2014 Fish Passage Plan

U.S. Army Corps of Engineers

Lower Columbia & Lower Snake River Hydropower Projects

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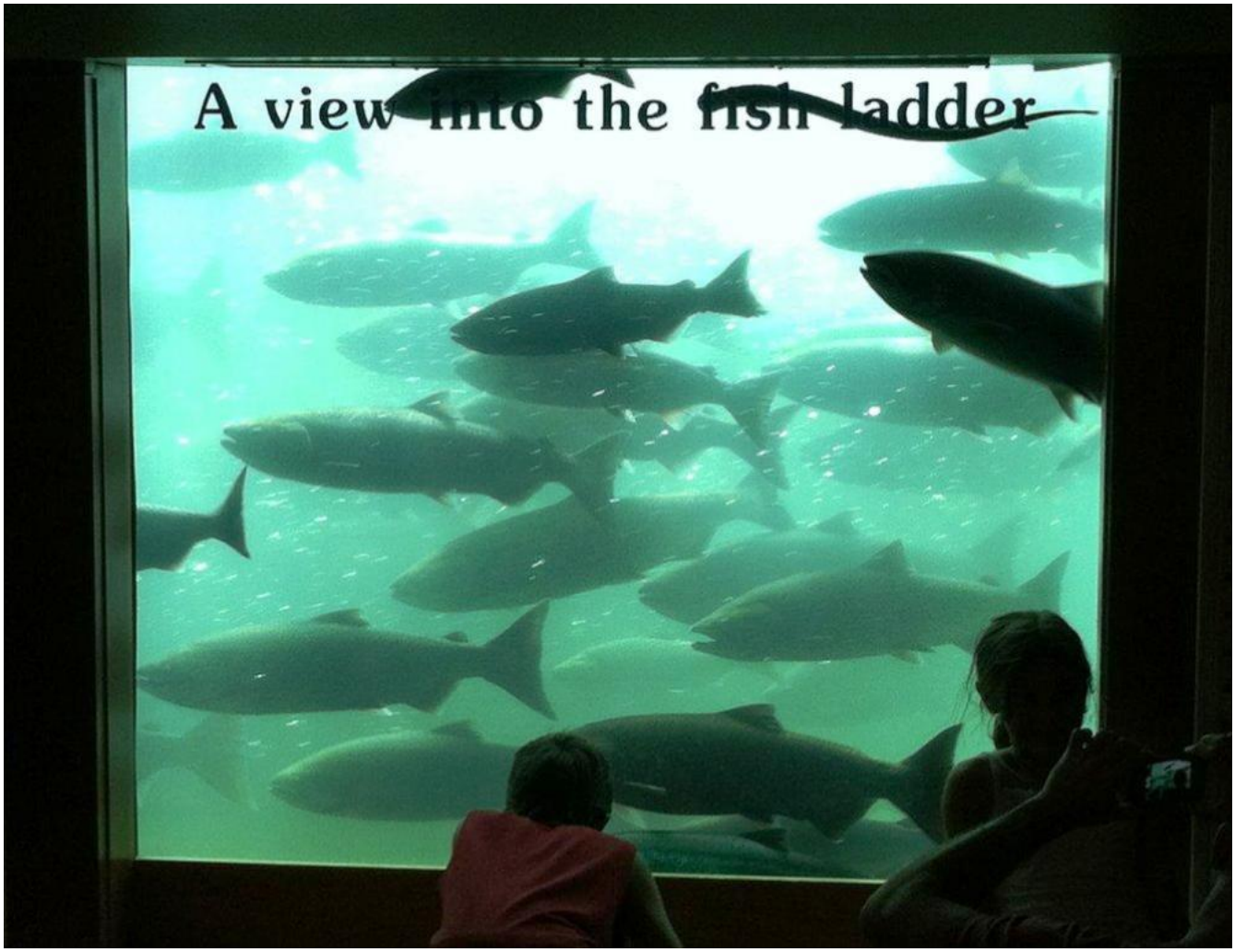

March 1, 2014 – February 28, 2015

Photo: Bonneville Dam Adult Fish Ladder (Bernard Klatte, COE-NWP)

2014 Fish Passage Plan

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2014 Fish Passage Plan

Section 1 – Overview

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1. FISH PASSAGE PLAN (FPP) OVERVIEW

