16	16	16	16	16	16	16	16	16	16	16	11				240	384.0	
5	9	11	13	**16**	16	16	16	16	16	16	16	16	16	16	16	11				241	385.6	
5	9	11	**14**	16	16	16	16	16	16	16	16	16	16	16	16	11				242	387.2	
5	9	**12**	14	16	16	16	16	16	16	16	16	16	16	16	16	11				243	388.8	
5	**10**	12	14	16	16	16	16	16	16	16	16	16	16	16	16	11				244	390.4	
6	10	12	14	16	16	16	16	16	16	16	16	16	16	16	16	11				245	392.0	
6	10	12	**15**	16	16	16	16	16	16	16	16	16	16	16	16	11				246	393.6	
6	10	**13**	15	16	16	16	16	16	16	16	16	16	16	16	16	11				247	395.2	
6	**11**	13	15	16	16	16	16	16	16	16	16	16	16	16	16	11				248	396.8	(2)
7	11	13	15	16	16	16	16	16	16	16	16	16	16	16	16	11				249	398.4	
7	11	13	**16**	16	16	16	16	16	16	16	16	16	16	16	16	11				250	400.0	
7	11	**14**	16	16	16	16	16	16	16	16	16	16	16	16	16	11				251	401.6	
8	11	14	16	16	16	16	16	16	16	16	16	16	16	16	16	11				252	403.2	
8	11	**15**	16	16	16	16	16	16	16	16	16	16	16	16	16	11				253	404.8	
9	11	15	16	16	16	16	16	16	16	16	16	16	16	16	16	11				254	406.4	
9	11	**16**	16	16	16	16	16	16	16	16	16	16	16	16	16	11				255	408.0	
10	11	16	16	16	16	16	16	16	16	16	16	16	16	16	16	11				256	409.6	
11	11	16	16	16	16	16	16	16	16	16	16	16	16	16	16	11				257	411.2	(3)
11	11	**17**	16	16	16	16	16	16	16	16	16	16	16	16	16	11				258	412.8	
11	11	17	**17**	16	16	16	16	16	16	16	16	16	16	16	16	11				259	414.4	
11	11	17	17	16	16	16	16	16	16	16	16	16	16	**17**	16	11				260	416.0	

SPILLWAY BAY NUMBER																	TSW	TSW		Total	SPILL
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	STOPS	Kcfs
11	11	17	17	**17**	16	16	16	16	16	16	16	16	16	17	16	11				261	417.6
11	11	17	17	17	16	16	**17**	16	16	16	16	16	16	17	16	11				262	419.2
11	11	17	17	17	16	16	17	16	**17**	16	16	16	16	17	16	11				263	420.8
11	11	17	17	17	16	16	17	16	17	16	**17**	16	16	17	16	11				264	422.4
11	11	17	17	17	**17**	16	17	16	17	16	17	16	16	17	16	11				265	424.0
11	11	17	17	17	17	16	17	16	17	16	17	16	16	17	**17**	11				266	425.6
11	11	17	17	17	17	**17**	17	16	17	16	17	16	16	17	17	11				267	427.2
11	11	17	17	17	17	17	17	16	17	16	17	16	**17**	17	17	11				268	428.8
11	11	17	17	17	17	17	17	**17**	17	16	17	16	17	17	17	11				269	430.4
11	11	17	17	17	17	17	17	17	17	**17**	17	16	17	17	17	11				270	432.0
11	11	17	17	17	17	17	17	17	17	17	17	**17**	17	17	17	11				271	433.6
11	11	**18**	17	17	17	17	17	17	17	17	17	17	17	17	17	11				272	435.2
11	11	18	**18**	17	17	17	17	17	17	17	17	17	17	17	17	11				273	436.8
11	11	18	18	17	17	17	17	17	17	17	17	17	17	**18**	17	11				274	438.4
11	11	18	18	**18**	17	17	17	17	17	17	17	17	17	18	17	11				275	440.0
11	11	18	18	18	17	17	**18**	17	17	17	17	17	17	18	17	11				276	441.6
11	11	18	18	18	17	17	18	17	**18**	17	17	17	17	18	17	11				277	443.2
11	11	18	18	18	17	17	18	17	18	17	**18**	17	17	18	17	11				278	444.8
11	11	18	18	18	**18**	17	18	17	18	17	18	17	17	18	17	11				279	446.4
11	11	18	18	18	18	17	18	17	18	17	18	17	17	18	**18**	11				280	448.0
11	11	18	18	18	18	**18**	18	17	18	17	18	17	17	18	18	11				281	449.6
11	11	18	18	18	18	18	18	17	18	17	18	17	**18**	18	18	11				282	451.2
11	11	18	18	18	18	18	18	**18**	18	17	18	17	18	18	18	11				283	452.8
11	11	18	18	18	18	18	18	18	18	**18**	18	17	18	18	18	11				284	454.4
11	11	18	18	18	18	18	18	18	18	18	18	**18**	18	18	18	11				285	456.0
11	11	**19**	18	18	18	18	18	18	18	18	18	18	18	18	18	11				286	457.6
11	11	19	**19**	18	18	18	18	18	18	18	18	18	18	18	18	11				287	459.2
11	11	19	19	18	18	18	18	18	18	18	18	18	18	**19**	18	11				288	460.8
11	11	19	19	**19**	18	18	18	18	18	18	18	18	18	19	18	11				289	462.4
11	11	19	19	19	18	18	**19**	18	18	18	18	18	18	19	18	11				290	464.0
11	11	19	19	19	18	18	19	18	**19**	18	18	18	18	19	18	11				291	465.6
11	11	19	19	19	18	18	19	18	19	18	**19**	18	18	19	18	11				292	467.2
11	11	19	19	19	**19**	18	19	18	19	18	19	18	18	19	18	11				293	468.8
11	11	19	19	19	19	18	19	18	19	18	19	18	18	19	**19**	11				294	470.4
11	11	19	19	19	19	**19**	19	18	19	18	19	18	18	19	19	11				295	472.0
11	11	19	19	19	19	19	19	18	19	18	19	18	**19**	19	19	11				296	473.6
11	11	19	19	19	19	19	19	**19**	19	18	19	18	19	19	19	11				297	475.2
11	11	19	19	19	19	19	19	19	19	**19**	19	18	19	19	19	11				298	476.8
11	11	19	19	19	19	19	19	19	19	19	19	**19**	19	19	19	11				299	478.4
11	11	**20**	19	19	19	19	19	19	19	19	19	19	19	19	19	11				300	480.0
11	11	20	**20**	19	19	19	19	19	19	19	19	19	19	19	19	11				301	481.6
11	11	20	20	19	19	19	19	19	19	19	19	19	19	**20**	19	11				302	483.2
11	11	20	20	**20**	19	19	19	19	19	19	19	19	19	20	19	11				303	484.8
11	11	20	20	20	19	19	**20**	19	19	19	19	19	19	20	19	11				304	486.4
11	11	20	20	20	19	19	20	19	**20**	19	19	19	19	20	19	11				305	488.0
11	11	20	20	20	19	19	20	19	20	19	**20**	19	19	20	19	11				306	489.6
11	11	20	20	20	**20**	19	20	19	20	19	20	19	19	20	19	11				307	491.2
11	11	20	20	20	20	19	20	19	20	19	20	19	19	20	**20**	11				308	492.8
11	11	20	20	20	20	**20**	20	19	20	19	20	19	19	20	20	11				309	494.4
11	11	20	20	20	20	20	20	19	20	19	20	19	**20**	20	20	11				310	496.0
11	11	20	20	20	20	20	20	**20**	20	19	20	19	20	20	20	11				311	497.6
11	11	20	20	20	20	20	20	20	20	**20**	20	19	20	20	20	11				312	499.2
11	11	20	20	20	20	20	20	20	20	20	20	**20**	20	20	20	11				313	500.8
11	11	**21**	20	20	20	20	20	20	20	20	20	20	20	20	20	11				314	502.4
11	11	21	**21**	20	20	20	20	20	20	20	20	20	20	20	20	11				315	504.0
11	11	21	21	20	20	20	20	20	20	20	20	20	20	**21**	20	11				316	505.6
11	11	21	21	**21**	20	20	20	20	20	20	20	20	20	21	20	11				317	507.2
11	11	21	21	21	20	20	**21**	20	20	20	20	20	20	21	20	11				318	508.8
11	11	21	21	21	20	20	21	20	**21**	20	20	20	20	21	20	11				319	510.4
11	11	21	21	21	20	20	21	20	21	20	**21**	20	20	21	20	11				320	512.0
11	11	21	21	21	**21**	20	21	20	21	20	21	20	20	21	20	11				321	513.6
11	11	21	21	21	21	20	21	20	21	20	21	20	20	21	**21**	11				322	515.2
11	11	21	21	21	21	**21**	21	20	21	20	21	20	20	21	21	11				323	516.8
11	11	21	21	21	21	21	21	20	21	20	21	20	**21**	21	21	11				324	518.4
11	11	21	21	21	21	21	21	**21**	21	20	21	20	21	21	21	11				325	520.0
11	11	21	21	21	21	21	21	21	21	**21**	21	20	21	21	21	11				326	521.6
11	11	21	21	21	21	21	21	21	21	21	21	**21**	21	21	21	11				327	523.2
11	11	**22**	21	21	21	21	21	21	21	21	21	21	21	21	21	11				328	524.8
11	11	22	**22**	21	21	21	21	21	21	21	21	21	21	21	21	11				329	526.4
11	11	22	22	21	21	21	21	21	21	21	21	21	21	**22**	21	11				330	528.0
11	11	22	22	**22**	21	21	21	21	21	21	21	21	21	22	21	11				331	529.6
11	11	22	22	22	21	21	**22**	21	21	21	21	21	21	22	21	11				332	531.2
11	11	22	22	22	21	21	22	21	**22**	21	21	21	21	22	21	11				333	532.8
11	11	22	22	22	21	21	22	21	22	21	**22**	21	21	22	21	11				334	534.4
11	11	22	22	22	**22**	21	22	21	22	21	22	21	21	22	21	11				335	536.0
11	11	22	22	22	22	21	22	21	22	21	22	21	21	22	**22**	11				336	537.6
11	11	22	22	22	22	**22**	22	21	22	21	22	21	21	22	22	11				337	539.2
11	11	22	22	22	22	22	22	21	22	21	22	21	**22**	22	22	11				338	540.8
11	11	22	22	22	22	22	22	**22**	22	21	22	21	22	22	22	11				339	542.4
11	11	22	22	22	22	22	22	22	22	**22**	22	21	22	22	22	11				340	544.0
11	11	22	22	22	22	22	22	22	22	22	22	**22**	22	22	22	11				341	545.6
11	11	**23**	22	22	22	22	22	22	22	22	22	22	22	22	22	11				342	547.2
11	11	23	**23**	22	22	22	22	22	22	22	22	22	22	22	22	11				343	548.8
11	11	23	23	22	22	22	22	22	22	22	22	22	22	**23**	22	11				344	550.4
11	11	23	23	**23**	22	22	22	22	22	22	22	22	22	23	22	11				345	552.0

SPILLWAY BAY NUMBER																	TSW	TSW		Total	SPILL
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	STOPS	Kcfs
11	11	23	23	23	22	22	**23**	22	22	22	22	22	22	23	22	11				346	553.6
11	11	23	23	23	22	22	23	22	**23**	22	22	22	22	23	22	11				347	555.2
11	11	23	23	23	22	22	23	22	23	22	**23**	22	22	23	22	11				348	556.8
11	11	23	23	23	**23**	22	23	22	23	22	23	22	22	23	22	11				349	558.4
11	11	23	23	23	23	22	23	22	23	22	23	22	22	23	**23**	11				350	560.0
11	11	23	23	23	23	**23**	23	22	23	22	23	22	22	23	23	11				351	561.6
11	11	23	23	23	23	23	23	22	23	22	23	22	**23**	23	23	11				352	563.2
11	11	23	23	23	23	23	23	**23**	23	22	23	22	23	23	23	11				353	564.8
11	11	23	23	23	23	23	23	23	23	**23**	23	22	23	23	23	11				354	566.4
11	11	23	23	23	23	23	23	23	23	23	23	**23**	23	23	23	11				355	568.0
11	11	**24**	23	23	23	23	23	23	23	23	23	23	23	23	23	11				356	569.6
11	11	24	**24**	23	23	23	23	23	23	23	23	23	23	23	23	11				357	571.2
11	11	24	24	23	23	23	23	23	23	23	23	23	23	**24**	23	11				358	572.8
11	11	24	24	**24**	23	23	23	23	23	23	23	23	23	24	23	11				359	574.4
11	11	24	24	24	23	23	**24**	23	23	23	23	23	23	24	23	11				360	576.0
11	11	24	24	24	23	23	24	23	**24**	23	23	23	23	24	23	11				361	577.6
11	11	24	24	24	23	23	24	23	24	23	**24**	23	23	24	23	11				362	579.2
11	11	24	24	24	**24**	23	24	23	24	23	24	23	23	24	23	11				363	580.8
11	11	24	24	24	24	23	24	23	24	23	24	23	23	24	**24**	11				364	582.4
11	11	24	24	24	24	**24**	24	23	24	23	24	23	23	24	24	11				365	584.0
11	11	24	24	24	24	24	24	23	24	23	24	23	**24**	24	24	11				366	585.6
11	11	24	24	24	24	24	24	**24**	24	23	24	23	24	24	24	11				367	587.2
11	11	24	24	24	24	24	24	24	24	**24**	24	23	24	24	24	11				368	588.8
11	11	24	24	24	24	24	24	24	24	24	24	**24**	24	24	24	11				369	590.4
11	11	**25**	24	24	24	24	24	24	24	24	24	24	24	24	24	11				370	592.0
11	11	25	**25**	24	24	24	24	24	24	24	24	24	24	24	24	11				371	593.6
11	11	25	25	24	24	24	24	24	24	24	24	24	24	**25**	24	11				372	595.2
11	11	25	25	**25**	24	24	24	24	24	24	24	24	24	25	24	11				373	596.8
11	11	25	25	25	24	24	**25**	24	24	24	24	24	24	25	24	11				374	598.4
11	11	25	25	25	24	24	25	24	**25**	24	24	24	24	25	24	11				375	600.0 (4)

(1) Begin transition from Juvenile Pattern to flood pattern
(2) Gate 2 blocked at 10.3 ft opening
(3) Gate 1 blocked at 10.3 ft opening
(4) TSW does not affect spillway flood capacity until flows reach 1,492 kcfs. TSW removal is recommended before river levels exceed 685 kcfs.

Section 5 – McNary Dam
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Section 5 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, 2002 – 2011.[1]

Yearling Chinook					Subyearling Chinook				
	10 %	50%	90 %	# of Days		10 %	50%	90 %	# of Days
2002	2-May	16-May	26-May	24	2002	22-Jun	7-Jul	12-Aug	51
2003	29-Apr	13-May	29-May	30	2003	20-Jun	2-Jul	31-Jul	41
2004	27-Apr	11-May	31-May	34	2004	22-Jun	30-Jun	18-Jul	26
2005	3-May	15-May	29-May	26	2005	16-Jun	25-Jun	3-Jul	17
2006	21-Apr	9-May	19-May	28	2006	14-Jun	6-Jul	19-Jul	35
2007	1-May	11-May	25-May	24	2007	22-Jun	6-Jul	28-Jul	36
2008	9-Apr	15-May	27-May	48	2008	22-Jun	8-Jul	9-Aug	48
2009	2-May	15-May	25-May	23	2009	18-Jun	4-Jul	22-Jul	34
2010	3-May	17-May	27-May	24	2010	18-Jun	4-Jul	4-Aug	47
2011	29-Apr	8-May	23-May	24	2011	24-Jun	24-Jul	19-Aug	56
MEDIAN	30-Apr	14-May	26-May	25	**MEDIAN**	21-Jun	5-Jul	29-Jul	38.5
MIN	9-Apr	9-May	19-May	23	**MIN**	14-Jun	25-Jun	3-Jul	17
MAX	3-May	17-May	31-May	48	**MAX**	24-Jun	24-Jul	19-Aug	56

Unclipped Steelhead					Clipped Steelhead				
	10 %	50%	90 %	# of Days		10 %	50%	90 %	# of Days
2002	24-Apr	19-May	2-Jun	39	2002	21-Apr	17-May	4-Jun	44
2003	19-Apr	25-May	4-Jun	46	2003	1-May	25-May	2-Jun	32
2004	23-Apr	13-May	4-Jun	42	2004	23-Apr	10-May	31-May	38
2005	1-May	17-May	27-May	26	2005	19-Apr	15-May	29-May	40
2006	19-Apr	7-May	27-May	38	2006	23-Apr	1-May	23-May	30
2007	27-Apr	11-May	25-May	28	2007	29-Apr	9-May	23-May	24
2008	1-May	15-May	29-May	28	2008	3-May	11-May	23-May	20
2009	25-Apr	7-May	23-May	28	2009	27-Apr	7-May	23-May	26
2010	1-May	13-May	2-Jun	32	2010	1-May	9-May	29-May	28
2011	19-Apr	7-May	27-May	38	2011	19-Apr	1-May	17-May	28
MEDIAN	24-Apr	13-May	28-May	35	**MEDIAN**	25-Apr	9-May	26-May	29
MIN	19-Apr	7-May	23-May	26	**MIN**	19-Apr	1-May	17-May	20
MAX	1-May	25-May	4-Jun	46	**MAX**	3-May	25-May	4-Jun	44

Coho					Sockeye (Wild & Hatchery)				
	10 %	50%	90 %	# of Days		10 %	50%	90 %	# of Days
2002	11-May	31-May	10-Jun	30	2002	4-May	14-May	25-May	21
2003	25-May	4-Jun	29-Jun	35	2003	3-May	15-May	27-May	24
2004	15-May	31-May	18-Jun	34	2004	15-May	31-May	14-Jun	30
2005	5-May	21-May	6-Jun	32	2005	11-May	19-May	31-May	20
2006	9-May	27-May	2-Jun	24	2006	3-May	17-May	29-May	26
2007	3-May	21-May	8-Jun	36	2007	11-May	21-May	31-May	20
2008	13-May	25-May	6-Jun	24	2008	15-May	25-May	6-Jun	22
2009	13-May	23-May	12-Jun	30	2009	5-May	21-May	2-Jun	28
2010	9-May	31-May	12-Jun	34	2010	11-May	29-May	2-Jun	22
2011	24-Apr	19-May	8-Jun	45	2011	4-May	13-May	31-May	27
MEDIAN	10-May	26-May	9-Jun	32	**MEDIAN**	8-May	20-May	31-May	22
MIN	24-Apr	19-May	2-Jun	24	**MIN**	3-May	13-May	25-May	20
MAX	25-May	4-Jun	29-Jun	36	**MAX**	15-May	31-May	14-Jun	30

1. Dates are derived from daily and yearly facility collection numbers.

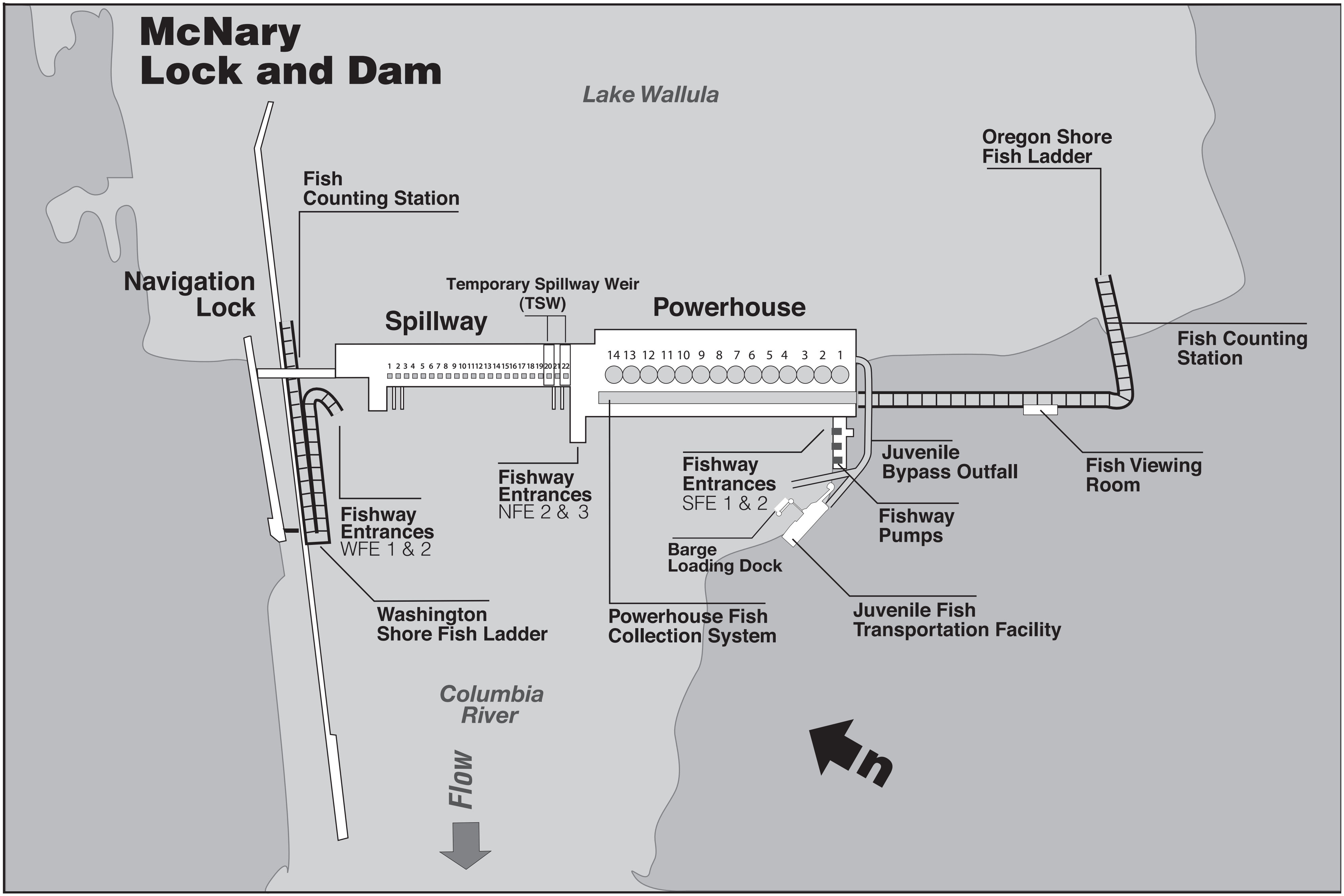
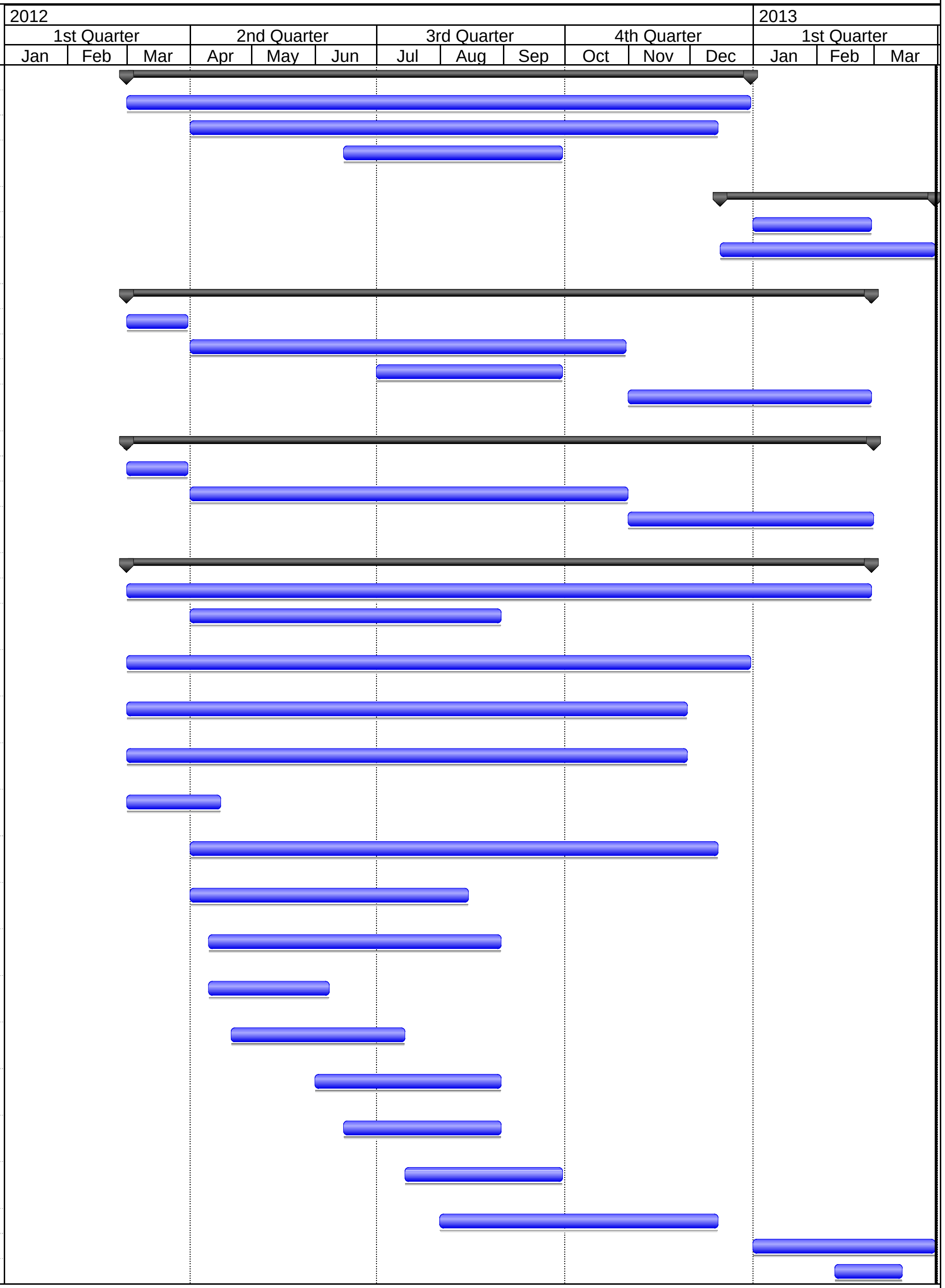


Figure 1. McNary Lock and Dam General Site Plan.

Table MCN-2. Dates of Fish-Related Operations at McNary Dam during the 2012 Fish Passage Season and 2012-2013 Winter Maintenance Period.

Task Name	Start	Finish	Reference
2012 FISH PASSAGE SEASON	**3/1/12**	**12/31/12**	
Adult Fish Passage Season	3/1/12	12/31/12	MCN 2.3.2.2
Juvenile Fish Passage Season	4/1/12	12/15/12	MCN 2.3.1.2
Lamprey Passage Season	6/15/12	9/30/12	MCN 2.3.2.2
2012-2013 WINTER MAINTENANCE PERIOD	**12/16/12**	**3/31/13**	
Winter Maintenance Adult Fish Facilities	1/1/13	2/28/13	MCN 2.3.2.1
Winter Maintenance Juvenile Fish Facilities	12/16/12	3/31/13	MCN 2.3.1.1
Adult Fish Counting (year-round)	**3/1/12**	**2/28/13**	**MCN Table MCN-2**
Video Count 0600-1800 PST	3/1/12	3/31/12	
Visual Count 0400-2000 PST	4/1/12	10/31/12	
Night Video Lamprey Counts 2000-0400 PST	7/1/12	9/30/12	
Video Count 0600-1800 PST	11/1/12	2/28/13	
1% Constraints (year-round)	**3/1/12**	**2/28/13**	**MCN 4.1.1**
1% soft constraint	3/1/12	3/31/12	
1% hard constraint	4/1/12	10/31/12	
1% soft constraint	11/1/12	2/28/13	
TDG Monitoring (year-round)	**3/1/12**	**2/28/13**	**App D Table 1**
TDG Monitoring - Tailrace (year-round)	3/1/12	2/28/13	MCPW
TDG Monitoring - Forebay	4/1/12	8/31/12	MCNA
Weekly Reports	3/1/12	12/31/12	MCN 2.3.3.1
Operate Turbines for Fish Passage	3/1/12	11/30/12	MCN 4.1
BiOp Kelt Passage & Survival Study	3/1/12	11/30/12	App A MCN 2.9
Adult Steelhead Fallback Study	3/1/12	4/16/12	App A MCN 2.1
Operate Juvenile Fish Passage Facilities	4/1/12	12/15/12	MCN 2.3.1
Backflush Orifices Twice Daily	4/1/12	8/15/12	MCN 2.3.1.2 c6
Oregon Shore Ladder Intake Screen Monitoring	4/10/12	8/31/12	App A MCN 2.6
TSW Operation	4/10/12	6/8/12	App A MCN 1.3
BiOp Performance Standard Testing (dates approximate)	4/21/12	7/15/12	App A MCN 2.2, App E
Adult Lamprey Passage Study	6/1/12	8/31/12	App A MCN 2.3
Daily Water Temperature Measurement	6/15/12	8/31/12	App B 4.g(3)
Juvenile Fish Transportation (approximate dates)	7/15/12	9/30/12	App B 3 MCN
Turbine Gates in Standard Position	8/1/12	12/15/12	MCN 4.2.1
Adult Steelhead Fallback Study	1/1/13	3/31/13	App A MCN 2.1
Annual Report (for 2012)	2/10/13	3/15/13	MCN 2.3.3.2



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.

1.2.1.1 North Shore Adult Fish Passage Facility. 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.

1.2.1.2 South Shore Adult Fish Passage Facility. 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.

1.2.1.3 Powerhouse Collection System. 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, but do not appear on the Corps daily website total due to relative infrequency of passage. These data are posted in the Miscellaneous Fish Counts report during the passage season (updated periodically during the season) found on the Corps' web site, and summarized in the Annual Fish Passage Report.

Table MCN- 3. Adult Fish Counting Schedule at McNary Dam.

Count Period	Counting Method and Hours
March 01 through March 31	Video 0600–1800 hours (PST)
April 1 through October 31	Visual 0400–2000 hours (PST)
July 1 through September 30	Night Video Lamprey count 2000–0400 hours (PST)
November 01 through end of February	Video 0600–1800 hours (PST)

Table MCN- 4. Adult Fish Count Period and Peak Migration Timing at McNary Dam (based on fish count data for 1954-2011).

Species	Count Period	Date of Peak Passage	
		Earliest	Latest
Spring Chinook	April 1 - June 8	April 20	May 26
Summer Chinook	June 9 - August 8	June 17	July 26
Fall Chinook	August 9 - October 31	September 10	September 28
Steelhead	April 1 – October 31	July 9	October 13
Coho	April 1 – October 31	September 5	October 11
Sockeye	April 1 – October 31	July 23	July 16
Lamprey	April 1 – October 31	July 21	August 12

2. Project Operation

2.1. Spill Management

See the Fish Operations Plan (Appendix E) for more information.

2.1.1. Involuntary Spill. Involuntary spill at McNary Dam 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 spill patterns included in Table MCN-7.

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. Prior to the end of January 15, inspect or rake up to four trashracks to determine if debris is present. Prioritize raking trashracks at units with known debris issues and longer run times, and insure to the extent practicable that raked units are distributed evenly across the powerhouse.

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.

1. 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 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 (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. Generally this will result in removing debris from trashracks at least four times per year - just prior to the fish passage season and, monthly for the first three months Raking may be required when heavy debris loads are present in the river. Fish quality and trash rack differential may also be an indicator of debris buildup on the trashracks. Project biologist shall determine when 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 the screen. Installation of the ESBSs will not start before April 5 and will be completed no later than April 15.

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, *and preferably less than 3 hours*, 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 dewatering).

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.

h. TSW Operation. A temporary spillway weir (TSW[1]) will be installed in spillbays 19 and 20, available for the start of the spring spill operations. Both TSWs will be removed from service on June 8 or the next available work day.

i. Emergency Bypass During Freezing Conditions

1. When cold weather is forecasted for Umatilla, Oregon, between November 1 and December 15, the McNary Fisheries staff may place the McNary Juvenile Fish Facility (JFF) channel in emergency bypass mode until the beginning of the winter maintenance season when the juvenile channel is fully dewatered.

2. "*Cold weather*" is defined as: forecasted daily high temperature below 32°F or daily low temperature below 20°F. Staff shall use the forecast for Umatilla, Oregon, provided by NOAA's National Weather Service at www.weather.gov.

3. If the projects installs a proposed "X" or "Y" valve in the south trash sluiceway that eliminates the need for emergency bypass, then the fisheries staff may shut down the water supply to the JFF after November 1 until the JFF is re-watered the following March, unless earlier re-watering is required for testing or maintenance.

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 end of February)

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.

[1] Temporary spillway weirs (TSWs) are installed at McNary, John Day and Little Goose dams. TSWs are differentiated from Removable Spillway Weirs (RSWs, installed at Lower Granite, Lower Monumental and Ice Harbor dams) by the ability to install, uninstall and move TSWs between spillbays using the project's gantry crane.

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. Outage periods will be minimized to the extent practicable. Only one ladder may be out of service or operating out of standard operating criteria at any one time, unless specifically coordinated with CENWW-OD-T and FPOM.

2.3.2.2 Fish Passage Period (March 1 through December 31). See special operations during lamprey passage June 15 to September 30 (paragraph **j** below).

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. Adult collection channel water velocities must flow between 1.5’ - 4’ per second. This velocity is optimum criteria for returning adult salmon and steelhead to migrate upstream though the fishway. Velocity readings are completed three times a week and are included in required fishway inspections and reported in the weekly and annual reports.

1. Surface water velocities will be measured in the open access area near the south shore fish entrance. The surface velocity will be measured using a large piece of woody debris (stick, bark) timed over a marked fixed distance. A Doppler meter location near the same location measures the subsurface flow. The measurement of the water velocity at this location typifies the slowest velocity conditions throughout the length of the channel.

e. North Shore Entrances (WFE 2 & 3)

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. Lamprey passage season June 15 to September 30 modifications with removal of the stationary section of the segmental gate.

1. Implement the following nighttime segmental gate operations between 2100 hours to 0400 hours:

   i. Lower the SFE 1 & 2 entrance weir to the lowest elevation (243 fmsl).

   ii. Lower the NFE 2 & 3 entrance weir to the lowest elevation (243 fmsl).

2. Daytime operations between 0400 hours and 2100 hours:

   i. Extend telescoping segmental gates SFE 1 &2 and NFE 2 & 3 depth: 9’ or greater below tailwater.

   ii. Maintain tail water and channel differential of 1.0 to 2.0’.

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 dewatering).

m. 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 Weekly Reports. 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. The reports shall include:

1. Any out-of-criteria situations observed and subsequent corrective actions taken;
2. Any equipment malfunctions, breakdowns, or damage along with a summary of resulting repair activities;
3. Adult fishway control calibrations;
4. ESBS and VBS inspections;
5. Any unusual activities which occurred at the project which may affect fish passage.

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.

2.3.3.2 Annual Reports. 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.

2.3.3.3 Monthly Inspections. Project biologists also inspect project facilities once per month and during dewaterings for the presence of zebra and Quagga mussels. Biologists shall provide a report to CENWW-OD-T on a monthly basis summarizing 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 2011 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 (see also the Overview (FPP Section 1) for the coordination form):

1. Description of the outage.
2. Type of outage required.
3. Impact on facility operation.
4. Length of time for repairs.
5. 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 cannot 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, and the outages are expected to be long-term then the middle eight of twelve open floating orifices should be closed and monitored (4,8,14,21,26,32,37,41) before closing main entrances, if extra water is still needed, 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 two pumps fail and the outages are expected to be short-term then 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 both 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 Units Operation and Maintenance

4.1. Turbine Units Operation

When in operation, turbine units will be operated to enhance adult and juvenile fish passage and juvenile bypass from March 1 through November 30 as in Table MCN -5. During this time period turbine units will be operated as needed to meet generation requirements in the following order: 1, then 14 through 2 in descending order when units are available for operation. Unit operating priority may be coordinated differently to allow for fish research, construction, or project maintenance activities. During the summer, (when all collected fish are transported) turbine operating priority will change to north powerhouse loading to improve juvenile egress conditions, when recorded forebay temperatures reach 70 degrees Fahrenheit (F). Under north powerhouse loading, turbine units shall be loaded consecutively from unit 14 back towards unit 1. Turbine unit 1 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, two or more at a time, should be avoided if possible during periods of warm water, especially between 1000 and 2400 hours. During times of elevated forebay temperatures (>70°F measured in the forebay) the project biologist may coordinate through CENWW-OD-T to designate up to 5 turbine units to a higher priority of operation to even out water temperature differences within the juvenile collection channel and to spread out the tailrace flow to reduce back eddies for safer smolt egress and safer fish barge docking conditions.

Table MCN- 5. Turbine Unit Operation Priority for McNary Dam.

Season	Operation	Unit Priority
March 1 to November 30	Fish Passage Season and Fish Bypass	1 then 14 through 2 in descending order*
	Fish Collection and Transport and no spill	14 to 1 in descending order
	Fish Bypass or Fish Collection and Transport at forebay temperatures ≥ 70°F with spill	14 to 1 Priority with modifications at the southern end of the powerhouse to be determined by Project Biologist to minimize temperature differentials in gatewells and juvenile collection channel

* Provides positive downstream flows at the outfall and based on unit availability.

4.1.1. Turbine Unit Operating Range

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:

a. 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);

b. If the turbine unit draft tube is to be dewatered, operate unit with full load for a minimum of 15 minutes prior to installing tail logs. If not possible to load, run unit at speed-no-load for minimum of 15 minutes. This is to reduce the number of fish in the scrollcase prior to installing stop logs;

c. Operating a turbine unit solely to provide station service; or

d. 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 Table MCN-6.

Table MCN- 6. Turbine Unit Operating Range Within 1% of Best Efficiency at McNary Dam With and Without Extended-Length Submersible Bar Screens (ESBSs) Installed.*

Head (feet)	With ESBSs Installed				Without ESBSs			
	Lower Limit		Upper Limit		Lower Limit		Upper Limit	
	(MW)	(cfs)	(MW)	(cfs)	(MW)	(cfs)	(MW)	(cfs)
67	37.5	7,934	56.7	11,997	37.7	7,739	57.9	11,887
68	38.0	7,911	58.2	12,121	38.2	7,716	59.4	12,009
69	38.5	7,887	59.7	12,240	38.7	7,694	60.9	12,128
70	**39.0**	**7,864**	**61.2**	**12,355**	**39.2**	**7,671**	**62.5**	**12,243**
71	39.6	7,874	62.1	12,355	39.8	7,681	63.4	12,243
72	40.2	7,883	63.1	12,354	40.4	7,691	64.4	12,242
73	40.9	7,892	64.0	12,353	41.1	7,699	65.3	12,241
74	41.5	7,901	64.9	12,351	41.7	7,708	66.3	12,240
75	**42.2**	**7,909**	**65.8**	**12,350**	**42.4**	**7,716**	**67.2**	**12,239**
76	42.8	7,907	66.4	12,282	43.0	7,714	67.9	12,172
77	43.4	7,905	67.1	12,216	43.6	7,713	68.5	12,107
78	44.0	7,903	67.7	12,151	44.2	7,711	69.1	12,043
79	44.6	7,900	68.3	12,088	44.8	7,709	69.7	11,980
80	**45.2**	**7,897**	**68.9**	**12,026**	**45.5**	**7,706**	**70.3**	**11,920**
81	45.9	7,893	70.0	12,039	46.1	7,720	71.5	11,961
82	46.5	7,889	71.1	12,050	46.8	7,734	72.6	12,000
83	47.2	7,884	72.2	12,061	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 November or December but can be completed in mid-August. Impacts to migrating adults should be minimized. When possible, units used for temperature operations should remain available. 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. Operating Gates. 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. 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 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. Unwatering turbine units should be accomplished in accordance with project unwatering plans. If the turbine unit draft tube is to be dewatered, operate unit with full load for a minimum of 15 minutes prior to installing tail logs. If not possible to load, run unit at speed-no-load for minimum of 15 minutes. This is to reduce the number of fish in the scrollcase prior to installing stop logs. 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.

4.2.3. Operational Testing. Units may be operationally tested for up to 30 minutes before going into maintenance status by running the unit at speed no load and various loads within the 1% criteria to allow pre-maintenance measurements and testing and to allow all fish to move through the unit. Units may be operationally tested after maintenance or repair while remaining in maintenance or forced outage status. Operational testing may consist of running the unit for up to a cumulative time of 30 minutes (within 1% criteria) before it is returned to operational status. Operational testing of unit under maintenance is in addition to a unit in run status (E.G. minimum generation) required for power plant reliability. Operational testing may deviate from fish priority units and may require water that would otherwise be used for spill if the running unit for reliability is at its 1% minimum load. Water will be used from the powerhouse allocation if possible, and water diverted from spill for operational testing will be minimized to that necessary to maintain and assure generation system reliability.

5. Forebay Debris Removal

Debris at projects can adversely 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 the spillway with boats where operators can spill it or to the shore 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. Normally, the project shall contact CENWW-OD-T and the John Day Dam Control Room and Fishery Biologist at least two workdays prior to the day the special operation is required. Using information provided by the project, CENWW-OD-T will notify FPOM. The special operation will be detailed in a teletype issued by RCC.

5.1. Special Spills

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.

5.1.1. Emergency spills may be implemented if necessary to pass woody debris that is accumulating in front of one or both TSWs, compromising the safe, unobstructed passage of fish. The operating project will immediately spill the woody debris to remove the obstructions to fish passage. The operating project will notify CENWW-OD-T of the emergency spill as soon as possible to provide notification to RCC, NOAA Fisheries, and other FPOM participants.

Table MCN- 7 (pg 1 of 5). McNary Spill Pattern for Fish Passage (discharge at forebay elevation 339 ft). *

SPILLWAY BAY (Gate Opening in feet)																						Total Stops	Total Spill
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22		(kcfs)
																		5.5	5.2	1		11.7	20.7
																	1	5.5	5.2	1		12.7	22.7
																	1	5.5	5.2	1	1	13.7	24.7
																	1	5.5	5.2	2	1	14.7	26.6
																	2	5.5	5.2	2	1	15.7	28.5
																1	2	5.5	5.2	2	1	16.7	30.5
																2	2	5.5	5.2	2	1	17.7	32.4
														1		2	2	5.5	5.2	2	1	18.7	34.4
														1		2	2	5.5	5.2	2	2	19.7	36.3
														2		2	2	5.5	5.2	2	2	20.7	38.2
														2	1	2	2	5.5	5.2	2	2	21.7	40.2
														2	2	2	2	5.5	5.2	2	2	22.7	42.1
													1	**2**	**2**	**2**	**2**	**5.5**	**5.2**	**2**	**2**	**23.7**	**44.1**
													2	2	2	2	2	5.5	5.2	2	2	24.7	46.0
										1		2		2	2	2	2	5.5	5.2	2	2	25.7	48.0
										2		2		2	2	2	2	5.5	5.2	2	2	26.7	49.9
								1		2		2		2	2	2	2	5.5	5.2	2	2	27.7	51.9
								2		2		2		2	2	2	2	5.5	5.2	2	2	28.7	53.8
								2	1	2		2		2	2	2	2	5.5	5.2	2	2	29.7	55.8
								2	2	2		2		2	2	2	2	5.5	5.2	2	2	30.7	57.7
								2	2	2		2	1	2	2	2	2	5.5	5.2	2	2	31.7	59.7
								2	**2**	**2**		**2**	**2**	**2**	**2**	**2**	**2**	**5.5**	**5.2**	**2**	**2**	32.7	61.6
								2	2	2	1	2	2	2	2	2	2	5.5	5.2	2	2	33.7	63.6
								2	2	2	2	2	2	2	2	2	2	5.5	5.2	2	2	34.7	65.5
						1		2	2	2	2	2	2	2	2	2	2	5.5	5.2	2	2	35.7	67.5

* TSWs in bays 19 and 20 have flows equivalent to 5.5 and 5.2 stops, respectively, at forebay elevation of 339 feet.

* Raise gates for TSWs approximately 3-5 feet above water surface to ensure free surface and debris passage.

Table MCN- 7 (pg 2 of 5). McNary Spill Pattern for Fish Passage (discharge at forebay elevation 339 ft). *

SPILLWAY BAY (Gate Opening in feet)																						Total Stops	Total Spill (kcfs)
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22		
						2		2	2	2	2	2	2	2	2	2	2	5.5	5.2	2	2	36.7	69.4
				1		2		2	2	2	2	2	2	2	2	2	2	5.5	5.2	2	2	37.7	71.4
				2		2		2	2	2	2	2	2	2	2	2	2	5.5	5.2	2	2	38.7	73.3
2.5	2	3.5		2		2		2		2		2	1	2		2	2	5.5	5.2	2	2	39.7	74.8
2.5	2	3.5		2		2		2		2		2	1	2	1	2	2	5.5	5.2	2	2	40.7	76.8
2.5	2	3.5		2	1	2		2		2		2	1	2	1	2	2	5.5	5.2	2	2	41.7	78.8
2.5	2	3.5		2	1	2		2	1	2		2	1	2	1	2	2	5.5	5.2	2	2	42.7	80.8
2.5	2	3.5		2	1	2		2	1	2	1	2	1	2	1	2	2	5.5	5.2	2	2	43.7	82.8
2.5	2	3.5		2	1	2	1	2	1	2	1	2	1	2	1	2	2	5.5	5.2	2	2	44.7	84.8
2.5	2	3.5	1	2	1	2	1	2	1	2	1	2	1	2	1	2	2	5.5	5.2	2	2	45.7	86.8
2.5	2	3.5	1	2	1	2	1	2	1	2	1	2	1	2	1	2	2	5.5	5.2	2.5	2.5	46.7	88.5
2.5	2	3.5	1	2	1	2	1	2	1	2	1	2	2	2	1	2	2	5.5	5.2	2.5	2.5	47.7	90.4
2.5	2	3.5	1	2	1	2	1	2	1	2	1	2	2	2	1	2	2	5.5	5.2	2.5	2.5	47.7	90.4
2.5	2	3.5	1	2	1	2	1	2	1	2	1	2	2	2	2	2	2	5.5	5.2	2.5	2.5	48.7	92.3
2.5	2	3.5	1	2	2	2	1	2	1	2	1	2	2	2	2	2	2	5.5	5.2	2.5	2.5	49.7	94.2
2.5	2	3.5	1	2	2	2	1	2	2	2	1	2	2	2	2	2	2	5.5	5.2	2.5	2.5	50.7	96.1
2.5	2	3.5	1	2	2	2	1	2	2	2	2	2	2	2	2	2	2	5.5	5.2	2.5	2.5	51.7	98.0
2.5	2	3.5	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	5.5	5.2	2.5	2.5	52.7	99.9
2.5	2	3.5	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	5.5	5.2	2.5	2.5	53.7	101.8
2.5	2.5	4	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	5.5	5.2	2.5	2.5	54.7	103.4
2.5	2.5	4	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	5.5	5.2	3.5	2.5	55.7	105.1
2.5	2.5	4	2	2	2	2	2	2	2	2	2	2	2	2	2.5	2.5	3	5.5	5.2	2.5	2.5	56.7	106.8
2.5	2.5	4	2	2	2	2.5	2	2	2	2.5	2	2	2	2	2.5	2.5	3	5.5	5.2	2.5	2.5	57.7	108.5
2.5	2.5	4	2	2.5	2	2.5	2	2	2	2.5	2	2	2	2.5	2.5	2.5	3	5.5	5.2	2.5	2.5	58.7	110.2
2.5	2.5	4	2	2.5	2	2.5	2	2.5	2	2.5	2	2.5	2	2.5	2.5	2.5	3	5.5	5.2	2.5	2.5	59.7	111.9

* TSWs in bays 19 and 20 have flows equivalent to 5.5 and 5.2 stops, respectively, at forebay elevation of 339 feet.

* Raise gates for TSWs approximately 3-5 feet above water surface to ensure free surface and debris passage.

Table MCN- 7 (pg 3 of 5). McNary Spill Pattern for Fish Passage (discharge at forebay elevation 339 ft). *

SPILLWAY BAY (Gate Opening in feet)																						Total Stops	Total Spill
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22		(kcfs)
2.5	2.5	4	2	2.5	2.5	2.5	2	2.5	2.5	2.5	2	2.5	2	2.5	2.5	2.5	3	5.5	5.2	2.5	2.5	60.7	113.6
2.5	2.5	4	2	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2	2.5	2.5	2.5	3	5.5	5.2	2.5	2.5	61.7	115.3
2.5	2.5	4	3	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2	2.5	2.5	2.5	3	5.5	5.2	2.5	2.5	62.7	117.0
2.5	2.5	4	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	3	5.5	5.2	3	2.5	63.7	118.7
2.5	2.5	4	3	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	3	3	3	5.5	5.2	3	2.5	64.7	120.4
2.5	2.5	4.5	3	2.5	2.5	2.5	2.5	2.5	2.5	3	2.5	2.5	2.5	2.5	3	3	3	5.5	5.2	3	2.5	65.7	122.1
2.5	2.5	4.5	3	2.5	2.5	3	2.5	2.5	2.5	3	2.5	3	2.5	2.5	3	3	3	5.5	5.2	3	2.5	66.7	123.8
2.5	2.5	4.5	3	3	2.5	3	2.5	3	2.5	3	2.5	3	2.5	2.5	3	3	3	5.5	5.2	3	2.5	67.7	125.5
2.5	2.5	4.5	3	3	3	3	2.5	3	2.5	3	2.5	3	2.5	3	3	3	3	5.5	5.2	3	2.5	68.7	127.2
2.5	2.5	5	3	3	3	3	2.5	3	3	3	2.5	3	2.5	3	3	3	3	5.5	5.2	3	2.5	69.7	128.8
2.5	2.5	5	3	3	3	3	3	3	3	3	3	3	2.5	3	3	3	3	5.5	5.2	3	2.5	70.7	130.5
3	3	5	3	3	3	3	3	3	3	3	3	3	2.5	3	3	3	3	5.5	5.2	3	2.5	71.7	132.2
3	3	5	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	5.5	5.2	3	3	72.7	133.9
3	3	5	3	3	3	3	3	3	3	3	3	3	3	3	3	3	4	5.5	5.2	3	3	73.7	135.5
3	3	5	3	3	3	3	3	3	3	3	3	3	3	3	3	4	4	5.5	5.2	3	3	74.7	137.1
3	4	5	3	3	3	3	3	3	3	3	3	3	3	3	3	4	4	5.5	5.2	3	3	75.7	138.7
4	4	5	3	3	3	3	3	3	3	3	3	3	3	3	3	4	4	5.5	5.2	3	3	76.7	140.3
4	4	5	3	3	3	4	3	3	3	3	3	3	3	3	3	4	4	5.5	5.2	3	3	77.7	141.9
4	4	5	3	3	3	4	3	3	3	4	3	3	3	3	3	4	4	5.5	5.2	3	3	78.7	143.5
4	4	5	3	4	3	4	3	3	3	4	3	3	3	3	3	4	4	5.5	5.2	3	3	79.7	145.1
4	4	5	3	4	3	4	3	3	3	4	3	3	3	4	3	4	4	5.5	5.2	3	3	80.7	146.7
4	4	5	3	4	3	4	3	4	3	4	3	3	3	4	3	4	4	5.5	5.2	3	3	81.7	148.3
4	4	5	3	4	3	4	3	4	3	4	3	4	3	4	3	4	4	5.5	5.2	3	3	82.7	149.9
4	4	5	3	4	4	4	3	4	3	4	3	4	3	4	3	4	4	5.5	5.2	3	3	83.7	151.5
4	4	5	3	4	4	4	3	4	4	4	3	4	3	4	3	4	4	5.5	5.2	3	3	84.7	153.1

* TSWs in bays 19 and 20 have flows equivalent to 5.5 and 5.2 stops, respectively, at forebay elevation of 339 feet.