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, State and Tribal fish agencies, the Bonneville Power Administration (BPA), and other regional partners through the Corps' Fish Passage Operations & Maintenance (FPOM) coordination team. The FPP describes year-round operations and maintenance (O&M) activities at Corps mainstem hydroelectric projects in the Federal Columbia River Power System (FCRPS; **Figure OVE-1**) that are coordinated through FPOM to protect and enhance anadromous and resident fish species listed as endangered or threatened under the Endangered Species Act (ESA), as well as non-listed species of concern (e.g., lamprey, sturgeon). The FPP guides Corps actions to provide fish protection and passage at eight Corps projects on the mainstem lower Columbia and lower Snake rivers, at Chief Joseph Dam on the upper Columbia River and at Dworshak Dam on the North Fork Clearwater River. Other Corps documents and agreements related to fish passage at these projects are consistent with the FPP.

Pursuant to the ESA Section 7, NOAA Fisheries issued a Biological Opinion (BiOp) on May 5, 2008, on the effects of FCRPS operations on ESA-listed anadromous fish species that included a Reasonable and Prudent Alternative (RPA) suite of recommended actions and strategies. The 2008 FCRPS BiOp was supplemented on May 20, 2010, with new information and an Adaptive Management Integration Plan (AMIP), and again on January 17, 2014, with review of new and updated scientific reports and data, additional project definitions, analyses and amended RPA actions. The U.S. Fish & Wildlife Service (USFWS) issued a BiOp on effects of the FCRPS on ESA-listed resident fish species (e.g., bull trout, white sturgeon) in 2000 and supplemented in 2006. In response to the FCRPS BiOps, the Corps prepared Records of Consultation and Statement of Decision (ROCASOD) to document Corps decisions to implement the actions and operate the FCRPS in a manner that enhances survival and recovery of ESA-listed fish species as well as other regionally important fish species. The BiOps, decision documents and other related information are available online at: http://www.salmonrecovery.gov.

The FPP is developed in accordance with the NOAA FCRPS BiOp RPA Action 32 as part of the hydropower strategy of operating and maintaining fish passage facilities to maintain biological performance. Key elements of the FPP include:

- **i.** Operate according to project-specific criteria and dates to operate and maintain fish facilities, turbine operating priorities, and spill patterns;
- **ii.** Operate according to fish transportation criteria;
- **iii.** Maintain turbine operations within ±1% of peak turbine efficiency (1% range);
- **iv.** Maintain spill rates and dates for fish passage;
- **v.** Implement TDG monitoring plans;
- **vi.** Operate according to protocols for fish trapping and handling;

vii. Take advantage of low river conditions, low reservoir elevations or periods outside juvenile migration season for repairs, maintenance, or inspections so there is minimal or no effect on juvenile fish;

viii. Coordinate routine and non-routine maintenance that affects fish operations or structures to eliminate and/or minimize fish operation impacts;

ix. Schedule routine maintenance during non-fish passage periods;

x. Conduct non-routine maintenance activities as needed; and

xi. Coordinate criteria changes and emergency operations with FPOM.

The FPP is revised as necessary to incorporate changes to project O&M 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 (**Section 3** below).

Comments on the FPP are welcome and may be sent to FPOM and/or the Corps' Northwestern Division, Reservoir Control Center (RCC) Fisheries Section in Portland, Oregon. Draft and final FPPs from 2000 through present, including all Change Forms, are available online at the *Fish Passage Plan Website*: http://www.nwd-wc.usace.army.mil/tmt/documents/fpp/

1.2. Emergency Deviations from Fish Passage Plan Criteria

River operations emergencies may occur that 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 3** below).

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

1.3. Technical Management Team (TMT)

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). Special operations identified in the FPP will be coordinated through

TMT and identified in the annual *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 peak efficiency range, zero nighttime generation, and implementation of the *Juvenile Fish Transportation Plan* (JFTP; see **Appendix B**).

1.4. Spill for Juvenile Fish Passage

Planned yearly spring and summer spill operations for juvenile fish passage at the eight lower Snake and lower Columbia River projects are defined in the *Fish Operations Plan* (FOP), included in the FPP as **Appendix E**. Spill operations to improve juvenile fish passage are defined in the 2014 Supplemental FCRPS BiOp RPA Action 29 and Table 2.

1.5. Total Dissolved Gas (TDG) Monitoring

The Federal Clean Water Act establishes the total dissolved gas (TDG) aquatic life criteria of 110% that has been adopted by the states of Washington, Oregon, Idaho and Montana. During spill operations for fish passage, Oregon and Washington have authorized exceptions (waiver and rule adjustment, respectively) of 120% in the project tailwater. The Oregon waiver applies to spill for fish passage April 1–August 31. The Washington rule adjustment applies to spill for fish passage year-round and includes a standard of 115% in the next downstream forebay. As such, the Corps monitors TDG levels in the forebay and tailrace of each project to ensure that spill for fish passage is in accordance with State standards.

The annual *TDG Management Plan* (included in the *Water Management Plan* as Appendix 4) provides the most current information regarding State water quality standards and includes detailed explanations of types of spill (e.g., fish passage, lack of turbine, etc.), the process for coordinating and implementing a spill priority list to manage system-wide TDG, the process for setting spill caps, and TDG management policies and monitoring programs. The Corps will coordinate with TMT to develop the spill priority list and to provide ongoing TDG information and reports as necessary.

1.6. System Load Shaping

BPA coordinated development of *System Load Shaping Guidelines Regarding Turbine Operation & Peak Efficiency* (**Appendix C**) to avoid or minimize impacts of hydropower operations on fish. The guidelines define how BPA requests load April 1–October 31 so that the Corps can operate turbine units at fish passage projects within ±1% of peak turbine efficiency (1% range).

1.7. Juvenile Fish Transportation Plan (JFTP)

Juvenile fish will be transported in accordance with the FOP, FPP, and ESA Section 10 permit. Criteria for collection, holding, and transport of juvenile fish are defined in the *Juvenile Fish Transportation Plan* (JFTP), included in the FPP as **Appendix B**. Other operating criteria for juvenile fish bypass facilities are contained in the project-specific **FPP Sections 2–9**. 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. Turbine Dewatering Fish Protection Protocols at Chief Joseph & Dworshak Dams

The Corps has coordinated and adopted procedures to protect fish during dewatering of turbine units for maintenance at Chief Joseph Dam (**Appendix H**) and Dworshak Dam (**Appendix I**). While these projects do not have fish passage capabilities, ESA-listed salmon and steelhead are present in the tailrace and may become trapped in the turbine unit draft tube during dewatering. The procedures and criteria defined in the Appendices provide fish-protection measures to avoid or minimize impacts on ESA-listed salmonids during turbine dewaterings at these projects.

1.9. Lamprey Passage

The Fish Accords were signed in May 2008 and address actions to protect Pacific lamprey and 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 operations for juvenile and adult lamprey are defined in **Appendix D** and in the appropriate project-specific **FPP Sections 2-9**. In-season conflicts between operations for ESA-listed species and Pacific lamprey that are not addressed in the FPP may be reviewed by FPOM and/or TMT.

2. FISH PASSAGE FACILITIES – INSPECTION & REPORTING CRITERIA

Project-specific **FPP Sections 2–9** include detailed inspection and reporting criteria for fish passage facilities at Corps projects. An example of a typical fish passage system is illustrated in **Figure OVE-2**. The Corps provides weekly written inspection reports to NOAA Fisheries Hydropower Program in Portland, Oregon, describing out-of-criteria situations, adjustments made to resolve problems, and a detailed account of impacts on 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 O&M, 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 spillbay 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 of ±1% of peak 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 of ±1% of peak 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

The Corps and BPA 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.

2.3. FPP Implementation & Coordination

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. The Corps evaluates fish operation recommendations to determine impact on overall system operations. See section below regarding TMT coordination.

Corps District and RCC biologists attend monthly FPOM meetings dealing with project-specific issues below (see section below regarding FPOM coordination):

- **i.** Consider recommendations from affected interests;
- **ii.** Provide updates on construction, O&M, research, and other topics;
- **iii.** Develop criteria for the annual FPP;
- **iv.** Coordinate fish passage issues that may require deviation from FPP criteria.

2.4. Agency Responsibilities

2.4.1. U.S. Army Corps of Engineers

- **i.** Coordinate with NOAA Fisheries and USFWS on operations that may impact ESA-listed threatened, endangered, or candidate species;
- **ii.** Prepare annual *Water Management Plan* and seasonal updates in coordination with TMT.

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

iv. 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;

v. Carry out routine and emergency fish passage operations and maintenance procedures in accordance with criteria in **FPP Sections 2-9** and **Appendix A**;

vi. Conduct the TDG Monitoring Program.

2.4.2. Federal, State and Tribal Fishery Agencies

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

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

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

iv. 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;

v. 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;

vi. 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;

vii. 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;

viii. 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;

2.4.3. Bonneville Power Administration

i. 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.