* Raise gates for TSWs approximately 3-5 feet above water surface to ensure free surface and debris passage.

Table MCN- 7 (pg 4 of 5). McNary Spill Pattern for Fish Passage (discharge at forebay elevation 339 ft). *

SPILLWAY BAY (Gate Opening in feet)																						Total Stops	Total Spill (kcfs)
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22		
4	4	5	3	4	4	4	3	4	4	4	4	4	3	4	3	4	4	5.5	5.2	3	3	85.7	154.7
4	4	5	3	4	4	4	4	4	4	4	4	4	3	4	3	4	4	5.5	5.2	3	3	86.7	156.3
4	4	5	3	4	4	4	4	4	4	4	4	4	3	4	4	4	4	5.5	5.2	3	3	87.7	157.9
4	4	5	4	4	4	4	4	4	4	4	4	4	3	4	4	4	4	5.5	5.2	3	3	88.7	159.5
4	4	5	4	4	4	4	4	4	4	4	4	4	3	4	4	4	4	5.5	5.2	4	3	89.7	161.1
4	4	5	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	5.5	5.2	4	3	90.7	162.7
4	4	5	4	4	4	4	4	4	4	4	4	4	4	4	4	4	5	5.5	5.2	4	3	91.7	164.3
4	4	5	4	4	4	4	4	4	4	4	4	4	4	4	4	5	5	5.5	5.2	4	3	92.7	165.9
4	5	5	4	4	4	4	4	4	4	4	4	4	4	4	4	5	5	5.5	5.2	4	3	93.7	167.5
5	5	5	4	4	4	4	4	4	4	4	4	4	4	4	4	5	5	5.5	5.2	4	3	94.7	169.1
5	5	5	4	4	4	5	4	4	4	4	4	4	4	4	4	5	5	5.5	5.2	4	3	95.7	170.7
5	5	5	4	4	4	5	4	4	4	5	4	4	4	4	4	5	5	5.5	5.2	4	3	96.7	172.3
5	5	5	4	5	4	5	4	4	4	5	4	4	4	4	4	5	5	5.5	5.2	4	3	97.7	173.9
5	5	5	4	5	4	5	4	4	4	5	4	4	4	5	4	5	5	5.5	5.2	4	3	98.7	175.5
5	5	5	4	5	4	5	4	5	4	5	4	4	4	5	4	5	5	5.5	5.2	4	3	99.7	177.1
5	5	5	4	5	4	5	4	5	4	5	4	5	4	5	4	5	5	5.5	5.2	4	3	100.7	178.7
5	5	5	4	5	4	5	4	5	4	5	4	5	4	5	4	5	5	5.5	5.2	5	3	101.7	180.3
5	5	5	4	5	5	5	4	5	4	5	4	5	4	5	4	5	5	5.5	5.2	5	3	102.7	181.9
5	5	5	4	5	5	5	4	5	5	5	4	5	4	5	4	5	5	5.5	5.2	5	3	103.7	183.5
5	5	5	4	5	5	5	4	5	5	5	5	5	4	5	4	5	5	5.5	5.2	5	3	104.7	185.1
5	5	5	4	5	5	5	5	5	5	5	5	5	4	5	4	5	5	5.5	5.2	5	3	105.7	186.7
5	5	5	4	5	5	5	5	5	5	5	5	5	4	5	5	5	5	5.5	5.2	5	3	106.7	188.3
5	5	5	5	5	5	5	5	5	5	5	5	5	4	5	5	5	5	5.5	5.2	5	3	107.7	189.9
5	5	6	5	5	5	5	5	5	5	5	5	5	4	5	5	5	5	5.5	5.2	5	3	108.7	191.5
5	5	6	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5.5	5.2	5	3	109.7	193.1

* TSWs in bays 19 and 20 have flows equivalent to 5.5 and 5.2 stops, respectively, at forebay elevation of 339 feet.

* Raise gates for TSWs approximately 3-5 feet above water surface to ensure free surface and debris passage.

Table MCN- 7 (pg 5 of 5). McNary Spill Pattern for Fish Passage (discharge at forebay elevation 339 ft). *

SPILLWAY BAY (Gate Opening in feet)																						Total Stops	Total Spill (kcfs)
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22		
5	5	6	5	5	5	5	5	5	5	5	5	5	5	5	5	5	6	5.5	5.2	5	3	110.7	194.7
5	5	6	5	5	5	5	5	5	5	5	5	5	5	5	5	6	6	5.5	5.2	5	3	111.7	196.3
5	5	6	5	5	5	5	5	5	5	5	5	5	5	6	5	6	6	5.5	5.2	5	3	112.7	197.9
5	5	6	5	5	5	5	5	5	5	5	5	6	5	6	5	6	6	5.5	5.2	5	3	113.7	199.5
5	5	6	5	5	5	5	5	5	5	5	5	6	5	6	6	6	6	5.5	5.2	5	3	114.7	201.1
5	5	6	6	5	5	5	5	5	5	5	5	6	5	6	6	6	6	5.5	5.2	5	3	115.7	202.7
5	5	6	6	5	5	5	5	5	5	5	5	6	5	6	6	6	6	5.5	5.2	6	3	116.7	204.3
5	5	6	6	5	5	5	5	5	5	5	6	6	5	6	6	6	6	5.5	5.2	6	3	117.7	205.9
5	5	6	6	5	5	5	5	5	5	5	5	6	6	6	6	6	6	5.5	5.2	6	4	118.7	207.5
5	5	6	6	6	5	5	5	5	5	5	6	6	6	6	6	6	6	5.5	5.2	6	4	120.7	210.7
5	5	6	6	6	5	6	5	5	5	6	6	6	6	6	6	6	6	5.5	5.2	6	4	122.7	213.9
5	5	6	6	6	6	6	5	6	5	6	6	6	6	6	6	6	6	5.5	5.2	6	4	124.7	217.1
5	5	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	5.5	5.2	6	4	126.7	220.3
6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	5.5	5.2	6	4	128.7	223.5
6	6	6	6	6	6	6	6	6	6	7	6	7	6	7	6	7	6	5.5	5.2	6	4	132.7	229.9
6	6	6	6	6	6	7	6	7	6	7	6	7	6	7	6	7	6	5.5	5.2	6	4	134.7	233.1
6	6	7	6	7	6	7	6	7	6	7	6	7	6	7	6	7	6	5.5	5.2	6	4	136.7	236.3
7	6	7	6	7	6	7	6	7	6	7	6	7	6	7	6	7	7	5.5	5.2	6	4	138.7	239.5
7	6	7	6	7	6	7	6	7	6	7	6	7	7	7	7	7	7	5.5	5.2	6	4	140.7	242.7
7	6	7	6	7	6	7	6	7	7	7	7	7	7	7	7	7	7	5.5	5.2	6	4	142.7	245.9
7	6	7	6	7	7	7	7	7	7	7	7	7	7	7	7	7	7	5.5	5.2	6	4	144.7	249.1
7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	5.5	5.2	6	4	146.7	252.3
7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	5.5	5.2	6	6	148.7	255.5
7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	5.5	5.2	7	7	150.7	258.7

* TSWs in bays 19 and 20 have flows equivalent to 5.5 and 5.2 stops, respectively, at forebay elevation of 339 feet.

* Raise gates for TSWs approximately 3-5 feet above water surface to ensure free surface and debris passage.

Table MCN- 8. McNary Spill Pattern for Navigation (discharge at forebay elevation 339 ft). *

SPILLWAY BAY (Gate Opening in feet)																						Total Stops	Total Spill
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22		(kcfs)
																		5.5	5.2	1		11.7	20.7
																	1	5.5	5.2	1		12.7	22.7
	1																1	5.5	5.2	1		13.7	24.7
	2																1	5.5	5.2	1		14.7	26.6
	3																1	5.5	5.2	1		15.7	28.3
	3																1	5.5	5.2	1	1	16.7	30.3
	4																1	5.5	5.2	1	1	17.7	31.9
	3	2															1	5.5	5.2	1	1	18.7	34.2
	4	2															1	5.5	5.2	1	1	19.7	35.8
	4	3															1	5.5	5.2	1	1	20.7	37.5
	4	3													1		1	5.5	5.2	1	1	21.7	39.5
	4	4													1		1	5.5	5.2	1	1	22.7	41.1
	4	4												1	1		1	5.5	5.2	1	1	**23.7**	**43.1**
	4	4										1		1	1		1	5.5	5.2	1	1	24.7	45.1
	4	4										2		1	1		1	5.5	5.2	1	1	25.7	47.0
	4	4								1		2		1	1		1	5.5	5.2	1	1	26.7	49.0
	4	4						1		1		2		1	1		1	5.5	5.2	1	1	27.7	51.0
	4	4						1		2		2		1	1		1	5.5	5.2	1	1	28.7	52.9
	4	4						1		2		2		1	1		1	5.5	5.2	2	1	29.7	54.8
	4	4						1		2		2		1	1		2	5.5	5.2	2	1	30.7	56.7
	4	4						2		2		2		1	1		2	5.5	5.2	2	1	31.7	58.6
	4	4						2		2		2		1	2		2	5.5	5.2	2	1	32.7	60.5
	4	4						2		2		2		2	2		2	5.5	5.2	2	1	33.7	62.4
	5	4						2		2		2		2	2		2	5.5	5.2	2	1	34.7	64.0
	5	4						2		2		2		2	2		2	5.5	5.2	2	2	35.7	65.9

* TSWs in bays 19 and 20 have flows equivalent to 5.5 and 5.2 stops, respectively, at forebay elevation of 339 feet.

* Raise gates for TSWs approximately 3-5 feet above water surface to ensure free surface and debris passage.

Table MCN- 9 (pg 1 of 5). McNary Spill Pattern After TSWs are Removed (discharge in kcfs at Forebay Elevation 339 ft). *

Spill (kcfs)	Spillbay – *No TSWs Installed*																						Total Stops
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	
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
29.0											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
39.0							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
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
67.0					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

Spill (kcfs)	Spillbay – *No TSWs Installed*																						Total Stops
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	
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
73.0	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
78.0	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
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
98.0	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
107.0	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
116.0	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
126.0	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

Spill (kcfs)	Spillbay – *No TSWs Installed*																					Total Stops
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	
131.0	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
136.0	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
144.0	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
152.0	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
157.0	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
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
165.0	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
173.0	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
181.0	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

Spill (kcfs)	Spillbay – *No TSWs Installed*																						Total Stops
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	
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
189.0	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
197.0	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
213.0	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
229.0	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
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

Spill (kcfs)	Spillbay – *No TSWs Installed*																					Total Stops
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	
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.)

<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- 10 (pg 1 of 3). McNary Dam Spill Pattern during TSW Removal (discharge in kcfs at Forebay Elevation 339 ft).*

Spill (kcfs)	Spillbay – *During TSW Removal*																						Total Stops
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	
73.5	2	3	4	3	2	2	2	2	2	2	2	2	2	2	2	2	2						38
75.1	2	4	4	3	2	2	2	2	2	2	2	2	2	2	2	2	2						39
76.8	3	4	4	3	2	2	2	2	2	2	2	2	2	2	2	2	2						40
78.4	3	4	4	3	3	2	2	2	2	2	2	2	2	2	2	2	2						41
80.1	3	4	4	3	3	3	2	2	2	2	2	2	2	2	2	2	2						42
81.6	3	4	5	3	3	3	2	2	2	2	2	2	2	2	2	2	2						43
83.2	3	5	5	3	3	3	2	2	2	2	2	2	2	2	2	2	2						44
84.9	3	5	5	3	3	3	3	2	2	2	2	2	2	2	2	2	2						45
86.5	3	5	5	3	3	3	3	3	2	2	2	2	2	2	2	2	2						46
88.2	3	5	5	3	3	3	3	3	3	2	2	2	2	2	2	2	2						47
89.8	3	5	5	3	3	3	3	3	3	3	2	2	2	2	2	2	2						48
91.5	3	5	5	3	3	3	3	3	3	3	3	2	2	2	2	2	2						49
93.1	3	5	5	3	3	3	3	3	3	3	3	3	2	2	2	2	2						50
94.8	3	5	5	3	3	3	3	3	3	3	3	3	3	2	2	2	2						51
96.4	4	5	5	3	3	3	3	3	3	3	3	3	3	2	2	2	2						52
98.1	4	5	5	4	3	3	3	3	3	3	3	3	3	2	2	2	2						53
99.7	4	5	5	4	4	3	3	3	3	3	3	3	3	2	2	2	2						54
101.3	4	5	6	4	4	3	3	3	3	3	3	3	3	2	2	2	2						55
102.9	4	6	6	4	4	3	3	3	3	3	3	3	3	2	2	2	2						56
104.6	4	6	6	4	4	4	3	3	3	3	3	3	3	2	2	2	2						57
106.2	4	6	6	4	4	4	4	3	3	3	3	3	3	2	2	2	2						58
107.9	4	6	6	4	4	4	4	4	3	3	3	3	3	2	2	2	2						59
109.5	4	6	6	4	4	4	4	4	4	3	3	3	3	2	2	2	2						60
111.2	4	6	6	4	4	4	4	4	4	4	3	3	3	2	2	2	2						61
112.8	4	6	6	4	4	4	4	4	4	4	4	3	3	2	2	2	2						62
114.5	4	6	6	4	4	4	4	4	4	4	4	4	3	2	2	2	2						63
116.1	4	6	6	4	4	4	4	4	4	4	4	4	4	2	2	2	2						64
117.8	4	6	6	4	4	4	4	4	4	4	4	4	4	3	2	2	2						65
119.4	4	6	6	4	4	4	4	4	4	4	4	4	4	3	3	2	2						66
121.1	4	6	6	4	4	4	4	4	4	4	4	4	4	3	3	3	2						67
122.7	4	6	6	4	4	4	4	4	4	4	4	4	4	3	3	3	3						68
124.3	5	6	6	4	4	4	4	4	4	4	4	4	4	3	3	3	3						69
125.8	5	6	6	5	4	4	4	4	4	4	4	4	4	3	3	3	3						70
127.4	5	6	6	5	5	4	4	4	4	4	4	4	4	3	3	3	3						71

Spill (kcfs)	Spillbay – *During TSW Removal*																						Total Stops
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	
129.1	5	6	7	5	5	4	4	4	4	4	4	4	4	3	3	3	3						**72**
130.7	5	7	7	5	5	4	4	4	4	4	4	4	4	3	3	3	3						**73**
132.3	5	7	7	5	5	5	4	4	4	4	4	4	4	3	3	3	3						**74**
133.8	5	7	7	5	5	5	5	4	4	4	4	4	4	3	3	3	3						**75**
135.4	5	7	7	5	5	5	5	5	4	4	4	4	4	3	3	3	3						**76**
136.9	5	7	7	5	5	5	5	5	5	4	4	4	4	3	3	3	3						**77**
138.5	5	7	7	5	5	5	5	5	5	5	4	4	4	3	3	3	3						**78**
140.1	5	7	7	5	5	5	5	5	5	5	5	4	4	3	3	3	3						**79**
141.6	5	7	7	5	5	5	5	5	5	5	5	5	4	3	3	3	3						**80**
143.2	5	7	7	5	5	5	5	5	5	5	5	5	5	3	3	3	3						**81**
144.8	5	7	7	5	5	5	5	5	5	5	5	5	5	4	3	3	3						**82**
146.5	5	7	7	5	5	5	5	5	5	5	5	5	5	4	4	3	3						**83**
148.1	5	7	7	5	5	5	5	5	5	5	5	5	5	4	4	4	3						**84**
149.8	5	7	7	5	5	5	5	5	5	5	5	5	5	4	4	4	4						**85**
151.3	6	7	7	5	5	5	5	5	5	5	5	5	5	4	4	4	4						**86**
152.9	6	7	7	6	5	5	5	5	5	5	5	5	5	4	4	4	4						**87**
154.5	6	7	7	6	6	5	5	5	5	5	5	5	5	4	4	4	4						**88**
156.1	6	7	8	6	6	5	5	5	5	5	5	5	5	4	4	4	4						**89**
157.7	6	8	8	6	6	5	5	5	5	5	5	5	5	4	4	4	4						**90**
159.3	6	8	8	6	6	6	5	5	5	5	5	5	5	4	4	4	4						**91**
160.9	6	8	8	6	6	6	6	5	5	5	5	5	5	4	4	4	4						**92**
162.5	6	8	8	6	6	6	6	6	5	5	5	5	5	4	4	4	4						**93**
164.1	6	8	8	6	6	6	6	6	6	5	5	5	5	4	4	4	4						**94**
165.7	6	8	8	6	6	6	6	6	6	6	5	5	5	4	4	4	4						**95**
167.3	6	8	8	6	6	6	6	6	6	6	6	5	5	4	4	4	4						**96**
168.9	6	8	8	6	6	6	6	6	6	6	6	6	5	4	4	4	4						**97**
170.5	6	8	8	6	6	6	6	6	6	6	6	6	6	4	4	4	4						**98**
172.1	6	8	8	6	6	6	6	6	6	6	6	6	6	5	4	4	4						**99**
173.6	6	8	8	6	6	6	6	6	6	6	6	6	6	5	5	4	4						**100**
175.2	6	8	8	6	6	6	6	6	6	6	6	6	6	5	5	5	4						**101**
176.7	6	8	8	6	6	6	6	6	6	6	6	6	6	5	5	5	5						**102**
178.4	7	8	8	6	6	6	6	6	6	6	6	6	6	5	5	5	5						**103**
180.1	7	8	8	7	6	6	6	6	6	6	6	6	6	5	5	5	5						**104**
181.7	7	8	8	7	7	6	6	6	6	6	6	6	6	5	5	5	5						**105**
183.3	7	8	9	7	7	6	6	6	6	6	6	6	6	5	5	5	5						**106**

Spill (kcfs)	Spillbay – *During TSW Removal*																						Total Stops
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	
184.9	7	9	9	7	7	6	6	6	6	6	6	6	6	5	5	5	5						**107**
186.6	7	9	9	7	7	7	6	6	6	6	6	6	6	5	5	5	5						**108**
188.2	7	9	9	7	7	7	7	6	6	6	6	6	6	5	5	5	5						**109**
189.9	7	9	9	7	7	7	7	7	6	6	6	6	6	5	5	5	5						**110**
191.5	7	9	9	7	7	7	7	7	7	6	6	6	6	5	5	5	5						**111**
193.2	7	9	9	7	7	7	7	7	7	7	6	6	6	5	5	5	5						**112**
194.9	7	9	9	7	7	7	7	7	7	7	7	6	6	5	5	5	5						**113**
196.5	7	9	9	7	7	7	7	7	7	7	7	7	6	5	5	5	5						**114**
198.2	7	9	9	7	7	7	7	7	7	7	7	7	7	5	5	5	5						**115**
199.8	7	9	9	7	7	7	7	7	7	7	7	7	7	6	5	5	5						**116**
201.4	7	9	9	7	7	7	7	7	7	7	7	7	7	6	6	5	5						**117**
203.0	7	9	9	7	7	7	7	7	7	7	7	7	7	6	6	6	5						**118**
204.6	7	9	9	7	7	7	7	7	7	7	7	7	7	6	6	6	6						**119**
206.2	8	9	9	7	7	7	7	7	7	7	7	7	7	6	6	6	6						**120**
207.8	8	9	9	8	7	7	7	7	7	7	7	7	7	6	6	6	6						**121.0**
209.3	8	9	9	8	8	7	7	7	7	7	7	7	7	6	6	6	6						**122.0**
210.9	8	9	10	8	8	7	7	7	7	7	7	7	7	6	6	6	6						**123.0**
212.5	8	10	10	8	8	7	7	7	7	7	7	7	7	6	6	6	6						**124.0**
214.1	8	10	10	8	8	8	7	7	7	7	7	7	7	6	6	6	6						**125.0**
215.7	8	10	10	8	8	8	8	7	7	7	7	7	7	6	6	6	6						**126.0**
217.3	8	10	10	8	8	8	8	8	7	7	7	7	7	6	6	6	6						**127.0**
218.9	8	10	10	8	8	8	8	8	8	7	7	7	7	6	6	6	6						**128.0**
220.5	8	10	10	8	8	8	8	8	8	8	7	7	7	6	6	6	6						**129.0**
222.1	8	10	10	8	8	8	8	8	8	8	8	7	7	6	6	6	6						**130.0**

* 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.

Section 6 – Ice Harbor Dam
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Section 6 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-1**). 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.

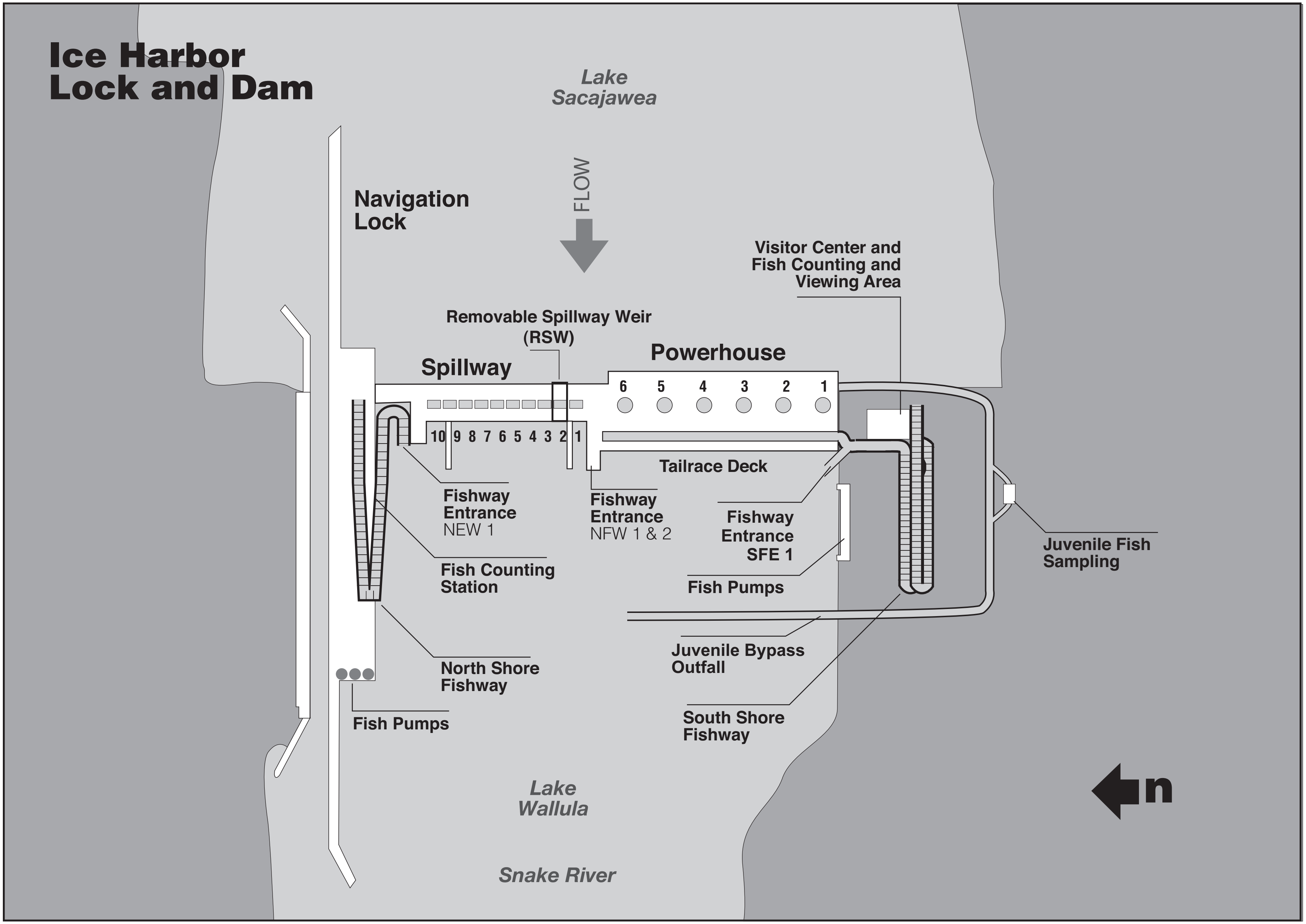
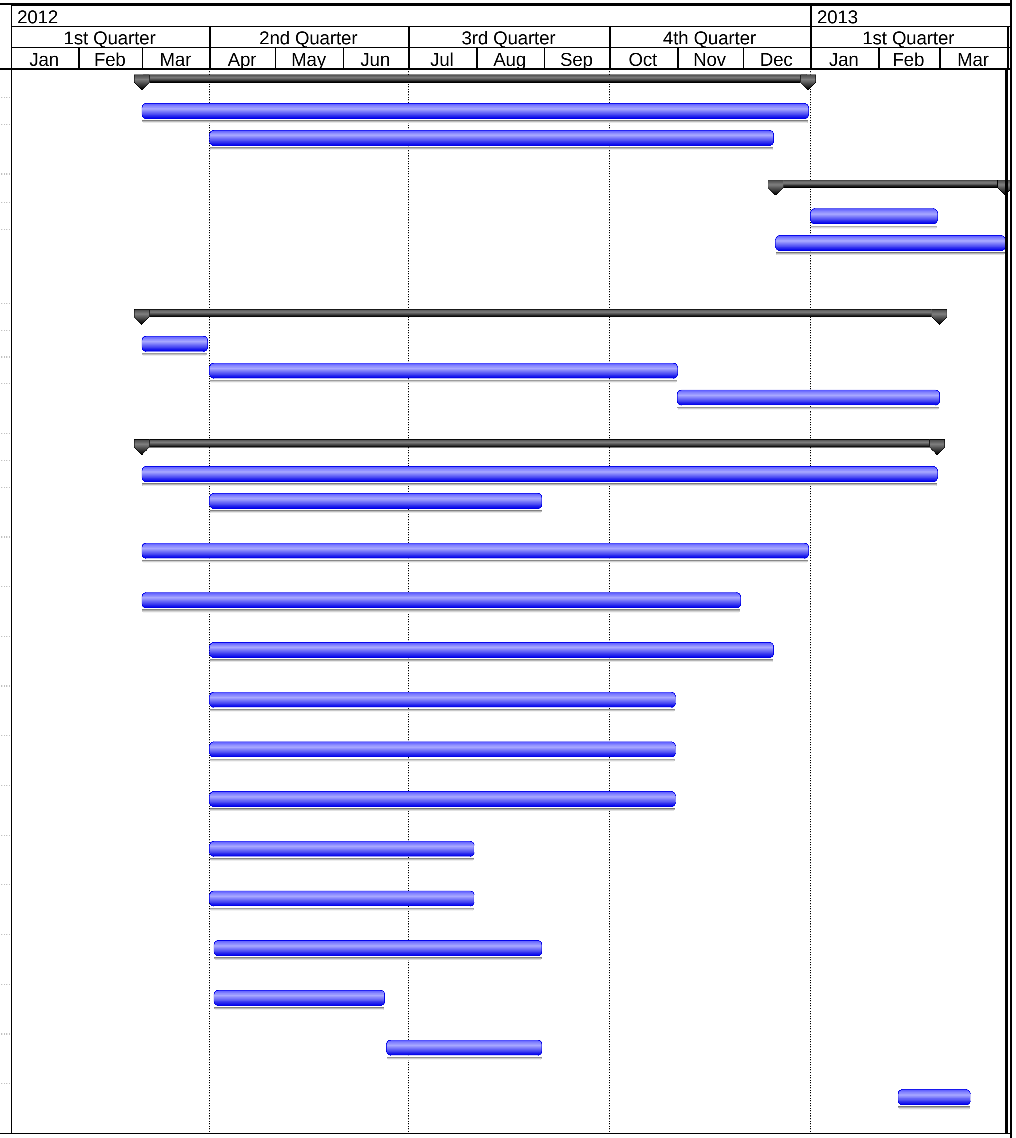


Figure IHR- 1. Ice Harbor Lock and Dam General Site Plan.

Table IHR-1. Dates of Fish-Related Operations at Ice Harbor Dam during the 2012 Fish Passage Season and 2012-2013 Winter Maintenance Period.

Task Name	Start	Finish	Reference
2012 FISH PASSAGE SEASON	**3/1/12**	**12/31/12**	
Adult Fish Passage Season	3/1/12	12/31/12	IHR 2.3.2.2
Juvenile Fish Passage Season	4/1/12	12/15/12	IHR 2.3.1.2
2012-2013 WINTER MAINTENANCE PERIOD	**12/16/12**	**3/31/13**	
Winter Maintenance Adult Fish Facilities	1/1/13	2/28/13	IHR 2.3.2.1
Winter Maintenance Juvenile Fish Facilities	12/16/12	3/31/13	IHR 2.3.1.1
1% Constraints (year-round)	**3/1/12**	**2/28/13**	**IHR 4.1.2**
1% soft constraint	3/1/12	3/31/12	
1% hard constraint	4/1/12	10/31/12	
1% soft constraint	11/1/12	2/28/13	
TDG Monitoring (year-round)	**3/1/12**	**2/28/13**	**App D Table 1**
TDG Monitoring - Tailwater (year-round)	3/1/12	2/28/13	IDSW
TDG Monitoring - Forebay	4/1/12	8/31/12	IHRA
Weekly Reports	3/1/12	12/31/12	IHR 2.3.3.1
Operate Turbines for Fish Passage	3/1/12	11/30/12	IHR 4.1
Operate Juvenile Fish Passage Facilities	4/1/12	12/15/12	IHR 2.3.1
Adult Fish Visual Count 0400-2000 PST	4/1/12	10/31/12	IHR Table IHR-2
Adult Lamprey Passage Study	4/1/12	10/31/12	App A IHR 2.2
Evaluation of Fish Counting Accuracy Study	4/1/12	10/31/12	App A IHR 2.1
Backflush Orifices Once per 8-Hour Shift	4/1/12	7/31/12	IHR 2.3.1.2 c6
Sample Juvenile Fish every 3-5 days	4/1/12	7/31/12	App E
Spillway Weir Operation	4/3/12	8/31/12	IHR 2.3.1.2 g
Spring Spill for Fish Passage	4/3/12	6/20/12	App E
Summer Spill for Fish Passage	6/21/12	8/31/12	App E
Annual Report (for 2012)	2/10/13	3/15/13	IHR 2.3.3.4



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 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.

Count Period	Counting Method and Hours
April 1 through October 31	Visual 0400–2000 hours (PST)

Table IHR- 3. Adult Counting Periods and Peak Migration Timing at Ice Harbor Dam (based on fish count data from years 1962-2011).

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 – 10/31	9/2	9/30
Steelhead	4/1 – 10/31	9/15	10/12
Sockeye	4/1 – 10/31	7/1	9/22
Lamprey	4/1 – 10/31	7/21	9/3

2. Project Operation.

2.1. Spill Management. See 2010 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-8, IHR-9, and IHR-10**. 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 criteria below.

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.

9. When extreme cold weather is forecasted (as defined as: anticipated temperatures below 20^{o} Fahrenheit for 24 hours) to occur for an extended period of time between Thanksgiving and December 15, ESBSs and STSs may be removed. The project will first request special permission from CENWW-OD-T. CENWW-OD-T will inform NOAA Fisheries and other FPOM participants of the action.

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[1] (RSW). The RSW will be in the raised position and operational on the first day of spill.

1. When the RSW is in operation, the spillgate shall be raised to where it does not touch flow passing down the RSW.

[1] Removable spillway weirs (RSWs) are installed at Ice Harbor, Lower Monumental and Lower Granite dams. RSWs are differentiated from Temporary Spillway Weirs (TSWs, installed at McNary, John Day and Little Goose dams) by being designed to be “removable” from the spillbay by controlled descent to the bottom of the forebay.

2. When the National Weather Service forecasts Ice Harbor inflows to exceed 200,000 cfs, initiate aggressive forebay debris removal so that RSW operation will not be impeded and coordinate with RCC and CENWW-OD-T.

3. 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 Ice Harbor inflow to exceed 300,000 cfs.

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 will be turned off so that the head differential on the auxiliary water supply conduit ceiling slab does not force water into the warehouse inside the dam.

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, OG1, 4, 10, and 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. Ice Harbor Dam monitors water velocity at the junction pool in the lower south fish ladder. The current device utilizes Doppler Technology. Decision for placement was not only what was considered to be the single most representative position, but also the placement for maintenance and ease of installation. In addition, head is measured at the north, north powerhouse, and south fishway entrances.

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 and quagga mussels. Biologists shall provide a report to CENWW-OD-T on a monthly basis summarizing 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 2011 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 significant effect on fish passage will be done during the January and February winter maintenance period. Maintenance of facilities that will have no effect 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 150-180 cfs of excess water from the juvenile fish passage facilities. Fluctuating water levels can require up to eight pumps to be operated to provide the auxiliary water and meet criteria. 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 and OG-10. 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 and OG-1. 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, Units will be operated to enhance adult and juvenile fish passage from March 1 through November 30. During this time period 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 eddies in front of the powerhouse. To provide the best fish passage conditions during periods of spill, it is important that the Units operate in a specific operating order to minimize eddying conditions. The original and desired unit prioritization is 1, 3, 6, 4, 2, 5. Unit 6 transformer has an internal fault and is generating gases that are indications of arcing and the levels are increasing with time, so it is desired to run this unit in a "last on, first off" basis.

The Sacajawea 500/115kV transformer is connected to the Ice Harbor-Franklin No. 2 115kV line, and Ice Harbor should not operate a single unit on the Ice Harbor-Franklin No. 2 115 kV line. The operation of a single unit on the Ice Harbor-Franklin No. 2 115kV line jeopardizes BPA system reliability. IHR should not be run as a single or two unit project if that unit(s) is unit 3 and/or 4 without switching those units to the Ice Harbor-Franklin No. 3 115kV line, disconnecting the Ice Harbor-Franklin No. 2 115kV line from Ice Harbor and disabling the transfer trip for the Ice Harbor-Franklin No. 2 115kV line at Ice Harbor. This switching is necessary to prevent the loss of all Ice Harbor generation and the Sacajawea transformer if there is an outage of the Ice Harbor-Franklin No. 2 115kV line.

If single unit operation is necessary and switching has not occurred in the yard, run unit 1, 2, 5, 6. Running units 3 and 4 alone on the Ice Harbor-Franklin No. 2 115kV line can only occur if the powerhouse operator can accomplish the needed switching. If unit 1 is out of service and switching has not occurred, then operate the following unit priority when operating more than one unit: 2, 3, 4, 5, 6.

Table IHR- 4. Unit Operating Priority for Ice Harbor Dam.

Season	Duration	Unit Priority (see Section 4.1)
January 01 – December 31 (year-round) Single unit operation w/ NO switching	24 hours/day	1,2,5,6
March 01 - November 30 Fish Passage Season	24 hours/day	1,3,4,2,5 and 6
December 01 – end of February Winter Maintenance Period	24 hours/day	Any order

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 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) If the turbine unit draft tube is to be dewatered, operate unit with full load for a minimum of 15 minutes prior to installing tail logs. If not possible to load, run unit at speed-no-load for minimum of 15 minutes. This is to reduce the number of fish in the scrollcase prior to installing stop logs;
>
> 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-7**.

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 8.5-10.3 kcfs through turbine units 1 and 3-6, and 11.3-13.1 kcfs through turbine unit 2. Actual attainable minimum generation levels may vary depending on project conditions.

4.2. Turbine Unit Outages During High River Flow Periods. During high spring flows, turbine unit outages for NERC regulatory requirements, 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 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 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 November or December but can be conducted in mid-August. Impacts to migrating adults should be minimized. 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. If the turbine unit draft tube is to be dewatered, operate unit with full load for a minimum of 15 minutes prior to installing tail logs. If not possible to load, run unit at speed-no-load for minimum of 15 minutes. This is to reduce the number of fish in the scrollcase prior to installing stop logs. 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.

4.3.2. Units may be operationally tested for up to 30 minutes before going into maintenance status by running the unit at speed no load and various loads within the 1% criteria to allow pre-maintenance measurements and testing AND TO ALLOW ALL FISH TO MOVE THROUGH THE UNIT. Units may be operationally tested after maintenance or repair while remaining in maintenance or forced outage status. Operational testing may consist of running the unit for up to a cumulative time of 30 minutes (within 1% criteria) before it is returned to operational status. Operational testing OF UNIT UNDER MAINTENANCE is in addition to a unit in run status (E.G. MINIMUM GENERATION) required for power plant reliability. Operational testing may deviate from fish priority units and may require water that would otherwise be used for spill if the running unit for reliability is at its 1% minimum load. Water will be used from the powerhouse allocation if possible, and water diverted from spill for operational testing will be minimized to that necessary to maintain and assure generation system reliability.

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. Normally, the project shall contact CENWW-OD-T at least two workdays prior to the day the special operation is required. Using information provided by the project, CENWW-OD-T will notify FPOM and RCC will issue a teletype detailing the special operations.

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.

5.1.1. Emergency spills may be implemented if necessary to pass woody debris that are accumulating in front of the spillbay weir(s), compromising the safe, unobstructed passage of fish. The operating project will immediately spill the woody debris to remove the obstructions to fish passage. The operating project will notify CENWW-OD-T of the emergency spill as soon as possible to provide notification to RCC, NOAA Fisheries, and other FPOM participants.

Table IHR- 5. Turbine Unit Operating Range Within 1% of Best Efficiency at Ice Harbor Dam – Units 1 and 3 With and Without STSs Installed.*

Head (feet)	Units 1 & 3 with STSs Installed				Units 1 & 3 with No STSs			
	Lower Limit		Upper Limit		Lower Limit		Upper Limit	
	(MW)	(cfs)	(MW)	(cfs)	(MW)	(cfs)	(MW)	(cfs)
85	**51.7**	**8,417**	**83.6**	**13,590**	**51.9**	**8340**	**89.9**	**14,452**
86	52.6	8,443	84.6	13,585	52.7	8367	91	14,447
87	53.4	8,469	85.6	13,580	53.5	8392	92	14,441
88	54.2	8,494	86.6	13,574	54.3	8417	93.1	14,436
89	55	8,518	87.6	13,569	55.1	8441	94.2	14,430
90	**55.8**	**8,542**	**88.6**	**13,563**	**55.9**	**8465**	**95.3**	**14,424**
91	56.5	8,548	89.8	13,585	56.6	8471	96.5	14,448
92	57.1	8,554	90.9	13,607	57.3	8477	97.8	14,471
93	57.8	8,559	92.1	13,628	58	8482	99	14,494
94	58.5	8,565	93.2	13,649	58.6	8,047	100.3	14,516
95	**59.2**	**8,570**	**94.4**	**13,669**	**59.3**	**8,052**	**101.5**	**14,537**
96	59.9	8,589	95.3	13,662	59	8,070	102.5	14,530
97	60.7	8,607	96.3	13,655	59	8,087	103.5	14,522
98	61.5	8,624	97.3	13,648	60	8,103	104.6	14,515
99	62.2	8,641	98.2	13,641	61	8,119	105.7	14,508
100	**63**	**8,658**	**99.2**	**13,634**	**62**	**8,135**	**106.7**	**14,500**
101	64	8,707	99.9	13,590	62	8,182	107.4	14,454
102	65	8,354	100.6	13,547	63	8,227	108.2	14,408
103	66	8,804	101.3	13,505	64	8,272	108.9	14,363
104	67	8,850	102	13,463	65	8,316	109.7	14,319
105	**68**	**8,896**	**102.6**	**13,422**	**66**	**8,359**	**110.4**	**14,275**

*** NOTE:** Table based on the 1978 model test and 2006 Unit 3 index test (IHR -5&6 revised 2008)

Table IHR- 6. Turbine Unit Operating Range Within 1% of Best Efficiency at Ice Harbor Dam – Units 4 and 6 With and Without STSs Installed.*

Head (feet)	Units 4 & 6 with STSs Installed				Units 4 & 6 with No STSs			
	Lower Limit		Upper Limit		Lower Limit		Upper Limit	
	(MW)	(cfs)	(MW)	(cfs)	(MW)	(cfs)	(MW)	(cfs)
85	**58.9**	**9,369**	**93.1**	**14,810**	**62**	**9,745**	**110.7**	**17,413**
86	59.7	9,380	94.4	14,824	62.8	9,756	112.3	17,430
87	60.6	9,390	95.7	14,838	63.7	9,767	113.8	17,447
88	61.4	9,400	97	14,851	64.5	9,777	115.3	17,462
89	62.2	9,410	98.2	14,864	65.4	9,787	116.8	17,477
90	**63**	**9,419**	**99.5**	**14,876**	**66.3**	**9,797**	**118.3**	**17,492**
91	63.7	9,416	100.7	14,885	67	9,794	119.8	17,503
92	64.5	9,414	102	14,895	67.8	9,792	121.3	17,515
93	65.2	9,411	103.2	14,904	68.6	9,789	122.7	17,525
94	65.9	9,409	104.5	14,912	69.3	9,787	124.2	17,535
95	**66.6**	**9,406**	**105.7**	**14,921**	**70.1**	**9,784**	**125.7**	**17,545**
96	67.5	9,416	106.7	14,892	70.9	9,794	126.8	17,512
97	68.3	9,425	107.7	14,864	71.8	9,804	128	17,479
98	69.1	9,434	108.6	14,836	72.7	9,813	129.2	17,446
99	69.9	9,442	109.6	14,809	73.5	9,822	130.3	17,414
100	**70.7**	**9,451**	**110.6**	**14,782**	**74.4**	**9,831**	**131.5**	**17,382**
101	71.4	9,446	112.9	14,939	75.1	9,825	134.2	17,567
102	72	9,441	115.1	15,093	75.7	9,820	136.9	17,748
103	72.7	9,436	117.4	15,224	76.4	9,815	139.6	17,926
104	73.3	9,431	119.7	15,392	77.1	9,810	142.3	18,100
105	**74**	**9,426**	**121.9**	**15,538**	**77.8**	**9,805**	**145**	**18,271**

*** NOTE:** Table based on the 1978 model test and 2006 Unit 6 index test (IHR -7&8 revised 2008)

Table IHR- 7. Turbine Unit Operating Range Within 1% of Best Efficiency at Ice Harbor Dam – Unit 2 With and Without STSs Installed.*

Head (feet)	Unit 2 with STSs Installed				Unit 2 with No STSs			
	Lower Limit		Upper Limit		Lower Limit		Upper Limit	
	(MW)	(cfs)	(MW)	(cfs)	(MW)	(cfs)	(MW)	(cfs)
85	**67.6**	**10,986**	**72.9**	**11,854**	**68.7**	**11,032**	**74**	**11,896**
86	68.6	11,017	73.9	11,864	69.7	11,064	75	11,905
87	69.6	11,047	74.8	11,873	70.7	11,094	76	11,914
88	70.6	11,077	75.8	11,882	71.8	11,124	76.9	11,923
89	71.7	11,105	76.7	11,890	72.8	11,153	77.9	11,932
90	**72.7**	**11,133**	**77.7**	**11,899**	**73.8**	**11,181**	**78.8**	**11,940**
91	73.4	11,120	78.7	11,917	74.6	11,167	79.9	11,959
92	74.2	11,107	79.8	11,936	75.4	11,154	80.9	11,978
93	75	11,093	80.8	11,953	76.2	11,141	82	11,995
94	75.8	11,080	81.8	11,970	76.9	11,128	83.1	12,013
95	**76.5**	**11,068**	**82.9**	**11,987**	**77.7**	**11,115**	**84.1**	**12,029**
96	77.3	11,071	83.5	11,955	78.6	11,118	84.8	11,998
97	78.2	11,073	84.2	11,924	79.4	11,121	85.4	11,966
98	79	11,076	84.8	11,894	80.2	11,124	86.1	11,936
99	79.8	11,079	85.5	11,864	81.1	11,127	86.7	11,906
100	**80.6**	**11,082**	**86.1**	**11,835**	**81.9**	**11,130**	**87.4**	**11,877**
101	81.5	11,096	87.1	11,852	82.8	11,144	88.4	11,894
102	82.5	11,110	88.1	11,869	83.8	11,158	89.4	11,911
103	83.4	11,124	89.1	11,886	84.7	11,172	90.4	11,928
104	84.3	11,138	90.1	11,902	85.6	11,186	91.4	11,944
105	**85.2**	**11,151**	**91.1**	**11,918**	**86.5**	**11,199**	**92.4**	**11,960**

*** NOTE**: Based on the 1956 Model Test and 2008 Unit 2 Index Test (IHR new 2008).

Table IHR- 8 (pg 1 of 2). Ice Harbor Dam High Spill Gate Pattern – Deflectors in All Spillbays and No Removable Spillway Weir (RSW).

Ice Harbor Dam Spill Pattern w/ Deflectors and No RSW Number of Gate Stops per Spillbay										Total Stops	Total Spill (kcfs)
Bay 1	Bay 2	Bay 3	Bay 4	Bay 5	Bay 6	Bay 7	Bay 8	Bay 9	Bay 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

Ice Harbor Dam Spill Pattern w/ Deflectors and No RSW Number of Gate Stops per Spillbay										Total Stops	Total Spill (kcfs)
Bay 1	Bay 2	Bay 3	Bay 4	Bay 5	Bay 6	Bay 7	Bay 8	Bay 9	Bay 10		
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
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- 9 (pg 1 of 2). Ice Harbor Dam Spill Pattern - RSW 30%. Revised May 17, 2011.

Ice Harbor Dam Spill Pattern - RSW 30% Number of Gate Stops per Spillbay										Total # of Stops	Total Spill* (kcfs)	Total River (kcfs)
Bay 1	Bay 2	Bay 3	Bay 4	Bay 5	Bay 6	Bay 7	Bay 8	Bay 9	Bay 10			
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**	**39.3**
0	RSW	0	0	0	0	0	1	1	1	**3**	**13.5**	**45.0**
0	RSW	0	0	0	0	1	1	1	1	**4**	**15.2**	**50.7**
0	RSW	0	0	0	1	1	1	1	1	**5**	**16.9**	**56.3**
0	RSW	5	0	0	0	0	0	0	1	**6**	**18.6**	**62.0**
0	RSW	5	0	0	0	0	0	1	1	**7**	**20.3**	**67.7**
0	RSW	5	0	0	0	0	1	1	1	**8**	**22.0**	**73.3**
0	RSW	5	0	0	0	1	1	1	1	**9**	**23.7**	**79.0**
0	RSW	5	0	0	1	1	1	1	1	**10**	**25.4**	**84.7**
0	RSW	5	0	5	0	0	0	0	1	**11**	**27.1**	**90.3**
0	RSW	5	0	5	0	0	0	1	1	**12**	**28.8**	**96.0**
0	RSW	5	0	5	0	0	1	1	1	**13**	**30.5**	**101.7**
0	RSW	5	0	5	0	0	1	1	2	**14**	**32.2**	**107.3**
0	RSW	5	0	5	0	0	1	2	2	**15**	**33.9**	**113.0**
0	RSW	5	0	5	0	0	2	2	2	**16**	**35.6**	**118.7**
0	RSW	6	0	5	0	0	2	2	2	**17**	**37.3**	**120.4**
0	RSW	6	0	6	0	0	2	2	2	**18**	**39.0**	**122.1**
0	RSW	6	0	6	0	1	2	2	2	**19**	**40.7**	**123.8**
0	RSW	6	0	6	0	2	2	2	2	**20**	**42.4**	**125.5**
0	RSW	5	0	5	0	5	2	2	2	**21**	**44.1**	**127.2**
0	RSW	5	0	5	0	6	2	2	2	**22**	**45.8**	**128.9**
0	RSW	5	0	6	0	6	2	2	2	**23**	**47.5**	**130.6**
0	RSW	6	0	6	0	6	2	2	2	**24**	**49.2**	**132.3**
0	RSW	6	0	6	0	6	2	3	2	**25**	**50.9**	**134.0**
0	RSW	6	0	6	0	6	2	4	2	**26**	**52.6**	**135.7**
0	RSW	6	0	6	0	6	2	5	2	**27**	**54.3**	**137.4**
0	RSW	6	0	6	0	6	2	6	2	**28**	**56.0**	**139.1**
0	RSW	6	0	6	1	6	2	6	2	**29**	**57.7**	**140.8**
0	RSW	6	0	6	2	6	2	6	2	**30**	**59.4**	**142.5**
0	RSW	6	0	6	3	6	2	6	2	**31**	**61.1**	**144.2**
0	RSW	6	0	6	4	6	2	6	2	**32**	**62.8**	**145.9**
0	RSW	6	0	6	5	6	2	6	2	**33**	**64.5**	**147.6**
0	RSW	6	0	6	6	6	2	6	2	**34**	**66.2**	**149.3**
0	RSW	6	0	6	6	6	3	6	2	**35**	**67.9**	**151.0**
0	RSW	6	0	6	6	6	4	6	2	**36**	**69.6**	**152.7**
0	RSW	6	0	6	6	6	5	6	2	**37**	**71.3**	**154.4**
0	RSW	6	0	6	6	6	6	6	2	**38**	**73.0**	**156.1**
0	RSW	6	1	6	6	6	6	6	2	**39**	**74.7**	**157.8**
0	RSW	6	2	6	6	6	6	6	2	**40**	**76.4**	**159.5**
0	RSW	6	3	6	6	6	6	6	2	**41**	**78.1**	**161.2**
0	RSW	6	4	6	6	6	6	6	2	**42**	**79.8**	**162.9**

Ice Harbor Dam Spill Pattern - RSW 30% Number of Gate Stops per Spillbay										Total # of Stops	Total Spill* (kcfs)	Total River (kcfs)
Bay 1	Bay 2	Bay 3	Bay 4	Bay 5	Bay 6	Bay 7	Bay 8	Bay 9	Bay 10			
0	RSW	6	5	6	6	6	6	6	2	**43**	**81.5**	**164.6**
0	RSW	6	6	6	6	6	6	6	2	**44**	**83.2**	**166.3**
0	RSW	7	6	6	6	6	6	6	2	**45**	**84.9**	**168.0**
0	RSW	7	7	6	6	6	6	6	2	**46**	**86.6**	**169.7**
0	RSW	7	7	7	6	6	6	6	2	**47**	**88.3**	**171.4**
0	RSW	7	7	7	7	6	6	6	2	**48**	**90.0**	**173.1**
0	RSW	7	7	7	7	7	6	6	2	**49**	**91.7**	**174.8**
0	RSW	7	7	7	7	7	7	6	2	**50**	**93.4**	**176.5**
0	RSW	8	7	7	7	7	7	7	2	**51**	**95.1**	**178.2**
0	RSW	8	7	7	7	7	7	7	2	**52**	**96.8**	**179.9**
0	RSW	8	8	7	7	7	7	7	2	**53**	**98.5**	**181.6**
0	RSW	8	8	8	7	7	7	7	2	**54**	**100.2**	**183.3**
0	RSW	8	8	8	8	7	7	7	2	**55**	**101.9**	**185.0**
0	RSW	8	8	8	8	8	7	7	2	**56**	**103.6**	**186.7**
0	RSW	8	8	8	8	8	8	7	2	**57**	**105.3**	**188.4**
0	RSW	8	8	8	8	8	8	8	2	**58**	**107.0**	**190.1**
0	RSW	9	8	8	8	8	8	8	2	**59**	**108.7**	**191.8**
0	RSW	9	9	8	8	8	8	8	2	**60**	**110.4**	**193.5**
0	RSW	9	9	9	8	8	8	8	2	**61**	**112.1**	**195.2**
0	RSW	9	9	9	9	8	8	8	2	**62**	**113.8**	**196.9**
0	RSW	9	9	9	9	9	8	8	2	**63**	**115.5**	**198.6**
0	RSW	9	9	9	9	9	9	8	2	**64**	**117.2**	**200.3**
0	RSW	9	9	9	9	9	9	9	2	**65**	**118.9**	**202.0**
0	RSW	10	9	9	9	9	9	9	2	**66**	**120.6**	**203.7**
0	RSW	10	10	9	9	9	9	9	2	**67**	**122.3**	**205.4**
0	RSW	10	10	10	9	9	9	9	2	**68**	**124.0**	**207.1**
0	RSW	10	10	10	10	9	9	9	2	**69**	**125.7**	**208.8**
0	RSW	10	10	10	10	10	9	9	2	**70**	**127.4**	**210.5**
0	RSW	10	10	10	10	10	10	9	2	**71**	**129.1**	**212.2**
0	RSW	10	10	10	10	10	10	10	2	**72**	**130.8**	**213.9**
0	RSW	11	10	10	10	10	10	10	2	**73**	**132.5**	**215.6**
0	RSW	11	11	10	10	10	10	10	2	**74**	**134.2**	**217.3**
0	RSW	11	11	11	10	10	10	10	2	**75**	**135.9**	**219.0**
0	RSW	11	11	11	11	10	10	10	2	**76**	**137.6**	**220.7**
0	RSW	11	11	11	11	11	10	10	2	**77**	**139.3**	**222.4**
0	RSW	11	11	11	11	11	11	10	2	**78**	**141.0**	**224.1**
0	RSW	11	11	11	11	11	11	11	2	**79**	**142.7**	**225.8**
0	RSW	12	11	11	11	11	11	11	2	**80**	**144.4**	**227.5**
0	RSW	12	12	11	11	11	11	11	2	**81**	**146.1**	**229.2**
0	RSW	12	12	12	11	11	11	11	2	**82**	**147.8**	**230.9**
0	RSW	12	12	12	12	11	11	11	2	**83**	**149.5**	**232.6**
0	RSW	12	12	12	12	12	11	11	2	**84**	**151.2**	**234.3**

* **Note**: The normal minimum spill rate is 15.2 kcfs.

Table IHR- 10 (pg 1 of 3). Ice Harbor Dam Spill Pattern - RSW 45 kcfs/Spill Cap.

Ice Harbor Dam Spill Pattern - RSW 45 kcfs/Spill Cap Number of Gate Stops per Spillbay										Total Stops	Total Spill (kcfs)
Bay 1	Bay 2	Bay 3	Bay 4	Bay 5	Bay 6	Bay 7	Bay 8	Bay 9	Bay 10		
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	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	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	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	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**
0	RSW	6	6	6	6	5	5	5	2	41	77.5

Ice Harbor Dam Spill Pattern - RSW 45 kcfs/Spill Cap Number of Gate Stops per Spillbay										Total Stops	Total Spill (kcfs)
Bay 1	**Bay 2**	**Bay 3**	**Bay 4**	**Bay 5**	**Bay 6**	**Bay 7**	**Bay 8**	**Bay 9**	**Bay 10**		
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
0	RSW	9	9	9	9	9	9	8	2	64	115.2
0	**RSW**	**9**	**9**	**9**	**9**	**9**	**9**	**9**	**2**	**65**	**116.9**
0	RSW	10	9	9	9	9	9	9	2	66	118.4
0	RSW	10	10	9	9	9	9	9	2	67	119.9
0	RSW	10	10	10	9	9	9	9	2	68	121.4
0	RSW	10	10	10	10	9	9	9	2	69	122.9
0	**RSW**	**10**	**10**	**10**	**10**	**10**	**9**	**9**	**2**	**70**	**124.4**
0	RSW	10	10	10	10	10	10	9	2	71	125.9
0	RSW	10	10	10	10	10	10	10	2	72	127.4
0	RSW	11	10	10	10	10	10	10	2	73	129.1
0	RSW	11	11	10	10	10	10	10	2	74	130.8
0	**RSW**	**11**	**11**	**11**	**10**	**10**	**10**	**10**	**2**	**75**	**132.5**
0	RSW	11	11	11	11	10	10	10	2	76	134.2
0	RSW	11	11	11	11	11	10	10	2	77	135.9
0	RSW	11	11	11	11	11	11	10	2	78	137.6
0	RSW	11	11	11	11	11	11	11	2	79	139.3
0	**RSW**	**12**	**11**	**11**	**11**	**11**	**11**	**11**	**2**	**80**	**140.8**
0	RSW	12	12	12	11	11	11	11	2	82	143.8
0	RSW	12	12	12	12	11	11	11	2	83	145.3
0	RSW	12	12	12	12	12	11	11	2	84	146.8
0	**RSW**	**12**	**12**	**12**	**12**	**12**	**12**	**11**	**2**	**85**	**148.3**

Ice Harbor Dam Spill Pattern - RSW 45 kcfs/Spill Cap **Number of Gate Stops per Spillbay**										**Total Stops**	**Total Spill (kcfs)**
Bay 1	**Bay 2**	**Bay 3**	**Bay 4**	**Bay 5**	**Bay 6**	**Bay 7**	**Bay 8**	**Bay 9**	**Bay 10**		
0	RSW	12	12	12	12	12	12	12	2	86	149.8
0	RSW	13	12	12	12	12	12	12	2	87	151.4
0	RSW	13	13	12	12	12	12	12	2	88	153.0
0	RSW	13	13	13	12	12	12	12	2	89	154.6
0	**RSW**	**13**	**13**	**13**	**13**	**12**	**12**	**12**	**2**	**90**	**156.2**
0	RSW	13	13	13	13	13	12	12	2	91	157.8
0	RSW	13	13	13	13	13	13	12	2	92	159.4
0	RSW	13	13	13	13	13	13	13	2	93	161.0
0	RSW	14	13	13	13	13	13	13	2	94	162.6
0	**RSW**	**14**	**14**	**13**	**13**	**13**	**13**	**13**	**2**	**95**	**164.2**
0	RSW	14	14	14	13	13	13	13	2	96	165.8
0	RSW	14	14	14	14	13	13	13	2	97	167.4
0	RSW	14	14	14	14	14	13	13	2	98	169.0
0	RSW	14	14	14	14	14	14	13	2	99	170.6
0	**RSW**	**14**	**14**	**14**	**14**	**14**	**14**	**14**	**2**	**100**	**172.2**

* **Note**: The normal minimum spill rate is 15.2 kcfs. Table expanded for higher spill levels on 6/7/2010.

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Section 7 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 (STSs), vertical barrier screens (VBSs), 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, RSW 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. Lower Monumental Dam Juvenile Migration Timing Data, 2000–2011.*

Yearling Chinook

	10 %	50%	90 %	# of Days
2002	2-May	13-May	25-May	23
2003	15-Apr	9-May	29-May	44
2004	16-Apr	22-Apr	18-May	32
2005	18-Apr	8-May	17-May	29
2006	1-May	10-May	20-May	19
2007	12-May	15-May	20-May	8
2008	18-May	21-May	28-May	10
2009	10-May	20-May	27-May	17
2010	18-May	21-May	8-Jun	21
2011	10-May	15-May	21-May	24
MEDIAN	6-May	14-May	23-May	20
MIN	15-Apr	22-Apr	17-May	8
MAX	18-May	21-May	8-Jun	44

Subyearling Chinook

	10 %	50%	90 %	# of Days
2002	21-Jun	9-Jul	27-Jul	36
2003	5-Jun	21-Jun	20-Jul	45
2004	16-May	26-Jun	13-Jul	58
2005	2-Jun	12-Jun	30-Jun	28
2006	26-May	8-Jun	1-Jul	36
2007	30-May	11-Jun	8-Jul	39
2008	5-Jun	14-Jun	5-Jul	30
2009	2-Jun	9-Jun	3-Jul	31
2010	8-Jun	12-Jun	7-Jul	29
2011	31-May	23-Jun	24-Jul	54
MEDIAN	2-Jun	13-Jun	7-Jul	36
MIN	16-May	8-Jun	30-Jun	28
MAX	21-Jun	15-Jul	27-Jul	58

Unclipped Steelhead

	10 %	50%	90 %	# of Days
2002	8-May	25-May	9-Jun	32
2003	1-May	26-May	31-May	30
2004	17-Apr	16-May	1-Jun	45
2005	6-May	14-May	24-May	18
2006	2-May	16-May	25-May	23
2007	12-May	15-May	23-May	11
2008	20-May	21-May	31-May	11
2009	10-May	22-May	6-Jun	27
2010	18-May	26-May	11-Jun	24
2011	14-May	20-May	1-Jun	18
MEDIAN	9-May	20-May	31-May	23.5
MIN	17-Apr	14-May	23-May	11
MAX	20-May	26-May	11-Jun	45

Clipped Steelhead

	10 %	50%	90 %	# of Days
2002	5-May	25-May	7-Jun	33
2003	1-May	26-May	30-May	29
2004	23-Apr	15-May	4-Jun	42
2005	20-Apr	13-May	20-May	30
2006	29-Apr	9-May	22-May	23
2007	12-May	15-May	21-May	9
2008	18-May	21-May	28-May	10
2009	10-May	20-May	1-Jun	22
2010	8-May	23-May	9-Jun	32
2011	11-May	16-May	29-May	18
MEDIAN	6-May	18-May	29-May	29
MIN	20-Apr	9-May	20-May	9
MAX	18-May	26-May	9-Jun	42

Coho

	10 %	50%	90 %	# of Days
2002	25-May	1-Jun	15-Jun	21
2003	19-May	28-May	7-Jun	19
2004	15-May	29-May	8-Jun	24
2005	11-May	16-May	23-May	12
2006	14-May	22-May	31-May	17
2007	14-May	16-May	23-May	9
2008	20-May	20-May	24-May	4
2009	18-May	26-May	30-Jun	43
2010	19-May	5-Jun	14-Jun	26
2011	13-May	21-May	3-Jun	21
MEDIAN	16-May	24-May	5-Jun	20
MIN	11-May	16-May	23-May	4
MAX	25-May	5-Jun	18-Aug	43

Sockeye (Wild & Hatchery)

	10 %	50%	90 %	# of Days
2002	2-May	22-May	11-Jun	40
2003	26-May	2-Jun	11-Jun	16
2004	16-May	25-May	3-Jun	18
2005	30-Apr	24-May	5-Jun	36
2006	4-May	21-May	29-May	25
2007	14-May	19-May	26-May	12
2008	21-May	22-May	3-Jun	13
2009	20-May	23-May	2-Jun	13
2010	23-May	3-Jun	16-Jun	24
2011	13-May	30-May	12-Jun	30
MEDIAN	15-May	23-May	4-Jun	21
MIN	30-Apr	19-May	26-May	12
MAX	26-May	3-Jun	16-Jun	40

* Dates are derived from daily and yearly facility collection numbers.

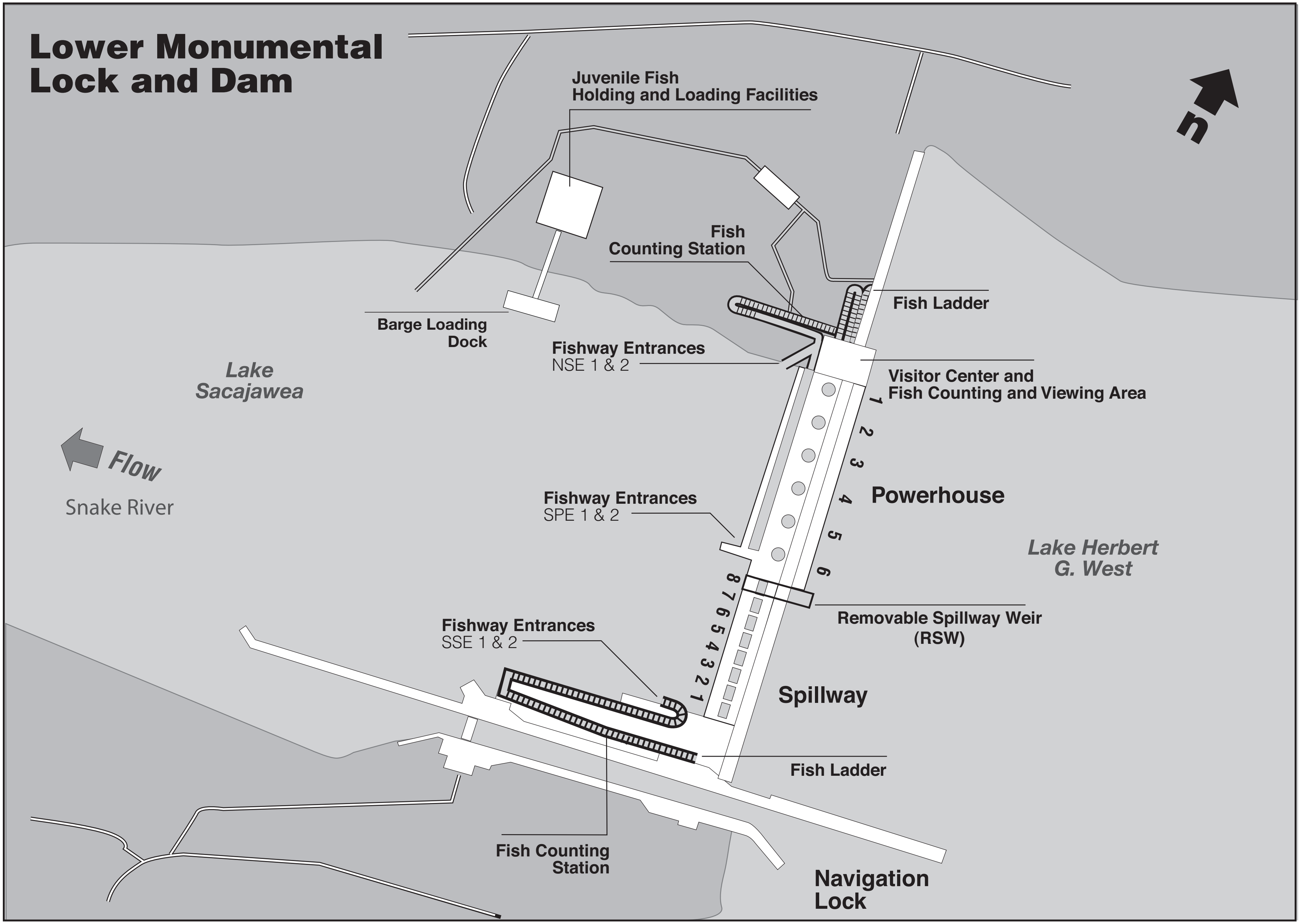

Figure LMN- 1. Lower Monumental Lock and Dam General Site Plan.

Table LMN-2. Dates of Fish-Related Operations at Lower Monumental Dam during the 2012 Fish Passage Season and 2012-2013 Winter Maintenance Period.

Task Name	Start	Finish	Reference
2012 FISH PASSAGE SEASON	**3/1/12**	**12/31/12**	
Adult Fish Passage Season	3/1/12	12/31/12	LMN 2.3.2.2
Juvenile Fish Passage Season	4/1/12	9/30/12	LMN 2.3.1
2012-2013 WINTER MAINTENANCE PERIOD	**12/16/12**	**3/31/13**	
Winter Maintenance Adult Fish Facilities	1/1/13	2/28/13	LMN 2.3.2.1
Winter Maintenance Juvenile Fish Facilities	12/16/12	3/31/13	LMN 2.3.1.1
1% Constraints (year-round)	**3/1/12**	**2/28/13**	**LMN 4.1.1**
1% soft constraint	3/1/12	3/31/12	
1% hard constraint	4/1/12	10/31/12	
1% soft constraint	11/1/12	2/28/13	
TDG Monitoring (year-round)	**3/1/12**	**2/28/13**	**App D Table 1**
TDG Monitoring - Tailwater (year-round)	3/1/12	2/28/13	LMNW
TDG Monitoring - Forebay	4/1/12	8/31/12	LMNA
Weekly Reports	3/1/12	12/31/12	LMN 2.3.3.1
Kelt Passage and Survival Study	3/1/12	12/31/12	App A LMN 2.4
Operate Turbines for Fish Passage	3/1/12	11/30/12	LMN 4.1
Adult Lamprey Passage Study	3/1/12	10/31/12	App A LMN 2.3
JBS Outfall Out of Service for Relocation Construction	3/1/12	3/15/12	App A LMN 1.6
Operate Juvenile Fish Passage Facilities	4/1/12	12/15/12	LMN 2.3.1
Operate turbine units w/ STSs Installed and Operating Gates Raised	4/1/12	12/15/12	LMN 2.3.1.2 b 8
Adult Fish Visual Count 0400-2000 PST	4/1/12	10/31/12	LMN Table LMN-3
Evaluation of Fish Counting Accuracy Study	4/1/12	10/31/12	App A LMN 2.2
Backflush Orifices Once per 8-Hour Shift	4/1/12	7/31/12	LMN 2.3.1.2 c 6
RSW Operation	4/3/12	8/31/12	LMN 2.3.1.2 g
Spring Spill for Fish Passage	4/3/12	6/20/12	App E
BiOp Performance Standard Testing (dates approximate)	4/21/12	7/15/12	App A LMN 2.1
Summer Spill for Fish Passage	6/21/12	8/31/12	App E
RSW Maintenance	9/1/12	4/1/13	LMN 2.3.1.2 h
Half of STSs may be pulled for maintenance	10/1/12	12/15/12	LMN 2.3.1.2 b 6
Annual Report (for 2012)	2/10/13	3/15/13	LMN 2.3.3.2

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 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; but do not appear on the Corps daily website total due to relative infrequency of passage. These data are posted in the Miscellaneous Fish Counts report during the passage season (updated periodically during the season) found on the Corps' web site, and summarized in the Annual Fish Passage Report.

Table LMN- 3. Adult Fish Counting Schedule at Lower Monumental Dam.

Count Period	Counting Method and Hours
April 1 through October 31	Visual 0400–2000 hours (PST)

Table LMN- 4. Adult Count Periods and Peak Migration Timing at Lower Monumental Dam based on 1969-2011 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	9/4	9/30
Steelhead	4/1 – 10/31	9/15	10/13
Sockeye	4/1 – 10/31	6/24	7/25
Lamprey	4/1 – 10/31	7/20	7/27

2. Project Operation.

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

2.1.1. Involuntary Spill. 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.

2.1.2. Voluntary Spill for Fish Passage. 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, avian deterrent devices, 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). Check and perform maintenance as required on the items listed below.

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 lipophilic 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 cycle mode when average fork length of sub-yearling Chinook or sockeye is greater than 120 mm.

2. Operate STSs in continuous run mode when average fork length of sub-yearling chinook or sockeye is less than 120 mm or if fish condition deteriorates. Return to cycle mode after one week has passed and re-evaluate.

3. Inspect each installed STS once per month by means of underwater video camera. 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 any replacement needs.

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.

10. When extreme cold weather is forecasted (as defined as: anticipated temperatures below 20^{o} Fahrenheit for 24 hours) to occur for an extended period of time between Thanksgiving and December 15, ESBSs and STSs may be removed. The project will first request special permission from CENWW-OD-T. CENWW-OD-T will inform NOAA Fisheries and other FPOM participants of the action.

c. Collection Channel.

1. Assure that orifices are clean and operable. 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. Assure that orifice lights are functional and operating in open orifices. Orifice lights and area lights may be turned off the evening before the channel is dewatered at the end of the season to encourage fish to exit the channel volitionally (dewatering occurs December 16 or later). 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 must hit no closer than 3’ from the back wall with the collection channel full.

5. Orifice valves must be either fully open or fully closed.

6. Backflush orifices at least once per day and more frequently if required. During periods of high debris volumes and fish numbers, 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. Assure the trash sweep is 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 once a day or as often as needed 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 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 will require 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[1] (RSW) Operations. The RSW will be in the raised position and operational on the first day of spill.

1. When the RSW is in operation, the spillgate shall be raised to where it does not touch flow passing down the RSW.

2. When the National Weather Service forecasts Lower Monumental inflows to exceed 200,000 cfs, initiate aggressive forebay debris removal so that RSW operation will not be impeded and coordinate with RCC and CENWW-OD-T.

3. 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 Monumental inflow to exceed 300,000 cfs.

4. 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)).

h. Removable Spillway Weir (RSW) Maintenance (September 1 through April 1).

1. Forebay debris removal; Prior to the onset of the inspections listed below in paragraphs 2-4, if a debris raft is present in the forebay and will interfered with the defined operations, a debris spill will be coordinated in accordance with paragraph 5.1. Debris entrapment in the RSW seals or between the transition plate and ogee will adversely affect the operation of the RSW.

2. Transition Plate Inspection will be performed annually to validate that the transition from the RSW to the ogee is intact. The primary means of inspection will be done with either a ROV or divers.

i. If divers are used, Powerhouse Units 5&6 will be removed from service as well as Spillbays 7&8. Units 5&6 outage will require a deviation from the Unit Priority listed in Paragraph 4.1. Coordination of the units being out of service will follow normal outage notification guidelines. The morning of the inspection, bay 8 will need to be opened 1 or 2 stops to facilitate the clearing of debris and silt from the transition plates. The spilling of water through bay 8 will be coordinated with RCC following normal guidelines.

ii. If an ROV is used for the inspection, spillbay 8 will be out of service for the inspection. The morning of the inspection, bay 8 will need to be opened 1 or 2 stops to facilitate the clearing of debris and silt from the transition plates.

[1] Removable spillway weirs (RSWs) are installed at Lower Monumental, Ice Harbor, and Lower Granite dams. RSWs are differentiated from Temporary Spillway Weirs (TSWs, installed at McNary, John Day and Little Goose dams) by being designed to be “removable” from the spillbay by controlled descent to the bottom of the forebay.

The spilling of water through bay 8 will be coordinated with RCC following normal guidelines.

3. Transition Plate bolts, umbilical and seal inspection. To facilitate this level of inspection, the RSW will need to be disengaged from the face of the dam and tipped back to the pierce point. Prior to moving the RSW, bay 8 will need to be opened 1 or 2 stops to remove and debris or silt that has accumulated on the transition plates or beak region. This debris or silt will slide off and land on the ogee, thus causing problems when the RSW is stowed. The spill of water through bay 8 will be coordinated through normal guidelines with RCC. This level of inspection will also require that bays 7&8 be out of serve, as well as Powerhouse Main units 5&6. Units 5&6 being out of service will require a deviation in unit priority as listed in paragraph 4.1. Coordination of the units out of service will follow normal outage notification guidelines. This level of inspection will be done with divers. Upon completion of the dive, prior to stowing the RSW, bay 8 will need to be opened up to 3 stops, to clean any debris from the ogee. The anticipated duration of this inspection is 1 to 3 days of effort. Reports of the inspection will be relayed back to the district biological staff.

4. Loss of Transition Plate or seals; the loss of a transition plate(s) or seals will render the RSW out of service until repaired. The level of inspection will initialize with a diver or ROV inspection as defined above for Transition Plate Inspection. The repair and replacement effort will be similar to Transition Plate Bolt, Umbilical and seal inspection above. The timeframe will be longer to repair and or install a new plate(s) or seals.

5. The outages will be coordinated as listed above for the necessary actions.

i. 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.

1. A permanently installed "RED LION PLC with DETEC sensor" type 3020-1002, 4-20 milliamp unit was installed (by Leopold Stevens Inc., Gresham, OR) in the collection channel at the unit 1 / unit 2 transition. The unit is located in the channel's length and width to avoid the non-characteristic high readings that would occur on the slope near an entrance or the non-characteristic low reading that would occur in the turbulent zone on the curve from the pump discharge supply conduit. The location of the sending unit typifies the velocity conditions throughout the length of the channel.

2. To read the meter, the toggle switch is positioned in the "ON" position. As the unit warms up the velocity reading output shows the numerical readout increasing. When it stabilizes and repeats a number the reading is recorded.

3. The velocity reading is a part of the ladder inspections that are done 3 times per week at Lower Monumental; additionally the reading will be added to the state biologists daily inspection form so that daily readings are documented.

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 physically 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 Weekly Reports. From March 1 through December 31, Project Biologists shall prepare weekly reports summarizing project operations. The weekly reports 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 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. 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.

2.3.3.2 Anual Reports. 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 actions taken to discourage avian predation at the project, and an overview of the effectiveness of those activities in discouraging predation.

2.3.3.3. Project Inspections. Project biologists inspect project facilities once per month and during dewaterings for the presence of zebra and Quagga mussels. Biologists shall provide a report to CENWW-OD-T on a monthly basis summarizing mussel inspections.

2.4. Navigation Spill Operations.

Short-term adjustments in spill are required for navigation safety. Types of adjustments may include: reductions in spill discharge rates, adjustments in spill patterns, and/or spill stoppages that result in exceedances of the Minimum Operating Pool elevation. Actual operations will vary due to conditions such as spill patterns, turbine unit operations, wind, experience of boat captains, etc. The Corps will make short-term adjustment in spill as appropriate in real-time to provide safe navigation conditions. Additional information regarding specific spill operations associated with navigation may be found in Appendix E: Operations Related to Project Spill for Fish Passage.

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 2011 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 that require facilities 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 secondary emergency bypass system while repairs are made. Since the piping to the river for secondary emergency bypass is also part of the raw water supply for the load and hold facility, the load and hold must be evacuated of fish and dewatered before going into secondary emergency bypass.

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 significant effect on fish passage will be done during the January and February winter maintenance period. Maintenance of facilities that will have no effect 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/or 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 may be 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 should begin immediately through the established unscheduled maintenance coordination procedures (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. Flows listed in Table LMN-5 are based upon daily average flows. 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
March 01 through November 30	Less than 70 kcfs	Bulk Spill Gas Cap	2, 3, 4, 5, 6 then 1
	Over 70 kcfs	Bulk Spill Gas Cap	1*, 2, 3, 4, 5, then 6
	Any River Flow	No Spill	2, 3, 4, 5, 6 then 1**
December 01 through end of February	Any River Flow	Any Spill Level, including No Spill	Any Order

* 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.

Turbine Unit 1 was the Fish Priority unit prior to the failure of blade linkages. Temporary repairs included blades being welded in fixed positions. Operating turbine unit 1 improves juvenile fish passage by eliminating the eddy at the fish loading dock. Turbine unit 1 operation is also preferred as operation attracts adult fish to the North fish ladder. Since this turbine unit has fixed blades and a narrow operation window, starts and stops can cause excessive wear and tear. Turbine unit 1 should be turned on and left on for extended periods to minimize starting and stopping the unit. The operation of turbine unit 1 in first priority position should be initiated when flows are in an increasing trend, and flows are over 70kcfs. Turbine unit 1 may be turned off at the power plant operator's discretion, when the flows are between 55kcfs-70kcfs.

4.1.1. Load Shaping. 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:

a. meet 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**);

b. If the turbine unit draft tube is to be dewatered, operate unit with full load for a minimum of 15 minutes prior to installing tail logs. If not possible to load, run unit at speed-no-load for minimum of 15 minutes. This is to reduce the number of fish in the scrollcase prior to installing stop logs;

c. operating a turbine unit solely to provide station service; or

d. 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, LMN-7 and LMN-8.**

4.1.2. Power System Reliability. 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: 16.5 – 19.5 kcfs, for turbine unit 1 (blades are fixed); 11.3 – 13.1 kcfs, for turbine units 2-3, and; 13.5 – 14.5 kcfs, for turbine units 4-6. Actual attainable minimum generation levels may vary depending on project conditions.

Table LMN- 6. Turbine Operating Ranges Within 1% of Best Efficiency for Lower Monumental Dam Unit 1* with and without STSs.

Head (feet)	TURBINE UNIT 1*							
	With STS				Without STS			
	Lower Limit		Upper Limit		Lower Limit		Upper Limit	
	(MW)	(cfs)	(MW)	(cfs)	(MW)	(cfs)	(MW)	(cfs)
85	**106.9**	**18,185**	**113.8**	**19,346**	**108.5**	**18,234**	**115.3**	**19,383**
86	108.6	18,222	115.4	19,361	110.1	18,268	116.9	19,395
87	110.2	18,258	116.9	19,375	111.8	18,301	118.5	19,406
88	111.8	18,292	118.5	19,388	113.4	18,332	120.1	19,416
89	113.5	18,325	120.1	19,400	115.1	18,361	121.7	19,425
90	**115.0**	**18,338**	**121.6**	**19,394**	**116.7**	**18,390**	**123.3**	**19,433**
91	116.4	18,335	123.1	19,390	118.1	18,384	124.8	19,426
92	117.8	18,331	124.6	19,385	119.5	18,377	126.3	19,418
93	119.2	18,328	126.0	19,381	120.9	18,370	127.7	19,411
94	120.6	18,323	127.5	19,375	122.3	18,364	129.2	19,403
95	**121.9**	**18,304**	**128.9**	**19,354**	**123.7**	**18,356**	**130.7**	**19,394**
96	123.3	18,310	130.4	19,367	125.1	18,360	132.2	19,404
97	124.7	18,315	131.9	19,379	126.5	18,362	133.7	19,413
98	126.1	18,321	133.5	19,390	127.9	18,365	135.3	19,421
99	127.5	18,326	135.0	19,401	129.3	18,367	136.8	19,430
100	**128.8**	**18,316**	**136.4**	**19,396**	**130.7**	**18,369**	**138.3**	**19,437**
101	130.3	18,322	138.1	19,430	132.2	18,373	140.0	19,468
102	131.7	18,328	139.8	19,463	133.6	18,376	141.7	19,498
103	133.1	18,334	141.5	19,494	135.0	18,380	143.4	19,526
104	134.5	18,340	143.2	19,525	136.4	18,382	145.1	19,554
105	**135.9**	**18,331**	**144.8**	**19,539**	**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- 7. Turbine Operating Ranges Within 1% of Best Efficiency for Lower Monumental Dam Units 2 and 3 with and without STSs.*

Head (feet)	TURBINE UNITS 2 and 3*							
	With STS				Without STS			
	Lower Limit		Upper Limit		Lower Limit		Upper Limit	
	(MW)	(cfs)	(MW)	(cfs)	(MW)	(cfs)	(MW)	(cfs)
80	**62.2**	**10,817**	**114.4**	**19,891**	**62.8**	**10,772**	**112.1**	**19,234**
81	63.5	10,892	117.2	20,106	64.1	10,846	114.8	19,442
82	64.8	10,964	120.0	20,314	65.4	10,919	117.6	19,644
83	66.1	11,035	122.8	20,517	66.6	10,989	120.3	19,840
84	67.3	11,103	125.6	20,714	67.9	11,057	123.1	20,031
85	**68.6**	**11,169**	**128.5**	**20,905**	**69.2**	**11,123**	**125.8**	**20,216**
86	69.4	11,154	131.0	21,056	70.0	11,109	128.3	20,363
87	70.2	11,140	133.5	21,204	70.8	11,094	130.8	20,506
88	70.9	11,125	136.1	21,348	71.6	11,080	133.3	20,645
89	71.7	11,111	138.6	21,488	72.3	11,066	135.8	20,781
90	**72.4**	**11,097**	**141.2**	**21,625**	**73.1**	**11,052**	**138.3**	**20,913**
91	73.3	11,088	141.6	21,418	74.0	11,043	138.7	20,714
92	74.1	11,079	142.0	21,216	74.8	11,035	139.1	20,518
93	75.0	11,071	142.4	21,018	75.7	11,026	139.5	20,327
94	75.8	11,061	142.8	20,824	76.5	11,017	139.9	20,140
95	**76.7**	**11,052**	**143.2**	**20,634**	**77.4**	**11,009**	**140.3**	**19,956**
96	77.7	11,071	143.3	20,416	78.4	11,027	140.4	19,746
97	78.8	11,088	143.5	20,203	79.5	11,044	140.6	19,540
98	79.8	11,105	143.6	19,994	80.5	11,061	140.7	19,338
99	80.8	11,121	143.8	19,789	81.5	11,078	140.9	19,141
100	**81.8**	**11,137**	**144.0**	**19,589**	**82.6**	**11,093**	**141.0**	**18,947**
101	82.7	11,138	145.9	19,641	83.5	11,095	142.9	18,998
102	83.6	11,140	147.8	19,692	84.3	11,096	144.8	19,047
103	84.5	11,141	149.7	19,741	85.2	11,098	146.7	19,095
104	85.4	11,142	151.6	19,789	86.1	11,099	148.5	19,142
105	**86.2**	**11,143**	**153.5**	**19,837**	**87.0**	**11,100**	**150.4**	**19,188**
106	86.9	11,122	154.9	19,822	87.7	11,079	151.8	19,173
107	87.6	11,101	155.2	19,632	88.4	11,059	153.2	19,159
108	88.4	11,081	155.2	19,420	89.1	11,038	154.6	19,145
109	89.1	11,061	155.2	19,221	89.9	11,019	155.2	19,016
110	**89.8**	**11,041**	**155.2**	**19,007**	**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-7 revised 2005).

Table LMN- 8. Turbine Operating Ranges Within 1% of Best Efficiency for Lower Monumental Dam Units 4, 5 and 6 with and without STSs.*

Head (feet)	TURBINE UNITS 4, 5 and 6*							
	With STS				Without STS			
	Lower Limit		Upper Limit		Lower Limit		Upper Limit	
	(MW)	(cfs)	(MW)	(cfs)	(MW)	(cfs)	(MW)	(cfs)
80	**84.3**	**14,189**	**115.1**	**19,364**	**84.0**	**13,999**	**113.9**	**18,975**
81	85.4	14,181	116.8	19,392	85.1	13,992	115.6	19,002
82	86.5	14,174	118.5	19,419	86.2	13,985	117.3	19,029
83	87.6	14,166	120.3	19,445	87.3	13,977	119.1	19,054
84	88.7	14,158	122.0	19,469	88.4	13,969	120.8	19,079
85	**89.8**	**14,150**	**123.8**	**19,493**	**89.5**	**13,962**	**122.5**	**19,102**
86	91.0	14,160	125.5	19,519	90.7	13,971	124.2	19,128
87	92.2	14,169	127.2	19,545	91.9	13,981	125.9	19,153
88	93.4	14,178	128.9	19,569	93.1	13,990	127.6	19,177
89	94.6	14,187	130.6	19,593	94.2	13,998	129.3	19,201
90	**95.7**	**14,195**	**132.3**	**19,616**	**95.4**	**14,006**	**131.0**	**19,224**
91	96.9	14,196	133.9	19,613	96.5	14,007	132.5	19,221
92	98.0	14,197	135.4	19,610	97.7	14,008	134.0	19,218
93	99.2	14,197	136.9	19,607	98.8	14,009	135.5	19,215
94	100.3	14,198	138.5	19,603	99.9	14,010	137.1	19,211
95	**101.4**	**14,198**	**140.0**	**19,600**	**101.1**	**14,010**	**138.6**	**19,208**
96	102.3	14,170	140.5	19,456	102.0	13,982	139.1	19,067
97	103.2	14,142	141.0	19,315	102.9	13,954	139.6	18,929
98	104.1	14,114	141.5	19,177	103.8	13,928	140.1	18,794
99	105.1	14,087	142.0	19,042	104.7	13,901	140.5	18,662
100	**106.0**	**14,061**	**142.5**	**18,909**	**105.6**	**13,875**	**141.0**	**18,532**
101	107.3	14,091	143.9	18,909	106.9	13,904	142.5	18,532
102	108.5	14,120	145.4	18,909	108.2	13,933	143.9	18,532
103	109.8	14,149	146.8	18,909	109.4	13,962	145.3	18,532
104	111.1	14,177	148.2	18,909	110.7	13,989	146.7	18,532
105	**112.4**	**14,204**	**149.6**	**18,909**	**112.0**	**14,017**	**148.1**	**18,532**
106	113.5	14,203	151.6	18,981	113.1	14,015	150.1	18,602
107	114.5	14,202	153.6	19,051	114.1	14,014	152.0	18,670
108	115.6	14,200	155.2	19,099	115.2	14,013	154.0	18,738
109	116.6	14,199	155.2	18,894	116.2	14,011	155.2	18,725
110	**117.7**	**14,198**	**155.2**	**18,694**	**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-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 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. Scheduled Maintenance. 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. Emergency Maintenance. 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.

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 completed in November and December but can be completed in mid-August. Impacts to migrating adults should be minimized. 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. If doble testing impacts priority units for fish passage, adult passage timing should be considered. Impacts to migrating adults should be minimized.

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 1200 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. If the turbine unit draft tube is to be dewatered, operate unit with full load for a minimum of 15 minutes prior to installing tail logs. If not possible to load, run unit at speed-no-load for minimum of 15 minutes. This is to reduce the number of fish in the scrollcase prior to installing stop logs. 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.

4.3.3. Units may be operationally tested for up to 30 minutes before going into maintenance status by running the unit at speed no load and various loads within the 1% criteria to allow pre-maintenance measurements and testing AND TO ALLOW ALL FISH TO MOVE THROUGH THE UNIT. Units may be operationally tested after maintenance or repair while remaining in maintenance or forced outage status. Operational testing may consist of running the unit for up to a cumulative time of 30 minutes (within 1% criteria) before it is returned to operational status. Operational testing OF UNIT UNDER MAINTENANCE is in addition to a unit in run status (E.G. MINIMUM GENERATION) required for power plant reliability. Operational testing may deviate from fish priority units and may require water that would otherwise be used for spill if the running unit for reliability is at its 1% minimum load. Water will be used from the powerhouse allocation if possible, and water diverted from spill for operational testing will be minimized to that necessary to maintain and assure generation system reliability.

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. Normally, the project shall contact CENWW-OD-T at least two workdays prior to the day the special operation is required. Using information provided by the project, CENWW-OD-T will notify FPOM and RCC will issue a teletype detailing the special operations.

5.1. Special Spills.

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.

5.1.1. Emergency Spills. Emergency spills may be implemented if necessary to pass woody debris that are accumulating in front of the spillbay weir(s) and compromising the safe, unobstructed passage of fish. The operating project will immediately spill the woody debris to remove the obstructions to fish passage. The operating project will notify CENWW-OD-T of the emergency spill as soon as possible to provide notification to RCC, NOAA Fisheries, and other FPOM participants.

Table LMN- 9 (page 1 of 3). Lower Monumental Dam Spill Pattern - Bulk.

Number of Spill Gate Stops – Bulk Spill Pattern								Total Stops [2]	Total Spill (kcfs) [1]	
Bay 1	**Bay 2**	**Bay 3**	**Bay 4**	**Bay 5**	**Bay 6**	**Bay 7**	**Bay 8**			
0	1	0	0	0	0	0	R	5.5	8.6	
0	2	0	0	0	0	0	R	6.5	10.1	
0	2	0	0	0	1	0	R	7.5	11.9	
0	2	0	0	0	2	0	R	8.5	13.4	
0	2	0	0	0	3	0	R	9.5	14.9	
0	2	0	0	0	4	0	R	10.5	16.3	
0	**3**	**0**	**0**	**0**	**4**	**0**	**R**	11.5	17.8	SUMMER
0	3	0	0	1	4	0	R	12.5	19.6	
0	3	0	0	1	5	0	R	13.5	21.3	
1	3	0	0	1	5	0	R	14.5	23.1	
1	1	1	1	1	6	0	R	15.5	25.4	
1	1	1	1	2	6	0	R	16.5	26.9	
1	1	1	2	2	6	0	R	17.5	28.4	
1	1	1	2	4	5	0	R	18.5	29.6	
1	1	1	2	5	5	0	R	19.5	31.3	
2	1	1	2	5	5	0	R	20.5	32.8	
2	1	2	2	5	5	0	R	21.5	34.3	
2	2	2	2	5	5	0	R	22.5	35.8	
3	2	2	2	5	5	0	R	23.5	37.3	
3	3	2	2	5	5	0	R	24.5	38.8	
3	3	2	2	5	5	1	R	25.5	40.6	
3	3	2	2	5	5	2	R	26.5	42.1	
3	3	2	3	5	5	2	R	27.5	43.6	
3	3	3	3	5	5	2	R	28.5	45.1	
3	3	3	3	5	6	2	R	29.5	46.8	
3	3	3	3	6	6	2	R	30.5	48.5	
3	3	3	3	6	6	3	R	31.5	50.0	
3	3	3	3	6	6	4	R	32.5	51.4	
3	3	3	3	6	6	5	R	33.5	53.1	
3	3	3	3	6	6	6	R	34.5	54.8	
3	3	3	4	6	6	6	R	35.5	56.2	
3	3	4	4	6	6	6	R	36.5	57.6	
3	4	4	4	6	6	6	R	37.5	59.0	
4	4	4	4	6	6	6	R	38.5	60.4	
4	4	4	5	6	6	6	R	39.5	62.1	
4	4	5	5	6	6	6	R	40.5	63.8	
4	5	5	5	6	6	6	R	41.5	65.5	
5	5	5	5	6	6	6	R	42.5	67.2	
5	5	5	6	6	6	6	R	43.5	68.9	
5	5	6	6	6	6	6	R	44.5	70.6	
5	6	6	6	6	6	6	R	45.5	72.3	
6	6	6	6	6	6	6	R	46.5	74.0	
6	6	6	6	6	7	6	R	47.5	75.6	
6	7	6	6	6	7	6	R	48.5	77.2	
6	7	6	6	7	7	6	R	49.5	78.8	
6	7	7	6	7	7	6	R	50.5	80.4	

Number of Spill Gate Stops – Bulk Spill Pattern								Total Stops [2]	Total Spill (kcfs) [1]
Bay 1	Bay 2	Bay 3	Bay 4	Bay 5	Bay 6	Bay 7	Bay 8		
6	7	7	7	7	7	6	R	51.5	82.0
7	7	7	7	7	7	6	R	52.5	83.6
7	7	7	7	7	7	7	R	53.5	85.2
7	7	7	7	7	8	7	R	54.5	87.0
7	8	7	7	7	8	7	R	55.5	88.8
7	8	7	7	8	8	7	R	56.5	90.6
7	8	8	7	8	8	7	R	57.5	92.4
7	8	8	8	8	8	7	R	58.5	94.2
8	8	8	8	8	8	7	R	59.5	96.0
8	8	8	8	8	8	8	R	60.5	97.8
8	8	8	8	8	9	8	R	61.5	99.4
8	9	8	8	8	9	8	R	62.5	101.0
8	9	8	8	9	9	8	R	63.5	102.6
8	9	9	8	9	9	8	R	64.5	104.2
8	9	9	9	9	9	8	R	65.5	105.8
9	9	9	9	9	9	8	R	66.5	107.4
9	9	9	9	9	9	9	R	67.5	109.0
9	9	9	9	9	10	9	R	68.5	110.8
9	10	9	9	9	10	9	R	69.5	112.6
9	10	9	9	10	10	9	R	70.5	114.4
9	10	10	9	10	10	9	R	71.5	116.2
9	10	10	10	10	10	9	R	72.5	118.0
10	10	10	10	10	10	9	R	73.5	119.8
10	10	10	10	10	10	10	R	74.5	121.6
10	10	10	10	10	11	10	R	75.5	123.3
10	11	10	10	10	11	10	R	76.5	125.0
10	11	10	10	11	11	10	R	77.5	126.7
10	11	11	10	11	11	10	R	78.5	128.4
10	11	11	11	11	11	10	R	79.5	130.1
11	11	11	11	11	11	10	R	80.5	131.8
11	11	11	11	11	11	11	R	81.5	133.5
11	11	11	11	11	12	11	R	82.5	135.2
11	12	11	11	11	12	11	R	83.5	136.9
11	12	11	11	12	12	11	R	84.5	138.6
11	12	12	11	12	12	11	R	85.5	140.3
11	12	12	12	12	12	11	R	86.5	142.0
12	12	12	12	12	12	11	R	87.5	143.7
12	12	12	12	12	12	12	R	88.5	145.4
12	12	12	12	12	13	12	R	89.5	147.1
12	13	12	12	12	13	12	R	90.5	148.8
12	13	12	12	13	13	12	R	91.5	150.5
12	13	13	12	13	13	12	R	92.5	152.2
12	13	13	13	13	13	12	R	93.5	153.9
13	13	13	13	13	13	12	R	94.5	155.6
13	13	13	13	13	13	13	R	95.5	157.3

Number of Spill Gate Stops – Bulk Spill Pattern								Total Stops [2]	Total Spill (kcfs) [1]
Bay 1	Bay 2	Bay 3	Bay 4	Bay 5	Bay 6	Bay 7	Bay 8		
13	13	13	13	13	14	13	R	96.5	159.0
13	14	13	13	13	14	13	R	97.5	160.7
13	14	13	13	14	14	13	R	98.5	162.4
13	14	14	13	14	14	13	R	99.5	164.1
13	14	14	14	14	14	13	R	100.5	165.8
14	14	14	14	14	14	13	R	101.5	167.5
14	14	14	14	14	14	14	R	102.5	169.2
14	14	14	14	14	15	14	R	103.5	171.0
14	15	14	14	14	15	14	R	104.5	172.8
14	15	14	14	15	15	14	R	105.5	174.6
14	15	15	14	15	15	14	R	106.5	176.4
14	15	15	15	15	15	14	R	107.5	178.2
15	15	15	15	15	15	14	R	108.5	180.0
15	15	15	15	15	15	15	R	109.5	181.8

1) Total spill is based on a forebay elevation of 537.0 feet and interim spillway rating table dated 2 Apr 2009.
2) RSW in Bay 8 has a flow equivalent of 4.5 stops at forebay elevation 537.0 feet.
3) Raise gate for the RSW bay above Stop 9 to ensure free surface and debris passage.

Table LMN- 10 (page 1 of 3). Lower Monumental Dam Spill Pattern - Uniform.

Number of Spill Gate Stops – Uniform Spill Pattern								Total Stops[2]	Total Spill (kcfs)[1]
Bay 1	Bay 2	Bay 3	Bay 4	Bay 5	Bay 6	Bay 7	Bay 8		
0	0	0	0	0	1	0	R	5.5	8.6
0	1	0	0	0	1	0	R	6.5	10.4
0	1	0	0	1	1	0	R	7.5	12.2
0	1	1	0	1	1	0	R	8.5	14.0
0	1	1	1	1	1	0	R	9.5	15.8
1	1	1	1	1	1	0	R	10.5	17.6
1	1	1	1	1	1	1	R	11.5	19.4
1	1	1	1	1	2	1	R	12.5	20.9
1	2	1	1	1	2	1	R	13.5	22.4
1	2	1	1	2	2	1	R	14.5	23.9
1	2	2	1	2	2	1	R	15.5	25.4
1	2	2	2	2	2	1	R	16.5	26.9
2	2	2	2	2	2	1	R	17.5	28.4
2	2	2	2	2	2	2	R	18.5	29.9
2	2	2	2	2	3	2	R	19.5	31.4
2	3	2	2	2	3	2	R	20.5	32.9
2	3	2	2	3	3	2	R	21.5	34.4
2	3	3	2	3	3	2	R	22.5	35.9
2	3	3	3	3	3	2	R	23.5	37.4
3	3	3	3	3	3	2	R	24.5	38.9
3	3	3	3	3	3	3	R	25.5	40.4
3	3	3	3	3	4	3	R	26.5	41.8
3	4	3	3	3	4	3	R	27.5	43.2
3	4	3	3	4	4	3	R	28.5	44.6
3	4	4	3	4	4	3	R	29.5	46.0
3	4	4	4	4	4	3	R	30.5	47.4
4	4	4	4	4	4	3	R	31.5	48.8
4	4	4	4	4	4	4	R	32.5	50.2
4	4	4	4	4	5	4	R	33.5	51.9
4	5	4	4	4	5	4	R	34.5	53.6
4	5	4	4	5	5	4	R	35.5	55.3
4	5	5	4	5	5	4	R	36.5	57.0
4	5	5	5	5	5	4	R	37.5	58.7
5	5	5	5	5	5	4	R	38.5	60.4
5	5	5	5	5	5	5	R	39.5	62.1
5	5	5	5	5	6	5	R	40.5	63.8
5	6	5	5	5	6	5	R	41.5	65.5
5	6	5	5	6	6	5	R	42.5	67.2
5	6	6	5	6	6	5	R	43.5	68.9
5	6	6	6	6	6	5	R	44.5	70.6
6	6	6	6	6	6	5	R	45.5	72.3
6	6	6	6	6	6	6	R	46.5	74.0
6	6	6	6	6	7	6	R	47.5	75.6
6	7	6	6	6	7	6	R	48.5	77.2
6	7	6	6	7	7	6	R	49.5	78.8
6	7	7	6	7	7	6	R	50.5	80.4

Number of Spill Gate Stops – Uniform Spill Pattern								Total Stops[2]	Total Spill (kcfs)[1]
Bay 1	Bay 2	Bay 3	Bay 4	Bay 5	Bay 6	Bay 7	Bay 8		
6	7	7	7	7	7	6	R	51.5	82.0
7	7	7	7	7	7	6	R	52.5	83.6
7	7	7	7	7	7	7	R	53.5	85.2
7	7	7	7	7	8	7	R	54.5	87.0
7	8	7	7	7	8	7	R	55.5	88.8
7	8	7	7	8	8	7	R	56.5	90.6
7	8	8	7	8	8	7	R	57.5	92.4
7	8	8	8	8	8	7	R	58.5	94.2
8	8	8	8	8	8	7	R	59.5	96.0
8	8	8	8	8	8	8	R	60.5	97.8
8	8	8	8	8	9	8	R	61.5	99.4
8	9	8	8	8	9	8	R	62.5	101.0
8	9	8	8	9	9	8	R	63.5	102.6
8	9	9	8	9	9	8	R	64.5	104.2
8	9	9	9	9	9	8	R	65.5	105.8
9	9	9	9	9	9	8	R	66.5	107.4
9	9	9	9	9	9	9	R	67.5	109.0
9	9	9	9	9	10	9	R	68.5	110.8
9	10	9	9	9	10	9	R	69.5	112.6
9	10	9	9	10	10	9	R	70.5	114.4
9	10	10	9	10	10	9	R	71.5	116.2
9	10	10	10	10	10	9	R	72.5	118.0
10	10	10	10	10	10	9	R	73.5	119.8
10	10	10	10	10	10	10	R	74.5	121.6
10	10	10	10	10	11	10	R	75.5	123.3
10	11	10	10	10	11	10	R	76.5	125.0
10	11	10	10	11	11	10	R	77.5	126.7
10	11	11	10	11	11	10	R	78.5	128.4
10	11	11	11	11	11	10	R	79.5	130.1
11	11	11	11	11	11	10	R	80.5	131.8
11	11	11	11	11	11	11	R	81.5	133.5
11	11	11	11	11	12	11	R	82.5	135.2
11	12	11	11	11	12	11	R	83.5	136.9
11	12	11	11	12	12	11	R	84.5	138.6
11	12	12	11	12	12	11	R	85.5	140.3
11	12	12	12	12	12	11	R	86.5	142.0
12	12	12	12	12	12	11	R	87.5	143.7
12	12	12	12	12	12	12	R	88.5	145.4
12	12	12	12	12	13	12	R	89.5	147.1
12	13	12	12	12	13	12	R	90.5	148.8
12	13	12	12	13	13	12	R	91.5	150.5
12	13	13	12	13	13	12	R	92.5	152.2
12	13	13	13	13	13	12	R	93.5	153.9
13	13	13	13	13	13	12	R	94.5	155.6
13	13	13	13	13	13	13	R	95.5	157.3
13	13	13	13	13	14	13	R	96.5	159.0

Number of Spill Gate Stops – Uniform Spill Pattern								Total Stops[2]	Total Spill (kcfs)[1]
Bay 1	**Bay 2**	**Bay 3**	**Bay 4**	**Bay 5**	**Bay 6**	**Bay 7**	**Bay 8**		
13	14	13	13	13	14	13	R	97.5	160.7
13	14	13	13	14	14	13	R	98.5	162.4
13	14	14	13	14	14	13	R	99.5	164.1
13	14	14	14	14	14	13	R	100.5	165.8
14	14	14	14	14	14	13	R	101.5	167.5
14	14	14	14	14	14	14	R	102.5	169.2
14	14	14	14	14	15	14	R	103.5	171.0
14	15	14	14	14	15	14	R	104.5	172.8
14	15	14	14	15	15	14	R	105.5	174.6
14	15	15	14	15	15	14	R	106.5	176.4
14	15	15	15	15	15	14	R	107.5	178.2
15	15	15	15	15	15	14	R	108.5	180.0
15	15	15	15	15	15	15	R	109.5	181.8

1) Total spill is based on a forebay elevation of 537.0 feet and interim spillway rating table dated 2 Apr 2009.
2) RSW in Bay 8 has a flow equivalent of 4.5 stops at forebay elevation 537.0 feet.
3) Raise gate for the RSW bay above Stop 9 to ensure free surface and debris passage.

Section 8 – Little Goose Dam
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Section 8 Little Goose Dam

1. Fish Passage Information. Fish passage facilities at Little Goose Dam are shown in **Figure LGS-1**. Project operations for fish and special operations are in **Table LGS-2**.

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 diversion systems.

1.1.2 Juvenile Migration Timing. *Timing dates affected by later collection start dates in 2006- 2009.* **Table LGS-1** shows passage timing at Little Goose Dam. **Table LGS-1** dates are based on juvenile fish collection numbers only. Salmon, steelhead, bull trout, lamprey, and other species are counted. Maintenance of fish passage facilities that may impact juvenile passage or facility operation should be conducted during the winter maintenance season.

Table LGS- 1. Juvenile Migration Timing at Little Goose Dam, 2002 – 2011. [1]

Yearling Chinook	10 %	50%	90 %	# of Days
2002	1-May	9-May	23-May	22
2003	26-Apr	11-May	3-Jun	38
2004	24-Apr	5-May	18-May	24
2005	3-May	11-May	19-May	16
2006	23-Apr	6-May	20-May	27
2007	8-May	14-May	22-May	14
2008	5-May	15-May	28-May	23
2009	24-Apr	7-May	23-May	29
2010	2-May	15-May	29-May	27
2011	5-May	12-May	19-May	14
MEDIAN	1-May	11-May	22-May	23.5
MIN	23-Apr	5-May	18-May	14
MAX	8-May	15-May	3-Jun	38

Subyearling Chinook	10 %	50%	90 %	# of Days
2002	18-Jun	5-Jul	26-Jul	38
2003	4-Jun	22-Jun	24-Jul	50
2004	9-Jun	21-Jun	17-Jul	38
2005	12-May	6-Jun	20-Jun	39
2006	24-May	9-Jun	4-Jul	41
2007	7-Jun	15-Jun	6-Jul	29
2008	4-Jun	20-Jun	23-Jul	49
2009	29-May	7-Jun	30-Jun	32
2010	6-Jun	12-Jun	8-Jul	32
2011	4-Jun	17-Jun	20-Jul	46
MEDIAN	4-Jun	16-Jun	12-Jul	38.5
MIN	12-May	6-Jun	20-Jun	29
MAX	30-Jun	5-Jul	26-Jul	50

Unclipped Steelhead	10 %	50%	90 %	# of Days
2002	22-Apr	22-May	3-Jun	42
2003	28-Apr	24-May	30-May	32
2004	25-Apr	11-May	2-Jun	38
2005	6-May	12-May	24-May	18
2006	20-Apr	5-May	23-May	33
2007	11-May	15-May	30-May	19
2008	8-May	18-May	1-Jun	24
2009	24-Apr	4-May	29-May	35
2010	3-May	22-May	8-Jun	36
2011	7-May	16-May	6-Jun	30
MEDIAN	30-Apr	15-May	31-May	32.5
MIN	20-Apr	4-May	23-May	18
MAX	11-May	24-May	8-Jun	42

Clipped Steelhead	10 %	50%	90 %	# of Days
2002	29-Apr	20-May	1-Jun	33
2003	30-Apr	24-May	29-May	29
2004	27-Apr	10-May	1-Jun	35
2005	6-May	12-May	22-May	16
2006	21-Apr	4-May	20-May	29
2007	10-May	15-May	27-May	17
2008	1-May	12-May	23-May	22
2009	23-Apr	30-Apr	25-May	32
2010	2-May	20-May	7-Jun	36
2011	4-Apr	12-May	20-May	46
MEDIAN	29-Apr	12-May	26-May	30.5
MIN	4-Apr	30-Apr	20-May	16
MAX	10-May	24-May	7-Jun	46

Coho	10 %	50%	90 %	# of Days
2002	23-May	31-May	9-Jun	17
2003	23-May	28-May	5-Jun	13
2004	19-May	30-May	19-Jun	31
2005	11-May	15-May	24-May	13
2006	5-May	22-May	1-Jun	27
2007	14-May	17-May	5-Jun	22
2008	12-May	22-May	30-May	18
2009	16-May	24-May	21-Jun	36
2010	15-May	22-May	7-Jun	23
2011	7-May	16-May	22-May	15
MEDIAN	14-May	22-May	5-Jun	27
MIN	5-May	15-May	22-May	13
MAX	23-May	31-May	21-Jun	70

Sockeye (Wild & Hatchery)	10 %	50%	90 %	# of Days
2002	6-May	22-May	7-Jun	32
2003	22-May	1-Jun	6-Jun	15
2004	3-May	25-May	11-Jun	39
2005	12-May	24-May	5-Jun	24
2006	22-Apr	20-May	27-May	35
2007	13-May	19-May	30-May	17
2008	20-May	26-May	6-Jun	17
2009	28-Apr	22-May	30-May	32
2010	20-May	28-May	8-Jun	19
2011	14-Apr	13-May	15-Jun	62
MEDIAN	9-May	23-May	6-Jun	26
MIN	14-Apr	13-May	27-May	15
MAX	22-May	1-Jun	15-Jun	62

1. Dates are derived from daily and yearly facility collection numbers.

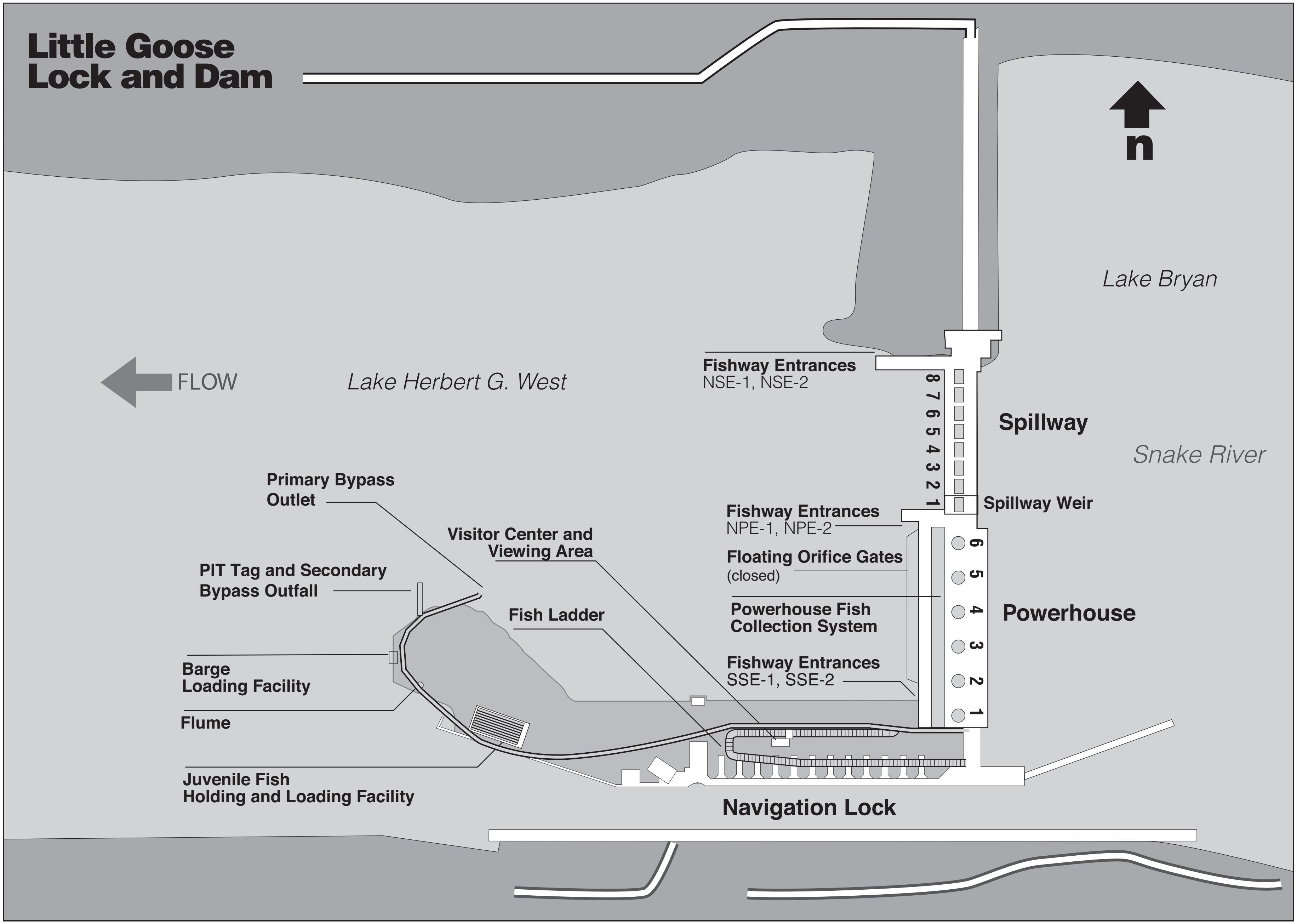

Figure LGS-1 Little Goose Lock and Dam General Site Plan

Table LGS-2. Dates of Fish-Related Operations at Little Goose Dam during the 2012 Fish Passage Season and 2012-2013 Winter Maintenance Period.

Task Name	Start	Finish	Reference
2012 FISH PASSAGE SEASON	**3/1/12**	**12/31/12**	
Adult Fish Passage Season	3/1/12	12/31/12	LGS 2.3.2.2
Juvenile Fish Passage Season	4/1/12	10/31/12	LGS 2.3.1
2012-2013 WINTER MAINTENANCE PERIOD	**12/16/12**	**3/31/13**	
Winter Maintenance Adult Fish Facilities	1/1/13	2/28/13	LGS 2.3.2.1
Winter Maintenance Juvenile Fish Facilities	12/16/12	3/31/13	LGS 2.3.1.1
1% Constraints (year-round)	**3/1/12**	**2/28/13**	**LGS 4.1.1**
1% soft constraint	3/1/12	3/31/12	
1% hard constraint	4/1/12	10/31/12	
1% soft constraint	11/1/12	2/28/13	
TDG Monitoring (year-round)	**3/1/12**	**2/28/13**	**App D, Table 1**
TDG Monitoring - Tailwater (year-round)	3/1/12	2/28/13	LGSW
TDG Monitoring - Forebay	4/1/12	8/31/12	LGSA
Weekly Reports	3/1/12	12/31/12	LGS 2.3.3.1
Operate Turbines for Fish Passage	3/1/12	11/30/12	LGS 4.1
Adult Lamprey Passage Study	3/1/12	12/15/12	App A LGS 2.2
Kelt Passage and Survival Study	3/1/12	12/15/12	App A LGS 2.3
Operate Juvenile Fish Passage Facilities	4/1/12	12/15/12	LGS 2.3.1
Operate turbine units w/ ESBSs Installed and Operating Gate Raised	4/1/12	12/15/12	LGS 2.3.1.2 b 8
Adult Fish Visual Count 0400-2000 PST	4/1/12	10/31/12	LGS Table LGS-3
Backflush Orifices Once per 8-Hour Shift	4/1/12	7/31/12	LGS 2.3.1.2 c 6
Measure VBS head differentials once per week or more	4/1/12	6/30/12	LGS 2.3.1.2 b 11
TSW Operation (end date approximate)	4/3/12	8/31/12	LGS 2.3.1.2 g
Spring Spill for Fish Passage	4/3/12	6/20/12	App E
BiOp Performance Standard Testing (dates approximate)	4/21/12	7/15/12	App A LGS 2.1, App E
Summer Spill for Fish Passage	6/21/12	8/31/12	App E
Half of ESBSs may be pulled for maintenance	10/1/12	12/15/12	LGS 2.3.1.2 b 6
Annual Report (for 2012)	2/10/13	3/15/13	LGS 2.3.3.4

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 facing entrances into the spillway basin on the north end of the powerhouse, and a common transportation channel. The north shore entrances are comprised of two downstream facing entrances into the spillway basin. 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.

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. Adult 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; but do not appear on the Corps daily website total due to relative infrequency of passage. These data are posted in the Miscellaneous Fish Counts report during the passage season (updated periodically during the season) found on the Corps' web site, and summarized in the Annual Fish Passage Report.

Table LGS- 3. Adult Fish Counting Schedule at Little Goose Dam.

Period	Counting Method and Hours
April 1 through October 31	Visual 0400–2000 hours (PST)

Table LGS- 4. Adult Count Periods and Peak Migration Timing from 1970-2011 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	6/16	7/12
Fall Chinook	8/16 – 10/31	9/3	9/30
Steelhead	4/1 – 10/31	9/6	10/14
Sockeye	6/15 – 10/31	6/24	7/25
Lamprey	4/1 – 10/31	7/6	8/20

2. Project Operation.

2.1. Spill Management. See the 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, Tables LGS-9 through LGS-12. 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.

2.1.4. Change from 30% Spill to a Constant Spill Rate. When forecast daily average inflows at Little Goose Dam (LGS) are 33 kcfs or less, for three consecutive days, and indicating a continued downward trend, change the 30% spill operation to spilling at a constant rate. The constant rate would be approximately 11.2, 9.3, or 7.5 kcfs. The rate selected should be the rate that will result in the daily spill average closest to 30%. These consistent spill levels are approximate and may vary depending on changing inflow, forebay and tailwater elevations, and other operational demands.

It is difficult for LGS to achieve 30% spill when inflows are less than 38 kcfs because it requires switching frequently between one and two unit operations. This operation is incompatible with the more constant discharge upstream at Lower Granite Dam (18 kcfs - 2012 FOP Spill Operation) and downstream at Lower Monumental Dam (17 kcfs – 2012 FOP). This causes both spillway and turbine discharge to vary considerably to maintain 30% spill within the 1-foot operating range, as total discharge must either be approximately 25 or 38 kcfs to meet 30% spill. It is also difficult to achieve the FOP prescribed spill level downstream at Lower Monumental Dam and maintain MOP operations at LGS.

2.2. Dissolved Gas Management and Control. Total dissolved gas (TDG) levels at LGS 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 passage condition. Change cleaning frequency as needed.

3. Monitor ESBS operating status regularly throughout work shifts via the ESBS operating computer display located in the control room.

4. Inspect ESBS, cleaning brush control panels located in the orifice gallery for cleaning brush failures (trouble lights) at least once per day throughout the entire fish passage season.

5. Manually operate ESBS cleaning brush monthly during the fish passage season April through December 15 (more frequently if required) to verify proper and complete up-and-down brush travel and to monitor and record amperage draws.

6. Inspect ESBS by means of underwater video during turbine unit annual maintenance (more frequently if required). Thoroughly inspect VBSs at the same time.

7. Inspect at least 2 VBSs in 2 different turbine units by means of underwater video 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.

8. 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.

9. One-half of the ESBSs may be pulled after October 1 for maintenance as long as unscreened turbine units are not operated.

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

11. 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.

12. 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.

13. 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.

14. When cold weather is forecasted for an extended period of time between Thanksgiving and December 15, ESBSs and STSs may be removed. The project will first request special permission from CENWW-OD-T. CENWW-OD-T will inform NOAA Fisheries and other FPOM participants. "Cold weather" is defined as: forecasted daily high temperature below 32°F or daily low temperatures below 20°F as forecasted for the Little Goose Dam area by NOAA's National Weather Service (http://www.weather.gov).

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. Temporary Spillway Weir (TSW).[1]

1. Spring fish passage season will start with the TSW deployed in the high crest (SW-HI) position [elevation 622 msl]. It will be operated in this position the entire spill season unless the conditions described in paragraph #2 below are met.

2. Change to TSW Low Crest (SW-LO) position three normal working days prior to the date on which the most recent stream flow forecast (STP) projects daily average flows above 85 kcfs for at least seven consecutive days or if actual flows indicate that 85 kcfs will be exceeded before the next STP forecast is issued, as determined by NWW Water Management staff. The position change will take place within three normal working days after RCC has issued the operating project a teletype. During the period when the change is occurring, the uniform spill pattern will be used, with the exception that spillbay 2 will not be used for safety reasons. The trigger to change to the SW-LO position is further based on the following:

a. review of the juvenile fish passage at Lower Granite and Little Goose dams to prevent changes during a peak in outmigration;

b. coordination with regional fish managers.

[1] Temporary spillway weirs (TSWs) are installed at Little Goose, McNary and John Day dams. TSWs are differentiated from Removable Spillway Weirs (RSWs, installed at Lower Granite, Lower Monumental and Ice Harbor dams) by the ability to install, uninstall and move TSWs between spillbays using the project's gantry crane.

3. After the spring freshet has passed, change to the SW-HI position after river discharge falls below 85 kcfs and streamflow forecasts indicate river discharges to remain below 85 kcfs for at least seven consecutive days. The TSW will not be operated in the SW-LO position for the rest of the season, even if river discharges subsequently increase above 85 kcfs. The position change will take place within three normal working days after RCC has issued the operating project a teletype. During the period when the change is occurring, the uniform spill pattern will be used, with the exception that spillbay 2 will not be used for safety reasons. The trigger to change to the SW-HI position is further based on the following:

a. a review of the juvenile fish passage at Lower Granite and Little Goose dams to prevent changes during a peak in outmigration;

b. coordination with regional fish managers.

4. When daily average discharge drops below 35 kcfs in the summer while the SW-HI is installed and forecasts predict flows to remain below 35 kcfs for at least three days, the TSW will be closed for the remainder of the spill season. The TSW will be closed within three normal working days and coordinated through CENWW-OD-T.

5. Special turbine unit 1 operations will change from the upper 25% of the 1% of best efficiency range to the full 1% of best efficiency range when project discharge is below 38 kcfs and above 31 kcfs.

6. The uniform spill pattern, with no TSW operating, will be used as an alternate pattern when the TSW must be closed for any reason, such as when switching from one crest elevation to the other, or when the TSW is removed from service due to low river flows.

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 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. Inspect ladder netting and repair prior to fish passage season.

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.

1. Adult collection channel water velocities must flow between 1.5’ and 4’ per second. This velocity is optimum criteria for returning adult salmon and steelhead to migrate upstream though the fishway. Velocity readings will be included in required fishway inspections and reported in the weekly and annual reports.

2. Surface water velocities will be measured in the open access area near the south shore weir / fish Entrance. The surface velocity will be measured using a piece of woody debris (stick, bark) or water bubble timed over a marked fixed distance. The measurement of the water velocity at this location typifies the velocity conditions throughout the length of the channel.

3. Subsurface water velocity will be measured and reported once per month using an underwater flowmeter. The average velocity will be calculated using several measurements taken at various depths across the width of the channel that best represents the average subsurface flow. The measurements will be taken at a location in the channel that represents the overall flow characteristic.

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 and Quagga mussels. Biologists shall provide a report to CENWW-OD-T on a monthly basis summarizing 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°F or greater, all adult fish handling will be coordinated through CENWW-OD-T.* Dewatering and fish handling plans were reviewed and revised in 2011 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.

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 110 MWs or less 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 significant effect on fish passage will be done during the January and February winter maintenance period. Maintenance of facilities that will have no effect 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.

Table LGS- 5. Turbine Unit Operating Priority for Little Goose Dam. [1]

Season	Time of Day	Unit Priority*
March 1 through November 30	24 hours/day	1, 2, 3, 4, 5, 6 *Maximize discharge through lowest numbered turbine units*
December 1 through end of February	24 hours/day	Any Order

* Unit 1 operation is manually restricted to operate between 115–125 MW, which is approximately 16.0-17.5 kcfs. Assume Unit 1 will be at the lower end of this range if other units are operating at discharges lower than 16.0 kcfs. Assume other units will be operated approximately uniformly, within constraints of normal 1% operation (Units 4-6 are different than units 1-3). When average unit discharge is higher than 16.0 kcfs, assume all units will operate uniformly, again given different 1% range for units 4-6. For low river discharges (Qr<38 kcfs), with only 1 unit operating, Unit 1 may operate at less than 16 kcfs.

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) If the turbine unit draft tube is to be dewatered, operate unit with full load for a minimum of 15 minutes prior to installing tail logs. If not possible to load, run unit at speed-no-load for minimum of 15 minutes. This is to reduce the number of fish in the scrollcase prior to installing stop logs;

3) Operating a turbine unit solely to provide station service; or

4) Comply 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 turbines within the 1% efficiency range at various heads are shown in **Tables LGS-7 and LGS-8.**

4.1.2. During fish passage season, Unit 1 lower operating limits shall follow **Table LGS-6**. Historic operation within the GDACS program tended to balance flows out of any units in operation. This year's operation will, at times, result in an unbalanced operation where more flow is passing through Unit 1 than other operating units. A heavier flow out of Unit 1 has been shown, in the Little Goose physical model, to be very important in disrupting the eddy that forms along the south shore downstream of the powerhouse. Disrupting the eddy optimizes the tailrace conditions for both adult passage and juvenile egress with the TSW operating in spillway bay 1.

Table LGS- 6. Little Goose Unit 1 Spill Season Operating Limits.

ESBSs Installed	Powerhouse Discharge (kcfs)	Lower Limit	Upper Limit
YES	≤ 16 kcfs	1% Lower Generation Limit (Varies w/Head)	1% Upper Generation Limit (Varies w/Head)
YES	> 16 kcfs	115 MW (16 kcfs)*	1% Upper Generation Limit (Varies w/Head)
NO	≤ 17.5 kcfs	1% Lower Generation Limit (Varies w/Head)	1% Upper Generation Limit (Varies w/Head)
NO	> 17.5 kcfs	125 MW (17.5 kcfs)*	1% Upper Generation Limit (Varies w/Head)

* See Tables LGS-7 and LGS-8 for the 1% Generation Limits at specific heads. * Discharges are approximate.

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 Little Goose Dam, minimum generation requirements are 11.3 – 13.1 kcfs for turbine units 1 – 3 and 13.5 – 14.5 kcfs for turbine units 4-6. Actual attainable minimum generation levels may vary depending on project conditions.

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- 7. Turbine Unit Operating Range Within 1% of Best Efficiency at Little Goose Dam Units 1-3 With and Without Extended-Length Submersible Bar Screens (ESBSs) Installed.*

Head (feet)	TURBINE UNITS 1, 2 and 3							
	With ESBS				Without ESBS			
	Lower Limit		Upper Limit		Lower Limit		Upper Limit	
	(MW)	(cfs)	(MW)	(cfs)	(MW)	(cfs)	(MW)	(cfs)
85	**69.6**	**11,396**	**111.5**	**18,269**	**70.5**	**11,320**	**124.5**	**20,006**
86	70.3	11,381	113.7	18,402	71.3	11,305	127.0	20,152
87	71.1	11,366	115.9	18,531	72.0	11,290	129.5	20,293
88	71.9	11,351	118.1	18,657	72.8	11,276	131.9	20,431
89	72.6	11,336	120.3	18,779	73.6	11,262	134.4	20,566
90	**73.4**	**11,322**	**122.5**	**18,898**	**74.4**	**11,247**	**136.9**	**20,696**
91	74.3	11,313	122.9	18,717	75.3	11,239	137.3	20,499
92	75.1	11,304	123.2	18,540	76.1	11,230	137.7	20,306
93	76.0	11,295	123.6	18,367	77.0	11,221	138.0	20,116
94	76.9	11,285	123.9	18,197	77.9	11,212	138.4	19,931
95	**77.7**	**11,276**	**124.3**	**18,031**	**78.7**	**11,203**	**138.8**	**19,750**
96	78.8	11,294	124.4	17,841	79.8	11,222	139.0	19,541
97	79.8	11,312	124.6	17,654	80.9	11,240	139.1	19,338
98	80.9	11,329	124.7	17,472	81.9	11,257	139.3	19,138
99	81.9	11,346	124.8	17,293	83.0	11,274	139.4	18,942
100	**82.9**	**11,361**	**125.0**	**17,117**	**84.0**	**11,290**	**139.6**	**18,751**
101	83.8	11,363	126.6	17,163	84.9	11,291	141.4	18,801
102	84.7	11,364	128.3	17,207	85.8	11,293	143.3	18,850
103	85.6	11,365	129.9	17,250	86.7	11,294	145.1	18,897
104	86.5	11,367	131.6	17,293	87.6	11,295	147.0	18,944
105	**87.4**	**11,367**	**133.2**	**17,334**	**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. Turbine Unit Operating Range Within 1% of Best Efficiency at Little Goose Dam Units 4-6 With and Without Extended-Length Submersible Bar Screens (ESBSs) Installed.*

Head (feet)	TURBINE UNITS 4, 5 and 6							
	With ESBS				Without ESBS			
	Lower Limit		Upper Limit		Lower Limit		Upper Limit	
	(MW)	(cfs)	(MW)	(cfs)	(MW)	(cfs)	(MW)	(cfs)
85	**87.1**	**13,880**	**119.6**	**19,076**	**86.4**	**13,479**	**122.2**	**19,052**
86	88.2	13,890	121.3	19,102	87.6	13,488	123.9	19,078
87	89.3	13,899	122.9	19,127	88.7	13,497	125.6	19,104
88	90.5	13,908	124.6	19,151	89.8	13,506	127.2	19,128
89	91.6	13,916	126.3	19,174	91.0	13,514	128.9	19,151
90	**92.8**	**13,924**	**127.9**	**19,196**	**92.1**	**13,522**	**130.6**	**19,174**
91	93.9	13,925	129.4	19,193	93.2	13,523	132.1	19,171
92	95.0	13,925	130.9	19,190	94.3	13,524	133.7	19,168
93	96.1	13,926	132.4	19,186	95.4	13,524	135.2	19,165
94	97.2	13,926	133.9	19,183	96.5	13,525	136.7	19,162
95	**98.3**	**13,926**	**135.3**	**19,179**	**97.6**	**13,525**	**138.2**	**19,158**
96	99.2	13,898	135.8	19,038	98.4	13,498	138.7	19,018
97	100.0	13,871	136.3	18,900	99.3	13,472	139.2	18,880
98	100.9	13,844	136.8	18,765	100.2	13,446	139.7	18,745
99	101.8	13,818	137.3	18,633	101.1	13,420	140.2	18,613
100	**102.7**	**13,791**	**137.8**	**18,503**	**101.9**	**13,395**	**140.7**	**18,484**
101	103.9	13,821	139.1	18,503	103.2	13,423	142.1	18,484
102	105.2	13,849	140.5	18,503	104.4	13,451	143.5	18,484
103	106.4	13,878	141.9	18,503	105.7	13,478	144.9	18,484
104	107.7	13,905	143.3	18,503	106.9	13,505	146.3	18,484
105	**108.9**	**13,932**	**144.6**	**18,503**	**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 three 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 November or December, but can be conducted in mid-August. Impacts to migrating adults should be minimized. 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. If Doble testing impacts priority units for adult fish passage, adult passage timing should be considered. Impacts to migrating adults should be minimized.

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. If the turbine unit draft tube is to be dewatered, operate unit with full load for a minimum of 15 minutes prior to installing tail logs. If not possible to load, run unit at speed-no-load for minimum of 15 minutes. This is to reduce the number of fish in the scrollcase prior to installing stop logs. 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.

4.3.3. Units may be operationally tested for up to 30 minutes before going into maintenance status by running the unit at speed no load and various loads within the 1% criteria to allow pre-maintenance measurements and testing AND TO ALLOW ALL FISH TO MOVE THROUGH THE UNIT. Units may be operationally tested after maintenance or repair while remaining in maintenance or forced outage status. Operational testing may consist of running the unit for up to a cumulative time of 30 minutes (within 1% criteria) before it is returned to operational status. Operational testing OF UNIT UNDER MAINTENANCE is in addition to a unit in run status (E.G. MINIMUM GENERATION) required for power plant reliability. Operational testing may deviate from fish priority units and may require water that would otherwise be used for spill if the running unit for reliability is at its 1% minimum load. Water will be used from the powerhouse allocation if possible, and water diverted from spill for operational testing will be minimized to that necessary to maintain and assure generation system reliability.

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. Normally, the project shall contact CENWW-OD-T at least two workdays prior to the day the special operation is required. Using information provided by the project, CENWW-OD-T will notify FPOM and RCC will issue a teletype detailing the special operations.

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.

5.1.1. Emergency spills may be implemented if necessary to pass woody debris that are accumulating in front of the spillbay weir(s), compromising the safe, unobstructed passage of fish. The operating project will immediately spill the woody debris to remove the obstructions to fish passage. The operating project will notify CENWW-OD-T of the emergency spill as soon as possible to provide notification to RCC, NOAA Fisheries, and other FPOM participants.

Table LGS- 9 (pg 1 of 2). Little Goose Dam Spill Pattern for Spillway Weir in Low Crest (SW-Lo) Configuration (Crest Elev = 618 ft).

					Powerhouse Flow (kcfs) [Notes 1 & 3]						Spillway Flow (stops) [Note 3]									
Calc River (kcfs)	PH (kcfs)	Spill (kcfs)	Percent Spill (Note 2)	Forebay WSE (ft) (Note 2)	1 (Note 4)	2	3	4	5	6	1	2	3	4	5	6	7	8	Total Stops TS	Notes
37.3	26.1	11.2	30.0%	633.5	14.8	11.3					SW-LO								0	Lowest Qr w/ SW-LO
38.5	27.3	11.2	29.1%	633.5	16.0	11.3					SW-LO								0	Lowest Qr for U1 special operation (Note 4)
43.2	30.2	13.0	30.0%	633.5	16.0	14.2					SW-LO							1	1	
49.0	34.3	14.7	30.0%	633.5	17.2	17.1					SW-LO	1						1	2	
49.7	35.0	14.7	29.6%	633.5	17.5	17.5					SW-LO	1						1	2	Max. Qr w/ 2 units, 2 stops, Qs ~30%
53.3	38.6	14.7	27.6%	633.5	16.0	11.3	11.3				SW-LO	1						1	2	Min. Qr w/ 3 units, 2 stops, Qs ~28%
55.4	38.8	16.6	30.0%	633.5	16.0	11.4	11.4				SW-LO	1						2	3	
61.3	42.9	18.4	30.0%	633.5	16.0	13.5	13.4				SW-LO	1		1				2	4	
67.1	47.0	20.1	30.0%	633.5	16.0	15.5	15.5				SW-LO	1		1		1		2	5	
73.0	51.1	21.9	30.0%	633.5	17.1	17.0	17.0				SW-LO	1	1	1		1		2	6	
74.4	52.5	21.9	29.4%	633.5	17.5	17.5	17.5				SW-LO	1	1	1		1		2	6	Max. Qr w/ 3 units, 6 stops, Qs ~29%
74.4	52.5	21.9	29.4%	633.5	16.0	11.3	11.3	13.9			SW-LO	1	1	1		1		2	6	Min. Qr w/ 4 units, 6 stops, Qs ~29%
78.9	55.2	23.7	30.0%	633.5	16.0	12.7	12.6	13.9			SW-LO	1	1	1		1	1	2	7	
84.7	59.3	25.4	30.0%	633.5	16.0	14.5	14.4	14.4			SW-LO	1	1	1	1	1	1	2	8	Trigger Qr to change SW crest elev. (Note 5
91.0	63.7	27.3	30.0%	633.5	16.0	15.9	15.9	15.9			SW-LO	2	1	1	1	1	1	2	9	
97.4	68.2	29.2	30.0%	633.5	17.1	17.1	17.0	17.0			SW-LO	2	1	2	1	1	1	2	10	
100.6	71.4	29.2	29.0%	633.5	17.5	17.5	17.5	18.9			SW-LO	2	1	2	1	1	1	2	10	Max. Qr w/ 4 units, 10 stops, Qs ~29%
100.6	71.4	29.2	29.0%	633.5	16.0	13.9	13.8	13.8	13.9		SW-LO	2	1	2	1	1	1	2	10	5 units, 10 stops, Qs~29%
103.7	72.6	31.1	30.0%	633.5	16.0	14.2	14.2	14.1	14.1		SW-LO	2	1	2	1	2	1	2	11	
110.0	77.0	33.0	30.0%	633.5	16.0	15.3	15.3	15.2	15.2		SW-LO	2	2	2	1	2	1	2	12	
116.4	81.5	34.9	30.0%	633.5	16.3	16.3	16.3	16.3	16.3		SW-LO	2	2	2	2	2	1	2	13	
122.7	85.9	36.8	30.0%	633.5	17.2	17.2	17.2	17.2	17.1		SW-LO	2	2	2	2	2	2	2	14	
129.4	90.6	38.8	30.0%	633.5	16.0	15.0	14.9	14.9	14.9	14.9	SW-LO	3	2	2	2	2	2	2	15	
136.0	95.2	40.8	30.0%	633.5	16.0	15.9	15.9	15.8	15.8	15.8	SW-LO	3	3	2	2	2	2	2	16	
142.7	99.9	42.8	30.0%	633.5	16.7	16.7	16.7	16.6	16.6	16.6	SW-LO	3	3	3	2	2	2	2	17	
149.3	104.5	44.8	30.0%	633.5	17.5	17.4	17.4	17.4	17.4	17.4	SW-LO	3	3	3	3	2	2	2	18	
156.0	109.2	46.8	30.0%	633.5	17.5	17.5	17.5	18.9	18.9	18.9	SW-LO	3	3	3	3	3	2	2	19	Max. PH capacity w/ Qs=30% (Note 6)
158.0	109.2	48.8	30.9%	633.5	17.5	17.5	17.5	18.9	18.9	18.9	SW-LO	3	3	3	3	3	3	2	20	
160.0	109.2	50.8	31.7%	633.5	17.5	17.5	17.5	18.9	18.9	18.9	SW-LO	3	3	3	3	3	3	3	21	
162.0	109.2	52.8	32.6%	633.5	17.5	17.5	17.5	18.9	18.9	18.9	SW-LO	4	3	3	3	3	3	3	22	
163.9	109.2	54.7	33.4%	633.5	17.5	17.5	17.5	18.9	18.9	18.9	SW-LO	4	4	3	3	3	3	3	23	
165.9	109.2	56.7	34.2%	633.5	17.5	17.5	17.5	18.9	18.9	18.9	SW-LO	4	4	4	3	3	3	3	24	
167.9	109.2	58.7	34.9%	633.5	17.5	17.5	17.5	18.9	18.9	18.9	SW-LO	4	4	4	4	3	3	3	25	
169.8	109.2	60.6	35.7%	633.5	17.5	17.5	17.5	18.9	18.9	18.9	SW-LO	4	4	4	4	4	3	3	26	
171.8	109.2	62.6	36.4%	633.5	17.5	17.5	17.5	18.9	18.9	18.9	SW-LO	4	4	4	4	4	4	3	27	
173.8	109.2	64.6	37.2%	633.5	17.5	17.5	17.5	18.9	18.9	18.9	SW-LO	4	4	4	4	4	4	4	28	
175.7	109.2	66.5	37.9%	633.5	17.5	17.5	17.5	18.9	18.9	18.9	SW-LO	5	4	4	4	4	4	4	29	
177.7	109.2	68.5	38.5%	633.5	17.5	17.5	17.5	18.9	18.9	18.9	SW-LO	5	5	4	4	4	4	4	30	
179.7	109.2	70.5	39.2%	633.5	17.5	17.5	17.5	18.9	18.9	18.9	SW-LO	5	5	5	4	4	4	4	31	
181.6	109.2	72.4	39.9%	633.5	17.5	17.5	17.5	18.9	18.9	18.9	SW-LO	5	5	5	5	4	4	4	32	
183.6	109.2	74.4	40.5%	633.5	17.5	17.5	17.5	18.9	18.9	18.9	SW-LO	5	5	5	5	5	4	4	33	
185.6	109.2	76.4	41.2%	633.5	17.5	17.5	17.5	18.9	18.9	18.9	SW-LO	5	5	5	5	5	5	4	34	
187.5	109.2	78.3	41.8%	633.5	17.5	17.5	17.5	18.9	18.9	18.9	SW-LO	5	5	5	5	5	5	5	35	
189.5	109.2	80.3	42.4%	633.5	17.5	17.5	17.5	18.9	18.9	18.9	SW-LO	6	5	5	5	5	5	5	36	
191.5	109.2	82.3	43.0%	633.5	17.5	17.5	17.5	18.9	18.9	18.9	SW-LO	6	6	5	5	5	5	5	37	
193.4	109.2	84.2	43.5%	633.5	17.5	17.5	17.5	18.9	18.9	18.9	SW-LO	6	6	6	5	5	5	5	38	
195.4	109.2	86.2	44.1%	633.5	17.5	17.5	17.5	18.9	18.9	18.9	SW-LO	6	6	6	6	5	5	5	39	

Table LGS- 9 (pg 2 of 2). SW-Lo

					Powerhouse Flow (kcfs) [Notes 1 & 3]						Spillway Flow (stops) [Note 3]									
Calc River (kcfs)	PH (kcfs)	Spill (kcfs)	Percent Spill (Note 2)	Forebay WSE (ft) (Note 2)	1 (Note 4)	2	3	4	5	6	1	2	3	4	5	6	7	8	Total Stops TS	Notes
197.3	109.2	88.1	44.7%	633.5	17.5	17.5	17.5	18.9	18.9	18.9	SW-LO	6	6	6	6	6	5	5	40	
199.3	109.2	90.1	45.2%	633.5	17.5	17.5	17.5	18.9	18.9	18.9	SW-LO	6	6	6	6	6	6	5	41	
201.3	109.2	92.1	45.7%	633.5	17.5	17.5	17.5	18.9	18.9	18.9	SW-LO	6	6	6	6	6	6	6	42	
203.2	109.2	94.0	46.3%	633.5	17.5	17.5	17.5	18.9	18.9	18.9	SW-LO	7	6	6	6	6	6	6	43	
205.1	109.2	95.9	46.8%	633.5	17.5	17.5	17.5	18.9	18.9	18.9	SW-LO	7	7	6	6	6	6	6	44	
207.1	109.2	97.9	47.3%	633.5	17.5	17.5	17.5	18.9	18.9	18.9	SW-LO	7	7	7	6	6	6	6	45	
209.0	109.2	99.8	47.8%	633.5	17.5	17.5	17.5	18.9	18.9	18.9	SW-LO	7	7	7	7	6	6	6	46	
211.0	109.2	101.8	48.2%	633.5	17.5	17.5	17.5	18.9	18.9	18.9	SW-LO	7	7	7	7	7	6	6	47	
212.9	109.2	103.7	48.7%	633.5	17.5	17.5	17.5	18.9	18.9	18.9	SW-LO	7	7	7	7	7	7	6	48	
214.9	109.2	105.7	49.2%	633.5	17.5	17.5	17.5	18.9	18.9	18.9	SW-LO	7	7	7	7	7	7	7	49	
216.8	109.2	107.6	49.6%	633.5	17.5	17.5	17.5	18.9	18.9	18.9	SW-LO	8	7	7	7	7	7	7	50	
218.8	109.2	109.6	50.1%	633.5	17.5	17.5	17.5	18.9	18.9	18.9	SW-LO	8	8	7	7	7	7	7	51	
220.8	109.2	111.6	50.5%	633.5	17.5	17.5	17.5	18.9	18.9	18.9	SW-LO	8	8	8	7	7	7	7	52	
222.7	109.2	113.5	51.0%	633.5	17.5	17.5	17.5	18.9	18.9	18.9	SW-LO	8	8	8	8	7	7	7	53	
224.7	109.2	115.5	51.4%	633.5	17.5	17.5	17.5	18.9	18.9	18.9	SW-LO	8	8	8	8	8	7	7	54	
226.7	109.2	117.5	51.8%	633.5	17.5	17.5	17.5	18.9	18.9	18.9	SW-LO	8	8	8	8	8	8	7	55	
228.6	109.2	119.4	52.2%	633.5	17.5	17.5	17.5	18.9	18.9	18.9	SW-LO	8	8	8	8	8	8	8	56	
230.6	109.2	121.4	52.6%	633.5	17.5	17.5	17.5	18.9	18.9	18.9	SW-LO	9	8	8	8	8	8	8	57	
232.5	109.2	123.3	53.0%	633.5	17.5	17.5	17.5	18.9	18.9	18.9	SW-LO	9	9	8	8	8	8	8	58	
234.4	109.2	125.2	53.4%	633.5	17.5	17.5	17.5	18.9	18.9	18.9	SW-LO	9	9	9	8	8	8	8	59	
236.3	109.2	127.1	53.8%	633.5	17.5	17.5	17.5	18.9	18.9	18.9	SW-LO	9	9	9	9	8	8	8	60	
238.3	109.2	129.1	54.2%	633.5	17.5	17.5	17.5	18.9	18.9	18.9	SW-LO	9	9	9	9	9	8	8	61	
240.2	109.2	131.0	54.5%	633.5	17.5	17.5	17.5	18.9	18.9	18.9	SW-LO	9	9	9	9	9	9	8	62	
242.1	109.2	132.9	54.9%	633.5	17.5	17.5	17.5	18.9	18.9	18.9	SW-LO	9	9	9	9	9	9	9	63	
244.1	109.2	134.9	55.3%	633.5	17.5	17.5	17.5	18.9	18.9	18.9	SW-LO	10	9	9	9	9	9	9	64	
246.2	109.2	137.0	55.6%	633.5	17.5	17.5	17.5	18.9	18.9	18.9	SW-LO	10	10	9	9	9	9	9	65	
248.2	109.2	139.0	56.0%	633.5	17.5	17.5	17.5	18.9	18.9	18.9	SW-LO	10	10	10	9	9	9	9	66	
250.2	109.2	141.0	56.3%	633.5	17.5	17.5	17.5	18.9	18.9	18.9	SW-LO	10	10	10	10	9	9	9	67	
252.2	109.2	143.0	56.7%	633.5	17.5	17.5	17.5	18.9	18.9	18.9	SW-LO	10	10	10	10	10	9	9	68	
254.2	109.2	145.0	57.0%	633.5	17.5	17.5	17.5	18.9	18.9	18.9	SW-LO	10	10	10	10	10	10	9	69	
256.2	109.2	147.0	57.4%	633.5	17.5	17.5	17.5	18.9	18.9	18.9	SW-LO	10	10	10	10	10	10	10	70	

Note 1: Powerhouse unit priority should be Unit 1 ==> 6. Unit 1 operation is especially important to maintain good tailrace conditions for juvenile fish egress and adult fish attraction.

Note 2: Assume Minimum Operating Pool (MOP) rules apply (i.e. forebay elevation between 633.0 - 634.0 feet).

Note 3: Discharges shown on this table are based on an average forebay elevation for the specified range (633.5 ft for MOP rules), and are approximate. Particularly the powerhouse discharges are shown as an indication of how the Unit 1 operating restriction will work, not as a precise requirement. Actual operation will change with changing inflow, forebay and tailwater elevations, and other operating constraints and demands.

Note 4: Unit 1 operation is manually restricted to operate between 115 - 125 MW, which is approximately 16.0 - 17.5 kcfs. Assume Unit 1 will be at the lower end of this range if other units are operating at discharges lower than 16.0 kcfs. Assume other operating units will be operated approximately uniformly, within constraints of normal 1% operation (Units 4-6 are different than Units 1-3). When average unit discharge is higher than 16.0 kcfs, assume all units will operate uniformly, again given different 1% range for Units 4-6. For low river discharges (Qr<38 kcfs), with only one unit operating, Unit 1 may operate at less than 16 kcfs.

Note 5: 85 kcfs is the river discharge trigger to switch from the SW-HI to SW-LO on the rising limb of the spring hydrograph, or from SW-LO to SW-HI on the receding limb, as detailed in the Fish Passage Plan.
In other words, 85 kcfs is the lowest river discharge at which the SW-LO should be operated.

Note 6: Above this river discharge, involuntary spill will force a spill ratio higher than 30%.

Table LGS- 10 (pg 1 of 2). Little Goose Dam Spill Pattern for Spillway Weir in High Crest (SW-HI) Configuration (Crest Elev = 622 ft).

					Powerhouse Flow (kcfs) [Notes 1 & 3]						Spillway Flow (stops) [Note 3]									
Calc River (kcfs)	PH (kcfs)	Spill (kcfs)	Percent Spill (Note 2)	Forebay WSE (ft) (Note 2)	1 (Note 4)	2	3	4	5	6	1	2	3	4	5	6	7	8	Total Stops TS	Notes
23.9	16.7	7.2	30.0%	633.5	16.7						SW-HI								0	Lowest Qr possible w/ SW-HI
26.4	17.5	8.9	33.7%	633.5	17.5						SW-HI							1	1	1 unit, 1 stop, Qs~34%
31.5	22.6	8.9	28.3%	633.5	11.3	11.3					SW-HI							1	1	2 units @ min. 1%, 1 stop, Qs~28%
35.0	24.3	10.7	30.5%	633.5	13.0	11.3					SW-HI	1						1	2	Lowest Qr w/ SW-HI per FPP (Note 5)
35.6	24.9	10.7	30.0%	633.5	13.6	11.3					SW-HI	1						1	2	
38.0	27.3	10.7	28.1%	633.5	16.0	11.3					SW-HI	1						1	2	Lowest Qr for U1 special operation (Note 4)
41.9	29.3	12.6	30.0%	633.5	16.0	13.3					SW-HI	1						2	3	
47.7	33.4	14.3	30.0%	633.5	17.5	15.9					SW-HI	1		1				2	4	
51.1	35.0	16.1	31.5%	633.5	17.5	17.5					SW-HI	1		1		1		2	5	2 units, 5 stops, Qs~31%
54.7	38.6	16.1	29.4%	633.5	16.0	11.3	11.3				SW-HI	1		1		1		2	5	3 units, 5 stops, Qs~29%
59.6	41.7	17.9	30.0%	633.5	16.0	12.9	12.8				SW-HI	1	1	1		1		2	6	
65.4	45.8	19.6	30.0%	633.5	16.0	14.9	14.9				SW-HI	1	1	1		1	1	2	7	
71.3	49.9	21.4	30.0%	633.5	16.6	16.7	16.6				SW-HI	1	1	1	1	1	1	2	8	
73.9	52.5	21.4	28.9%	633.5	17.5	17.5	17.5				SW-HI	1	1	1	1	1	1	2	8	Max. Qr w/ 3 units, Qs ~29%
73.9	52.5	21.4	28.9%	633.5	16.0	11.3	11.3	13.9			SW-HI	1	1	1	1	1	1	2	8	Min. Qr w/ 4 units, Qs ~31%
77.6	54.3	23.3	30.0%	633.5	16.0	12.2	12.2	13.9			SW-HI	2	1	1	1	1	1	2	9	
83.9	58.7	25.2	30.0%	633.5	16.0	14.3	14.2	14.2			SW-HI	2	1	2	1	1	1	2	10	
85.0	59.8	25.2	29.6%	633.5	16.0	14.6	14.6	14.6			SW-HI	2	1	2	1	1	1	2	10	Trigger Qr to change SW crest elev. (Note 6)
90.3	63.2	27.1	30.0%	633.5	16.0	15.8	15.7	15.7			SW-HI	2	1	2	1	2	1	2	11	
96.6	67.6	29.0	30.0%	633.5	16.9	16.9	16.9	16.9			SW-HI	2	2	2	1	2	1	2	12	
100.4	71.4	29.0	28.9%	633.5	17.5	17.5	17.5	18.9			SW-HI	2	2	2	1	2	1	2	12	Max. Qr w/ 4 units, 12 stops, Qs ~29%
100.4	71.4	29.0	28.9%	633.5	16.0	13.9	13.8	13.8	13.9		SW-HI	2	2	2	1	2	1	2	12	5 units, 12 stops, Qs~29%
102.9	72.0	30.9	30.0%	633.5	16.0	14.0	14.0	14.0	14.0		SW-HI	2	2	2	2	2	1	2	13	
109.3	76.5	32.8	30.0%	633.5	16.0	15.2	15.1	15.1	15.1		SW-HI	2	2	2	2	2	2	2	14	
115.9	81.1	34.8	30.0%	633.5	16.3	16.2	16.2	16.2	16.2		SW-HI	3	2	2	2	2	2	2	15	
122.6	85.8	36.8	30.0%	633.5	17.2	17.2	17.2	17.1	17.1		SW-HI	3	3	2	2	2	2	2	16	
129.2	90.4	38.8	30.0%	633.5	16.0	14.9	14.9	14.9	14.9	14.8	SW-HI	3	3	3	2	2	2	2	17	
135.9	95.1	40.8	30.0%	633.5	16.0	15.9	15.8	15.8	15.8	15.8	SW-HI	3	3	3	3	2	2	2	18	
142.4	99.7	42.7	30.0%	633.5	16.7	16.6	16.6	16.6	16.6	16.6	SW-HI	3	3	3	3	3	2	2	19	
149.1	104.4	44.7	30.0%	633.5	17.4	17.4	17.4	17.4	17.4	17.4	SW-HI	3	3	3	3	3	3	2	20	
155.9	109.2	46.7	30.0%	633.5	17.5	17.5	17.5	18.9	18.9	18.9	SW-HI	3	3	3	3	3	3	3	21	Max. PH capacity w/ Qs=30% (Note 7)
157.9	109.2	48.7	30.8%	633.5	17.5	17.5	17.5	18.9	18.9	18.9	SW-HI	4	3	3	3	3	3	3	22	
159.9	109.2	50.7	31.7%	633.5	17.5	17.5	17.5	18.9	18.9	18.9	SW-HI	4	4	3	3	3	3	3	23	
161.8	109.2	52.6	32.5%	633.5	17.5	17.5	17.5	18.9	18.9	18.9	SW-HI	4	4	4	3	3	3	3	24	
163.8	109.2	54.6	33.3%	633.5	17.5	17.5	17.5	18.9	18.9	18.9	SW-HI	4	4	4	4	3	3	3	25	
165.8	109.2	56.6	34.1%	633.5	17.5	17.5	17.5	18.9	18.9	18.9	SW-HI	4	4	4	4	4	3	3	26	
167.8	109.2	58.6	34.9%	633.5	17.5	17.5	17.5	18.9	18.9	18.9	SW-HI	4	4	4	4	4	4	3	27	
169.7	109.2	60.5	35.7%	633.5	17.5	17.5	17.5	18.9	18.9	18.9	SW-HI	4	4	4	4	4	4	4	28	
171.7	109.2	62.5	36.4%	633.5	17.5	17.5	17.5	18.9	18.9	18.9	SW-HI	5	4	4	4	4	4	4	29	
173.7	109.2	64.5	37.1%	633.5	17.5	17.5	17.5	18.9	18.9	18.9	SW-HI	5	5	4	4	4	4	4	30	
175.6	109.2	66.4	37.8%	633.5	17.5	17.5	17.5	18.9	18.9	18.9	SW-HI	5	5	5	4	4	4	4	31	
177.6	109.2	68.4	38.5%	633.5	17.5	17.5	17.5	18.9	18.9	18.9	SW-HI	5	5	5	5	4	4	4	32	
179.6	109.2	70.4	39.2%	633.5	17.5	17.5	17.5	18.9	18.9	18.9	SW-HI	5	5	5	5	5	4	4	33	
181.5	109.2	72.3	39.8%	633.5	17.5	17.5	17.5	18.9	18.9	18.9	SW-HI	5	5	5	5	5	5	4	34	
183.5	109.2	74.3	40.5%	633.5	17.5	17.5	17.5	18.9	18.9	18.9	SW-HI	5	5	5	5	5	5	5	35	
185.4	109.2	76.2	41.1%	633.5	17.5	17.5	17.5	18.9	18.9	18.9	SW-HI	6	5	5	5	5	5	5	36	
187.4	109.2	78.2	41.7%	633.5	17.5	17.5	17.5	18.9	18.9	18.9	SW-HI	6	6	5	5	5	5	5	37	
189.4	109.2	80.2	42.3%	633.5	17.5	17.5	17.5	18.9	18.9	18.9	SW-HI	6	6	6	5	5	5	5	38	
191.3	109.2	82.1	42.9%	633.5	17.5	17.5	17.5	18.9	18.9	18.9	SW-HI	6	6	6	6	5	5	5	39	
193.3	109.2	84.1	43.5%	633.5	17.5	17.5	17.5	18.9	18.9	18.9	SW-HI	6	6	6	6	6	5	5	40	

Table LGS- 10 (pg 2 of 2). SW-Hi

					Powerhouse Flow (kcfs) [Notes 1 & 3]						Spillway Flow (stops) [Note 3]									
Calc River (kcfs)	PH (kcfs)	Spill (kcfs)	Percent Spill (Note 2)	Forebay WSE (ft) (Note 2)	1 (Note 4)	2	3	4	5	6	1	2	3	4	5	6	7	8	Total Stops TS	Notes
195.2	109.2	86.0	44.1%	633.5	17.5	17.5	17.5	18.9	18.9	18.9	SW-HI	6	6	6	6	6	6	5	41	
197.2	109.2	88.0	44.6%	633.5	17.5	17.5	17.5	18.9	18.9	18.9	SW-HI	6	6	6	6	6	6	6	42	
199.1	109.2	89.9	45.2%	633.5	17.5	17.5	17.5	18.9	18.9	18.9	SW-HI	7	6	6	6	6	6	6	43	
201.1	109.2	91.9	45.7%	633.5	17.5	17.5	17.5	18.9	18.9	18.9	SW-HI	7	7	6	6	6	6	6	44	
203.0	109.2	93.8	46.2%	633.5	17.5	17.5	17.5	18.9	18.9	18.9	SW-HI	7	7	7	6	6	6	6	45	
205.0	109.2	95.8	46.7%	633.5	17.5	17.5	17.5	18.9	18.9	18.9	SW-HI	7	7	7	7	6	6	6	46	
206.9	109.2	97.7	47.2%	633.5	17.5	17.5	17.5	18.9	18.9	18.9	SW-HI	7	7	7	7	7	6	6	47	
208.9	109.2	99.7	47.7%	633.5	17.5	17.5	17.5	18.9	18.9	18.9	SW-HI	7	7	7	7	7	7	6	48	
210.8	109.2	101.6	48.2%	633.5	17.5	17.5	17.5	18.9	18.9	18.9	SW-HI	7	7	7	7	7	7	7	49	
212.8	109.2	103.6	48.7%	633.5	17.5	17.5	17.5	18.9	18.9	18.9	SW-HI	8	7	7	7	7	7	7	50	
214.7	109.2	105.5	49.1%	633.5	17.5	17.5	17.5	18.9	18.9	18.9	SW-HI	8	8	7	7	7	7	7	51	
216.7	109.2	107.5	49.6%	633.5	17.5	17.5	17.5	18.9	18.9	18.9	SW-HI	8	8	8	7	7	7	7	52	
218.7	109.2	109.5	50.1%	633.5	17.5	17.5	17.5	18.9	18.9	18.9	SW-HI	8	8	8	8	7	7	7	53	
220.6	109.2	111.4	50.5%	633.5	17.5	17.5	17.5	18.9	18.9	18.9	SW-HI	8	8	8	8	8	7	7	54	
222.6	109.2	113.4	50.9%	633.5	17.5	17.5	17.5	18.9	18.9	18.9	SW-HI	8	8	8	8	8	8	7	55	
224.6	109.2	115.4	51.4%	633.5	17.5	17.5	17.5	18.9	18.9	18.9	SW-HI	8	8	8	8	8	8	8	56	
226.5	109.2	117.3	51.8%	633.5	17.5	17.5	17.5	18.9	18.9	18.9	SW-HI	9	8	8	8	8	8	8	57	
228.4	109.2	119.2	52.2%	633.5	17.5	17.5	17.5	18.9	18.9	18.9	SW-HI	9	9	8	8	8	8	8	58	
230.4	109.2	121.2	52.6%	633.5	17.5	17.5	17.5	18.9	18.9	18.9	SW-HI	9	9	9	8	8	8	8	59	
232.3	109.2	123.1	53.0%	633.5	17.5	17.5	17.5	18.9	18.9	18.9	SW-HI	9	9	9	9	8	8	8	60	
234.2	109.2	125.0	53.4%	633.5	17.5	17.5	17.5	18.9	18.9	18.9	SW-HI	9	9	9	9	9	8	8	61	
236.2	109.2	127.0	53.8%	633.5	17.5	17.5	17.5	18.9	18.9	18.9	SW-HI	9	9	9	9	9	9	8	62	
238.1	109.2	128.9	54.1%	633.5	17.5	17.5	17.5	18.9	18.9	18.9	SW-HI	9	9	9	9	9	9	9	63	
240.1	109.2	130.9	54.5%	633.5	17.5	17.5	17.5	18.9	18.9	18.9	SW-HI	10	9	9	9	9	9	9	64	
242.1	109.2	132.9	54.9%	633.5	17.5	17.5	17.5	18.9	18.9	18.9	SW-HI	10	10	9	9	9	9	9	65	
244.1	109.2	134.9	55.3%	633.5	17.5	17.5	17.5	18.9	18.9	18.9	SW-HI	10	10	10	9	9	9	9	66	
246.1	109.2	136.9	55.6%	633.5	17.5	17.5	17.5	18.9	18.9	18.9	SW-HI	10	10	10	10	9	9	9	67	
248.1	109.2	138.9	56.0%	633.5	17.5	17.5	17.5	18.9	18.9	18.9	SW-HI	10	10	10	10	10	9	9	68	
250.1	109.2	140.9	56.3%	633.5	17.5	17.5	17.5	18.9	18.9	18.9	SW-HI	10	10	10	10	10	10	9	69	
252.2	109.2	143.0	56.7%	633.5	17.5	17.5	17.5	18.9	18.9	18.9	SW-HI	10	10	10	10	10	10	10	70	

Note 1: Powerhouse unit priority should be Unit 1 ==> 6. Unit 1 operation is especially important to maintain good tailrace conditions for juvenile fish egress and adult fish attraction.

Note 2: Assume Minimum Operating Pool (MOP) rules apply (i.e. forebay elevation between 633.0 - 634.0 feet).

Note 3: Discharges shown on this table are based on an average forebay elevation for the specified range (633.5 ft for MOP rules), and are approximate. Particularly the powerhouse discharges are shown as an indication of how the Unit 1 operating restriction will work, not as a precise requirement. Actual operation will change with changing inflow, forebay and tailwater elevations, and other operating constraints and demands.

Note 4: Unit 1 operation is manually restricted to operate between 115 - 125 MW, which is approximately 16.0 - 17.5 kcfs. Assume Unit 1 will be at the lower end of this range if other units are operating at discharges lower than 16.0 kcfs. Assume other operating units will be operated approximately uniformly, within constraints of normal 1% operation (Units 4-6 are different than Units 1-3). When average unit discharge is higher than 16.0 kcfs, assume all units will operate uniformly, again given different 1% range for Units 4-6. For low river discharges (Qr<38 kcfs), with only one unit operating, Unit 1 may operate at less than 16 kcfs.

Note 5: For river discharges less than this value, the SW will be closed, and the remaining spill bays will be used, following the uniform spill pattern (see separate table).

Note 6: 85 kcfs is the river discharge trigger to switch from the SW-HI to SW-LO on the rising limb of the spring hydrograph, or from SW-LO to SW-HI on the receding limb, as detailed in the Fish Passage Plan. In other words, 85 kcfs is the lowest river discharge at which the SW-LO should be operated.

Note 7: Above this river discharge, involuntary spill will force a spill ratio higher than 30%.

Table LGS- 11 (pg 1 of 2). Little Goose Dam Spill Pattern for Uniform Spill Configuration (No Spillway Weir).

					Powerhouse Flow (kcfs) [Notes 1 & 3]						Spillway Flow (stops) [Notes 3 & 7]									
Calc River (kcfs)	PH (kcfs)	Spill (kcfs)	Percent Spill (Note 2)	Forebay WSE (ft) (Note 2)	1 (Note 4)	2	3	4	5	6	1	2	3	4	5	6	7	8	Total Stops TS	Notes
11.3	11.3	0.0	0.0%	633.5	11.3						No SW								0	No spill, minimum Qp
13.1	11.3	1.8	13.5%	633.5	11.3						No SW							1	1	
14.8	11.3	3.5	23.8%	633.5	11.3						No SW	1						1	2	
18.0	12.6	5.4	30.0%	633.5	12.6						No SW	1						2	3	Lowest Qr possible w/ 30% spill and no SW (Note 5)
24.0	16.8	7.2	29.9%	633.5	16.8						No SW	1		1				2	4	
26.4	17.5	8.9	33.8%	633.5	17.5						No SW	1		1		1		2	5	1 unit, 5 stops, Qs~34%
31.5	22.6	8.9	28.3%	633.5	11.3	11.3					No SW	1		1		1		2	5	2 units, 5 stops, Qs~28%
35.7	25.0	10.7	30.0%	633.5	13.7	11.3					No SW	1	1	1		1		2	6	
38.0	27.3	10.7	28.2%	633.5	16.0	11.3					No SW	1	1	1		1		2	6	Lowest Qr for U1 special operation (Note 4
41.6	29.1	12.5	30.0%	633.5	16.0	13.1					No SW	1	1	1		1	1	2	7	
47.4	33.2	14.2	30.0%	633.5	16.6	16.6					No SW	1	1	1	1	1	1	2	8	
51.1	35.0	16.1	31.5%	633.5	17.5	17.5					No SW	2	1	1	1	1	1	2	9	2 units, 9 stops, Qs~31%
54.7	38.6	16.1	29.5%	633.5	16.0	11.3	11.3				No SW	2	1	1	1	1	1	2	9	3 units, 9 stops, Qs~29%
60.0	42.0	18.0	30.0%	633.5	16.0	13.0	13.0				No SW	2	1	2	1	1	1	2	10	
66.4	46.5	19.9	30.0%	633.5	16.0	15.3	15.2				No SW	2	1	2	1	2	1	2	11	
72.7	50.9	21.8	30.0%	633.5	17.0	17.0	16.9				No SW	2	2	2	1	2	1	2	12	
74.3	52.5	21.8	29.4%	633.5	17.5	17.5	17.5				No SW	2	2	2	1	2	1	2	12	Max. Qr w/ 3 units, Qs ~29%
76.2	52.5	23.7	31.1%	633.5	16.0	11.3	11.3	13.9			No SW	2	2	2	2	2	1	2	13	Min. Qr w/ 4 units, Qs ~31%
79.0	55.3	23.7	30.0%	633.5	16.0	12.7	12.7	13.9			No SW	2	2	2	2	2	1	2	13	
85.4	59.8	25.6	30.0%	633.5	16.0	14.6	14.6	14.6			No SW	2	2	2	2	2	2	2	14	
92.0	64.4	27.6	30.0%	633.5	16.1	16.1	16.1	16.1			No SW	3	2	2	2	2	2	2	15	
98.7	69.1	29.6	30.0%	633.5	17.3	17.3	17.3	17.2			No SW	3	3	2	2	2	2	2	16	
105.3	73.7	31.6	30.0%	633.5	16.0	14.5	14.4	14.4	14.4		No SW	3	3	3	2	2	2	2	17	
112.0	78.4	33.6	30.0%	633.5	16.0	15.6	15.6	15.6	15.6		No SW	3	3	3	3	2	2	2	18	
118.7	83.1	35.6	30.0%	633.5	16.7	16.6	16.6	16.6	16.6		No SW	3	3	3	3	3	2	2	19	
125.1	87.5	37.6	30.1%	633.5	17.5	17.5	17.5	17.5	17.5		No SW	3	3	3	3	3	3	2	20	
132.0	92.4	39.6	30.0%	633.5	16.0	15.3	15.3	15.3	15.3	15.2	No SW	3	3	3	3	3	3	3	21	
138.6	97.0	41.6	30.0%	633.5	16.2	16.2	16.2	16.2	16.1	16.1	No SW	4	3	3	3	3	3	3	22	
145.1	101.6	43.5	30.0%	633.5	17.0	17.0	16.9	16.9	16.9	16.9	No SW	4	4	3	3	3	3	3	23	
151.7	106.2	45.5	30.0%	633.5	17.5	17.5	17.5	17.9	17.9	17.9	No SW	4	4	4	3	3	3	3	24	
156.7	109.2	47.5	30.3%	633.5	17.5	17.5	17.5	18.9	18.9	18.9	No SW	4	4	4	4	3	3	3	25	Max. PH capacity w/ Qs=30% (Note 6)
158.6	109.2	49.4	31.2%	633.5	17.5	17.5	17.5	18.9	18.9	18.9	No SW	4	4	4	4	4	3	3	26	
160.6	109.2	51.4	32.0%	633.5	17.5	17.5	17.5	18.9	18.9	18.9	No SW	4	4	4	4	4	4	3	27	
162.6	109.2	53.4	32.8%	633.5	17.5	17.5	17.5	18.9	18.9	18.9	No SW	4	4	4	4	4	4	4	28	
164.5	109.2	55.3	33.6%	633.5	17.5	17.5	17.5	18.9	18.9	18.9	No SW	5	4	4	4	4	4	4	29	
166.5	109.2	57.3	34.4%	633.5	17.5	17.5	17.5	18.9	18.9	18.9	No SW	5	5	4	4	4	4	4	30	
168.5	109.2	59.3	35.2%	633.5	17.5	17.5	17.5	18.9	18.9	18.9	No SW	5	5	5	4	4	4	4	31	
170.4	109.2	61.2	35.9%	633.5	17.5	17.5	17.5	18.9	18.9	18.9	No SW	5	5	5	5	4	4	4	32	
172.4	109.2	63.2	36.7%	633.5	17.5	17.5	17.5	18.9	18.9	18.9	No SW	5	5	5	5	5	4	4	33	
174.4	109.2	65.2	37.4%	633.5	17.5	17.5	17.5	18.9	18.9	18.9	No SW	5	5	5	5	5	5	4	34	
176.3	109.2	67.1	38.1%	633.5	17.5	17.5	17.5	18.9	18.9	18.9	No SW	5	5	5	5	5	5	5	35	
178.3	109.2	69.1	38.8%	633.5	17.5	17.5	17.5	18.9	18.9	18.9	No SW	6	5	5	5	5	5	5	36	
180.3	109.2	71.1	39.4%	633.5	17.5	17.5	17.5	18.9	18.9	18.9	No SW	6	6	5	5	5	5	5	37	
182.2	109.2	73.0	40.1%	633.5	17.5	17.5	17.5	18.9	18.9	18.9	No SW	6	6	6	5	5	5	5	38	
184.2	109.2	75.0	40.7%	633.5	17.5	17.5	17.5	18.9	18.9	18.9	No SW	6	6	6	6	5	5	5	39	
186.1	109.2	76.9	41.3%	633.5	17.5	17.5	17.5	18.9	18.9	18.9	No SW	6	6	6	6	6	5	5	40	

Table LGS- 11 (pg 2 of 2). No SW

Calc River (kcfs)	PH (kcfs)	Spill (kcfs)	Percent Spill (Note 2)	Forebay WSE (ft) (Note 2)	Powerhouse Flow (kcfs) [Notes 1 & 3]						Spillway Flow (stops) [Notes 3 & 7]								Total Stops TS	Notes
					1 (Note 4)	2	3	4	5	6	1	2	3	4	5	6	7	8		
188.1	109.2	78.9	41.9%	633.5	17.5	17.5	17.5	18.9	18.9	18.9	No SW	6	6	6	6	6	6	5	41	
190.1	109.2	80.9	42.5%	633.5	17.5	17.5	17.5	18.9	18.9	18.9	No SW	6	6	6	6	6	6	6	42	
192.0	109.2	82.8	43.1%	633.5	17.5	17.5	17.5	18.9	18.9	18.9	No SW	7	6	6	6	6	6	6	43	
193.9	109.2	84.7	43.7%	633.5	17.5	17.5	17.5	18.9	18.9	18.9	No SW	7	7	6	6	6	6	6	44	
195.9	109.2	86.7	44.3%	633.5	17.5	17.5	17.5	18.9	18.9	18.9	No SW	7	7	7	6	6	6	6	45	
197.8	109.2	88.6	44.8%	633.5	17.5	17.5	17.5	18.9	18.9	18.9	No SW	7	7	7	7	6	6	6	46	
199.8	109.2	90.6	45.3%	633.5	17.5	17.5	17.5	18.9	18.9	18.9	No SW	7	7	7	7	7	6	6	47	
201.7	109.2	92.5	45.9%	633.5	17.5	17.5	17.5	18.9	18.9	18.9	No SW	7	7	7	7	7	7	6	48	
203.7	109.2	94.5	46.4%	633.5	17.5	17.5	17.5	18.9	18.9	18.9	No SW	7	7	7	7	7	7	7	49	
205.6	109.2	96.4	46.9%	633.5	17.5	17.5	17.5	18.9	18.9	18.9	No SW	8	7	7	7	7	7	7	50	
207.6	109.2	98.4	47.4%	633.5	17.5	17.5	17.5	18.9	18.9	18.9	No SW	8	8	7	7	7	7	7	51	
209.6	109.2	100.4	47.9%	633.5	17.5	17.5	17.5	18.9	18.9	18.9	No SW	8	8	8	7	7	7	7	52	
211.5	109.2	102.3	48.4%	633.5	17.5	17.5	17.5	18.9	18.9	18.9	No SW	8	8	8	8	7	7	7	53	
213.5	109.2	104.3	48.9%	633.5	17.5	17.5	17.5	18.9	18.9	18.9	No SW	8	8	8	8	8	7	7	54	
215.5	109.2	106.3	49.3%	633.5	17.5	17.5	17.5	18.9	18.9	18.9	No SW	8	8	8	8	8	8	7	55	
217.4	109.2	108.2	49.8%	633.5	17.5	17.5	17.5	18.9	18.9	18.9	No SW	8	8	8	8	8	8	8	56	
219.4	109.2	110.2	50.2%	633.5	17.5	17.5	17.5	18.9	18.9	18.9	No SW	9	8	8	8	8	8	8	57	
221.3	109.2	112.1	50.7%	633.5	17.5	17.5	17.5	18.9	18.9	18.9	No SW	9	9	8	8	8	8	8	58	
223.2	109.2	114.0	51.1%	633.5	17.5	17.5	17.5	18.9	18.9	18.9	No SW	9	9	9	8	8	8	8	59	
225.1	109.2	115.9	51.5%	633.5	17.5	17.5	17.5	18.9	18.9	18.9	No SW	9	9	9	9	8	8	8	60	
227.1	109.2	117.9	51.9%	633.5	17.5	17.5	17.5	18.9	18.9	18.9	No SW	9	9	9	9	9	8	8	61	
229.0	109.2	119.8	52.3%	633.5	17.5	17.5	17.5	18.9	18.9	18.9	No SW	9	9	9	9	9	9	8	62	
230.9	109.2	121.7	52.7%	633.5	17.5	17.5	17.5	18.9	18.9	18.9	No SW	9	9	9	9	9	9	9	63	
232.9	109.2	123.7	53.1%	633.5	17.5	17.5	17.5	18.9	18.9	18.9	No SW	10	9	9	9	9	9	9	64	
235.0	109.2	125.8	53.5%	633.5	17.5	17.5	17.5	18.9	18.9	18.9	No SW	10	10	9	9	9	9	9	65	
237.0	109.2	127.8	53.9%	633.5	17.5	17.5	17.5	18.9	18.9	18.9	No SW	10	10	10	9	9	9	9	66	
239.0	109.2	129.8	54.3%	633.5	17.5	17.5	17.5	18.9	18.9	18.9	No SW	10	10	10	10	9	9	9	67	
241.0	109.2	131.8	54.7%	633.5	17.5	17.5	17.5	18.9	18.9	18.9	No SW	10	10	10	10	10	9	9	68	
243.0	109.2	133.8	55.1%	633.5	17.5	17.5	17.5	18.9	18.9	18.9	No SW	10	10	10	10	10	10	9	69	
245.0	109.2	135.8	55.4%	633.5	17.5	17.5	17.5	18.9	18.9	18.9	No SW	10	10	10	10	10	10	10	70	

Note 1: Powerhouse unit priority should be Unit 1 ==> 6. Unit 1 operation is especially important to maintain good tailrace conditions for juvenile fish egress and adult fish attraction.

Note 2: Assume Minimum Operating Pool (MOP) rules apply (i.e. forebay elevation between 633.0 - 634.0 feet).

Note 3: Discharges shown on this table are based on an average forebay elevation for the specified range (633.5 ft for MOP rules), and are approximate. Particularly the powerhouse discharges are shown as an indication of how the Unit 1 operating restriction will work, not as a precise requirement. Actual operation will change with changing inflow, forebay and tailwater elevations, and other operating constraints and demands.

Note 4: Unit 1 operation is manually restricted to operate between 115 - 125 MW, which is approximately 16.0 - 17.5 kcfs. Assume Unit 1 will be at the lower end of this range if other units are operating at discharges lower than 16.0 kcfs. Assume other operating units will be operated approximately uniformly, within constraints of normal 1% operation (Units 4-6 are different than Units 1-3). When average unit discharge is higher than 16.0 kcfs, assume all units will operate uniformly, again given different 1% range for Units 4-6. For low river discharges (Qr<38 kcfs), with only one unit operating, Unit 1 may operate at less than 16 kcfs.

Note 5: For river discharges less than this value, additional spill bays will be closed, Unit 1 will operate at the lower end of the 1% efficiency range, and the spill ratio will be less than 30%.

Note 6: Above this river discharge, involuntary spill will force a spill ratio higher than 30%.

Note 7: This uniform spill pattern, with no SW operating, will be used when river discharges are less than ~35 kcfs, or as an alternate pattern when the SW must be closed for any reason, such as when switching from SW-LO to SW-HI.

Table LGS- 12 (pg 1 of 2). Little Goose Dam Spill Pattern for ALTERNATE UNIFORM Spill Configuration (Spillway Weir Crest Change). [see Note 7 at end of table]

					Powerhouse Flow (kcfs) [Notes 1 & 3]						Spillway Flow (stops) [Notes 3 & 7]									
Calc River (kcfs)	PH (kcfs)	Spill (kcfs)	Percent Spill (Note 2)	Forebay WSE (ft) (Note 2)	1 (Note 4)	2	3	4	5	6	1	2	3	4	5	6	7	8	Total Stops TS	Notes
11.3	11.3	0.0	0.0%	633.5	11.3						No SW								0	No spill, minimum Qp
13.1	11.3	1.8	13.5%	633.5	11.3						No SW							1	1	
14.8	11.3	3.5	23.8%	633.5	11.3						No SW		1					1	2	
18.0	12.6	5.4	30.0%	633.5	12.6						No SW		1					2	3	Lowest Qr possible w/ 30% spill and no SW (Note 5)
24.0	16.8	7.2	29.9%	633.5	16.8						No SW		1		1			2	4	
26.4	17.5	8.9	33.8%	633.5	17.5						No SW		1		1		1	2	5	1 unit, 5 stops, Qs~34%
31.5	22.6	8.9	28.3%	633.5	11.3	11.3					No SW		1		1		1	2	5	2 units, 5 stops, Qs~28%
35.7	25.0	10.7	30.0%	633.5	13.7	11.3					No SW		1	1	1		1	2	6	
38.0	27.3	10.7	28.2%	633.5	16.0	11.3					No SW		1	1	1		1	2	6	Lowest Qr for U1 special operation (Note 4
41.6	29.1	12.5	30.0%	633.5	16.0	13.1					No SW		1	1	1	1	1	2	7	
47.6	33.2	14.4	30.2%	633.5	16.6	16.6					No SW		2	1	1	1	1	2	8	
51.3	35.0	16.3	31.7%	633.5	17.5	17.5					No SW		2	1	2	1	1	2	9	2 units, 9 stops, Qs~31%
54.9	38.6	16.3	29.6%	633.5	16.0	11.3	11.3				No SW		2	1	2	1	1	2	9	3 units, 9 stops, Qs~29%
60.2	42.0	18.2	30.2%	633.5	16.0	13.0	13.0				No SW		2	1	2	1	2	2	10	
66.6	46.5	20.1	30.1%	633.5	16.0	15.3	15.2				No SW		2	2	2	1	2	2	11	
72.9	50.9	22.0	30.1%	633.5	17.0	17.0	16.9				No SW		2	2	2	2	2	2	12	
74.5	52.5	22.0	29.5%	633.5	17.5	17.5	17.5				No SW		2	2	2	2	2	2	12	Max. Qr w/ 3 units, Qs ~29%
76.5	52.5	24.0	31.3%	633.5	16.0	11.3	11.3	13.9			No SW		3	2	2	2	2	2	13	Min. Qr w/ 4 units, Qs ~31%
79.3	55.3	24.0	30.2%	633.5	16.0	12.7	12.7	13.9			No SW		3	2	2	2	2	2	13	
85.8	59.8	26.0	30.3%	633.5	16.0	14.6	14.6	14.6			No SW		3	3	2	2	2	2	14	
92.3	64.4	27.9	30.3%	633.5	16.1	16.1	16.1	16.1			No SW		3	3	3	2	2	2	15	
99.0	69.1	29.9	30.2%	633.5	17.3	17.3	17.3	17.2			No SW		3	3	3	3	2	2	16	
105.6	73.7	31.9	30.2%	633.5	16.0	14.5	14.4	14.4	14.4		No SW		3	3	3	3	3	2	17	
112.3	78.4	33.9	30.2%	633.5	16.0	15.6	15.6	15.6	15.6		No SW		3	3	3	3	3	3	18	
119.0	83.1	35.9	30.2%	633.5	16.7	16.6	16.6	16.6	16.6		No SW		4	3	3	3	3	3	19	
125.4	87.5	37.9	30.2%	633.5	17.5	17.5	17.5	17.5	17.5		No SW		4	4	3	3	3	3	20	
132.2	92.4	39.8	30.1%	633.5	16.0	15.3	15.3	15.3	15.3	15.2	No SW		4	4	4	3	3	3	21	
138.8	97.0	41.8	30.1%	633.5	16.2	16.2	16.2	16.2	16.1	16.1	No SW		4	4	4	4	3	3	22	
145.4	101.6	43.8	30.1%	633.5	17.0	17.0	16.9	16.9	16.9	16.9	No SW		4	4	4	4	4	3	23	
152.0	106.2	45.8	30.1%	633.5	17.5	17.5	17.5	17.9	17.9	17.9	No SW		4	4	4	4	4	4	24	
156.9	109.2	47.7	30.4%	633.5	17.5	17.5	17.5	18.9	18.9	18.9	No SW		5	4	4	4	4	4	25	Max. PH capacity w/ Qs=30% (Note 6)
158.9	109.2	49.7	31.3%	633.5	17.5	17.5	17.5	18.9	18.9	18.9	No SW		5	5	4	4	4	4	26	
160.8	109.2	51.6	32.1%	633.5	17.5	17.5	17.5	18.9	18.9	18.9	No SW		5	5	5	4	4	4	27	
162.8	109.2	53.6	32.9%	633.5	17.5	17.5	17.5	18.9	18.9	18.9	No SW		5	5	5	5	4	4	28	
164.8	109.2	55.6	33.7%	633.5	17.5	17.5	17.5	18.9	18.9	18.9	No SW		5	5	5	5	5	4	29	
166.7	109.2	57.5	34.5%	633.5	17.5	17.5	17.5	18.9	18.9	18.9	No SW		5	5	5	5	5	5	30	
168.7	109.2	59.5	35.3%	633.5	17.5	17.5	17.5	18.9	18.9	18.9	No SW		6	5	5	5	5	5	31	
170.7	109.2	61.5	36.0%	633.5	17.5	17.5	17.5	18.9	18.9	18.9	No SW		6	6	5	5	5	5	32	
172.6	109.2	63.4	36.7%	633.5	17.5	17.5	17.5	18.9	18.9	18.9	No SW		6	6	6	5	5	5	33	
174.6	109.2	65.4	37.4%	633.5	17.5	17.5	17.5	18.9	18.9	18.9	No SW		6	6	6	6	5	5	34	
176.5	109.2	67.3	38.1%	633.5	17.5	17.5	17.5	18.9	18.9	18.9	No SW		6	6	6	6	6	5	35	
178.5	109.2	69.3	38.8%	633.5	17.5	17.5	17.5	18.9	18.9	18.9	No SW		6	6	6	6	6	6	36	
180.4	109.2	71.2	39.5%	633.5	17.5	17.5	17.5	18.9	18.9	18.9	No SW		7	6	6	6	6	6	37	
182.4	109.2	73.2	40.1%	633.5	17.5	17.5	17.5	18.9	18.9	18.9	No SW		7	7	6	6	6	6	38	
184.3	109.2	75.1	40.8%	633.5	17.5	17.5	17.5	18.9	18.9	18.9	No SW		7	7	7	6	6	6	39	
186.3	109.2	77.1	41.4%	633.5	17.5	17.5	17.5	18.9	18.9	18.9	No SW		7	7	7	7	6	6	40	

Table LGS- 12 (pg 2 of 2). Crest Change

Calc River (kcfs)	PH (kcfs)	Spill (kcfs)	Percent Spill (Note 2)	Forebay WSE (ft) (Note 2)	Powerhouse Flow (kcfs) [Notes 1 & 3] 1 (Note 4)	2	3	4	5	6	Spillway Flow (stops) [Notes 3 & 7] 1	2	3	4	5	6	7	8	Total Stops TS	Notes
188.2	109.2	79.0	42.0%	633.5	17.5	17.5	17.5	18.9	18.9	18.9	No SW		7	7	7	7	7	6	41	
190.2	109.2	81.0	42.6%	633.5	17.5	17.5	17.5	18.9	18.9	18.9	No SW		7	7	7	7	7	7	42	
192.1	109.2	82.9	43.2%	633.5	17.5	17.5	17.5	18.9	18.9	18.9	No SW		8	7	7	7	7	7	43	
194.1	109.2	84.9	43.7%	633.5	17.5	17.5	17.5	18.9	18.9	18.9	No SW		8	8	7	7	7	7	44	
196.1	109.2	86.9	44.3%	633.5	17.5	17.5	17.5	18.9	18.9	18.9	No SW		8	8	8	7	7	7	45	
198.0	109.2	88.8	44.9%	633.5	17.5	17.5	17.5	18.9	18.9	18.9	No SW		8	8	8	8	7	7	46	
200.0	109.2	90.8	45.4%	633.5	17.5	17.5	17.5	18.9	18.9	18.9	No SW		8	8	8	8	8	7	47	
202.0	109.2	92.8	45.9%	633.5	17.5	17.5	17.5	18.9	18.9	18.9	No SW		8	8	8	8	8	8	48	
203.9	109.2	94.7	46.4%	633.5	17.5	17.5	17.5	18.9	18.9	18.9	No SW		9	8	8	8	8	8	49	
205.8	109.2	96.6	46.9%	633.5	17.5	17.5	17.5	18.9	18.9	18.9	No SW		9	9	8	8	8	8	50	
207.8	109.2	98.6	47.4%	633.5	17.5	17.5	17.5	18.9	18.9	18.9	No SW		9	9	9	8	8	8	51	
209.7	109.2	100.5	47.9%	633.5	17.5	17.5	17.5	18.9	18.9	18.9	No SW		9	9	9	9	8	8	52	
211.6	109.2	102.4	48.4%	633.5	17.5	17.5	17.5	18.9	18.9	18.9	No SW		9	9	9	9	9	8	53	
213.5	109.2	104.3	48.9%	633.5	17.5	17.5	17.5	18.9	18.9	18.9	No SW		9	9	9	9	9	9	54	
215.6	109.2	106.4	49.3%	633.5	17.5	17.5	17.5	18.9	18.9	18.9	No SW		10	9	9	9	9	9	55	
217.6	109.2	108.4	49.8%	633.5	17.5	17.5	17.5	18.9	18.9	18.9	No SW		10	10	9	9	9	9	56	
219.6	109.2	110.4	50.3%	633.5	17.5	17.5	17.5	18.9	18.9	18.9	No SW		10	10	10	9	9	9	57	
221.6	109.2	112.4	50.7%	633.5	17.5	17.5	17.5	18.9	18.9	18.9	No SW		10	10	10	10	9	9	58	
223.6	109.2	114.4	51.2%	633.5	17.5	17.5	17.5	18.9	18.9	18.9	No SW		10	10	10	10	10	9	59	
225.6	109.2	116.4	51.6%	633.5	17.5	17.5	17.5	18.9	18.9	18.9	No SW		10	10	10	10	10	10	60	
227.6	109.2	118.4	52.0%	633.5	17.5	17.5	17.5	18.9	18.9	18.9	No SW		11	10	10	10	10	10	61	
229.6	109.2	120.4	52.4%	633.5	17.5	17.5	17.5	18.9	18.9	18.9	No SW		11	11	10	10	10	10	62	
231.7	109.2	122.5	52.9%	633.5	17.5	17.5	17.5	18.9	18.9	18.9	No SW		11	11	11	10	10	10	63	
233.7	109.2	124.5	53.3%	633.5	17.5	17.5	17.5	18.9	18.9	18.9	No SW		11	11	11	11	10	10	64	
235.7	109.2	126.5	53.7%	633.5	17.5	17.5	17.5	18.9	18.9	18.9	No SW		11	11	11	11	11	10	65	
237.7	109.2	128.5	54.1%	633.5	17.5	17.5	17.5	18.9	18.9	18.9	No SW		11	11	11	11	11	11	66	
239.7	109.2	130.5	54.4%	633.5	17.5	17.5	17.5	18.9	18.9	18.9	No SW		12	11	11	11	11	11	67	
241.8	109.2	132.6	54.8%	633.5	17.5	17.5	17.5	18.9	18.9	18.9	No SW		12	12	11	11	11	11	68	
243.8	109.2	134.6	55.2%	633.5	17.5	17.5	17.5	18.9	18.9	18.9	No SW		12	12	12	11	11	11	69	
245.8	109.2	136.6	55.6%	633.5	17.5	17.5	17.5	18.9	18.9	18.9	No SW		12	12	12	12	11	11	70	

Note 1: Powerhouse unit priority should be Unit 1 ==> 6. Unit 1 operation is especially important to maintain good tailrace conditions for juvenile fish egress and adult fish attraction.

Note 2: Assume Minimum Operating Pool (MOP) rules apply (i.e. forebay elevation between 633.0 - 634.0 feet).

Note 3: Discharges shown on this table are based on an average forebay elevation for the specified range (633.5 ft for MOP rules), and are approximate. Particularly the powerhouse discharges are shown as an indication of how the Unit 1 operating restriction will work, not as a precise requirement. Actual operation will change with changing inflow, forebay and tailwater elevations, and other operating constraints and demands.

Note 4: Unit 1 operation is manually restricted to operate between 115 - 125 MW, which is approximately 16.0 - 17.5 kcfs. Assume Unit 1 will be at the lower end of this range if other units are operating at discharges lower than 16.0 kcfs. Assume other operating units will be operated approximately uniformly, within constraints of normal 1% operation (Units 4-6 are different than Units 1-3). When average unit discharge is higher than 16.0 kcfs, assume all units will operate uniformly, again given different 1% range for Units 4-6. For low river discharges (Qr<38 kcfs), with only one unit operating, Unit 1 may operate at less than 16 kcfs.

Note 5: For river discharges less than this value, additional spill bays will be closed, Unit 1 will operate at the lower end of the 1% efficiency range, and the spill ratio will be less than 30%.

Note 6: Above this river discharge, involuntary spill will force a spill ratio higher than 30%.

Note 7: This alternate uniform spill pattern, with no SW operating, will be used when changing the SW weir crest elevations. Bay 2 is also closed for safety reasons with personnel working in Bay 1 to change the SW crest.

Section 9 – Lower Granite Dam
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Section 9 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 diversion systems.

1.1.2. Juvenile Migration Timing. Juvenile migration timing at Lower Granite Dam is indicated in **Table LWG-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 LWG- 1. Juvenile Migration Timing at Lower Granite Dam, 2002 – 2011. [1]

Yearling Chinook						Subyearling Chinook				
	10 %	50%	90 %	# of Days			10 %	50%	90 %	# of Days
2002	17-Apr	6-May	21-May	34		2002	23-Jun	15-Jul	9-Aug	47
2003	21-Apr	6-May	20-May	29		2003	4-Jun	22-Jun	16-Jul	42
2004	24-Apr	5-May	12-May	18		2004	8-Jun	21-Jun	14-Jul	36
2005	24-Apr	5-May	10-May	16		2005	29-May	3-Jun	17-Jun	19
2006	20-Apr	5-May	15-May	25		2006	26-May	5-Jun	3-Jul	38
2007	19-Apr	4-May	14-May	25		2007	3-Jun	9-Jun	12-Jul	39
2008	26-Apr	9-May	18-May	22		2008	31-May	20-Jun	28-Jul	58
2009	22-Apr	7-May	20-May	28		2009	29-May	11-Jun	2-Jul	34
2010	24-Apr	4-May	21-May	27		2010	2-Jun	9-Jun	14-Jul	42
2011	19-Apr	8-May	16-May	27		2011	26-May	11-Jun	16-Jul	51
MEDIAN	21-Apr	5-May	16-May	26		**MEDIAN**	1-Jun	11-Jun	14-Jul	40.5
MIN	17-Apr	4-May	10-May	16		**MIN**	26-May	3-Jun	17-Jun	19
MAX	26-Apr	9-May	21-May	34		**MAX**	23-Jun	15-Jul	9-Aug	58
Unclipped Steelhead						Clipped Steelhead				
	10 %	50%	90 %	# of Days			10 %	50%	90 %	# of Days
2002	17-Apr	19-May	1-Jun	45		2002	21-Apr	10-May	29-May	38
2003	19-Apr	17-May	30-May	41		2003	25-Apr	14-May	28-May	33
2004	29-Apr	9-May	24-May	25		2004	27-Apr	9-May	24-May	27
2005	27-Apr	9-May	20-May	23		2005	26-Apr	8-May	16-May	20
2006	19-Apr	5-May	21-May	32		2006	21-Apr	4-May	19-May	28
2007	1-May	10-May	21-May	20		2007	28-Apr	7-May	20-May	22
2008	20-Apr	11-May	27-May	37		2008	28-Apr	8-May	21-May	23
2009	22-Apr	6-May	29-May	37		2009	21-Apr	1-May	21-May	30
2010	26-Apr	19-May	5-Jun	40		2010	25-Apr	11-May	4-Jun	40
2011	22-Apr	13-May	31-May	39		2011	3-Apr	6-May	20-May	47
MEDIAN	22-Apr	11-May	28-May	37		**MEDIAN**	25-Apr	8-May	21-May	29
MIN	17-Apr	5-May	20-May	20		**MIN**	3-Apr	1-May	16-May	20
MAX	1-May	19-May	5-Jun	45		**MAX**	29-Apr	14-May	4-Jun	47
Coho						Sockeye (Wild & Hatchery)				
	10 %	50%	90 %	# of Days			10 %	50%	90 %	# of Days
2002	18-May	23-May	8-Jun	21		2002	25-Apr	19-May	31-May	36
2003	18-May	27-May	15-Jun	28		2003	15-May	31-May	6-Jun	22
2004	8-May	21-May	28-May	20		2004	12-May	22-May	19-Jun	38
2005	30-Apr	10-May	17-May	17		2005	9-May	20-May	1-Jun	23
2006	2-May	18-May	1-Jun	30		2006	11-Apr	12-May	28-May	47
2007	5-May	15-May	23-May	18		2007	11-May	16-May	21-May	10
2008	6-May	10-May	22-May	16		2008	17-May	20-May	8-Jun	22
2009	13-May	21-May	23-Jun	41		2009	21-Apr	20-May	28-May	37
2010	6-Jun	21-May	5-Jul	29		2010	19-May	30-May	5-Jun	17
2011	05 May	15-May	1-Jun	27		2011	04-Apr	20-May	4-Jun	61
MEDIAN	7-May	19-May	1-Jun	24		**MEDIAN**	10-May	20-May	2-Jun	29.5
MIN	30-Apr	10-May	17-May	16		**MIN**	4-Apr	12-May	21-May	10
MAX	6-Jun	27-May	5-Jul	41		**MAX**	19-May	31-May	19-Jun	61

1. Dates are derived from daily and yearly facility collection numbers.

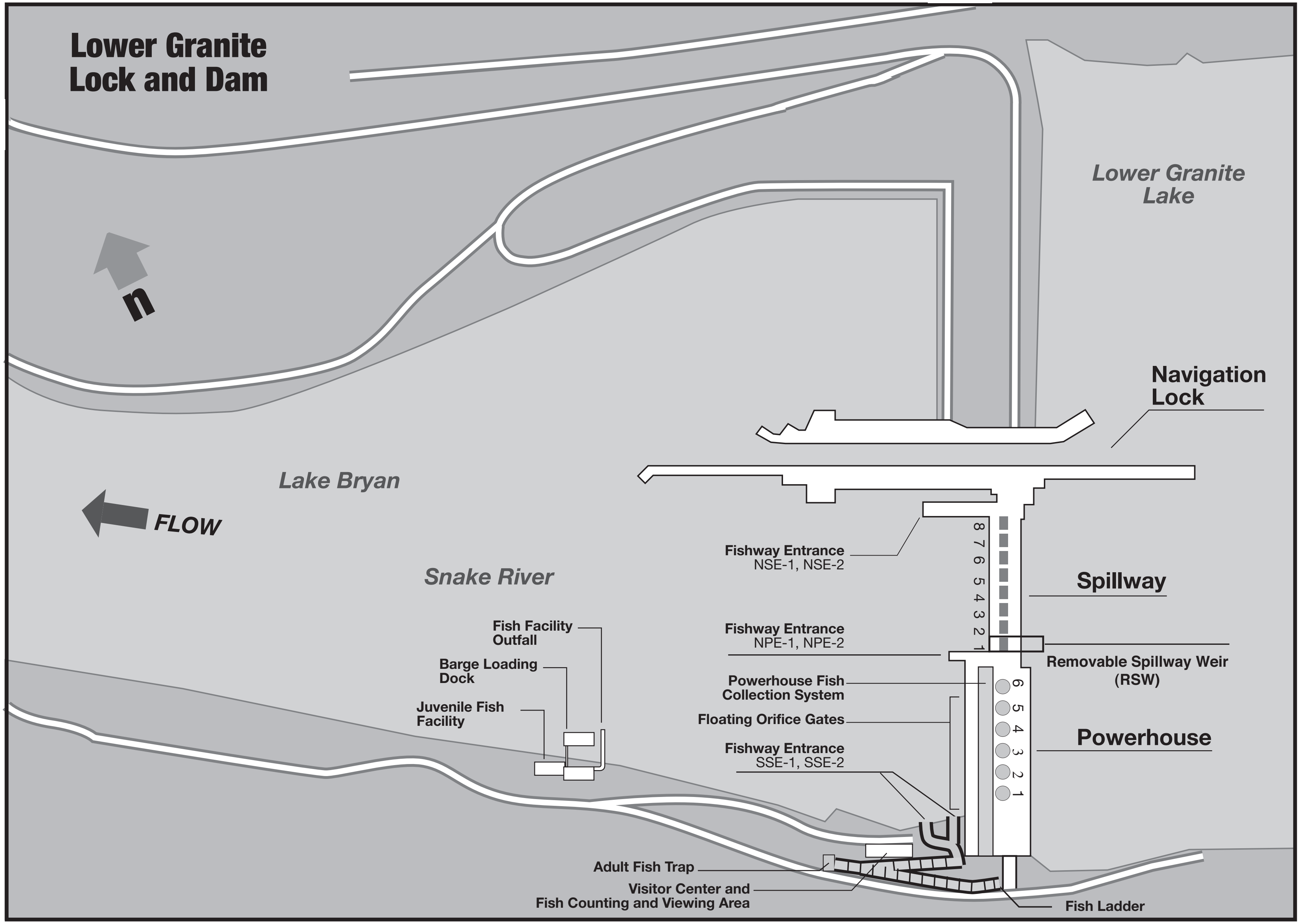
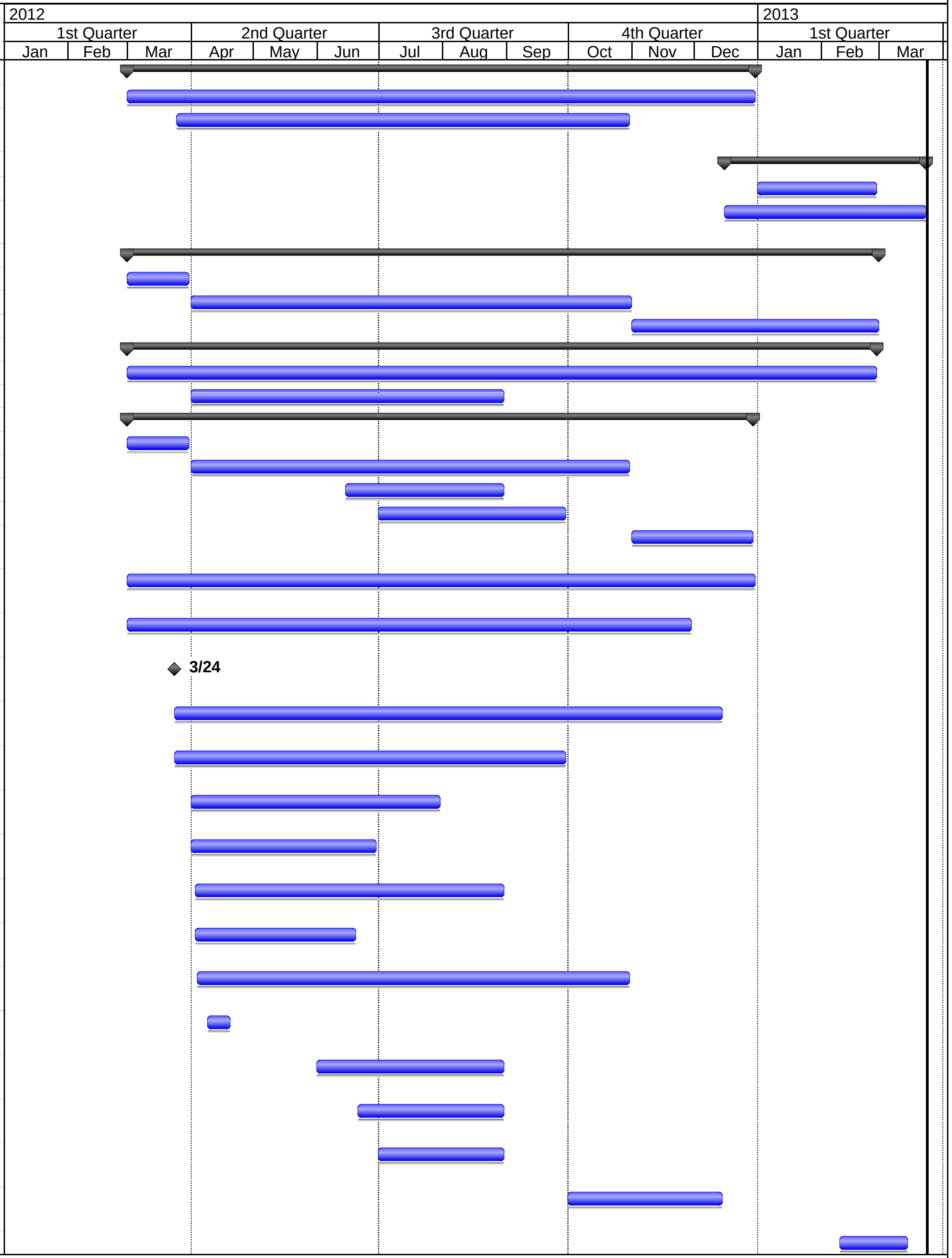


Figure LWG- 1. Lower Granite Lock and Dam General Site Plan.

Table LWG-2. Dates of Fish-Related Operations at Lower Granite Dam during the 2012 Fish Passage Season and 2012-2013 Winter Maintenance Period.

Task Name	Start	Finish	Reference
2012 FISH PASSAGE SEASON	**3/1/12**	**12/31/12**	
Adult Fish Passage Season	3/1/12	12/31/12	LWG 2.3.2.2
Juvenile Fish Passage Season	3/25/12	10/31/12	LWG 2.3.1
2012-2013 WINTER MAINTENANCE PERIOD	**12/16/12**	**3/24/13**	
Winter Maintenance Adult Fish Facilities	1/1/13	2/28/13	LWG 2.3.2.1
Winter Maintenance Juvenile Fish Facilities	12/16/12	3/24/13	LWG 2.3.1.1
1% Constraints (year-round)	**3/1/12**	**2/28/13**	**LWG 4.1.1**
1% soft constraint	3/1/12	3/31/12	
1% hard constraint	4/1/12	10/31/12	
1% soft constraint	11/1/12	2/28/13	
TDG Monitoring (year-round)	**3/1/12**	**2/28/13**	**App D, Table 1**
TDG Monitoring - Tailwater (year-round)	3/1/12	2/28/13	LGNW
TDG Monitoring - Forebay	4/1/12	8/31/12	LWG
Adult Fish Counting	**3/1/12**	**12/30/12**	**LWG Table LWG-3**
Video 0600-1600 PST	3/1/12	3/31/12	
Visual count 0400-2000 PST	4/1/12	10/31/12	
Night video counts for sockeye 2000-0400 PST	6/15/12	8/31/12	
Night video counts for lamprey 2000–0400 PST	7/1/12	9/30/12	
Video count 0600-1600 PST	11/1/12	12/30/12	
Weekly Reports	3/1/12	12/31/12	LWG 2.3.3.1
Operate Turbines for Fish Passage	3/1/12	11/30/12	LWG 4.1
ESBSs installed in at least 4 units (NLT date)	3/24/12	3/24/12	LWG 2.3.1.1 b 6
Operate Juvenile Fish Passage Facilities	3/24/12	12/15/12	LWG 2.3.1
BiOp Kelt Passage & Survival Study	3/24/12	9/30/12	App A LWG 2.9
Backflush Orifices Once per 8-Hour Shift	4/1/12	7/31/12	LWG 2.3.1.2 c 7
Measure VBS head differentials at least once per week	4/1/12	6/30/12	LWG 2.3.1.2 b 8
RSW Operation (end date approximate)	4/3/12	8/31/12	LWG 2.3.1.2 f
Spring Spill for Fish Passage	4/3/12	6/20/12	App E
Comparative SARs Study (early transport vs. in-river)	4/4/12	10/31/12	App A LWG 2.1, 2.2
AWS pump #2 out of service for repair	4/9/12	4/20/12	App A LWG 1.8
Adult Lamprey Passage Study	6/1/12	8/31/12	App A LWG 2.7.
Summer Spill for Fish Passage	6/21/12	8/31/12	App E
Installation of New Intake Gantry Crane and Test Operations	7/1/12	8/31/12	App A LWG 1.5
Half of ESBSs may be pulled for maintenance	10/1/12	12/15/12	LWG 2.3.1.2 b 6
Annual Report (for 2012)	2/10/13	3/15/13	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. In addition, auxiliary water is also provided through diffuser 14, from the forebay. 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. 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; but do not appear on the Corps daily website total due to relative infrequency of passage. These data are posted in the Miscellaneous Fish Counts report during the passage season (updated periodically during the season) found on the Corps' web site, and summarized in the Annual Fish Passage Report.

Table LWG- 3. Adult fish counting schedule at Lower Granite Dam.

Count Period	Counting Method and Hours
March 1 through March 31	Video 0600–1600 hours (PST)
April 1 through October 31	Visual 0400–2000 hours (PST)
June 15 through August 31	Night video sockeye counts 2000–0400 hours (PST)
July 1 through September 30	Night video lamprey counts 2000–0400 hours (PST)
November 1 through December 30	Video 0600–1600 hours (PST)

Table LWG- 4. Adult count period and peak migration timing at Lower Granite Dam from 1975-2011 based on fish counts.

Species	Counting Period	Date of Peak Passage	
		Earliest	Latest
Spring Chinook	3/1 – 6/17	4/26	6/17
Summer Chinook	6/18 – 8/17	6/18	7/17
Fall Chinook	8/18 – 12/30	9/5	10/6
Steelhead	3/1 – 12/30	9/1	10/16
Sockeye	3/1 – 10/31	7/1	7/19
Lamprey	4/1 – 10/31	7/18	7/25

2. Project Operation.

2.1. Spill Management. See 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-10** and **LWG-11**, and summer **LWG-12**. 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 25 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 (relative to the drawdown with a clean screen). 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.

11. When extreme cold weather is forecasted (as defined as: anticipated temperatures below 20^{o} Fahrenheit for 24 hours) to occur for an extended period of time between Thanksgiving and December 15, ESBSs and STSs may be removed. The project will first request special permission from CENWW-OD-T. CENWW-OD-T will inform NOAA Fisheries and other FPOM participants of the action.

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 dewatering).

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].

1. When the RSW is in operation, the spillgate shall be raised to where it does not touch flow passing down the RSW (at least nine stops).

2. When the National Weather Service 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 and CENWW-OD-T.

3. 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.

4. 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.

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[1] Removable spillway weirs (RSWs) are installed at Lower Granite, Lower Monumental and Ice Harbor dams. RSWs are differentiated from Temporary Spillway Weirs (TSWs, installed at McNary, John Day and Little Goose dams) by being designed to be "removable" from the spillbay by controlled descent to the bottom of the forebay.

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'.

1. In order to facilitate proper operation of the adult fishway weirgate entrances, powerhouse electricians shall raise and lower individual weirgates to check the limit switch settings and make necessary adjustments and/or begin planning for necessary repairs to occur during the winter maintenance period (Jan 1-Feb 28). The checks must be performed while the ladder is watered up and are expected to take approximately one hour per weirgate. The checks shall be conducted near the end of the day during the period of December 15-31 when adult fish passage is minimal.

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 tailwater 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.

3. At tailwater below elevation 633' weirs should be on sill.

h. Channel Velocity. 1.5' to 4' per second. The velocity is measured by means of a "Stevens Programmable Monitor" which is connected to a flow meter located in the junction pool area. The meter and monitor were installed, and are serviced every few years, by Dale Fraser (Dale R. Fraser, Sales and Service, P.O. Box 785, Gresham, OR 97030, ph no: 503-658-2649).

1. To take an actual reading, we turn the monitor on and allow it to warm up for a few seconds. We then record six separate velocity readings and average them. This information is recorded on the daily adult fishway inspection form. At the end of the inspection week, all readings are averaged and we note the maximum and minimum velocity from the various inspections. This information is included in the weekly adult fishway report.

i. Tunnel Lights. Lights in the tunnel section under the spillway shall be on during fish passage period. The mirror that is placed so that the tunnel lights can be seen should be clean and functional.

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 dewatering).

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 may require that modifications be made to the auxiliary water supply to diffuser #14.

1. Prior to and during the period of use of any holding tanks at the Adult Trap, the COE should inspect and clean if necessary the intake to the diffuser #14 auxiliary water supply. Additionally, the COE should inspect and repair potential sources of leakage in the diffuser #14 water supply.

2. 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.

3. After September 1 of each year, the two smaller of the six holding tanks <u>only</u> may be used to hold adult fish, for hatchery broodstock or other research needs, if the use of more tanks will limit the ability of the LGR fish ladder to meet its depth over ladder weir criteria.

4. Additional holding tanks may be used if modifications are made to the diffuser #14 water supply that allow a water depth of 12 inches or greater over the ladder weirs in addition to meeting the needs of the additional tanks.

5. Current configuration and operation of the adult fish trap are being reviewed during winter maintenance period 2009. Changes if needed to existing configurations will be completed prior to the fish passage season. If any changes in the Lower Granite reservoir elevation are needed, these will be coordinated through CENWW-OD-T, in consultation with NOAA Fisheries, and the regional members of FPOM. In-season operational changed that deviate from MOP will be coordinated through TMT.

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 and Quagga mussels. Biologists shall provide a report to CENWW-OD-T on a monthly basis summarizing mussel inspections.

2.4 Navigation Spill Operations. Short-term adjustments in spill are required for navigation safety. Types of adjustments may include: reduction in spill discharges rates, adjustments in spill patterns, and/or spill stoppages that result in exceedances of the Minimum Operating Pool. Actual operations will vary due to conditions such as spill patterns, turbine unit operations, experience of boat captains, etc. The Corps will make short-term adjustments in spill as appropriate in real-time to provide safe navigation conditions. Additional information regarding spill-specific operations associated with navigation may be found in Appendix E (Operations Related to Project Spill for Fish Passage).

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 2011 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 110 MWs or less 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 significant effect on fish passage will be done during the January and February winter maintenance period. Maintenance of facilities that will have no effect 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, and the outage is expected to be long-term, the floating orifices should be closed and monitored in the following order: OG-4, OG-7, OG-10, and OG-1. If fishway criteria still cannot be met, 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', then 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-5. 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, operate turbine units within 1% of best turbine efficiency. 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	Duration	Unit Priority
March 1 – December 15	Start Units - 24 hours/day	2, 3, then 4-6 any order, then 1*
	Stop Units - 24 hours/day	4-6 any order, then 3, 2, 1* Stop Units in reverse Start Unit order, except run Unit 1 as long as BPA load request and required spill rates can be met.
December 16 – February 28	24 hours/day	Any Order

* Unit 1 has fixed Kaplan blades and can only run at 130 megawatts. The Unit Priority order in Table LWG-5 minimizes starts and stops of Unit 1 and allows for the longest runtime once Unit 1 is started.

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) If the turbine unit draft tube is to be dewatered, operate unit with full load for a minimum of 15 minutes prior to installing tail logs. If not possible to load, run unit at speed-no-load for minimum of 15 minutes. This is to reduce the number of fish in the unit prior to installing stop logs;

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**.

Table LWG- 6. Turbine Operating Range Within 1% of Best Efficiency at Lower Granite Dam Units 1-3 *With* Extended-Length Submersible Bar Screens (ESBSs) Installed.*

Head (ft)	Lower Generator Limits (MW)	(CFS)	Upper Generator Limits (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. Turbine Operating Range Within 1% of Best Efficiency at Lower Granite Dam Units 1-3 *Without* Extended-Length Submersible Bar Screens (ESBSs) Installed.*

Head (ft)	Lower Generator Limits (MW)	(CFS)	Upper Generator Limits (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. Turbine Operating Range Within 1% of Best Efficiency at Lower Granite Dam Units 4-6 *With* Extended-Length Submersible Bar Screens (ESBSs) 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. Turbine Operating Range Within 1% of Best Efficiency at Lower Granite Dam Units 4-6 *Without* Extended-Length Submersible Bar Screens (ESBSs) 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.

4.1.2. 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.

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 CBT 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.

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). On the completion of maintenance, the turbine unit can be operated with one operating gate 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.

4.3.2. Dewatering turbine units should be accomplished in accordance with project dewatering plans. If the turbine unit draft tube is to be dewatered, operate unit with full load for a minimum of 15 minutes prior to installing tail logs. If not possible to load, run unit at speed-no-load for minimum of 15 minutes. This is to reduce the number of fish in the scroll case prior to installing stop logs. If a turbine unit is out of service for maintenance for an extended period of time without tailrace stop logs 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.

4.3.3. Units may be operationally tested for up to 30 minutes before going into maintenance status by running the unit at speed no load and various loads within the 1% criteria to allow pre-maintenance measurements and testing AND TO ALLOW ALL FISH TO MOVE THROUGH THE UNIT. Units may be operationally tested after maintenance or repair while remaining in maintenance or forced outage status. Operational testing may consist of running the unit for up to a cumulative time of 30 minutes (within 1% criteria) before it is returned to operational status. Operational testing OF UNIT UNDER MAINTENANCE is in addition to a unit in run status (E.G. MINIMUM GENERATION) required for power plant reliability. Operational testing may deviate from fish priority units and may require water that would otherwise be used for spill if the running unit for reliability is at its 1% minimum load. Water will be used from the powerhouse allocation if possible, and water diverted from spill for operational testing will be minimized to that necessary to maintain and assure generation system reliability.

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. Normally, the Project shall contact CENWW-OD-T at least two workdays prior to the day the special operation is required. Using information provided by the Project, CENWW-OD-T will notify FPOM and RCC will issue a teletype detailing the special operations.

5.1. Special Spills.

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.

5.1.1. Emergency spills may be implemented if necessary to pass woody debris that are accumulating in front of the spillbay weir(s), compromising the safe, unobstructed passage of fish. The operating project will immediately spill the woody debris to remove the obstructions to fish passage. The operating project will notify CENWW-OD-T of the emergency spill as soon as possible to provide notification to RCC, NOAA Fisheries, and other FPOM participants.

Table LWG-10. Lower Granite Dam Spring Spill Pattern for Fish Passage (with RSW Operating at Pool Elevation 734 feet).

Number of Gate Stops per Spillbay								Total Stops	Total Spill (kcfs)
Bay 1	Bay 2	Bay 3	Bay 4	Bay 5	Bay 6	Bay 7	Bay 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 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

RSW Discharge (Bay 1) = 6.7 kcfs (equivalent to about 3.5 stops on a gated spillbay)

Table LWG-11. Lower Granite Dam Spill Pattern for Fish Passage (RSW NOT Operating, Pool Elevation 734 feet).

Number of Gate Stops per Spillbay								Total Stops	Total Spill (kcfs)
Bay 1 (RSW)	Bay 2	Bay 3	Bay 4	Bay 5	Bay 6	Bay 7	Bay 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.

Table LWG-12 (pg 1 of 2). Lower Granite Dam Summer Spill Pattern for Fish Passage (with RSW Operating at Pool Elevation 734 feet).

Number of Gate Stops per Spillbay								Total Stops	Total Spill (kcfs)
Bay 1	Bay 2	Bay 3	Bay 4	Bay 5	Bay 6	Bay 7	Bay 8		
3.5	0	0	0	0	0	0	0	3.5	6.1
3.5	0	1	0	0	0	0	0	4.5	7.9
3.5	0	2	0	0	0	0	0	5.5	9.6
3.5	0	3	0	0	0	0	0	6.5	11.4
3.5	0	4	0	0	0	0	0	7.5	13.1
3.5	0	4	0	0	0	1	0	8.5	14.9
3.5	0	4	0	0	1	1	0	9.5	16.6
3.5	0	4	0	0	1	1	1	10.5	18.4
3.5	0	4	0	1	1	1	1	11.5	20.1
3.5	1	4	0	1	1	1	1	12.5	21.9
3.5	1	4	1	1	1	1	1	13.5	23.6
3.5	1	5	1	1	1	1	1	14.5	25.4
3.5	1	5	1	2	1	1	1	15.5	27.1
3.5	1	5	1	3	1	1	1	16.5	28.9
3.5	1	5	1	4	1	1	1	17.5	30.6
3.5	1	5	1	5	1	1	1	18.5	32.4
3.5	1	5	1	5	1	2	1	19.5	34.1
3.5	1	5	1	5	1	3	1	20.5	35.9
3.5	1	5	1	5	1	4	1	21.5	37.6
3.5	1	5	1	5	1	5	1	22.5	39.4
3.5	1	5	2	5	1	5	1	23.5	41.1
3.5	1	5	3	5	1	5	1	24.5	42.9
3.5	1	5	4	5	1	5	1	25.5	44.6
3.5	1	5	5	5	1	5	1	26.5	46.4
3.5	1	5	5	5	2	5	1	27.5	48.1
3.5	1	5	5	5	3	5	1	28.5	49.9
3.5	1	5	5	5	4	5	1	29.5	51.6
3.5	1	5	5	5	5	5	1	30.5	53.4
3.5	1	5	5	5	5	5	2	31.5	55.1
3.5	1	5	5	5	5	5	3	32.5	56.9
3.5	1	5	5	5	5	5	4	33.5	58.6
3.5	1	5	5	5	5	5	5	34.5	60.4
3.5	2	5	5	5	5	5	5	35.5	62.1
3.5	3	5	5	5	5	5	5	36.5	63.9
3.5	4	5	5	5	5	5	5	37.5	65.6
3.5	5	5	5	5	5	5	5	38.5	67.4
3.5	5	5	6	5	5	5	5	39.5	69.1
3.5	5	5	6	6	5	5	5	40.5	70.9
3.5	5	6	6	6	5	5	5	41.5	72.6
3.5	5	6	6	6	6	5	5	42.5	74.4
3.5	5	6	6	6	6	6	5	43.5	76.1
3.5	5	6	6	6	6	6	6	44.5	77.9
3.5	6	6	6	6	6	6	6	45.5	79.6
3.5	6	6	7	6	6	6	6	46.5	81.4

Number of Gate Stops per Spillbay								Total Stops	Total Spill (kcfs)
Bay 1	Bay 2	Bay 3	Bay 4	Bay 5	Bay 6	Bay 7	Bay 8		
3.5	6	6	7	7	6	6	6	47.5	83.1
3.5	6	7	7	7	6	6	6	48.5	84.9
3.5	6	7	7	7	7	6	6	49.5	86.6
3.5	6	7	7	7	7	7	6	50.5	88.4
3.5	6	7	7	7	7	7	7	51.5	90.1
3.5	7	7	7	7	7	7	7	52.5	91.9
3.5	7	7	8	7	7	7	7	53.5	93.6

Note: At approximately 3.5 stops, the tainter gate no longer regulates flow through the RSW. The tainter gate should be raised at least 9 stops so the gate does not interfere with the spillbay flow. 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

RSW Discharge (Bay 1) = 6.7 kcfs (equivalent to about 3.5 stops on a gated spillbay)

Appendix A – Special Project Operations & Studies
Bonneville Dam

The purpose of this Appendix is to notify regional interests of special project operations and studies that are planned to occur during the current year that will or may affect fish passage. Further coordination may occur as needed.

1. Special Project Operations.

RCC will coordinate needed changes with the project and authorize operations changes with issuance of a teletype describing the regulations.

1.1 Spill. Spill for fish passage will be provided during the spring and summer outmigration seasons in accordance with spill specifications in the Fish Operations Plan (FOP), pursuant to the U.S. District of Oregon Court Order for Fish Operations, and as coordinated through the TMT. The FOPs and Court Order are included in the Fish Passage Plan as Appendix E. Alternative spill patterns to control total dissolved gas levels or change fish passage conditions will be coordinated through the FPOM. Planning dates for spill at projects on the Lower Columbia River are from April 10 through August 31 for spring and summer migrants.

1.2 Spillway Debris Removal and Special Spill Pattern. In 2011, high river flows and spill levels resulted in substantial debris accumulation and erosion in the Bonneville spillway stilling basin. The Corps will remove this debris during the 2011-2012 in-water work window (IWW), which has been extended through March 31, 2012. To prevent this erosion problem from re-occurring during times of high spill, special spill patterns are being developed for spill rates of 200 kcfs or higher. These special spill patterns will be coordinated through FPOM.

2. Studies.

2.1 BiOp Performance Standard Compliance Test. In 2012, the Pacific Northwest National Laboratory (PNNL) will conduct a second year of testing to assess juvenile passage at Bonneville Dam in relation to BiOp Juvenile Salmon Performance Standards. This test will utilize acoustic telemetry to estimate dam passage survival for subyearling Chinook. Hydrophones will be deployed on the upstream face of the dam to monitor all major routes of passage that are available to juvenile salmon. In addition, hydrophones will be deployed in the forebays of the spillway and both powerhouses. Autonomous receivers will be deployed in both the forebay and tailrace each approximately two kilometers from the dam.

2.2 Steelhead Kelt Downstream Passage. Adult steelhead implanted with acoustic transmitters by ODFW in the Deschutes and Hood rivers, and other tributaries to the Columbia River upstream of Bonneville Dam, will be monitored as they pass downstream through Bonneville Dam. This study will use the autonomous and dam-mounted receivers and hydrophones deployed for the BiOp Performance Standard test described in section 2.1.

2.3 Adult Lamprey Passage. In 2012, from early June to the end of August, up to 900 adult Pacific lamprey will be captured and tagged at the Bonneville Dam Adult Fish Facility (AFF) with half-duplex PIT-tags and released below the dam to evaluate the efficacy of modifications to the Cascades Island fishway entrance and to the picket leads at the Washington Shore Fish Ladder count station, as well as to evaluate overall dam and system passage efficiency, including the Bonneville Dam Lamprey Passage Systems (LPS). Access to antennas and receivers for downloading and maintenance will be needed from March through October. The LPS and half-duplex PIT antennas will be operational no later than the middle of May and run until at least October 1. Any new antenna or receivers will be installed during the 2011-12 IWW.

NOAA Fisheries will continue improvements to the Cascades Island LPS, which currently terminates at a holding tank on the forebay deck. The LPS will be extended to the forebay to eliminate the need for handling lamprey that pass through the structure. LPS routing and construction will be coordinated with the region via FFDRWG and FPOM, though most of the LPS extension work will not involve in-water work.

To evaluate the use of Juvenile Salmon Acoustic Telemetry System (JSATS) tags in adult Pacific lamprey studies, and to determine the fate of adult lamprey in the FCRPS, up to 300 adult Pacific lamprey will be captured and tagged with both a JSATS acoustic tag and a half-duplex PIT-tag. Approximately half of the lamprey with JSATS tags will be released in the Bonneville Dam forebay and half in the tailrace. Lamprey movements will be monitored by fixed autonomous receivers equipped with hydrophones and by boat-based mobile tracking. This work may require a permit for access to the boat-restricted zone (BRZ) of Bonneville Dam.

In addition, dual-frequency identification sonar (DIDSON) and low-light optical video cameras will be used to evaluate fine-scale passage behavior of adult Pacific lamprey at the Washington Shore Fish Ladder North Downstream Entrance (NDE), at the raised picket leads at count stations, and at serpentine weir sections of fishways. As with other lamprey study objectives, operation of the DIDSON and conventional video cameras will occur throughout the adult lamprey passage season (early June – October).

2.4 Adult Salmon Passage. No adult salmon passage studies are planned for the 2012 adult fish passage season, so there are no adult salmon collection needs at the AFF. Any new radio-telemetry equipment installations or maintenance will be completed during the 2011-2012 IWW.

2.5 Sea Lion Predation. Beginning when the first sea lion is observed at Bonneville Dam until the last sea lion leaves (typically mid-November through June 1, or as coordinated through FPOM), exclusion gates will be installed at all fish ladder entrance downstream slots, and barriers will be installed at all Powerhouse 2 floating orifice gates. Additionally, NMFS-approved sea lion hazing activities will occur from land and water during sea lion season. The Fisheries Field Unit will monitor sea lion predation and evaluate sea lion deterrent efforts from the powerhouse decks and the spillway public parking lot from early January through May 31.

2.6 Summary. 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 prior to April 1 through AFEP (FFDRWG and SRWG). All significant special operation requests or schedule changes will be coordinated with the fisheries agencies and tribes through the appropriate regional forum with the action agencies making the final decision.

Appendix A – Special Project Operations & Studies
The Dalles Dam

The purpose of this Appendix is to notify regional interests of special project operations and studies that are planned to occur during the current year that will or may affect fish passage. Further coordination may occur as needed.

1. Special Project Operations.

RCC will coordinate needed changes with the project and authorize operations changes with issuance of a teletype describing the regulations.

1.1 Spill. Spill for fish passage will be provided during the spring and summer outmigration seasons in accordance with spill specifications in the Fish Operations Plan (FOP), pursuant to the U.S. District of Oregon Court Order for Fish Operations, and as coordinated through the TMT. The FOPs and Court Order are included in the Fish Passage Plan as Appendix E. Alternative spill patterns to control total dissolved gas levels or change fish passage conditions will be coordinated through the FPOM. Planning dates for spill at projects on the Lower Columbia River are from April 10 through August 31 for spring and summer migrants.

2. Studies.

2.1 Adult Lamprey Passage. Half-duplex PIT antennas will be operational to monitor adult lamprey passage no later than mid-May. Access to antennas and receivers for downloading and maintenance will be needed from March until August. Any new antenna or receiver installations will be completed during the 2011-2012 in-water work window (IWW).

JSATS-tagged adult lamprey will be released in the Bonneville Dam forebay and tailrace and mobile-tracked by boat through the reservoir reaches, tributary mouths, and tailraces of upstream dams. This work may require a permit for access to the tailrace BRZ of The Dalles Dam.

Dual-frequency identification sonar (DIDSON) and/or underwater video cameras and red or infrared LED lighting will be operated behind picket leads at both count stations to estimate the number of adult Pacific lamprey that bypass fish count stations through picketed leads. Cameras will be operated 24 hours per day from April 1 through October 31. In 2012, researchers will explore the use of alternative sites that can be used to provide visual counts for adult lamprey. Such locations may include submerged orifices, vertical slot weirs, or locations associated with the count stations. Specific locations for deploying DIDSON or conventional video cameras will be coordinated with the region via FPOM to avoid passage impacts, and installation of camera/DIDSON mounts will occur during the IWW. Any lighting changes that might impact passage will also be coordinated with the region via FPOM.

During the 2011-2012 IWW, NOAA Fisheries will install metal or concrete ramps to four raised submerged orifices in the East Fish Ladder to improve lamprey passage conditions. All modifications will be coordinated with the region via FPOM and FFDRWG.

2.2 Adult Salmon Studies. No adult salmon passage studies are planned for the 2012 adult passage season. Any new radio-telemetry antenna or receiver installations or maintenance will be completed during the 2011-2012 IWW.

2.3 BiOp Performance Standard Testing. In 2012, the Pacific Northwest National Laboratory (PNNL) will complete BiOp Juvenile Salmon Performance Standard testing. This test will utilize acoustic telemetry to estimate dam passage survival for subyearling Chinook salmon and juvenile steelhead. Hydrophones will be deployed on the upstream face of the dam to monitor all major routes of passage that are available to juvenile salmon. In addition, hydrophones will be deployed in the forebays of the spillway and powerhouse. Autonomous receivers will be deployed in both the forebay and tailrace approximately two kilometers from The Dalles Dam.

2.4 Steelhead Kelt Downstream Passage Study. Adult steelhead implanted with acoustic transmitters by ODFW in the Deschutes River and other tributaries to the Columbia River upstream of The Dalles Dam will be monitored as they pass downstream through The Dalles Dam. This study will use the autonomous and dam mounted receivers and hydrophones deployed for the BiOp Performance Test described in section 2.3 above.

2.5 Summary. 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 failure. Some evaluations may not proceed. All special operation requests or schedule changes will be coordinated with the fisheries agencies and tribes through the appropriate regional forums (e.g., FPOM, FFDRWG, SRWG, TMT) and with RCC and BPA.

Appendix A – Special Project Operations & Studies
John Day Dam

The purpose of this Appendix is to notify regional interests of special project operations and studies that are planned to occur during the current year that will or may affect fish passage. Further coordination may occur as needed.

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 the Fish Operations Plan (FOP), pursuant to the U.S. District of Oregon Court Order for Fish Operations, and as coordinated through the TMT. The FOPs and Court Order are included in the Fish Passage Plan as Appendix E. Alternative spill patterns to control total dissolved gas levels or change fish passage conditions will be coordinated through the FPOM. Planning dates for spill at projects on the Lower Columbia River are from April 10 through August 31 for spring and summer migrants.

2. Studies.

2.1 Adult Lamprey Studies. Modifications to the John Day Dam North Fish Ladder will begin during the 2011-2012 in-water work window (IWW). In 2012, studies will begin assessing the impact of these changes on adult lamprey passage behavior. New antenna or receiver installations associated with the North Fish Ladder entrance improvements will be completed during the coordinated 2011-2012 IWW. Half-duplex PIT antennas and receivers will be operational to monitor adult lamprey passage no later than mid-May. Access to PIT antennas and receivers for downloading and maintenance will be needed from March until August.

The post-construction evaluation of lamprey passage behavior will also include the use of a dual-frequency identification sonar (DIDSON) camera at key locations in the entrance area of the North Fish Ladder—in and above the new bollard field, at the proposed entrance to the Lamprey Passage System (LPS), and near the new variable-width weir entrance. Four new I-beams will be installed during the 2011-2012 IWW to facilitate deployment of the DIDSON camera. Installation locations will be coordinated with the region via FPOM and FFDRWG. As with other lamprey study objectives, operation of the DIDSON will occur throughout the adult lamprey passage season (early June through October).

JSATS-tagged adult lamprey will be released in the Bonneville Dam forebay and mobile-tracked by boat through reservoir reaches, tributary mouths, and tailraces of upstream dams. This work may require a permit for access to the tailrace boat-restricted zone (BRZ) of John Day Dam.

DIDSON and/or underwater video cameras and red or infrared LED lighting will be operated behind picket leads at both count stations to estimate the number of adult Pacific lamprey that bypass fish count stations through picketed leads. Cameras will be operated 24 hours per day from April 1 – October 31. In 2012, researchers will explore the use of alternative sites that can be used to provide visual counts for adult lamprey. Such locations may include submerged orifices, vertical slot weirs, or locations associated with the count stations. Specific locations for deploying DIDSON or conventional video cameras will be coordinated with the region via FPOM to avoid passage impacts, and installation of camera/DIDSON mounts will occur during the IWW. Any lighting changes that might impact passage will also be coordinated with the region via FPOM.

2.2 Adult Salmon Studies. No adult salmon passage studies are planned for the 2012 adult passage season. Any new radio-telemetry antenna or receiver installations or maintenance will be completed during the 2011-2012 IWW.

2.3 BiOp Performance Standard Compliance Test. In 2012, Pacific Northwest National Laboratory (PNNL) will conduct the second year of a two year study to assess compliance with the BiOp Juvenile Salmon Performance Standard. This test will utilize acoustic telemetry to estimate dam passage survival for yearling and subyearling Chinook salmon and juvenile steelhead. Hydrophones will be deployed on the upstream face of the dam to monitor all major routes of passage that are available to juvenile salmon. In addition, hydrophones will be deployed in the forebays of the spillway and powerhouse. Autonomous receivers will be deployed in both the forebay and tailrace approximately two kilometers from John Day Dam.

2.4 Out-of-Criteria Operations Related to Research. Emergency outages may be requested for replacement or repair of damaged equipment during the studies. These will be coordinated through the Anadromous Fish Evaluation Program (AFEP) and RCC. Approximately every two weeks from May through July, battery changes will be necessary for hydrophones located in the John Day Dam forebay.

2.5 Summary. 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 prior to April 1 through the AFEP (FFDRWG, FPOM, and/or SRWG). All special operation requests or schedule changes will be coordinated with the fisheries agencies and tribes through the appropriate regional forums (e.g., FPOM, FFDRWG, SRWG, TMT) and with RCC and BPA.

Appendix A – Special Project Operations & Studies
McNary Dam

The purpose of this Appendix is to notify regional interests of special operations and studies that are planned to occur at the project during the current year that will or may affect fish passage. Further coordination may occur as needed.

1. Special Project Operations.

RCC will coordinate needed changes with the project and authorize operational changes with issuance of a teletype describing the regulations.

1.1 Spill. Spill for fish passage will be provided during the spring and summer outmigration seasons in accordance with spill specifications in the Fish Operations Plan (FOP), pursuant to the U.S. District of Oregon Court Order for Fish Operations, and as coordinated through the TMT. The FOPs and Court Order are included in the Fish Passage Plan as Appendix E. Alternative spill patterns to control total dissolved gas levels or change fish passage conditions will be coordinated through the FPOM. Planning dates for spill at projects on the Lower Columbia River are from April 10 through August 31 for spring and summer migrants. During periods of high river flow, spill rates and forebay elevation at McNary Dam may need to be adjusted on a daily or every-other-day basis to provide safe conditions for loading the fish barge at the juvenile fish facility downstream of the dam.

1.2 Doble Tests. From June 18 - July 20, 2012, Doble testing of transformer banks, T1, T3, T6, and T7 will require their respective turbine units to be out of service (OOS) and unavailable for up to 4 days during testing. There may be some overlap between the two 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 FPP requirements.

1.3 TSW Installation. A temporary spillway weir (TSW) will be installed in spillbay 20 for the spring fish passage season and will be removed from service on June 8 or the next available workday for the summer fish passage season. Another TSW will be placed in spillbay 19 for the spring fish passage season and also be removed for the summer fish passage season on or around June 8.

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 4-6 hours to complete, and occur approximately every 2 months. Headgate movements are to take place concurrently with other outages as they occur, and the project does not expect any special operations outside FPP criteria.

1.5 Waterfowl Nesting. From the end of April to the beginning of July, the McNary pool may be restricted to operate between elevations of 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 1982.

1.6 Steady State Model Validation Testing. The Western Electricity Coordinating Council requires steady state model validation testing on a periodic basis to ensure the generating equipment will meet real and reactive power ratings. All units will be tested on a 1-2 year cycle. The test will involve running the unit out of fish priority sequence and outside the 1% criteria. Testing can take place at any time except from April 1 to August 31 due to fish considerations. Tests will preferably be conducted just after unit annual maintenance, but may happen at other times. Tests will last for a standard of 30 minutes at maximum load with additional time to run the unit along the maximum real/reactive power curve to the minimum settings. Total test time is anticipated to be 90 minutes or less. Operators will minimize test durations to the extent possible, and will only run tests for the purpose of completing the required model validation testing.

1.7 Transient Model Validation (Exciter Step Response). The Western Electricity Coordinating Council requires model validation testing on a five year minimum cycle to ensure the generating equipment responds to as planned to system requirements and disturbances. Operators will conduct tests on 6 units. Testing will involve running the test unit out of fish priority sequence and outside the 1% criteria. Testing will take place at some time from October 1 to April 1 or at night in July or August; each unit will be run for approximately 1 hour with 30 minutes outside the 1% criteria. Operators will minimize test durations to the extent possible.

1.8 Unit 3 and 8 Rewind. Units 3 and 8 will be taken out of service June 18, 2012 through February 1, 2013 for winding and various other electrical and mechanical component replacements from the old excitation system down to the wicked gate servomotors.

1.9 Relay install. Installations to T6 and T3 will occur throughout the year and scheduled coinciding with unit annuals or rewinds.

2. Studies

2.1 Adult steelhead fallback study. The Corps will continue a hydroacoustics evaluation in several units of the powerhouse during the time period when fish screens are not in place. The study duration is January 1 through April 16 when fish screens are expected to be reinstalled. Affected units will be 2, 3, 4, 5, 6, 8, 9, 11, 12, 13, and 14. Installation of equipment will involve diving in front of the trashracks to install transducers, and then removal after study is complete. Transducers will be aimed from the bottom trashrack at the intake ceiling. Primary objective for this study is to provide an updated passage estimate for adult steelhead falling back downstream. Secondary interests are in their vertical and horizontal passage location.

2.2 BiOp Performance Standard Compliance Test. In 2012, Battelle will conduct the first year of a two year study to assess compliance with the BiOp Juvenile Salmon Performance Standard. This test will utilize acoustic telemetry to estimate dam passage survival for yearling and subyearling Chinook salmon and juvenile steelhead. Hydrophones will be deployed on the upstream face of the dam to monitor all major routes of passage available to juvenile salmon. In addition, hydrophones will be deployed in the forebays of the spillway and powerhouse and autonomous receivers will be deployed in both the Forebay and tailrace each approximately two kilometers from the dam. Performance of the new juvenile fish bypass outfall relocation project will be evaluated under this study.

2.3 Evaluation of Adult Pacific Lamprey Passage Success at McNary. This study will evaluate passage success for adult Pacific lamprey at McNary Dam, Ice Harbor Dam, and the remaining lower Snake River dams and associated river segments using half duplex passive integrated transponder (HD PIT) systems. This study will require McNary, Ice Harbor and Lower Snake River dams to provide power for electronics, and access for the downloading of data from the PIT tag detection equipment. Maintenance of equipment will occur during the winter maintenance period when adult fishways are dewatered.

2.4 Underwater Video Monitoring of Adult Fish Ladder Modifications to Improve Pacific Lamprey Passage at McNary Dam. The purpose of this study is to use underwater video, acoustic imaging, and/or other non-invasive technologies to count and observe adult salmonids and Pacific lampreys, in the fish ladders at McNary Dam. The primary goal of this work is to estimate the numbers of adult lamprey passing behind the picketed lead gates at count stations and to develop escapement estimates of the total number of lamprey passing McNary Dam. A second goal is to evaluate the behavior of adult lamprey at Oregon Shore fishway entrances using underwater video equipment. This study will require McNary to provide power for electronics equipment in the fishways, access for the installation, repair, and testing of electronic equipment and access for the downloading of data from video camera equipment. Some project support will be needed to install blocks on the bottom leaf of telescoping weir to provide an 18” deep attraction gap at the end sill of either SFE1 or SFE2. Some project crane support may be needed to raise and lower camera structures in both entrance bulkhead slots. Maintenance and installation of camera equipment and alteration of the telescoping weir gate will occur during the winter maintenance period when adult fishways are dewatered.

2.5 Identify potential for adverse impact of aquatic invertebrates growing within the juvenile collection and bypass systems at McNary, 2012. Purpose for this work will be to taxonomically identify the sponge species and the potential for release of irritable or toxic components. Secondary objective is summarization of possible control measures that could be implemented. Freshwater sponge and bryozoan species grow on structures at McNary dam where minimal velocities occur. This nuisance has been steadily becoming more prevalent each year. These animals are thought to have spicules that may be hazardous to fish gills. Many pounds of these animals are removed from raceways during the transportation period creating additional maintenance concerns. They grow on picketed leads, screens, intake walls and interfere with flow, and potentially shed irritants/toxicants into the surrounding water.

2.6 Oregon shore ladder intake screen monitoring. The purpose of this monitoring study is to ensure that the current Oregon shore adult ladder fish screens are not impinging listed or threatened juvenile fish. These screens don’t meet NMFS current screening criteria since they were designed and installed in the early 1950s. The area in front of this intake screen will be monitored using video cameras to discern the extent to which fish populations are impacted by operation of these travelling screens. Monitoring will be conducted throughout the juvenile fish passage season, April 10 thru August 31. Equipment must be able to record fish movement underwater, under very low light conditions. The video cameras will be attached by divers on both sides of the screens and aimed at different angles in order to record as much of the screens as possible.

2.7 Determining the feasibility of detecting JSAT Transmitters in the Tailrace Environment at McNary Dam. The purpose of this study is to use to see if JSAT acoustic transmitter signal can be received in a noisy tailrace environment. JSAT hydrophone will be mounted above some turbine draft tubes, abo*ve fishway entrances, adj*acent to spillbays and in the tailrace environment. Researchers will then release JSATs transmitters into various tailrace locations to determining the feasibility of detecting these transmitters. This study will require McNary to provide power for electronics equipment in the fishways, access for the installation, repair, and testing of electronic equipment and access for the downloading of data from telemetry receivers. BRZ Boat access may be needed and will be coordinated with the project.

2.8 Steelhead straying study. The purpose of this study is to assess imprinting associated physiological characteristics between juvenile in-river migrants and barged fish. NMFS will need to access a fish barge twice (once in early May and once the 3rd week of May) at the lock at McNary Dam to sample fish from a net pen on the barge. Fish will also be collected via SbC at the juvenile fish facility at McNary Dam on the same days as barged fish are sampled. Identifying physiological differences between in-river and barged fish will allow for a mechanistic understanding of the higher stray rates observed in barged fish.

2.9 BiOp Kelt Passage and Survival Monitoring. In 2012, a contractor will conduct the first year of a two year study to assess dam route passage efficiency and survival for downriver migrating steelhead kelt utilizing the existing acoustic telemetry receiver system installed by Battelle for the BiOp Juvenile Salmon Performance Standard. Access for contractor downloading acoustic data from the arrays of receivers is the only requirement for this study.

Appendix A – Special Project Operations & Studies
Ice Harbor Dam

The purpose of this Appendix is to notify regional interests of special project operations and studies that are planned to occur during the current year that will or may affect fish passage. Further coordination may occur as needed.

1. Special Project Operations.

RCC will coordinate needed changes with the project and authorize operations changes with issuance of a teletype describing the regulations.

1.1 Spill. Spill for fish passage will be provided during the spring and summer outmigration seasons in accordance with spill specifications in the Fish Operations Plan (FOP), pursuant to the U.S. District of Oregon Court Order for Fish Operations, and as coordinated through the TMT. The FOPs and Court Order are included in the Fish Passage Plan as Appendix E. Alternative spill patterns to control total dissolved gas levels or change fish passage conditions will be coordinated through the FPOM. Planning dates for spill at projects on the Lower Snake River are from April 3 through August 31 for spring and summer migrants.

1.2 Doble Tests. Two transformers, TW5 and TW6 and turbine units 5 and6 will be taken out of service for Doble testing in 2012**.** The outage is tentatively scheduled for 24-31 August 2012. 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. Scheduled navigation lock outage for 2012 is March 7 – March 26.

1.4 Steady State Model Validation Testing. Western Electricity Coordinating Council requires steady state model validation testing on a periodic basis to ensure the generating equipment will meet real and reactive power ratings. All units will be tested on a 1-2 year cycle. Test will involve running the unit out of fish priority sequence and outside the 1% criteria. Testing can take place at any time except from 1 April to 31 August due to fish considerations. Tests will preferably be conducted just after unit annual maintenance, but may happen at other times. Tests will last for a standard of 30 minutes at maximum load with additional time to run the unit along the maximum real/reactive power curve to the minimum settings. Total test time is anticipated to be 90 minutes or less. Test durations will be minimized to the extent possible and will only be run for the purpose of completing the required model validation testing.

1.5 Governor Training. During the scheduled annual maintenance of main turbine unit 4 which begins September 10, 2012 and ends September 28, 2012; governor training for Project Mechanics will be performed. This training will take place during the first part of the scheduled unit outage. It is expected that the governor as-found condition check-out will take approximately 6 hours to complete. The governor will be run through a series of situations and settings. This evolution may utilize water that would normally be used for spill. The training element will include governor troubleshooting, teardown during the maintenance period, and inspection and repair during re-assembly.

1.6 Transformer TW-6 Replacement. The replacement of Transformer TW-6 is anticipated during 2012. The work windows start and end work dates are tentatively established as 30 June 2012 and 30 October 2012, respectively. Testing of this Unit may utilize water that would normally be used for spill.

1.7 DC System and Low Voltage Switchgear replacement. This project will start in May 2012 through May 2013 and will require turbine unit outages for the replacement of the associated panels. The project may start before May 2012 but only field work will be done that does not impact unit priority. There are times during this evolution when switching electrical unit control busses must occur in which the unit will be brought down to accommodate switching. This switching will affect unit priority to assist with lineup of power on the units to minimize downtime on evolutions for this project. At times all turbine units or priority units will be out of service during panel replacements and temporary power installations and these outages will be limited in duration. After the panel, breaker and switchgear replacements, the turbine units will need to be ran and tested out of unit priority to support commissioning of the modifications. These evolutions may utilize water that would normally be used for spill.

1.8 Main Unit #5 XJ Breaker Repair and Unit Annual. The project will be working to repair the 115KV Output Breaker for Main unit #5. Once the 115KV output breaker is repaired the unit will be ran to verify the repair is complete. As part of this the Main unit #5 Annual has been started and will be completed once the repair of the XW5 breaker is completed. Testing of this Unit may utilize water that would normally be used for spill.

1.9 Main Unit #5 Reactive Limit Testing. Reactive limit testing is required for generator owners to be performed every two years. The test quantitatively measures machine performance limits to ensure it is capable of providing protective functions during grid disturbances and to ensure it is not a contributor to these disturbances. The test requires exit from the best 1% efficiency range to ensure the reactive limits of the generator can be met and held for a period of time, typically 15 minutes. This test will be done in FY12 after the XW5 Breaker is repaired. Testing of this Unit may utilize water that would normally be used for spill.

1.10 XW-5 Breaker Removal. In order to repair the current failed 115KV output breaker for main Unit #5 it has to be removed from the transformer canyon and a new one must be put into its place. In order to accomplish this task the Ice Harbor 115KV Line #3 will have to be out of service to raise and lower the new breakers from the intake deck to the transformer canyon. This evolution will be performed during the month of April 2012 and Line #3 will only be out of service during the use of the crane to move these breakers into place.

1.11 Ice Harbor 115KV Line #2 Relay Calibrations. The week of 3/26/2012 through 3/29/2012 Bonneville Power Administration will be onsite calibrating the relays for the 115KV Ice Harbor Line #2. During this week Units 3 and 4 will be out of service as well as Station Service XWO Breaker to accommodate this relay testing.

2. Studies

2.1 Evaluation of Fish Counting Accuracy Issues at FCRPS Dams, at Ice Harbor and Lower Monumental Dams. Determine if counting slot lighting modifications, video camera location and upgrades, and video monitor placement can improve fish counting accuracy at Ice Harbor and Lower Monumental dams. During daytime, the IHR north counting slot is exposed to direct sunlight, particularly in June and July, when the sun is highest and when the majority of count discrepancies are seen, and this creates difficult viewing conditions for fish counters. By conducting random visual sampling counts of the video recorded count stations (and sample video recordings periods) and comparing to the visual counter at the other count station, we can determine if there are count accuracy and/or identification issues. Fish counts at IHR are often lower than those at upstream dams, possibly suggesting some issue with fish counting accuracy at IHR. This is particularly frequent in June and July, when the sun is highest and glare may be at its worst at these count windows. At IHR and at LMN, all fish counting is done by video in the IHR north and the LMN south fish ladder counting slots. Evaluate effects of modified Ice Harbor and Lower Monumental counting slot lighting and video monitoring equipment on counting accuracy.

2.2 Evaluation of Adult Pacific Lamprey Passage Success at Ice Harbor Dam. This study will evaluate passage success for adult Pacific lamprey *Entosphenus tridentatus* at McNary Dam, Ice Harbor Dam, and the remaining lower Snake River dams and associated river segments using half duplex passive integrated transponder (HD PIT) systems. This study will require McNary, Ice Harbor and Lower Snake River dams to provide power for electronics, and access for the downloading of data from the PIT tag detection equipment. Maintenance of equipment will occur during the winter maintenance period when adult fishways are dewatered.

2.3 Underwater Video Monitoring of Adult Fish Ladder Modifications to Improve Pacific Lamprey Passage at Ice Harbor Dam. The purpose of this study is to use underwater video, acoustic imaging, and/or other non-invasive technologies to count and observe adult salmonids and Pacific lampreys, *Entosphenus tridentatus*, in the fish ladders at Ice Harbor Dam. The primary goal of this work is to estimate the numbers of adult lamprey passing behind the picketed lead gates at count stations and to develop escapement estimates of the total number of lamprey passing Ice Harbor Dam. A second goal is to evaluate the behavior of adult salmonids and lamprey at newly installed lamprey orifices in the control section of the adult fish ladders (both ladders) using underwater video equipment. This study will require Ice Harbor to provide power for electronics equipment in the fishways, access for the installation, repair, and testing of electronic equipment and access for the downloading of data from video camera equipment. Maintenance and installation of camera equipment and will occur during the winter maintenance period when adult fishways are dewatered.

Appendix A – Special Project Operations & Studies
Lower Monumental Dam

The purpose of this Appendix is to notify regional interests of special project operations and studies that are planned to occur during the current year that will or may affect fish passage. Further coordination may occur as needed.

1. Special Project Operations.

RCC will coordinate needed changes with the project and authorize operations changes with issuance of a teletype describing the regulations.

1.1 Spill. Spill for fish passage will be provided during the spring and summer outmigration seasons in accordance with spill specifications in the Fish Operations Plan (FOP), pursuant to the U.S. District of Oregon Court Order for Fish Operations, and as coordinated through the TMT. The FOPs and Court Order are included in the Fish Passage Plan as Appendix E. Alternative spill patterns to control total dissolved gas levels or change fish passage conditions will be coordinated through the FPOM. Planning dates for spill at projects on the Lower Snake River are from April 3 through August 31 for spring and summer migrants. During periods of high river flow, spill rates and forebay elevation at Lower Monumental Dam may need to be adjusted on a daily or every-other-day basis to provide safe conditions for loading the fish barge at the juvenile fish facility downstream of the dam.

1.2 Steady State Model Validation Testing. Western Electricity Coordinating Council requires steady state model validation testing on a periodic basis to ensure the generating equipment will meet real and reactive power ratings. All units will be tested on a 1-2 year cycle. Test will involve running the unit out of fish priority sequence and outside the 1% criteria. Testing can take place at any time except from 1 April to 31 August due to fish considerations. Tests will preferably be conducted just after unit annual maintenance, but may happen at other times. Tests will last for a standard of 30 minutes at maximum load with additional time to run the unit along the maximum real/reactive power curve to the minimum settings. Total test time is anticipated to be 90 minutes or less. Test durations will be minimized to the extent possible and will only be run for the purpose of completing the required model validation testing.

1.3 T2 Doble Tests. Transformer bank T2 and turbine units 5 and 6 will be taken out of service for doble testing in 2012. The outage is tentatively scheduled for July 30 to Aug 3, 2012. This work will require a total powerhouse outage, and 100% spill (except for station service) for up to 4 hours. By then, all clearance tags should be hung, and the line could be re-energized allowing generation availability of Units 1-4. Turbine unit 1% efficiency operations and turbine priorities will continue to follow fish passage plan requirements during these tests. Another total plant outage will be required on the last day of testing to remove clearance tags and restore T2 bank.

1.4 Intake Deck Crane. The new intake crane at Lower Monumental is slated for installation starting April 2012. Load testing of raising and lowering at rated speed will require the use of a STS, intake gate, and spillway stop log. This is scheduled happen in May-June

2012. A unit will need to be taken out of service for this effort. This is contract work and subject to normal contractual delays.

1.5 Lower Snake Exciter Replacement: Lower Snake exciter replacement will take place at Lower Monumental. Unit 6 is scheduled for Dec 8 to Feb 16, 2011. Unit 4 is scheduled for Feb 2 to March 24, 2012. Unit 5 is scheduled for February 21 to April 9, 2012. This work will also require performance testing and model validation testing. Thus running units out of Priority and outside 1%. See model validation testing paragraph number 1.2. Unit 6 Model validation is scheduled for 6-16 February. Unit 4 model validation testing is scheduled for 3-24 March. Unit 5 model validation testing is scheduled for 29 March to 9 April, 2012. This contract work is subject to normal contracting and construction delays

1.6 Lower Monumental JBS Outfall: LMN JBS outfall relocation contract work window is Nov 15, 2011 to March 15, 2012. This work requires the JBS outfall pipe out of service. The contract should be complete on 3/15/12. This work was coordinated through FPOM in 2011. This contract work is subject to normal contracting and construction delays or issues.

1.7 Lower Snake Emergency Diesel Generator and Switchgear Replacement; Lower Monumental Dam will be replacing their EDG and SQ2 switchgear under this contract work. The SQ2 work will require Main Units 5&6 to be out of service from 4-19 January. This work will also require performance testing of Main Units 5 &6. It is anticipated that the performance testing will take place in January. The EDG portion of the work will require intermittent station service outages from January to March. This work may require that units be run outside of unit priority to properly configure power to the station service busses. This contract work is subject to normal contracting and construction delays and issues.

2. Studies

2.1 BiOp Performance Standard Compliance Test. In 2012, Battelle will conduct the first year of a two year study to assess compliance with the BiOp Juvenile Salmon Performance Standard. This test will utilize acoustic telemetry to estimate dam passage survival for yearling and subyearling Chinook salmon and juvenile steelhead. Hydrophones will be deployed on the upstream face of the dam to monitor all major routes of passage available to juvenile salmon. In addition, hydrophones will be deployed in the forebays of the spillway and powerhouse and autonomous receivers will be deployed in both the Forebay and tailrace each approximately two kilometers from the dam. At Lower Monumental Dam forebay coverage will include two additional clusters stationed upstream of the RSW to monitor RSW passage. These clusters will be positioned far enough upstream as not to interfere with RSW operation.

2.2 Evaluation of Fish Counting Accuracy Issues at FCRPS Dams, at Ice Harbor and Lower Monumental Dams. Determine if counting slot lighting modifications, video camera location and upgrades, and video monitor placement can improve fish counting accuracy at Ice Harbor and Lower Monumental dams. During daytime, the IHR north counting slot is exposed to direct sunlight, particularly in June and July, when the sun is highest and when the majority of count discrepancies are seen, and this creates difficult viewing conditions for fish counters. By conducting random visual sampling counts of the video recorded count stations (and sample video recordings periods) and comparing to the visual counter at the other count station, we can determine if there are count accuracy and/or identification issues. Fish counts at IHR are often lower than those at upstream dams, possibly suggesting some issue with fish counting accuracy at IHR. This is particularly frequent in June and July, when the sun is highest and glare may be at its worst at these count windows. At IHR and at LMN, all fish counting is done by video in the IHR north and the LMN south fish ladder counting slots. Evaluate effects of modified Ice Harbor and Lower Monumental counting slot lighting and video monitoring equipment on counting accuracy.

2.3 Evaluation of Adult Pacific Lamprey Passage Success at Lower Monumental Dam. This study will evaluate passage success for adult Pacific lamprey, *Entosphenus tridentatus,* at McNary Dam, Ice Harbor Dam, and the remaining lower Snake River dams and associated river segments using half duplex passive integrated transponder (HD PIT) systems. This study will require McNary, Ice Harbor and Lower Snake River dams to provide power for electronics, and access for the downloading of data from the PIT tag detection equipment. Maintenance of equipment will occur during the winter maintenance period when adult fishways are dewatered.

2.4 BiOp Kelt Passage and Survival Monitoring. In 2012, a contractor will conduct the first year of a two year study to assess dam route passage efficiency and survival for downriver migrating steelhead kelt utilizing the existing acoustic telemetry receiver system installed by Battelle for the BiOp Juvenile Salmon Performance Standard. Access for contractor downloading acoustic data from the arrays of receivers is the only requirement for this study.

Appendix A – Special Project Operations & Studies
Little Goose Dam

The purpose of this Appendix is to notify regional interests of special project operations and studies that are planned to occur during the current year that will or may affect fish passage. Further coordination may occur as needed.

1. Special Project Operations.

RCC will coordinate needed changes with the project and authorize operations changes with issuance of a teletype describing the regulations.

1.1 Spill. Spill for fish passage will be provided during the spring and summer outmigration seasons in accordance with spill specifications in the Fish Operations Plan (FOP), pursuant to the U.S. District of Oregon Court Order for Fish Operations, and as coordinated through the TMT. The FOPs and Court Order are included in the Fish Passage Plan as Appendix E. Alternative spill patterns to control total dissolved gas levels or change fish passage conditions will be coordinated through the FPOM. Planning dates for spill at projects on the Lower Snake River are from April 3 through August 31 for spring and summer migrants.

1.2 Navigation. Scheduled navigation lock outage for 2012 is March 6 – March 28.

1.3 Periodic Inspection. The Little Goose Navigation Lock is scheduled to be inspected during the Lock Outage in February 2012. This is part of the 5 year formal Periodic Inspection process.

1.4 Steady State Model Validation Testing. Western Electricity Coordinating Council requires steady state model validation testing on a periodic basis to ensure the generating equipment will meet real and reactive power ratings. All units will be tested on a 1-2 year cycle. Test will involve running the unit out of fish priority sequence and outside the 1% criteria. Testing can take place at any time except from 1 April to 31 August due to fish considerations. Tests will preferably be conducted just after unit annual maintenance, but may happen at other times. Tests will last for a standard of 30 minutes at maximum load with additional time to run the unit along the maximum real/reactive power curve to the minimum settings. Total test time is anticipated to be 90 minutes or less. Test durations will be minimized to the extent possible and will only be run for the purpose of completing the required model validation testing.

1.5 Transient Model Validation (Exciter Step Response) Little Goose. Western Electricity Coordinating Council requires model validation testing on a five year minimum cycle to ensure the generating equipment responds to as planned to system requirements and disturbances. Unit tests will be accomplished on all 6 units during exciter commissioning. Testing will involve running the test unit out of fish priority sequence and outside the 1% criteria. Testing will take place sometime during July 23, 2012 to March 31, 2013. Each unit will be run for approximately 1 hour with 30 minutes outside the 1% criteria. Test durations will be minimized to the extent possible.

1.6 Capacitive Voltage Transformer (CVT) Replacement. A set of capacitive voltage transformers (CVT's) at Little Goose Substation contain PCB's and need to be replaced. This replacement will require an outage of the Little Goose Powerhouse line. The outage duration will be approximately 2 weeks. The exact date for this outage has not been finalized yet; however, there is a strong possibility that it will occur sometime in Calendar Year 2012. Final coordination of this operation will occur at FPOM.

1.7 Lower Snake exciter replacement. Exciter replacement will take place at Little Goose. Units 6-1 are scheduled for July 12 to Feb 13. This work will also require performance testing and model validation testing. Thus running units out of Priority and outside 1%. See model validation testing paragraph number 1.5 and 1.6. This contract work is subject to normal contracting and construction delays or issues.

1.8 Doble Testing. Two transformers, T-2 and turbine units 5 and 6 will be taken out of service for Doble testing in **2012.** The outage is tentatively scheduled for August 6-16 2012. Since Little Goose Dam has multiple transformer banks, 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.

2. Studies.

2.1 BiOp Performance Standard Compliance Test. In 2012, Battelle will conduct the first year of a two year study to assess compliance with the BiOp Juvenile Salmon Performance Standard. This test will utilize acoustic telemetry to estimate dam passage survival for yearling and subyearling Chinook salmon and juvenile steelhead. Hydrophones will be deployed on the upstream face of the dam to monitor all major routes of passage available to juvenile salmon. In addition, hydrophones will be deployed in the forebays of the spillway and powerhouse and autonomous receivers will be deployed in both the Forebay and tailrace each approximately two kilometers from the dam.

2.2 Evaluation of Adult Pacific Lamprey Passage Success at Little Goose Dam. This study will evaluate passage success for adult Pacific lamprey *Entosphenus tridentatus* at McNary Dam, Ice Harbor Dam, and the remaining lower Snake River dams and associated river segments using half duplex passive integrated transponder (HD PIT) systems. This study will require McNary, Ice Harbor and Lower Snake River dams to provide power for electronics, and access for the downloading of data from the PIT tag detection equipment. Maintenance of equipment will occur during the winter maintenance period when adult fishways are dewatered. Work is continuing in 2012.

2.3 BiOp Kelt Passage and Survival Monitoring. In 2012, a contractor will conduct the first year of a two year study to assess dam route passage efficiency and survival for downriver migrating steelhead kelt utilizing the existing acoustic telemetry receiver system installed by Battelle for the BiOp Juvenile Salmon Performance Standard. Access for contractor downloading acoustic data from the arrays of receivers is the only requirement for this study.

Appendix A – Special Project Operations & Studies
Lower Granite Dam

The purpose of this Appendix is to notify regional interests of special project operations and studies that are planned to occur during the current year that will or may affect fish passage. Further coordination may occur as needed.

1. Special Project Operations.

RCC will coordinate needed changes with the project and authorize operations changes with issuance of a teletype describing the regulations.

1.1 Spill. Spill for fish passage will be provided during the spring and summer outmigration seasons in accordance with spill specifications in the Fish Operations Plan (FOP), pursuant to the U.S. District of Oregon Court Order for Fish Operations, and as coordinated through the TMT. The FOPs and Court Order are included in the Fish Passage Plan as Appendix E. Alternative spill patterns to control total dissolved gas levels or change fish passage conditions will be coordinated through the FPOM. Planning dates for spill at projects on the Lower Snake River are from April 3 through August 31 for spring and summer migrants. During periods of high river flow, spill rates and forebay elevation at Lower Granite Dam may need to be adjusted on a daily or every-other-day basis to provide safe conditions for loading the fish barge at the juvenile fish facility downstream of the dam.

1.2 Navigation. Scheduled navigation lock outage for 2012 is in March.

1.3 Doble Test. Lower Granite transformer bank T2 will be Doble tested this year. A full line outage will be taken daily. Unit 5 will be run at speed-no-load daily to supply station service power. At night, T1 (Units 1-4) will be returned to service. T2 (Units 5 and 6) will remain out of service for the duration of the Doble test. The Doble test is scheduled for 5 days starting at 0600 August 13, 2012. T2 is scheduled to return to service on August 17, 2012.

1.4 Intake Gantry Crane. Lower Granite intake gantry crane will be replaced in 2012. The completion of installation is scheduled for JULY 2012. Upon completion, a functional test will be required before acceptance. The functional test consists of installing a main unit headgate with the cylinder attached, installing, deploying and uninstalling an ESBS, and installing a spillway stop log. This will require one Unit and one spillbay to be out of service for a day each during the period July-August 2012. The choice of spillbay and Unit will be approved by NWW OD-T personnel to minimize fish passage impacts.

1.5 Unit Cavitation Repairs. Lower Granite has a contract in place to continue cavitation repairs on Units 4, 5, and 6. Each unit will be out one at a time for blade and liner cavitation repairs. The work will commence approximately March 1, 2012 and is scheduled for completion, March 15, 2013.

1.6 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, but it may cause an occasional outage on a priority unit.

1.7 Fish Screen Repair. This is a long-term program to return the fish screens to a safe operating condition by tearing down, repainting and rebuilding the screens. The plan will require short unit outages throughout the year while transporting rebuilt screens 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. Fish screen movements are to normally take place concurrently with other outages as they occur, and no special operations outside the Fish Passage Plan are expected, but it may cause an occasional outage on a priority unit.

1.8 Auxiliary Water Pump #2. Auxiliary Water Pump #2's gearbox has an oil leak on the bottom of the gearbox that requires a crane to lift the gearbox. The pump is functional at this time, but is considered the standby pump. The pump will remain functional until the shaft seal is replaced. Lower Granite maintenance staff will replace the shaft seal, April 9 through April 20. During this time, AWS pump #2 will not be available for service.

2. Studies.

2.1 Study to compare seasonal SARs of early in-river migrating versus transported Snake River yearling anadromous salmonids. 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 approximately April 4, with marking beginning on April 5, 2012. 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 4,000 - 6,000 wild steelhead weekly for approximately eight weeks.

2.2 Study to compare SARs of Snake River fall Chinook salmon under alternative transportation and dam operational strategies. A sample of Subyearling Chinook salmon will be collected at Lower Granite juvenile fish facility using the sort by code system. Fish will be measured and compared to fish captured at Bonneville Dam to determine growth for in-river migrants. Sort by code will also be used to collect holdover fall Chinook juveniles in the spring. Scales will be collected from a subsample of returning adults in the fall for age at ocean entry and overall age analysis.

2.3 Kelt Reconditioning / Transportation. Provide assistance to post spawn steelhead (kelt) collected at Lower Granite separator either by transportation, temporary rearing and feed, or other measures to determine the feasibility and success of these alternatives for rehabilitation to support increased steelhead population growth was completed in 2010 and 2011, and will be repeated at a reduced level of effort in 2012. Depending on flow year conditions, separator technicians will collect a similar number of A-run and B-run kelt for transfer to CRITFC researchers for either transport to reconditioning facilities at Dworshak Dam (about 400 kelt), JSAT and PIT-tagging (300 kelt) with direct release into the tailwaters, or PIT-tagging with direct release into the tailwaters (about 1200 to 1400 kelt). During the 2011 smolt passage season, CRITFC researchers initiating a kelt acoustic tag telemetry study from three Clearwater River streams through Lower Granite dam. In 2012, CRITFC will not be repeating their acoustic telemetry study or tagging transporting tagged kelt from Lower Granite. The acoustic passage study beginning at Lower Granite will be contracted by the Corps in 2012. The single barge supported hydrophone array utilized by CRITFC in 2011 is owned and operated by NOAA-Fisheries for a study on adult conversion from the estuary and will remain in 2012 to be operated by NOAA-Fisheries in both the entrance gate upriver of the forebay BRZ and the exit gate downriver of the tailrace BRZ.

2.4 Study to Evaluate Hydropower System-related Latent Mortality Associated with Passage of Yearling Chinook Salmon Smolts through Snake River Dams. This study will test the hypothesis of hydropower system-related latent mortality that was promoted as an explanation for the difference in life-cycle productivity between upstream and downstream populations of spring/summer Chinook salmon prior to and after dam construction. Three groups of hatchery-reared yearling Chinook salmon smolts will be PIT tagged at Lower Granite Dam on the Snake River. One group will be transferred by truck and released below Ice Harbor Dam; a second group will be transported an identical amount of time by truck before being released into the Lower Granite Dam tailrace; a third group will be released into the Lower Granite Dam tailrace without having been transported by truck.

2.5 Study to evaluate straying behavior in steelhead. In 2012, juvenile steelhead will be collected for physiological monitoring at several points during barging to assess imprinting-associated changes in the olfactory system and endocrine physiology. Specifically, fish will be collected at Lower Granite Dam prior to barging, every 12 hours during barging, and as fish are released at Bonneville Dam. At each sampling point, 20 fish will be euthanized and olfactory rosettes and bulbs will be collected for subsequent mRNA analysis of imprinting-associated genes. Blood plasma will be collected and frozen for later analysis of thyroid hormone levels, and gill filaments will be collected to assess Na+,K+ ATP-ase levels as an indicator of smoltification. Equivalent in-stream migrants will be collected at Lower Granite Dam and at the juvenile fish bypass and monitoring facility at Bonneville Dam.

2.6 Study to identify overwintering behavior of Fall Chinook salmon. Adult fall Chinook salmon collected at the Lower Granite adult trap in fall 2012 would be sampled for otoliths at Lyons Ferry Hatchery. Otolith microchemistry would be used to assess juvenile overwintering location of these returning adults. Comparisons between natural and surrogate overwintering behavior would be made to assess similarity (and thus appropriateness) of using hatchery origin fish (surrogates) to make management decisions with respect to natural origin fish.

2.7 Evaluation of Adult Pacific Lamprey Passage Success at Lower Granite Dam. This study will evaluate passage success for adult Pacific lamprey *Entosphenus tridentatus* at McNary Dam, Ice Harbor Dam, and the remaining lower Snake River dams and associated river segments using half duplex passive integrated transponder (HD PIT) systems. This study will require McNary, Ice Harbor and Lower Snake River dams to provide power for electronics, and access for the downloading of data from the PIT tag detection equipment. Maintenance of equipment will occur during the winter maintenance period when adult fishways are dewatered. Work is continuing in 2012.

2.8 Developing Half-Duplex PIT-tag Antennas at Fishway Entrances and Exits at Lower Granite Dam. New lamprey Half-Duplex PIT-tag antennas will be installed near fish way entrances and the exit during the winter maintenance period at Lower Granite Dam. This study will require Lower Granite to provide power for electronics equipment in the fishways, access for the installation, repair, and testing of electronic equipment and access for the downloading of data from video camera equipment. Some project support may be needed to install video cameras in and near fishways. Maintenance and installation of equipment will occur during the winter maintenance period when adult fishways are dewatered.

2.9 BiOp Kelt Passage and Survival Monitoring. In 2012, a contractor will conduct the first year of a two year study to assess dam route passage efficiency and survival for downriver migrating steelhead kelt utilizing the existing acoustic telemetry receiver system installed by Battelle for the BiOp Juvenile Salmon Performance Standard at Little Goose, Lower Monumental, and McNary dams. Two-thirds of sample kelt will be dominated by A-run steelhead collected off the LGR JFF separator as collaboration with the CRITFC study. The remaining one-third of the sample will be double-tagged PIT- and JSAT from 4-5 subbasin stream weirs in the Clearwater and South Fork Salmon rivers. Passage route distribution and survivals at Lower Granite require installation of acoustic receiver arrays in the Lower Granite forebay and tailrace beginning the last week of March. Minimal array systems will cover the RSW and Turbine units 1 and 2, as well as the forebay entrance and tailwater exit lines placed outside the BRZs. No unit outages are planned as necessary for receiver installation. The Contractor will likely request placement of a single computer trailer with cable routing and electrical hook-up for turbine units 1 and 2 if they choose to use the trolley pipes for receiver deployment. Access for contractor downloading acoustic data from the arrays of receivers between 24 March and 30 September is required for this study.

Appendix B Corps of Engineers' Juvenile Fish Transportation Plan[1]

1. INTRODUCTION

The Juvenile Fish Transportation Plan (JFTP) describes operations and establishes criteria for the collection and 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 for the collector dams presented in the Fish Passage Plan (FPP), Sections 5, 7, 8, and 9, available online at: http://www.nwd-wc.usace.army.mil/tmt/documents/fpp/2012/.

The JFTP is implemented by the Corps of Engineers' Walla Walla District (CENWW) under an Endangered Species Act (ESA) Section 10 (a)(1)(A) incidental take permit issued by the National Oceanic and Atmospheric Administration's National Marine Fisheries Service (NOAA Fisheries, formerly referred to as NMFS).

On-site biological assistance is provided by fishery agencies through a contract with the Pacific States Marine Fisheries Commission (PSMFSC) and sub-contracts with Washington Department of Fish & Wildlife (WDFW) and Oregon Department of Fish & Wildlife (ODFW). On-site biological assistance is provided by WDFW at Lower Granite, Lower Monumental, and McNary dams and by ODFW at Little Goose Dam.

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 the appropriate regional forums, such as the Fish Passage Operations and Maintenance (FPOM) Coordination Team and the Technical Management Team (TMT), and with 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;

[1] If any provisions herein conflict with the Corps' 2012 Fish Operations Plan (Appendix E), the latter shall prevail.

e. Establishing operating criteria for facilities, barges, and trucks including fish holding and transport densities, sampling rates, and facility operations and maintenance;

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

3.a. Starting Operations: Consistent with the Fish Operations Plan (FOP), which is included with the Fish Passage Plan as Appendix E, and guidance provided by TMT, 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 65 kcfs, transport operations will begin between April 21 and May 1 at Lower Granite as determined by TMT. In these years, transportation will begin at Little Goose and Lower Monumental dams in a staggered fashion, with the start dates being determined at TMT. Prior to the start of transportation at a given collector project all collected fish will be bypassed directly to the river unless needed for a regionally approved study. In years when the spring seasonal average river flows are expected to be below 65 kcfs, transport operations will start on April 3 at Lower Granite, 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 17. Transport operations at McNary Dam will not begin until conditions specified under paragraph 4.b. (2) in coordination and discussions with TMT are met.

3.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 in coordination and discussions with TMT. 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.

3.c. Ending Operations: Transport operations are anticipated to continue through approximately September 30 at Lower Monumental and McNary dams and through October 31 at Lower Granite and Little Goose dams. However, the presence of factors such as excess shad, algae, bryozoans that can clog screens and flumes may result in discontinuing transport operations at McNary before September 30.

3.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: if daily collection mortality exceeds 10,000 fish, and provide early notice if mortality rates are increasing at such a rate that these numbers are likely to be met. The Transportation Coordinator will evaluate the situation and shall notify NOAA Fisheries and may arrange a conference call, if needed, with TMT to discuss options to provide adequate fish protection measures. 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

4.a. Early Season, Non-Transport Operations: Prior to initiation of transport 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 and routed to the mid-river release outfall and full flow PIT tag detection system. Limited sampling may take place daily from April 1 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 and routed to the primary bypass outfall and full flow PIT tag detection system. Limited sampling may take place daily from April 1 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.

4.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) Lower Granite, Little Goose, and Lower Monumental**:** 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 and barging operations to begin are April 6 during low flow years (first barge departs April 8)and on April 21 in higher flow years (first barge departs April 22 or 23), continuing through approximately August 15 of each year.

(2) McNary**:** 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 will be adjusted if the projected seasonal average flows at McNary Dam are greater than 125 kcfs, juvenile fish will be bypassed to the river at McNary Dam from April 10 through July 14. The Corps will adaptively manage starting July 15 through July 30. (2008 Biological Opinion Table – RPA 30, Table 4). The term "adaptive" in this table refers to a transition between (Spill and Bypass) and (Spill and Transport). The decision for each option would be made based on RM&E and in-season data in coordination and discussions with TMT. Transportation operations may be adjusted for research purposes, due to conditions at the collection facilities, or as a result of the adaptive management process (to better match juvenile outmigration timing and/or to achieve or maintain performance standards). If new information indicates that modifying or eliminating transportation operations at McNary Dam is warranted, adaptive management will be used to make appropriate adjustments. In August (spill and transport) and September (transport and no voluntary spill), transportation operations will occur. Transportation of juvenile fish from McNary will be via barges through August 16. After August 16, trucks will be used for transporting juvenile fish from McNary on an every-other-day basis through September 30, 2009.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.

4.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 April 3 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.

4.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, if it appears that holding capacity may be exceeded on a given day, 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 operations. 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.

4.e. Sampling Procedures:

(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.

4.f. Loading Criteria:

(1) Raceways: 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:

i. species composition;

ii. total anticipated collection during the critical holding period;

iii. in-river fish passage conditions; and

iv. fish condition.

v. Project biologists will provide information to the CENWW Transportation Coordinator upon which to base these decisions.

(3) Distribution Among Raceways: 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) Holding Time: 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) Truck and Barge Capacities: 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 transport vehicle are shown in Table B-1.

Table B- 1. Juvenile Fish Transportation Program Transport Vehicle Capacity.

Transport Vehicle	Capacity (gal)	Inflow(gpm)	Fish Capacity (lbs)
Barge 2127 - “SOCKEYE”	85,000	4,600	23,000
Barge 2817 - “BLUEBACK”	85,000	4,600	23,000
Barge 4382 - “STEELHEAD”	100,000	10,000	50,000
Barge 4394 - “COHO”	100,000	10,000	50,000
Barge 8105 - “CHINOOK”	150,000	15,000	75,000
Barge 8106 - “KING SALMON”	150,000	15,000	75,000
Barge 8107	150,000	15,000	75,000
Barge 8108	150,000	15,000	75,000
Truck	3,500	n/a	1,750
Truck - Midi-tank	300	n/a	150
Truck - Mini-tank	150	n/a	75

4.g. Summer Transport Operations:

(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 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.

(6) If a temperature gradient between the forebay and the gatewells or the gatewells and the collection channel is observed in real time or predicted from temperature modeling at McNary exceeds 6^0F; collection mortality increases to 6 percent of daily collection for any 3 days in a rolling 5 day period; or the mortality is increasing at such a rate that these mortality numbers are likely to be met, the project will immediately alter turbine operations to reduce mortality and temperature where possible.

(7) If turbine operations are already optimized for temperature and collection mortality increases to 6 percent of daily collection for any 3 days in a rolling 5 day period, or if daily collection mortality exceeds 10,000 fish, then additional spill may be provided so long as the spill levels do not exceed the gas cap. Transportation will be shifted to everyday, if possible, to reduce holding of fish in raceways. If everyday transport is not possible, redirect fish to the outfall instead of the raceways. Emergency operations will be implemented by RCC and coordinated with an emergency conference call with TMT.

4.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

5.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 a truck pad behind the Bonneville Dam Smolt Monitoring Facility (SMF). Fish released from the truck pad pass through the SMF outfall into the Columbia River. . From August 15 through the end of the transport season, trucks, midi-tanks and mini-tanks will also release fish into the Bonneville SMF outfall flume. Dalton Point will be utilized as an alternate release site in the case of an emergency or if unsafe conditions exist at the Bonneville facility.

(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) Truck Loading Schedules: 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.

5.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 the second day after the initiation of collection. The FOP (Appendix E) specifies the date collection will start for transportation in coordination and discussion with TMT. 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 141 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 141 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

6.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.

6.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.

6.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

7.a. The fishery agencies provide biological assistance at transportation dams. CENWW contracts for state fish biologists to work at each collector facility.

7.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 data in the correct format for project annual reports.

8. DISSEMINATION OF INFORMATION

8.a. <u>Daily Reports</u>: 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.

8.b. <u>Weekly Reports</u>: 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. REQUIREMENTS FOR FISHERY AGENCY ACTIVITIES AND RESEARCH

9.a. <u>Coordination</u>: 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 annually.

9.b. <u>Protocol:</u> 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

1. Background: Outmigrating 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 Federal Columbia River Power System (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, the National Oceanic and Atmospheric Administration's Fisheries Service (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. <u>In-Season Best Efficiency Operating Period</u>: This period is defined as 24 hours per day from April 1 through October 31 for all Lower Columbia (LCOL) and Lower Snake (LSN) hydroelectric projects. BPA will maintain generation requests that allow turbines to operate within 1% 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 off 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 C-1. Codes for Reporting Excursions outside 1% of Best Efficiency Range.

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

U.S. ARMY CORPS OF ENGINEERS PLAN OF ACTION FOR DISSOLVED GAS MONITORING IN 2010-2014

DECEMBER 2008

U.S. Army Corps of Engineers Plan of Action for Dissolved Gas Monitoring for 2010-2014

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U.S. ARMY CORPS OF ENGINEERS PLAN OF ACTION FOR DISSOLVED GAS MONITORING IN 2010-2014

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 generally 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 USACE 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 (2008) 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 daily average TDG levels (average of the 12 highest hourly values in a calendar day for the State of Oregon and the highest average of 12 consecutive hours for the State of Washington) do 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 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 USACE TDG monitoring program and summarize the role and responsibilities of the USACE 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, 2010 through March 31st, 2014. However, with regional coordination, this plan may be modified as necessary to keep current with system operations, regulatory requirements, and technical innovations.

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 USACE 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 USACE 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 1 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 and into the CROHMS database
- 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 USACE' 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 USACE 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 November or early December to discuss and firm up the details of implementation of this 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 2010-2014 ACTION PLAN

The 2010-2014 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

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 implementation of the plan 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 2010-2014 monitoring activities and will prepare the proper contracts to secure the necessary equipment and services to conduct the monitoring program in each of the years 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 USACE. 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 2008-2009 fall-winter 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 December, at which time a final plan of action will be produced. It is also expected that the following entities will continue to operate their monitoring instruments in 2010-2014:

- 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 2008-2009 fall-winter monitoring.
All seasonal 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.

USACE stations that remain in service during the fall-winter season 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 USACE' 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 most gauges, data transmission will be done via the GOES Satellite, to the USACE' 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. 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 USACE' Water Quality Data Base. Additional data posting in the TMT home page will continue.

4.3.1 Data Quality Process

As part of the TDG monitoring program, the USACE, in cooperation with the Regional Forum Water Quality Team, developed a set of quality control/quality assurance protocols for operating TDG gauges. These protocols are detailed in the Data Quality Criteria report which includes a discussion of Quality Control and Quality Assurance including redundant and backup monitoring, bi-weekly calibration, and spot-checking of monitoring equipment. These Data Quality Criteria also 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

A secondary TDG standard is used since the primary standard created at the Laboratory cannot be used in the field. The secondary standard is calibrated with the primary standard, transported to the field and is used to calibrate the field instrument. Calibrate the secondary 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 USACE, 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. In the event that a TDG monitor is expected to be out of service for an extended period of time, the USACE RCC will utilize the SYSTDG model to provide estimated TDG levels for the location of the malfunctioning gauge and use that estimation for spill management purposes.

USACE 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. Service and repair of the Sutron DCP will be performed by the manufacturer. 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 USACE 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 USACE will adopt the 2000 Plan of Action language on the subject. According to the May 2, 2000 letter from the USACE 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. For 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 may be 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 USACE of the erroneous data. The USACE 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 USACE 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, USACE 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 each 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 USACE Districts, the Bureau of Reclamation, the Mid-Columbia PUD's, and the Regional Forum WQT. Each 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. These summaries should include statistics on data confidence limits. Division staff will prepare the Annual TDG Monitoring Reports based on field input, other material provided by each District, and recommendations by the WQT. These reports will also contain suggestions and recommendations to improve the quality of the data for the FY2010-2014 monitoring programs.

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 USACE in collecting and reporting total dissolved gas and related water quality parameters. It is expected that this cooperation will extend through the 2014 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 is expected to continue at International Boundary and the Grand Coulee forebay and tailrace, and the Hungry Horse sites through 2014. Hourly data transmission to CROHMS will continue via the GOES satellite.

Douglas County PUD: TDG monitoring is expected to continue at the forebay and tailrace of Wells Dam through 2014. Hourly data from both of these stations will continue to be sent to the USACE.

Chelan County PUD: Chelan County PUD is expected to continue to monitor TDG in the forebays and tailraces of Rocky Reach and Rock Island dams through 2014. Hourly data from these four stations will continue to be posted in the USACE 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: 2010-2014 Dissolved Gas Monitoring Network

STATION NAME	STATION CODE	OWNER [d,e,f]	DATES OF OPERATION	CALIBRATION FREQUENCY FALL-WINTER [a]	CALIBRATION FREQUENCY SPRING-SUMMER [b]
Albeni Falls Forebay	ALFI	USACE-NWS	April 1 – September 30	N/A	2 Weeks
Albeni Falls Tailwater	ALQI	USACE-NWS	April 1 – September 30	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 30	N/A	2 Weeks
Chief Joseph Tailwater	CHQW	USACE-NWS	April 1 – September 30	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 30	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]	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 2010-2014

Project	Name	Position	Phone #	E-Mail
Internat'l Bndry., Hungry Horse, Grand Coulee	Norbert Cannon	Chemist	(208) 334-1540	ncannon@pn.usbr.gov
	Clyde Lay	Water Quality Regional Coordinator	(208) 685-6926	clay@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
	Kevin Wright	USGS/ Oversight	(509) 527-2571	kswright@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
USACE 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) 808-4878	Tina.m.lundell@usace.army.mil

Figure 1: 2010-2014 Dissolved Gas Monitoring

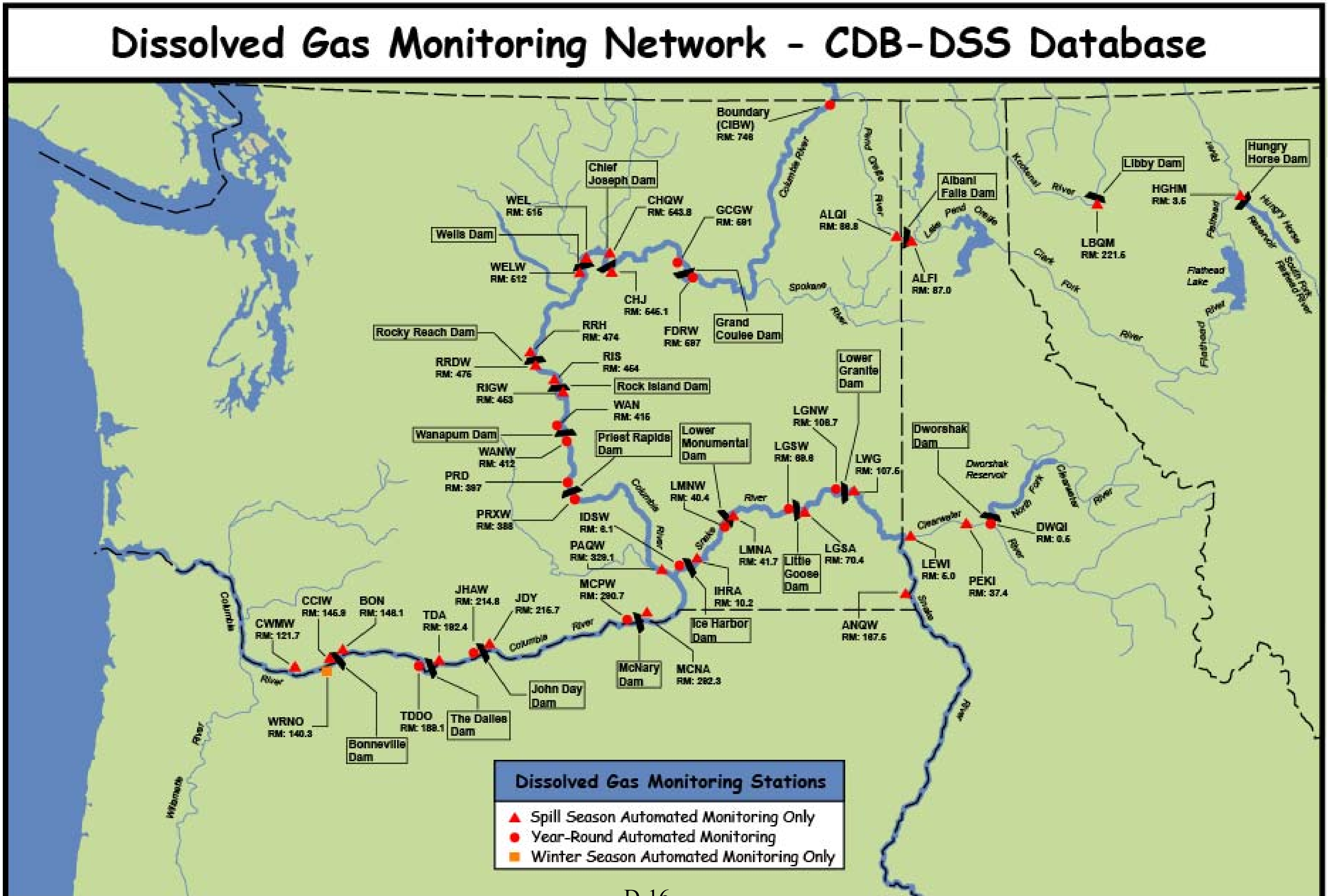
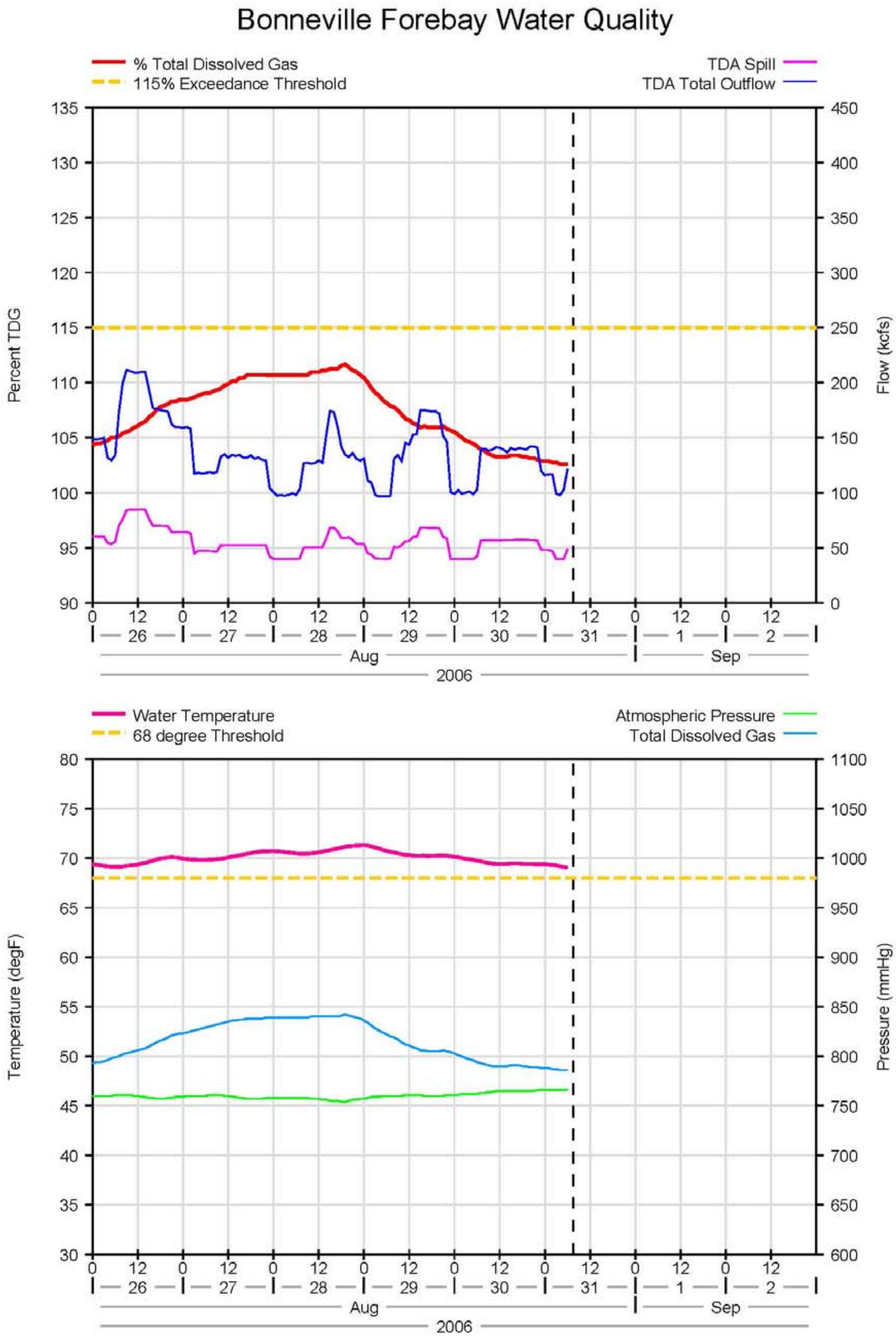


Figure 2: Graphs for Data Review



DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS, NORTHWESTERN DIVISION
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March 2012

2012 Fish Operations Plan

INTRODUCTION

The 2012 Fish Operations Plan (FOP) describes the U.S. Army Corps of Engineers' (Corps) planned operations for fish passage at its mainstem Federal Columbia River Power System (FCRPS) dams during the 2012 fish migration season; generally April through August. The 2012 FOP is consistent with the 2011 Court ordered spring and summer spill operations, and the adaptive management provisions in the 2010 NOAA Fisheries FCRPS Supplemental Biological Opinion (2010 Supplemental BiOp)[1] and the Corps' Record of Consultation and Statement of Decision (ROCASOD) adopting the project operations contained in the 2010 Supplemental BiOp and the Columbia Basin Fish Accords (Accords).

As in 2011, the 2012 FOP incorporates planned project operational adjustments necessary to conduct essential research to evaluate fish passage features during the 2012 migration season. Other FCRPS water management actions and project operations not specifically addressed in this document shall be consistent with the 2010 Supplemental BiOp and other guiding operative documents, including the 2012 Water Management Plan (WMP), seasonal WMP updates, and the 2012 Fish Passage Plan (FPP). Operations described herein are consistent with the 2011 Court Order, including adjustments to address in-season developments through discussion and coordination with the regional sovereigns as provided for in the 2010 Supplemental BiOp.

The following sections describe factors that influence management of fish operations during various runoff conditions, including: management of spill for fish passage, spillway operations, minimum generation requirements, operations under low flow conditions, navigation safety, juvenile fish transportation operations, specified spring operations for fish at each mainstem project, protocols for fish protection measures related to operational emergencies, coordination with regional entities, and monthly reporting.

GENERAL CONSIDERATIONS FOR FISH OPERATIONS

For planning purposes, the Corps' 2012 FOP assumes average runoff conditions. As actual runoff conditions vary in timing and shape and may be higher or lower than average in any given year, adjustments in fish transportation and/or spill operations (spill levels, spill percentages, or spill caps) will be adaptively managed in-season. These in-season changes will be coordinated through the Technical Management Team (TMT) and

[1] The 2010 Supplemental BiOp incorporates the 2008 NOAA BiOp.

other appropriate regional forums, to avoid or minimize adverse impacts to juvenile and/or adult fish passage conditions, navigation safety concerns, or to accommodate powerhouse and/or transmission system constraints. Actual spill levels may be adaptively managed to accommodate fish research or other conditions and will be coordinated through the TMT and other appropriate regional forums.

Management of Spill for Fish Passage

The Corps will manage spill levels for fish passage to avoid exceeding 120% total dissolved gas (TDG) in project tailraces, and 115% TDG in the forebay of the next project downstream consistent with the current State of Washington percent TDG limits.[2] These limits are referred to as gas caps. The maximum project spill level that meets, but does not exceed, the gas cap is referred to as the spill cap. Gas caps are constant, whereas spill caps may vary daily depending on flow, spill operation, spill pattern, temperature, and other environmental conditions.

As noted above, the spill levels presented below in Tables 2 and 3 are planned spill operations and assume average runoff conditions; however, adjustments to these spill rates may be necessary. Reasons for these adjustments may include:

1. Low runoff conditions that may require adjustments in spill level while still meeting project minimum generation requirements.
2. High runoff conditions where flows exceed the powerhouse hydraulic capacity with the specified spill rates.
3. Navigation safety concerns.
4. Generation unit outages that reduce the powerhouse hydraulic capacity.
5. Power system or other emergencies that reduces powerhouse outflow.
6. Lack of power demand resulting in an increase in spill levels.

The Corps' Reservoir Control Center (RCC) is responsible for daily management of spill operations responsive to changing TDG conditions. In order to manage gas cap spill levels consistent with the states' TDG saturation limits, the RCC establishes the TDG spill caps for the lower Columbia and Snake River projects on a daily basis throughout the fish passage season. The resultant TDG spill caps are set to provide percent TDG saturation levels that are not expected to exceed the 120%/115% TDG limits, which are measured as the average of the highest 12 hourly readings for each day.

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

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[2] The 2010 Supplemental BiOp provides: "Specific spill levels will be provided for juvenile fish passage at each project, not to exceed established TDG levels (either 110 percent TDG standard, or as modified by State water quality waivers, currently up to 115 percent TDG in the dam forebay and up to 120 percent TDG in the project tailwater…". In February 2009, the State of Oregon modified its 5-year waiver to remove the 115% forebay TDG limit. However, the Corps will continue to manage to 120% and 115% (the Washington TDG standard) consistent with the 2011 Court Order in 2012.

(including flow, spill, temperature, and TDG levels) and taking into consideration a number of forecast conditions (including total river flow, powerhouse flow, wind and temperature forecast, etc.). These data are used as input variables into the System TDG (SYSTDG) model. The SYSTDG model estimates TDG levels expected several days into the future and is a tool integral to daily decision-making when establishing spill caps at individual dams. Spill caps set by RCC and contained in the daily spill priority list will be met at the projects using the individual project spill pattern(s) contained in the FPP Sections 2 through 9, that most closely corresponds to the specified spill level (i.e. may be slightly over or under the specified spill level or percent value). During the spring freshet, when river flow may be greater than project powerhouse hydraulic capacity given the specified FOP spill level, or a lack of power load results in an increase in the spill level, the Corps will attempt to minimize TDG on a system-wide basis. In this case, spill caps are also developed for 122%, 125%, 127%, 130%, or 135% TDG as a means of minimizing TDG throughout the system.

The Corps will initiate spill at 0001 hours, or shortly after midnight, at each of the projects on the start dates specified in the project sections below. Spill caps will be established at the specified FOP levels and will continue unless conditions require changing to maintain TDG within the upper limits of 120% in the tailwater of a dam and 115% in the forebay of the next project downstream (and at Camas/Washougal[3] - except during summer testing). Unless otherwise specified, spill will transition to summer levels at 0001 hours, or shortly after midnight, at each project on the day after spring spill ends, (specified in the project sections below). Operations to manage TDG will continue to be coordinated through the TMT.

Spillway Operations

The Action Agencies will meet the specified spill levels to the extent feasible; however, actual hourly spill levels at each dam may be slightly more or less than those specified in Tables 2 and 3 below. Actual spill levels vary depending 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), automatic load following, and other factors.

Operational Considerations:

- Spill levels: Project spill levels listed in Tables 2 and 3 coincide with specific gate settings in the FPP project spill pattern tables. Due to limits in the precision of spill gates and control devices, short term flow variations, and head changes, it is not always possible to meet the exact spill levels identified in Tables 2 and 3 or in RCC spill requests (teletypes) to specific projects. Therefore, spillway gates are opened to the gate settings identified in the FPP project spill pattern tables to provide spill levels that are the closest to the prescribed FOP spill levels.

3 The Camas/Washougal TDG fixed monitoring site is located approximately 24 miles downstream of Bonneville Dam and is used to simulate a forebay gauge for Bonneville Dam.

- Spill percentages: Spill percentages are considered target spill levels. The project control room operator and BPA duty scheduler calculate spill levels to attempt to be within ±1% of the target percentage for the following hour (or more than ±1% at The Dalles and Little Goose dams as specified in FPP Sections 3 and 8 spill pattern tables). Prescribed or specified spill percentages in Tables 2 and 3 may not always be attained due to low flow conditions and minimum generation requirements (Table 1), TDG gas cap limitations, temporary spill curtailment for navigation safety, and other unavoidable circumstances. Operators and schedulers review the percentages achieved during the day and adjust spill levels in later hours, with the objective of ending the day with a daily average spill percentage that achieves the specified spill percentage.

Minimum Generation

Both Snake and Columbia River dams have a minimum generation requirement that has been established to maintain power system stability and reliability. The Corps has identified minimum generation powerhouse outflow values derived from actual generation records when turbines were operating within ±1% of best efficiency (Table 1). Values stated in Table 1 are approximations that account for varying head or other small adjustments in turbine unit operation that may result in variations from 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, but cannot precisely control a unit flow; variations may be 1-2% of unit flow.
3. System disturbances: once a 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 or decrease flow and generation slightly within an hour. Individual units operate differently from each other and often have unit specific constraints.
4. Generation control systems regulate megawatt (MW) generation only; not flow through individual turbine units.

All of the lower Snake River powerhouses may be required to keep one generating unit on line at all times for power system reliability under low river flow conditions, which may result in a reduction of spill at that project. These projects have two “families” of turbines with slightly different capacities – small and large. In most cases during low flow conditions, one of the smaller turbine units (with reduced generation and flow capabilities) will be online. The smaller turbine units are generally numbered 1–3 and are the first priority for operation during the fish passage season. If smaller turbine units are unavailable, larger units may be used.

During low river flow events, the operating unit generally runs at the lower end of the ±1% of best efficiency range. At Lower Monumental Dam, however, turbine unit 1 (the first priority unit during fish passage) cannot operate at the low end of the design range because it has welded blades. Ice Harbor turbine units cannot be operated at the lower end of the ±1% of best efficiency range because these units experience cavitation, which damages the turbine runner and can be detrimental to fish. Therefore, Ice Harbor turbine units will operate at their lower cavitation limits. Minimum generation flow ranges at McNary, John Day, and The Dalles dams are 50-60 kcfs and 30-40 kcfs at Bonneville, as shown in Table 1.

Table 1.— Minimum generation ranges for turbine units at the four lower Snake and four lower Columbia River dams.

Project	Turbine Units	Minimum Generation (kcfs)
Lower Granite	1-3	11.3-13.1
	4-6	13.5-14.5
Little Goose	1-3	11.3-13.1
	4-6	13.5-14.5
Lower Monumental	1	16.5-19.5
	2-3	11.3-13.1
	4-6	13.5-14.5
Ice Harbor	1, 3-6	8.5-10.3
	2	11.3-13.1
McNary	N/A	50-60
John Day	N/A	50-60
The Dalles	N/A	50-60
Bonneville	N/A	30-40

Low Flow Operations

Low flow operations at lower Snake and Columbia River projects are triggered when inflow is not sufficient to meet both minimum generation requirements and planned FOP spill levels listed in Tables 2 and 3. In these situations, Snake River projects will operate one turbine unit at the minimum generation outflow and spill the remainder of inflow at the project. Columbia River projects will also operate at minimum generation and pass the remaining inflow as spill down to minimum spill levels. As river flow transitions from higher flow to low flow, there may be situations when maintaining minimum generation and the target spill identified in Tables 2 and 3 may not be possible every hour, since these projects have limited flexibility. During the transition phase, flow may recede at a higher rate than forecasted and inflow provided by non-Federal projects upstream is often variable and uncertain. The combination of these factors may result in instances where unanticipated changes to inflow cause forebay elevations to go outside of the normal minimum operating pool (MOP) ranges for Snake River projects as provided for in the 2010 Supplemental BiOp.

During low flow conditions when the navigation lock is being emptied at some projects, the total spill volume remains constant, but the spill reported as a percent of total flow may be temporarily reduced below the target spill percentage. This occurs 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 when river flow is higher.
At Little Goose Dam, when daily average flow in the lower Snake River is ≤32 kcfs, achieving 30% spill would require switching powerhouse operations between operating two units at the low end of the ±1% of best efficiency range to operating one unit at the high end of the ±1% of best efficiency range. This operation, in combination with constant inflow from Lower Granite Dam, often makes it difficult to achieve the FOP prescribed spill level downstream at Lower Monumental Dam and to also maintain MOP operations. In years past, through coordination with TMT during low flow periods, Little Goose spill operations changed from 30% to a constant spill level of approximately 7-11 kcfs to smooth out Little Goose outflow, meet Lower Monumental FOP specified spill levels, and maintain the MOP elevation at Little Goose. A similar operation will be implemented in 2012, if necessary, depending on river flow.

Operations during Rapid Load Changes

Project operations during hours when power system load and/or intermittent generation changes rapidly, may result in not meeting FOP specified hourly spill levels because projects must be available to respond to within-hour load variability to satisfy North American Electric Reliability Council (NERC) reserve requirements (“on response”). This usually occurs at McNary, John Day, and The Dalles dams. In addition to within-hour load variability, projects on response must be able to respond to within hour changes that result from intermittent generation (such as wind generation). During periods of rapidly changing loads and intermittent generation, projects on response may have significant changes in turbine flow within the hour, while the spill quantity remains the same within the hour. Under normal conditions, within-hour load changes occur mostly on hours immediately preceding and after the peak load hours; however, within-hour changes in intermittent generation can occur at any hour of the day. Due to the high variability of within-hour load and intermittent generation, these load swing hours may have a greater instance of reporting actual spill percentages that vary more than the ±1% requirement in other hours.

Turbine Unit Testing around Maintenance Outages

Turbine units may be operationally tested for up to 30 minutes by running the unit at speed no load and various loads within the 1% of best efficiency range to allow for pre-maintenance measurements and testing, and to allow all fish to move through the unit. Units may be operationally tested after maintenance or repair, but before a unit comes out of a maintenance or forced outage status. This testing may consist of running the unit for up to 30 minutes before it is returned to operational status. Testing of a unit under maintenance is in addition to a unit operating at minimum generation required for power system reliability. Testing may deviate from unit operating priorities specified in FPP sections 2-9 and may use water that would otherwise be used for spill if the running unit for reliability is at the bottom of the ±1% of best efficiency range. Water will be used from the powerhouse outflow allocation if possible, and water diverted from spill for operational testing will be minimized. Consistent with the 2011 Court Order and previous years, the Corps will coordinate this testing with the region through the Fish Passage Operations and Maintenance (FPOM) group.

Navigation Safety

Short-term adjustments in spill may be required for navigation safety, primarily at the lower Snake projects, but may also be necessary at the lower Columbia projects. This may include changes in spill patterns, reductions in spill, or short-term spill curtailment. In addition, unsteady flow at Little Goose and Ice Harbor dams during low flow conditions may impact reservoir elevations at those projects and cause inadequate navigation depths at the downstream entrances to the Lower Granite and Lower Monumental navigation locks. Therefore, adjustments to pool elevation in the Little Goose pool and Ice Harbor pool, of up to 1.0 ft. above the MOP operating range may be necessary to accommodate safe entrance to the navigation locks at Lower Granite and Lower Monumental dams during periods of low flow (approximately 50 kcfs or less) and will be coordinated in TMT. These adjustments may be necessary for both commercial tows and fish barges. Additionally, to accommodate safe navigation, the Lower Granite pool will be operated up to MOP+2 ft. depending on river flow, consistent with operations coordinated in 2011[4].

JUVENILE FISH TRANSPORTATION PROGRAM OPERATIONS

As noted above, the Corps' planned spill operations assume average runoff conditions. In previous years, the FOP provided that spill for fish passage would occur under all flow conditions.[5] To improve survival of juvenile migrants, the 2010 Supplemental BiOp calls for an annual review of the previous year's fish survival information and discussion with the Regional Implementation Oversight Group (RIOG) to inform transport/spill operations for the subsequent year. After considering the best available information and taking into account input from regional sovereigns, the Corps will continue implementation of the 2011 juvenile fish transportation program operations at the Snake River collector projects in 2012. These operations will continue spill levels specified in Tables 2 and 3 independent of flow conditions. River flow and fish condition will be monitored, and if regional sovereigns recommend adjustments in spill and/or transportation operations that differ from those stated herein, the Corps will use the regional coordination process to make a determination on recommended operational changes.

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[4] Flow specific criteria under the variable-MOP operation are as follows: If inflow is ≥120 kcfs, then operate at 733.0-734.0 ft. (MOP); if inflow is 80-119 kcfs, then operate at 734.0-735.0 ft. (MOP+1); if inflow 50-79 kcfs, then operate at 734.5-735.5 ft. (MOP+1.5); if inflow is ≤49 kcfs, then operate at 735.0-736.0 ft. (MOP+2).

[5] The 2009 FOP provided: "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."

The following describes the proposed transportation operations for the lower Snake River projects. Detailed descriptions of project and transport facility operations to implement the juvenile fish transportation program are contained in the FPP Appendix B.

Lower Snake River Dams - Operation and Timing

Transportation will be initiated at Lower Granite Dam no earlier than April 20 and no later than May 1. Transportation will start up to 4 days and up to 7 days after the Lower Granite Dam start date at Little Goose and Lower Monumental dams, respectively. The actual start date for Lower Granite, Little Goose, and Lower Monumental dams 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).

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 transported from each facility on a daily or every-other-day basis (depending on the number of fish) throughout the migration season. Transportation operations will be carried out at each project in accordance with all relevant FPP operating criteria.

Transportation and spill operations may be adjusted due to research, conditions at fish collection facilities such as overcrowding or temperature extremes, through the adaptive management process with FPOM and/or TMT to better match juvenile outmigration timing or achieve/maintain performance standards.

McNary Dam - Operation and Timing

Transportation will be initiated at McNary Dam between July 15–30 per the 2010 Supplemental BiOp (RPA 30, Table 4) and in coordination with NOAA Fisheries and the TMT. Fish will be transported from McNary Dam by barge through August 16, then transported by truck every other day. All fish collected will be transported except those marked for in-river studies. Fish are expected to be transported through September 30. The presence of factors such as excess shad, algae or bryozoans that can clog screens and flumes may result in discontinuing transport operations at McNary Dam before September 30. Detailed criteria for McNary transport are contained in the FPP, Appendix B.

Transportation operations may be adjusted for research purposes, due to conditions at the collection facilities, or as a result of the adaptive management process (to better match juvenile outmigration timing and/or to achieve or maintain performance standards). If new information indicates that modifying (or eliminating) transportation operations at McNary Dam is warranted, adaptive management will be used to make appropriate adjustments through coordination with the FPOM/TMT.

SPRING SPILL OPERATIONS

Lower Snake River Projects

Spring spill will begin on April 3 at Lower Granite, Little Goose, Lower Monumental, and Ice Harbor dams. Spring spill operations will continue through June 20. However, fish run timing and research schedules may require an earlier transition date to summer operations to assure that research occurs during the bulk of the migration. Such changes will be coordinated through TMT. Spring spill levels for Snake River dams are shown in Table 2.

Lower Columbia River Projects

Spring spill will begin April 10 at McNary, John Day, The Dalles, and Bonneville dams. Spring spill operations will continue through June 30 at John Day, and The Dalles dams, through June 19 at McNary Dam, and through June 15 at Bonneville Dam. However, fish run timing and research schedules may require earlier transition dates to summer spill operations to assure that research occurs during the bulk of the migration. Such changes if necessary will be coordinated through the TMT. Spring spill operations are shown in Table 2.

SUMMER SPILL OPERATIONS

Lower Snake River Projects

Summer spill will begin on June 21 at Lower Granite, Little Goose, Lower Monumental and Ice Harbor dams and continue through August 31 at all four Snake River projects. Summer spill levels are shown in Table 3.

Lower Columbia River Projects

Summer spill will begin June 16 at Bonneville Dam, June 20 at McNary Dam, and July 1 at John Day and The Dalles dams and continue through August 31 at all four Columbia River projects. Summer spill levels are shown in Table 3.

PROJECT BY PROJECT OPERATIONS

The following sections describe 2012 spill operations for each project. Included in the descriptions are planned research activities identified in the 2010 Supplemental BiOp. The Corps, regional fishery agencies, and Tribes are interested in the continuation of project research studies under the Corps' Anadromous Fish Evaluation Program (AFEP). These studies have been evaluated through the annual AFEP review process with the regional fishery agencies and Tribes, with the study designs being finalized prior to initiation in 2012. The studies are intended to provide further information on project survival that will help inform the region in making decisions on future operation and configuration actions to improve fish passage and survival and meet BiOp performance standards at the lower Snake and Columbia River dams.

Table 2.— Summary of 2012 spring spill levels at lower Snake and Columbia River projects.[6]

Project	Planned 2012 Spring Spill Operations (Day/Night)	Comments
Lower Granite	20 kcfs/20 kcfs	Same as 2011
Little Goose	30%/30%	Same as 2011
Lower Monumental	Gas Cap/Gas Cap (approximate Gas Cap range: 20-29 kcfs)	Same as 2011
Ice Harbor	**April 3-April 28:** 45 kcfs/Gas Cap **April 28-June 20:** 30%/30% vs. 45 kcfs/Gas Cap (approximate Gas Cap range: 75-95 kcfs)	Same as 2011
McNary	40%/40%	Same as 2011
John Day	**Pre-test:** 30%/30% **Testing:** 30%/30% and 40%/40%	Same as 2011
The Dalles	40%/40%	Same as 2011
Bonneville	100 kcfs/100 kcfs	Same as 2011

[6] Table 2 summarizes the planned spring spill operations. More specific detail governing project operations is included in project specific sections.

Table 3.— Summary of 2012 summer spill levels at lower Snake and Columbia River projects.[7]

Project	Planned 2012 Summer Spill Operations (Day/Night)	Comments
Lower Granite	18 kcfs/18 kcfs	Same as 2011
Little Goose	30%/30%	Same as 2011
Lower Monumental	17 kcfs/17 kcfs	Same as 2011
Ice Harbor	**June 21-July 13:** 30%/30% vs. 45 kcfs/Gas Cap **July 13-August 31:** 45 kcfs/Gas Cap (approximate Gas Cap range: 75-95 kcfs)	Same as 2011
McNary	50%/50%	Same as 2011
John Day	**July 1-July 20:** 30%/30% and 40%/40% **July 20-August 31:** 30%/30%	Same as 2011
The Dalles	40%/40%	Same as 2011
Bonneville	**June 16-July 20:** 85 kcfs/121 kcfs and 95 kcfs/95 kcfs **July 21-August 31:** 75 kcfs/Gas Cap	Same as 2011

Lower Granite

Spring Spill Operations April 3 through June 20: 20 kcfs 24 hours per day.

Summer Spill Operations June 21 through August 31: 18 kcfs 24 hours per day.

Changes in Operations for Research Purposes:

- Research operations: There are no special spill operations for research planned in 2012. Established spill patterns as described in FPP Section 9 will be used.

Operational Considerations:

- Lack of power load or unexpected unit outages could cause involuntary spill at higher total river flow that could result in exceeding the gas cap limits.
- During periods of high spring runoff when involuntary spill occurs, there may be periods where spill levels create unsafe hydraulic conditions for commercial, non-commercial, and fish transportation barges entering and exiting the tailrace and/or while moored at the fish loading facility. If such runoff conditions occur, spill may be reduced temporarily when fish transport barges approach or leave the barge

[7] Table 3 summarizes the planned summer spill operations. More specific detail governing project operations is included in project specific sections.

docking area or are moored at loading facilities. If conditions warrant a spill reduction for any navigational passage, Lower Granite pool MOP elevation restrictions may be temporarily exceeded until the barge/vessel exits the tailrace safely and spill resumes.
- Unit outages may occur for required or emergency unscheduled maintenance activities described in FPP Appendix A. Maintenance dates are subject to change.

Little Goose

Spring Spill Operations April 3 through June 20: 30% spill 24 hours per day. The spillway weir closure gate will be raised as soon after 0630 hours on April 3 as weather permits.

Summer Spill Operations June 21 through August 31: 30% spill 24 hours per day.

Changes in Operations for Research Purposes:

- Research operations: Performance standard testing at 30% spill will occur in spring and summer 2012 at Little Goose Dam. Testing will begin in late April and continue through mid-July. The dates of testing will be dependent on the size and availability of fish for tagging. Final dates for testing will be coordinated through the Studies Review Workgroup (SRWG). Established spill patterns as described in FPP Section 8 will be used.
- Objectives of the biological test: The objectives of the test are to assess passage distribution and efficiency metrics, forebay retention and tailrace egress times, and dam survival for yearling Chinook, juvenile steelhead, and subyearling Chinook to determine if juvenile dam survival at 30% spill under the current project configuration meets or exceeds the juvenile dam survival performance standard for spring (96%) and summer (93%) migrants specified in the 2010 Supplemental BiOp.

Operational Considerations:

- Daily average flows in the lower Snake River of ≤32 kcfs can result in incompatible operations with Lower Monumental Dam and cause spill quantity fluctuations. Alternative Little Goose operations to resolve this issue are described in the Low Flow Operations section above and will be coordinated through the FPOM/TMT.
- Unit outages may occur for required or emergency unscheduled maintenance activities described in FPP Appendix A. Maintenance dates are subject to change.
- Turbine Unit 1 Operation: Operating range will be set within the GDACS program for Little Goose Dam to restrict Turbine Unit 1 operation to approximately the upper 25% of the 1% of best efficiency range (about 16-17.5 kcfs). This will ensure a strong current along the south shore to counter the strong eddy that forms in the tailrace during certain spill conditions. A strong south shore current in the tailrace is important for both adult fish passage and juvenile fish egress. If low flow conditions occur in the spring, the full ±1% of best efficiency range will be restored to minimize impacts on spill levels.

Lower Monumental

Spring Spill Operations April 3 through approximately June 20: Spill to the 115/120% TDG gas cap 24 hours per day.

Summer Spill Operations Approximately June 21 through August 31: 17 kcfs 24 hours per day.

Changes in Operations for Research Purposes:

- Research operations: Performance standard testing at the TDG Gas Cap (spring) and at 17 kcfs (summer) spill will occur in 2012 at Lower Monumental Dam. Testing will begin in late April and continue through mid-July. The dates of testing will be dependent on the size and availability of fish for tagging. Final dates for testing will be coordinated through the SRWG. The "bulk" spill pattern as described in FPP Section 7 will be used. Based on a previous year's study results, dam survival is higher using the "bulk" spill pattern compared to the "uniform" spill pattern.
- Objectives of the biological test: The objectives of the test are to assess passage distribution and efficiency metrics, forebay retention and tailrace egress times, and dam survival for yearling Chinook, juvenile steelhead, and subyearling Chinook to determine if juvenile dam survival at Gas Cap (spring) and 17 kcfs (summer) spill under the current project configuration meets or exceeds the juvenile dam survival performance standard for spring (96%) and summer (93%) migrants specified in the 2010 Supplemental BiOp.

Operational Considerations:

- Consistent with adjustments made in 2011 spring operations through regional coordination, when total river flow is likely to exceed turbine capacity and spill over the 120% TDG gas cap (occurs at a total river flow of ~140 kcfs) for three or more days, the project will use the uniform spill pattern. This may also occur if spill over the 120% TDG gas cap is required due to "lack of demand" spill at any river flow level.
- Daily average flows of ≤32 kcfs can result in incompatible operations with Little Goose Dam and may cause spill quantity fluctuations.
- Transit of the juvenile fish barge across the Lower Monumental tailrace, then docking at and departing from the fish collection facility, may require spill level to be reduced due to safety concerns. The towboat captain may request that spill level be reduced or eliminated during transit. During juvenile fish loading operations, spill is typically reduced to 15 kcfs, but can be reduced further if necessary for safety reasons. Barge loading duration can be up to 3.5 hours. Because of the time needed to complete loading at Lower Monumental, the Little Goose Project personnel will notify the Lower Monumental personnel when the fish barge departs from Little Goose. This ensures that BPA scheduling is provided advance notice for spill control at Lower Monumental Dam. Reducing spill may cause the Lower Monumental pool to briefly operate outside of MOP elevations.

- Operating units within the 1% of best efficiency range translates to as much as 19 kcfs discharge for each of the 6 turbine units, for a maximum hydraulic capacity of approximately 114 kcfs. The expected spill cap is roughly 27 kcfs (but varies depending on total river flow). Therefore, if total river flow 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 limits at higher total river flow.
- Unit outages may occur for required or emergency unscheduled maintenance activities described in FPP Appendix A. Maintenance dates are subject to change.

Ice Harbor

Spring Spill Operations April 3 through June 20: Spill will begin at 45 kcfs day/spill cap night on April 3 and continue until April 28. On April 28, spill will alternate between 45 kcfs day/spill cap night and 30% /30% with the SW operating and continue through the spring season. Nighttime spill hours are 1800–0500.

Summer Spill Operations June 21 through August 31: Spill operations will continue from spring at 30% 24 hours per day vs. 45 kcfs day/Gas Cap night until July 13 at 0500 hours, then 45 kcfs day/Gas Cap night through August 31.

Changes in Operations for Research Purposes:

- Research operations: There are no special spill operations for research planned in 2012. Spill patterns as described in FPP Section 6 will be used.

Operational Considerations:

- Spill operation treatments may be rearranged within a week throughout the season. If rearrangement of treatments occurs, the total number of each spill level treatment for the spring season will not change. The flexibility to rearrange treatments during periods of higher power demand may alleviate the need to declare a power emergency.
- Powerhouse capacity at Ice Harbor is approximately 94 kcfs with all 6 units operating within the 1% of best efficiency range, while spill cap rates are about 100 kcfs. If total river flow exceeds about 194 kcfs, TDG levels may exceed the water quality standards set by the States of Oregon and Washington.
- Unit outages may occur for required or emergency unscheduled maintenance activities described in FPP Appendix A. Dates are subject to change.
- Submersible Traveling Screens (STSs) will be installed by April 1. The normal juvenile bypass operation will be to route fish through the full flow bypass pipe, which has interrogation capability to monitor for PIT tags. From April 1 through July 31, juvenile fish will be sampled every 3 to 5 days to monitor fish condition and then bypassed to the river. Sampling activity may be terminated early should juvenile bypass fish numbers drop to the point where valid sampling is no longer feasible (100 fish of the most dominant species present are needed to properly assess fish

condition). Sampling may also cease if the cumulative number of fish sampled for the season reach the permitted maximum.

McNary

Spring Spill Operations April 10 through approximately June 19: 40% spill 24 hours per day with the two spillway weirs operating. A spillway weir will be operated in both spillbay 19 and spillbay 20 for the period April 10 through June 6. As in past years, both spillbay weirs will be removed from service by June 8 (or next business day as coordinated through the FPOM) for the benefit of subyearling Chinook. This operational change will be coordinated through the Fish Facility Design Review Workgroup (FFDRWG), FPOM, the Tribes, and NOAA. Temporary spill pattern changes to allow removal of the spillway weirs will occur, however spill will continue at 40% during the spillway weir removal process. Following removal of the spillway weirs, the spill pattern contained in Table MCN-10 in FPP section 5 will be used for the remainder of the spring.

Summer Spill Operations June 20 through August 31: 50% spill 24 hours per day without spillway weirs.

Changes in Operations for Research Purposes:

- Research operations: Performance standard testing at 40% spill the spring and 50% during the summer will occur in 2012 at McNary Dam. Testing will begin in late April and continue through mid-July. The dates of testing will be dependent on the size and availability of fish for tagging. Final dates for testing will be coordinated through the SRWG. Spill patterns as described in FPP Section 5 will be used.
- Objectives of the biological test: The objectives of the test are to assess passage distribution and efficiency metrics, forebay retention and tailrace egress times, and dam survival for yearling Chinook, juvenile steelhead, and subyearling Chinook to determine if juvenile dam survival at 40% (spring) and 50% (summer) spill under the current project configuration meets or exceeds the juvenile dam survival performance standard for spring (96%) and summer (93%) migrants specified in the 2010 Supplemental BiOp.

Operational Considerations:

- Juvenile fish collected at McNary during the spring FOP implementation period 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.
- All extended-length submersible bar screens (ESBSs) at McNary will be installed by April 15 as agreed to in consultation with FPOM, the Tribes, and NOAA. This is part of the Corps' consideration of lifting (or waiting to install) some turbine intake screens during periods of significant juvenile lamprey passage. Effects to both

salmon and lamprey have been considered. Although there are some adverse impacts to migrating salmon from this delay in screen installation, regional sovereigns have considered this acceptable in balancing the needs of multiple species.

- Spill will be curtailed as needed to allow safe operation of fish transportation barges near collection facilities downstream of the project.
- During the periods when total river flow 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 at total river flow of less than 320 kcfs.
- Unit outages may occur for required or emergency unscheduled maintenance activities described in FPP Appendix A. Dates are subject to change.

John Day

Spring Spill Operations April 10 through June 30: 30% spill 24 hours per day will begin on April 10 and continue until testing begins on approximately April 27. During the test, spill 30% and 40% 24 hours per day for the remainder of spring. Spill levels will alternate between 30% and 40% spill in 4-day blocks with two-day treatments. Spill level changes will occur at 0600 hours.

Summer Spill Operations July 1 through August 31: Spill operations will continue from spring at 30% and 40% spill 24 hours per day and continue through approximately July 20. Spill levels will alternate in a four-day block with two-day treatments (30% or 40% spill). Spill treatment changes will occur at 0600 hours. Once performance standard testing concludes, 30% spill 24 hours per day will begin approximately July 20 and continue through August 31.

Changes in Operations for Research Purposes:

- Research operations: Performance standard testing at 30% and 40% spill will occur in spring and summer 2012 at John Day Dam. Testing will begin in late April and continue through mid-July. 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. Spill patterns contained in FPP section 4 will be used.
  Objectives of the biological test: The objectives of the test are to assess passage distribution and efficiency metrics, forebay retention and tailrace egress times, and dam survival for yearling Chinook, juvenile steelhead, and subyearling Chinook to determine if juvenile dam survival at 30% and/or 40% spill under the current project configuration meets or exceeds the juvenile dam survival performance standard for spring (96%) and summer (93%) migrants specified in the 2010 Supplemental BiOp.

Operational Considerations:

- Spill operation treatments may be rearranged within a week throughout the season. If rearrangement of treatment occurs, the total number of each spill level treatment for the spring season will not change. The flexibility to rearrange treatments during periods of higher power demand may alleviate the need to declare a power emergency.

- Unit outages may occur for required or emergency unscheduled maintenance activities described in FPP Appendix A. Maintenance dates are subject to change.
- Unit outages and spillway outages may also be required to repair hydrophones and other research equipment. These will be coordinated through FPOM and TMT as needed.

The Dalles

Spring Spill Operations April 10 through June 30: 40% spill 24 hours per day.

Summer Spill Operations July 1 through August 31: 40% spill 24 hours per day.

Changes in Operations for Research Purposes:

- Research operations: Performance standard testing at 40% spill will occur in summer 2012 at The Dalles Dam. Testing will begin in June and continue through mid-July. The dates of testing will be dependent on the size and availability of fish for tagging. Final dates for testing will be coordinated through the SRWG. Spill patterns developed for use with the spillwall and included in FPP section 3 will be used.
- Objectives of the biological test: The objectives of the test are to assess passage distribution and efficiency metrics, forebay retention and tailrace egress times, and dam survival for subyearling Chinook to determine if juvenile dam survival at 40% spill under the current project configuration meets the juvenile dam survival performance standard for summer migrants (93%) specified in the 2010 Supplemental BiOp.

Operational Considerations:

- If total river flow is between 90 and 150 kcfs, the spill percentage could range from 38.6 to 41.4 percent; if the total river flow is between 150 and 300 kcfs, the spill percentage could range from 38.9 to 41.2 percent; if the total river flow is between 300 and 420 kcfs, the spill percentage could range from 38.4 to 41.0 percent.
- At no time is spill recommended on the south side of the spillway (Bays 9-23) as this creates a poor tailrace egress condition for spillway-passed fish.
- Spill bays 10, 11, 13, 16, 18, 19, and 23 are not operational due to wire rope, structural, and concrete erosion concerns.
- The spill pattern in the FPP is based on a nominal Bonneville forebay elevation of 74 feet.
- Unit outages may occur for required or emergency unscheduled maintenance activities described in FPP Appendix A. Maintenance dates are subject to change.

Bonneville

Spring Spill Operations April 10 through June 15: 100 kcfs spill 24 hours per day.

Summer Spill Operations June 16 through August 31: Summer spill operations will alternate every two days between 85 kcfs/121 kcfs and 95 kcfs 24 hours per day. The alternating operation will begin at 0430 hours approximately June 16 and continue through July 20. Spill changes will occur according the daytime spill schedule contained in Table BON-5 in FPP section 2. Spill at 85 kcfs/121 kcfs and/or 95kcfs/95 kcfs will be unconstrained by the Camas/Washougal fixed monitoring TDG station. Following the alternating spill operation, a 75 kcfs/Gas Cap operation (managed using the Camas/Washougal fixed monitoring TDG station) will begin on July 21 and continue through August 31.

Changes in Operations for Research Purposes:

- Research operations: Performance standard testing at 85 kcfs/121 kcfs and 95 kcfs spill 24 hours per day will occur in summer 2012 at Bonneville Dam. Testing will begin in June and continue through mid-July. The dates of testing will be dependent on the size and availability of fish for tagging. Final dates for testing will be coordinated through the SRWG. Spill patterns as described in FPP section 2 will be used.
- Objectives of the biological test: The objectives of the test are to assess passage distribution and efficiency metrics, forebay retention and tailrace egress times, and dam survival for subyearling Chinook to determine if juvenile dam survival at either 85 kcfs/121 kcfs and/or 95 kcfs 24 hours per day spill under the current project configuration meets the juvenile dam survival performance standard for summer migrants (93%) specified in the 2010 Supplemental BiOp.

Operational Considerations:

- High flow conditions in 2011 moved rock and large boulders into the Bonneville spillway stilling basin. If left in place, the rock and boulders would cause significant erosion and damage to the stilling basin due to ball milling during spill. For dam safety, before spill for juvenile fish passage occurs in April 2012, this material will be removed from the stilling basin. The schedule is to complete removal of material from the stilling basin by April 1, 2012. This has been coordinated through FPOM and any schedule delays impacting the initiation of spill will be coordinated through the FPOM and TMT.
- Minimum spill level is 50 kcfs; however, as in past years, under extreme low flow conditions lower spill levels may be considered and coordinated through the TMT. This is to provide acceptable juvenile fish egress conditions in the tailrace.
- During spring, at a total river flow of less than about 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. second powerhouse corner collector, first powerhouse sluiceway).

- The TMT will consider the possible effects of TDG on emerging chum salmon downstream of Bonneville Dam. The TMT may request special operations such as flow increases or spill reductions to protect ESA-listed fish.
- Unit outages may occur for required or emergency unscheduled maintenance activities described in FPP Appendix A. Maintenance dates are subject to change.
- Actual spill levels at Bonneville Dam may range from up to 3 kcfs lower or higher than specified in Table 2. 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 flow) will operate from the morning of April 10 through the remainder of the spill season as coordinated through the FPOM.
- High river flow and excessive debris load at the second powerhouse may require removal of submersible traveling screens (STSs) and vertical barrier screens (VBSs) according to criteria described in FPP Section 2 in coordination with the FPOM.

TRANSPORT AND LATENT MORTALITY RESEARCH

Seasonal Effects of Transport

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 4, with marking beginning on April 5. 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 4,000 - 6,000 wild steelhead weekly for approximately eight weeks.

Latent Mortality

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 approximately April 20, with the goal of tagging approximately 74,000 smolts of which 45,000 will be released into the tailrace of Lower Granite Dam, and 29,000 transported by truck and released in the tailrace of Ice Harbor Dam.

EMERGENCY PROTOCOLS

The Corps and the Bureau of Reclamation will operate the projects in emergency situations in accordance with the WMP Emergency Protocol (WMP Appendix 1). This protocol identifies the process the Action Agencies will use in the event of an emergency concerning the operation of FCRPS that impacts planned fish protection measures. The most recent version of the Emergency Protocols is located at: http://www.nwd-wc.usace.army.mil/tmt/documents/wmp/2010/final/emerproto

COORDINATION

To make adjustments in response to changes in conditions, the Corps will utilize the existing regional coordination committees. Changes in spill levels when flow conditions are higher or lower than anticipated will be coordinated through the TMT. This could include potential issues and adjustments to the juvenile fish transportation program. Spill patterns and biological testing protocols that have not been coordinated to date will be finalized through the Corps' AFEP subcommittees, which include the SRWG, FFDRWG, and FPOM.

REPORTING

The Corps will provide periodic in-season updates to TMT members on the implementation of 2012 fish passage operations. The updates 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 updates 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), and 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 hour: 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 hour, 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 will calculate both the highest and highest consecutive 12-hour average TDG levels daily for each station. These averages are reported at:

http://www.nwd-wc.usace.army.mil/ftppub/water_quality/12hr/wa/

Appendix F - 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.

1. 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.

2. 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.

3. 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.

4. 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.

5. 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.

6. 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.

7. 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.

8. 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.

9. 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.

10. 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 Facility Trapping Operations at 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. Researchers shall perform no maintenance on Corps owned/installed equipment. Nets may be mended as necessary.

1.10. Qualified users may lower the main ladder picket leads and downstream exit bulkhead when they arrive, and must raise the picket leads when they are completed for the day. The downstream exit bulkhead may be left down when shad and lamprey are attempting to pass.

1.11. Users will be permitted to operate valves 9 and 10 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.

1.12. Users must use a cotton mesh net, large enough to safely handle the largest fish passing the project during the trapping period.

1.13. Fish greater than 100 cm in length may be diverted into the main anesthetic tank or returned to the ladder untouched. These fish will not be diverted into any auxiliary anesthetic tanks.

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. Lamprey may be held up to 48 hours in the AFF. Researchers will notify Project Fisheries and the Control Room whenever lamprey are held.

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. 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.

2.5. 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 six 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 Chinook or steelhead or two sockeye 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. Four picket leads will be allowed during trap operations for up to 4 hours. After all picketed leads are raised, fish already in the AFF can be sampled for an additional one hour. The picketed lead operations are as follows. (**All counts are adult salmonids as enumerated at the Washington Shore count station for the previous day. Assumes that 4 shad = 1 salmonid*):

- **A. zero – 6,000* -** All 4 picket leads can be lowered for 4 continuous hours.
- **B. 6,000 -12,000* -** All 4 picket leads down for 3 hours. At the 3rd hour raise at least one picket lead for ½ hour, and then continue sampling for an additional 1 hour.
- **C. 12,000 -18,000* -** All four picket leads down for 2 hours. At the 2nd hour raise at least 2 picket leads for ½ hour, and then continue sampling for an additional 2 hours.
- **D. Greater than 18,000* -** All four picket leads down for 1 hour. At the end of the 1 hour raise at least 2 picket leads for ½ hour, and then continue sampling for 1 hour and raise 2 picket leads for ½ hour. Continue until 4 hours of operations with 4 picket leads down has been achieved.

3.10. Researchers will also be required to monitor the ladder every hour to ensure that crowding is not taking place. If evidence of crowding is occurring at least two picket leads will be raised for a minimum 1/2 hour before all four picket lead may be deployed again.

3.11. FPOM will be notified as soon as Weir 37 violates FPP criteria.

3.12. 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 *US v Oregon* requirements and for nighttime lamprey trapping.

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. Researchers can review temperatures from (insert web based temp address here) to determine if the trap is within temperature criteria prior to traveling to BON. Instantaneous temperatures will still be used to determine if trapping operations will continue for the day.

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. Between 70°F and 72°F, sampling will be permitted as defined below for up to four days per week from 0600-1030 hours to allow for *U.S. v Oregon* requirements and for nighttime lamprey trapping. This operation will remain in effect until daily average water temperatures drop to ≤ 69.9°F. All sampling will cease when temperatures reach 72°F. No sampling may resume until daily average water temperatures drop to ≤ 71.9°F.

4.2.1 Researchers may continue to work through fish in the holding pool for one hour after picket leads have been raised.

4.2.2 FPOM will be notified as soon as Weir 37 violates FPP criteria.

4.2.3 The density criteria for picket lead operations will be reduced by half and the operations will be as follows The density criteria and monitoring of the adult ladder by the researchers as outlined in 3.9.1 also apply. (**All counts are adult salmonids as enumerated at the Washington Shore count station for the previous day. Assumes that 4 shad = 1 salmonid*):

- **A. zero – 3,000* -** All four picket leads can be lowered for four continuous hours.
- **B. 3,000 -6,000* -** All four picket leads down for 3 hours, at the 3rd hour raise at least one picket lead for ½ hour and then continue sampling for an additional one hour.
- **C. 6,000 -9,000* -** All four picket leads down for 2 hours, at the 2rd hour raise at least one picket lead for ½ hour and then continue sampling for an additional 2 hours.
- **D. Greater than 9,000* -** All four picket leads down for one hour, at the end of the hour raise at least 2 picket lead for ½ hour and then continue sampling for one hour and raise 2 picket lead for ½ hour. Continue until four hours of four picket lead operation has been achieved and all picket leads need to be raised by 10:30 am.

4.2.4 There will be no more than three adult Chinook or steelhead or four sockeye in the anesthetic tank at a time. A combination of salmonids is allowed, with the maximum of either two Chinook or steelhead and a sockeye or one Chinook or steelhead and two sockeye. This assumes users can effectively track the length of time fish stay in the anesthetic tank.

4.2.5 The brail pool is the primary and preferred recovery pool.

4.2.6 The small recovery tank will only be used in emergencies. If used, there will be no more than one adult Chinook or steelhead or two sockeye allowed in the small recovery tank at any one time.

4.2.7 If used, water in the small recovery tank will be running continuously allowing a constant exchange of water through the tank.

4.2.8 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.

4.2.9 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.

4.2.10 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.

4.2.11 Personnel shall ensure fish are fully recovered from anesthetization prior to release. Fish may volitionally leave the brail pool when they are ready.

4.2.12 Project biologists retain the authority to raise additional picket leads depending on fish densities and ladder conditions.

5. Winter trapping protocols - 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.

Appendix G Protocols for Adult Fish Facility Trapping Operations at 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 Fish Passage Season (March 1 - December 15) when Fish Ladder Water Temperatures are < 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 Fish Passage Season (March 1 - December 15) when Fish Ladder Water Temperatures are ≥70°F and ≤ 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.

Appendix G Protocols for Adult Fish Facility Trapping Operations at 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. Notification Required For Work During Regular Business Hours (Monday through Thursday, 0630 to 1700 hours). 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. Notification Required For Work During All Other Hours (Monday through Thursday, 1700 to 0630 hours, or anytime from Friday through Sunday). 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 in advance. Users may 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 Fish Passage Season (March 1 - December 15) when Fish Ladder Water Temperatures are < 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. Refer to section 2.3.2.2.n "Adult Trap Holding Tanks" in the 2009 Fish Passage Plan for further information on the operation of the adult fish trap.

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 Fish Passage Season (March 1 - December 15) when Fish Ladder Water Temperatures are ≥ 70°F and ≤ 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.

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.

OPERATING GUIDANCE #14

Fish Protection Procedures for Turbine Maintenance

Dworshak O&M Section	Date of Issue: March 2012	Last Revision: 17 November 2011

1. **PURPOSE:** Define operational procedures to minimize the number of fish that can become trapped when unwatering a penstock/scrollcase for annual maintenance, repairs, or overhaul of a power unit. If any fish are trapped, define proper handling procedures and documentation requirements. **These activities will be followed to completion including the fish protection and recovery provisions outlined in this procedure, regardless of overtime requirements**.

2. This procedure provides a general outline of the unwatering 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 unwatering process. Personnel safety provisions are detailed in the appropriate activity hazard analysis. Details of the operational steps for unwatering are covered by separate Operating Procedures. All unwatering efforts will be adhered to in reducing the time incurred throughout the unwatering process.

3. Hydroelectric turbines and water passages must be inspected and serviced periodically. This requires draining the water passages between the emergency (headgate) gates and the tailrace stoplogs. After the water reaches tail water level, the remaining water is drained to an unwatering 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 the numbers of fish involved in the draining process and then to quickly salvage any fish that may have been trapped.

4. The DWR Operations and Maintenance Section will coordinate with the NWW District Operations Technical Support Branch and provide notification at least two weeks if possible in advance of any maintenance requiring unwatering or otherwise potentially affecting fish. District Operations will inform NOAA and other regional fishery agencies through Fish Passage Operations and Maintenance (FPOM) Team standard coordination process when any fish salvage operations are to occur.

5. DWR Operations and Maintenance Section will notify LWG of the need to provide the LWG Fisheries Biologist to lead the planned turbine unit unwatering as soon as possible prior to the date of unwatering. LWG Fisheries Biologist will direct and coordinate the fish protection procedures and the recovery and release process. The exact location for any fish release will be identified and visited just before fish salvage operations begins. If a flume is used, there will need to be flushing flow and the impact velocity with the tailrace will need to be at a level that does not harm fish of the size anticipated in this salvage operation. The LWG Fisheries Biologist will conduct meetings and briefings as necessary to ensure all unwatering team

members are familiar with this Operating Guidance, documenting entrapped fish, and the required ESA safe fish handling and recovery process.

6. LWG Fisheries Biologist directs fish protection and recovery operations with the help of operations and maintenance personnel from the operating project. The LWG Fisheries Biologist may request additional personnel from USFWS Dworshak hatchery personnel to work in concert with and assist with the activity at the discretion of the Dworshak Operations Manager. During the unwatering process, the LWG Fisheries Biologist will be present at the draft tube entry door and will direct and monitor water levels, and fish condition through the final stages of the draft tube unwatering.

7. Several hours before the unit is to be unwatered the DWR 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 unwatering, the mechanics and operators will coordinate to lower the emergency gate and/or install the intake bulkhead. This will isolate the intake water passage from the forebay. A least one day in advance the LWG Fisheries Biologist will ensure that adequate fish recovery equipment and personnel trained in fish handling are available for the unwatering and fish recovery event. Trained personnel to assist in the salvage procedure may come from local fish facilities and/or district operations division.

8. When the turbine unit draft tube is to be unwatered, the operator will coordinate with local agencies (e.g., USFWS personnel from Dworshak Hatchery), RCC, and BPA to run the unit with a full load for 15 minutes to flush the scroll case and the draft tube of fish. In the case of unit 3, full load will not be achieved and 2.5 kcfs will be used to stay within the river rate-of-change restrictions. At pool elevation of 1520' minimum discharge of 3.5kcfs is required to obtain stable operation and reduce gassing, at the same time a small unit would be cut back to allow for the rate of change which is still limited to 1'/hr on ramp up and down. The operator will close the penstock emergency gate (hydraulic headgate) to drain the water out of the penstock down to tailrace water elevation. Once a seal is confirmed by closing the unit wicket gates and monitoring penstock pressure and flow, the mechanics will place the tailrace stoplogs. The process from flushing the remaining water out of the penstock and confirmation of a seal through complete installation of tailrace stoplogs is estimated to take 4-6 hours barring any complications. All efforts in this step will be made to reduce the time involved from flushing to the installation of stop logs via staging equipment, support supplies material and crews. (Units 1&2 have 2 stop logs each and unit 3 has 4 each). If a seal is not obtained, the process, *including flushing*, must be repeated. Installation of the penstock maintenance bulkhead may be accomplished after the tailrace stoplogs are installed.

9. Once seal is confirmed, the operator will open the penstock drain and the draft tube unwatering valve and start draining the draft tube thorough the unwatering sump. At the same time the sump unwatering pumps will be initially reprogrammed to maintain water level in the draft tube to an elevation between 936 to 938 feet, depending on the unit to provide a sanctuary pool. The draft tube is drained by gravity to the unwatering sump, so by restricting the unwatering sump to a minimum elevation of 936 to 938 feet, the draft tube is also restricted to this minimum elevation. The bottom of the draft tube is at an elevation of 929' for unit 3 and 933' for units 1 and 2, creating a large sanctuary pool between 3 to 7 feet deep for any trapped fish. The water level in the draft tube will be monitored remotely from the draft tube access door. At no time will the water level in the unwatering sump drop below 936' or 938' depending on the unit, without all aspects of the fish recovery plan in place to include; recovery devices, insulated transport device, etc. Project personnel will have dip nets, lifting sling, and insulated fish carrying tank, and all other required fish recovery equipment and safety equipment at the unit during the final unwatering process.

10. 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 two unwatering pumps 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, maintenance personnel will place a tube with a bubbling device turned on to provide additional oxygen to any trapped fish. The biologist will deploy sonar into the draft tube capable of viewing fish to determine if a large number of fish are present. If a large number of fish are present, the process will be reversed and the turbine will be readied to be re-run at night when fish are less likely to move into the unit. If an unusually large number of fish are not identified, maintenance personnel will prepare for access into the draft tube.

11. When satisfied all fish recovery preparations are in place, the LWG Fisheries Biologist will authorize the clearance holder to request the water level in the draft tube be lowered to 935 feet for units 1 and 2, and 931.5' for unit 3, a level that allows for safe entry into the draft tube. Upon receiving the clearance holder's request to lower the draft tube water elevation, the shift operator shall contact the LWG Fisheries Biologist to confirm that all fish recovery preparations are complete, and lowering the water level that allows safe entry is authorized. Once the level in the draft tube drops below 935 to 938 feet, the LWG Fisheries Biologist and project maintenance personnel will visually monitor the draft tube water level.

12. When the water is down to a level where entry is safe, approximately two feet in depth, personnel should enter the draft tube through the draft tube access door to inspect for trapped fish. Any live fish will be netted one at a time with a knotless dip net and placed in a lifting sling that is sized to hold the fish and water. The sling will then be lifted vertically to the entry door then transferred directly to large insulated fish carrying tank full of river water with no more than ½ pound of fish per gallon of water in the tank at one time. The container will then be transported to the freight elevator, and be taken to the 1005-foot level erection floor, transferred to the release site as determined by the LWG Fisheries Biologist earlier and released into the tailwater, using a flume if necessary, as determined previously in section 5. All fish handling only once during the process. At all other times the fish transfer will be water to water. Adequate flushing flow must be maintained throughout each step the fish salvage process. If a large number of fish are involved, it may be necessary to remove the salvage personnel, allow a sanctuary pool to refill, allowing the fish to recover from the activity and low oxygen levels.

13. When the LWG Fisheries Biologist 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 shift 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 unwatering sump have been released.

14. Other considerations for fish protection include the following:

- **a.** Annual routine maintenance work windows intended to minimize likelihood of trapping endangered species will be investigated to determine if work can be shifted to a time with less migration of endangered species, although BPA power demands and requirements to control TDG, provide temperature to the river and hatchery along with providing flow augmentation somewhat limit the timing of unit outages. Initially, avoidance of the peak adult fish migration from October thru February. Unwatering work is recommended to occur as soon as possible during the month of September. Adjustments may be considered according to experience.

- **b.** A routine annual maintenance schedule will be submitted to NWW Operations, Technical Support Branch, Adult Fish Passage Coordinator for review.

- **c.** Within 24 hours of Operation and Maintenance activities being completed, fish salvage activities should be documented with a "Record of Fish Salvage Operations". The records should be maintained providing helpful information to predict the numbers of fish to be salvaged in a forthcoming unwatering activity. The records should also contain comments on how well the unwatering and fish recovery activities preceded, any problems encountered, and observations on fish and holding conditions. Submit this report to NWW-OD-T Adult Fish Passage Coordinator.

15. Equipment required for performing this procedure:

- **a.** Hose attached to tailrace deck wash system (river water) for filling fish transfer tanks as needed.
- **b.** Two large fish nets, knotless, one for each worker.
- **c.** Two small fish nets, knotless, one for each worker.
- **d.** Two vinyl slings sized to hold fish and water
- **e.** Headlamps for workers in draft tube.
- **f.** One radio.
- **g.** Waders for workers.
- **h.** Rubber or neoprene gloves for workers.
- **i.** Wristwatches.
- **j.** Thermometers.
- **k.** Hard hats, waders/rubber boots, neoprene gloves and rain gear for personnel entering draft tube.
- **l.** Fish bucket lifting gear (station at entry door).
- **m.** Four wheel carts (2) with 150 gallon fish tanks approximately 1/3 filled with water on each return from the tailrace or industrial water supply. Have supplemental oxygen system, air lines and air stones standing by at same location. The four wheel carts should have a portable source of oxygen and air lines during transport to the release location.
- **n.** Hazardous atmosphere monitoring device for sensing inside the draft tube (at entry door).

o. Record of Fish Salvage Operations

16. Personnel required for performing this procedure:

a. Operators for lift line (lowers and raises fish).
b. LWG Fisheries Biologist.
c. Shift operator (ensures slow and proper timing of draft tube drainage).
d. Four laborers (two inside draft tube to net fish into rubber lifting slings and at least two outside draft tube to transfer fish to release site).

17. Fish Handling Procedures:

a. Establish an unwatering coordinator, usually the LWG Fisheries Biologist.

b. Roll the unit for about 15 minutes before lowering the emergency gate and tailrace stoplogs. (all done within 4-6 hours)

c. Attend a safety meeting and discuss safe operating and Walla Walla District ESA fish handling policy and procedures. Be sure proper clearance procedures are discussed. Also, the draft tube area should be treated as a confined space.

d. Begin draining the draft tube as described above. This requires several hours.

e. Obtain a tailrace river temperature, draft tube reading.

f. Allow the deck wash system to run until the water temperature matches within 2^{o}F of the river temperature, then fill the fish transport tanks with this water.

g. Ensure that unwatering is done very slowly once the water is about two feet deep. Mechanics and LWG Fisheries Biologist will monitor water level throughout the unwatering process.

h. Two workers enter the draft tube.

i. Net fish into fish slings and lift them out of the draft tube via the rope hoist. Nets should be knotless and no more than one fish should be in a net at one time. When it is necessary to transport fish in sanctuary bags, ensure the bags contain a sufficient amount of water and that fish return to fresh water as soon as possible. Pour fish into the fish transfer tank. The LWG Fisheries Biologist will determine if water should be refreshed and if oxygen is needed by monitoring the overall fish condition. Generally from the draft tube to release in the river tailrace, it should take no more than 6 to 8 minutes to capture, transport and release a fish.

j. The LWG Fisheries Biologist monitors the number of fish in the transfer tank and, considering the water temperature and holding time, determines when the fish should be taken to the tailrace to be released to the river. Fish placed in tanks and containers will not exceed ½ pound per gallon of water and will be released as soon as possible.

k. When the fish transfer tank exits the powerhouse, use the deck wash system to refresh the water and/or adjust the water temperature as needed. Ensure that the water temperature in the tank, the deck wash system, flume flushing water is within 2^{o}F of the river temperature. May use frozen river ice in maintenance of water conditions during the transport of fish to the tailrace.

l. Fish should not be netted twice (once in the salvage location and not again at the release site). The preferred method of releasing fish should to the tailrace flume or river via water to water transfer.

m. Complete the Record of Fish Salvage Operations (attached at end of this document). This is a permanent record.

RECORD OF FISH SALVAGE OPERATIONS - DWORSHAK DAM

	Activity	Date	Time
LWG Fisheries Biologist in Charge:	Emergency Gate in Place		
Other Personnel:	Tailrace Stoplogs Installed		
	Draft Tube Door Open		
	Fish Recovery Begins		
	Fish Recovery Complete		

Purpose of un-watering:

River Temperature:
(Note: Temperature of containers to be maintained within 2°F of river temperature.)

Problems/Comments:

SPECIES AND COUNTS OF FISH RELEASED TO TAILRACE

Species	Female		Male		Comments
	Clipped	Un-clipped	Clipped	Un-clipped	

SPECIES AND COUNTS OF FISH MORTALITIES

Species	Female		Male		Comments
	Clipped	Un-clipped	Clipped	Un-clipped	

**Submit this report to NWW-OD-T Adult Fish Passage Coordinator within 24 hours of fish recovery.
FPOM must be notified immediately of any fish mortalities.

Appendix J Bonneville Dam Protocols for Juvenile Monitoring Facility Operations

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.

1.1. Sample rates should not exceed 25% unless collecting fish for research when temperatures are below 70°F.

1.2. Personnel conducting research or monitoring must be present at the facility to monitor the separator bars for debris and stranded fish.

1.3. The Corps reserves the right to terminate trapping operations at any time.

1.4. Project Biologists will use the Corps temperature probe reading as the official temperature. Temperatures are taken in the general holding tank and are both instantaneous readings and 0000 to 2400 daily averages.

2. General Requirements for JMF Users. All personnel conducting research or monitoring in the JMF will implement the following requirements.

2.1. Users must have appropriate documentation for conducting research at the dam. (See *Guide for Researchers at Bonneville Dam*).

2.2. 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.**

2.3. JMF personnel will be trained in the proper operation of the JMF to insure fish and personnel safety. Users may request training through the Project Biologists.

2.4. Hard hats are to be worn outside at all times.

2.5. Long pants or raingear are to be worn at all times. Shorts will not be permitted in the lab.

2.6. Steel-toed shoes or rubber boots will be worn at all times. No tennis shoes or sandals are permitted.

2.7. If JMF users supply the Project Biologists with a season schedule, it will not be necessary to notify Project Biologists upon arrival and departure.

2.8. Users may coordinate with Smolt Monitoring Program (SMP) personnel regarding sample rates.

2.9. Users are permitted to routinely operate flushing valves, fish lifts, and release pipes/valves within the monitoring building.

2.10. Any modifications to the building or equipment will first be approved by Bonneville Project through Project Fisheries.

2.11. All anesthetic water will be emptied into the sewage lift station after running through the activated charcoal filters.

2.12. 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.

2.13. The lower switchgate is in automatic control. Users will monitor and report to Project biologists any problems with the lower switchgate.

2.14. 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.

2.15. 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.

2.16. Avian cannons will be operated 24 hours per day from March 1 through November 1.

2.17. Project operators and mechanics are responsible for starting and stopping avian cannons.

3. <u>Operations in Sample Mode (typically Fish Passage Season March 1- November 30).</u>

3.1. During August, avian SMP personnel will operate the sampling facility as part of the SMP and to collect fish for regionally-approved research.

3.2. Research updates and equipment or sampling trouble reports will go through the Project Biologists to the FPOM Coordination Team.

3.3. JMF personnel will monitor the JMF continuously while in sample mode to ensure proper functioning and to provide quick response to an emergency while the JMF is in sample operation.

3.4. 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.

3.5. During August, avian cannons may be shut off if Project Biologists observe no predatory birds at the outfall and coordinate through FPOM.

3.6. 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.

3.7. JMF personnel will observe video monitors at least every 1/2 hour or continuously, and manually inspect every two hours or more frequently according to trash sweep operation or other debris potential.

3.8. JMF personnel shall monitor kelt passage over the separator.

4. Sampling at Water Temperatures > 70°F.

4.1. Daily average river temperatures will be obtained from the Corps website at: http://www.nwd-wc.usace.army.mil/tmt/documents/ops/temp/string_by_project.html.

4.2. Daily Index sampling will be reduced to every other day index/condition monitoring.

4.3. The upper switchgate is used to select between sample and bypass mode.

4.4. Sample sizes will be reduced to approximately 100 fish per day.

4.5. Monitoring for Gas Bubble Trauma (GBT) symptoms will continue.

4.6. Project Fisheries will use the Project temperature probe in the sample holding tank for official reporting requirements, instantaneous temperatures, and when web-based temperatures are unavailable.

4.7. An instantaneous temperature of 70°F or greater taken between 0630 and 0700 hours will trigger a change in sampling mode after Project Fisheries notify SMP Biologists.

4.8. Normal index sampling may resume when the daily average temperature decreases to ≤ 69.5°F.

4.9. If there is a research need to sample at temperatures above 70°F, coordination with FPOM will be initiated by the researcher through the District POC.

4.10. If the SMP and Project Fisheries Biologists suspect a bypass system problem during a high temperature sampling period, additional sample collection may occur. FPOM will be notified ASAP and provided with updates as problem resolution attempts proceed.

5. Operation in Bypass Mode (or when PDS monitors are not present).

5.1. The upper switchgate will be in bypass mode.

5.2. The Emergency fish release valve will be open.

5.3. All rotating gates will be set to bypass.

5.4. The bypass flume gate will be raised.

5.5. Project Biologists will inspect the facility daily.

6. System Failures.

6.1. 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.

6.2. If a high or low water situation occurs in the PDS area, operate as follows:

6.2.1. Contact the control room immediately.

6.2.2. Switch the upper switchgate to bypass mode until the problem is corrected.

6.2.3. Immediately open the emergency fish release valve.

6.2.4. Raise bypass flume gate. **DO NOT ADJUST ANY WEIRS.**

6.3. If a monitoring facility failure occurs, operate as follows:

6.3.1. Open the emergency fish release valve.

6.3.2. Switch the upper switchgate to bypass mode until the problem is corrected.

6.3.3. Raise the bypass flume gate.

6.3.4. Begin fish salvage operations.

6.4. 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.

6.5. If a problem with either the 2-way or 3-way rotating gates is discovered (e.g., stuck open or partially open), the response protocol is as follows:

6.5.1. Switch the upper switchgate to bypass.

6.5.2. Open the emergency fish release valve.

6.5.3. Turn off the air to the rotating gate and manually rotate the half-round pipe section to the bypass position.

6.5.4. 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.**

6.5.5. 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.

6.5.6. 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 John Day Dam Protocols for Smolt Monitoring Facility Operations

1. General. The following protocols will be implemented by agencies conducting research in the John Day Dam Smolt Monitoring Facility (SMF). 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.

1.1. Sample rates should not exceed 25% unless collecting fish for research when water temperatures are below 70°F.

1.2. 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.

2.1. Users must have appropriate documentation for conducting research at the dam. (See *Guide for Researchers at John Day Dam*).

2.2. 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.**

2.3. Hard hats are to be worn outside at all times.

2.4. Long pants or raingear will be worn at all times. Shorts or sweats are not permitted in the lab.

2.5. Steel-toed shoes or rubber boots will be worn at all times. No tennis shoes or sandals are permitted.

2.6. If users supply Project Biologists with a season schedule, it will not be necessary to notify Project Biologists upon arrival and departure.

2.7. Users may coordinate with Smolt Monitoring Program (SMP) personnel regarding sample rates.

2.8. Users are permitted to routinely operate flushing valves and release pipes/valves within the monitoring building.

2.9. Any modifications to the building or equipment will first be approved by The Dalles/John Day/Willow Creek Project through Project Fisheries.

2.10. All anesthetic water will be emptied into the activated charcoal filters tanks.

3. Operation in Sample Mode (typically Fish Passage Season)

3.1. SMP personnel will operate the sampling facility as part of the SMP and to collect fish for regionally-approved research.

3.2. Research updates and equipment or sampling trouble reports will go through the Project Biologists to FPOM.

4. Sampling at Water Temperatures > 70°F.

4.1. Daily average river temperatures will be obtained from the Corps website at: http://www.nwd-wc.usace.army.mil/tmt/documents/ops/temp/string_by_project.html.

4.2. Daily 24-hour Index sampling will be reduced to twice weekly every other day index/condition monitoring from 0700 to 1300 hours. Mondays and Thursdays are preferred.

4.3. The switchgate is used to select between sample and bypass mode.

4.4. Sample sizes will be reduced to approximately 100 fish per day.

4.5. Project Fisheries will use the Project temperature probe in the sample holding tank for official reporting requirements, instantaneous temperatures, and when web-based temperatures are unavailable.

4.6. An instantaneous temperature of 70°F or greater taken between 0630 and 0700 hours will trigger a change in sampling mode after Project Fisheries notifies SMP Biologists.

4.7. Normal index sampling may resume when the daily average temperature decreases to ≤ 69.5°F.

4.8. If there is a research need to sample at temperatures above 70°F, coordination with FPOM will be initiated by the researcher through the District POC.

4.9. If the SMP and Project Fisheries biologists suspect a bypass system problem during a high temperature sampling period, additional sample collection may occur. FPOM will be notified ASAP and provided with updates as problem resolution attempts proceed.

5. Operation in Bypass Mode.

5.1. All rotating gates will be set to bypass.

5.2. Project Biologists will inspect the facility every two hours.

5.3. If the full-flow PIT-tag detector is found to be effective, the switch gate will be moved to bypass.

6. <u>System Failures</u>.

6.1. 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.

6.2. If a problem with either the 2-way or 3-way rotating gates is discovered (e.g. stuck open or partially open), the response protocol is as follows:

6.2.1. Contact the Project Biologist, or if that is not possible, the control room operator. Project personnel (SMF Biologist) will request maintenance crews. Repairs should commence within four hours of discovering the problem.

6.2.2. Once all fish safety issues have been addressed and repair requests have been made, the problem should be thoroughly documented in writing and e-mailed to Project Biologists prior to sending to other interested parties.

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)
BON	Bonneville Lock and Dam
BPA	Bonneville Power Administration
BRZ	Boat Restricted Zone
CBFWA	Columbia Basin Fish and Wildlife Authority
CBT	Columbia Basin Teletype
CENWP	Corps of Engineers (CE), Northwestern Division (NW), Portland District (P)
CENWW	Corps of Engineers (CE), Northwestern Division (NW), Walla Walla District (W)
CENWW-OD-T	Walla Walla District (W), Operations Division (OD), Technical Support Branch (T)
CFS	Cubic Feet per Second
CI	Cascades Island (BON)
COE	Corps of Engineers
CRITFC	Columbia River Inter-Tribal Fish Commission
DSM	Downstream Migrant (Channel)
DST	Daylight Savings Time
DWR	Dworshak Dam
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

ACRONYMS	
FFU	Fisheries Field Unit
FG	Fish Gate
FGE	Fish Guidance Efficiency
FPC	Fish Passage Center
FPE	Fish Passage Efficiency
FPOM	Fish Passage Operations & Maintenance 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 (BON)
JP	Junction Pool
JSAT	Juvenile Salmon Acoustic Telemetry
kcfs	One-thousand cubic feet per second
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

ACRONYMS	
NFH	National Fish Hatchery
NOAA Fisheries	National Oceanic & Atmospheric Administration's National Marine Fisheries Service (also referred to as NMFS)
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 (PIT-tag)
PLC	Program Logic Controller
PSMFC	Pacific States Marine Fisheries Commission
PST	Pacific Standard Time
PUD	Public Utility District
RCC	Reservoir Control Center (COE)
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

ACRONYMS	
SPO	Special Project Operations
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 or Top 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