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

iii. 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.

iv. Adjust system generation to provide adequate water for fish operation requirements in accordance with the FOP and relevant FCRPS BiOps.

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

vi. Provide information on unit operations outside ±1% peak efficiency, as defined in **Appendix C**.

2.4.4. Mid-Columbia Public Utility Districts

i. Operate projects for spill transfer in accordance with provisions of the FPP with at least 1.5 hours notification to start or stop spill.

2.5. FPOM Coordination

Pursuant to the 2008 RPA Action 32, project O&M activities included in the annual FPP are regionally 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 printed FPP is published annually on or about March 1 and is effective year-round, though revisions may be approved through FPOM at any time. Proposed revisions are presented to the relevant project's District Operations biologist for consideration by the Corps in an FPP Change Form[1] that includes a description and justification for the change. The Corps will submit Change Forms to FPOM for a minimum of two weeks to review and provide feedback to the Corps POC. Approved Change Forms will be finalized with comments received and a record of the final action, then amended to the current year's online FPP (if finalized after mid-February) or published in the next printed FPP (if finalized before mid-February). The Corps will provide FPP changes to TMT as necessary for use as part of the overall river operation plan. Sections dealing with special operational requirements will also be included in the Action Agency's annual *Water Management Plan*.

[1] Change Form template is available on the FPP website at: http://www.nwd-wc.usace.army.mil/tmt/documents/fpp/

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 O&M activities within the District's Operations Division, project personnel will communicate their needs to a District biologist (or other appropriate personnel) who will compile relevant information into a *Memorandum of Coordination*[2] (MOC) that includes a summary of the activity, location, date, time, analyses of potential impacts to ESA-listed species, and potential alternative actions. The District biologist will submit the MOC to FPOM at the next monthly meeting and/or via email, and then if necessary, follow up with appropriate FPOM members via phone or email. For planned O&M, an MOC should be provided to FPOM for review at least two weeks in advance. For unplanned O&M that is not considered an emergency (e.g., equipment failure) the MOC should be provided to FPOM at least three workdays in advance. Emergency O&M may be performed immediately and the MOC submitted to FPOM as soon as possible either prior to or subsequent to the required activity (see section 1.2 above). FPOM members may submit responses to an MOC by the requested due date via email, phone or in person, and all responses will be documented in the final MOC for distribution to FPOM and posting to the FPOM website. The District biologist will forward the final coordinated operation to project personnel, and if necessary, RCC will issue a teletype.

For research and construction activities involving both the Planning and Operations divisions within a District, the Planning Division biologists will typically lead the coordination effort while keeping Operations Division biologists informed and 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, and/or operational changes, then both Planning and Operations biologists will work closely together and with Project personnel and any others necessary to ensure all personnel are continually informed and updated throughout the process.

Following are some of the individuals involved with the FPOM coordination process, as of February 2014 *(*FPOM chair / ** FPOM co-chair*):

- **i.** Corps Portland District, Operations – Bernard Klatte*, Tammy Mackey, Bob Stansell
- **ii.** Corps Portland District, Planning, Programs & Project Mgmt – Mike Langeslay
- **iii.** Corps Walla Walla District, Operations – Ann Setter**, Greg Moody, Ken Fone, John Bailey
- **iv.** Corps Walla Walla District, Planning, Programs & Project Mgmt – Marvin Shutters

[2] *Memorandum of Coordination* (MOC) template is included at the end of this section.

v. Corps Northwestern Division, Reservoir Control Center – Doug Baus, Lisa Wright

vi. Bonneville Power Administration (BPA) – Scott Bettin, Agnes Lut

vii. NOAA Fisheries – Gary Fredricks, Trevor Conder, Bill Hevlin, Ed Meyer

viii. US Fish & Wildlife Service (USFWS) – David Wills

ix. Columbia River Inter-Tribal Fish Commission (CRITFC) – Tom Lorz

x. Oregon Dept. of Fish & Wildlife (ODFW) – Erick Van Dyke, Kathryn Kostow

xi. Washington Dept. of Fish & Wildlife (WDFW) – vacant

xii. Idaho Dept. of Fish & Game (IDFG) – Russ Kiefer

xiii. Fish Passage Center (FPC) – Dave Benner

2.6. TMT Coordination

Actions that may impact fish system-wide will be coordinated and documented through TMT. 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 as an Appendix to the annual Water Management Plan, available online at: http://www.nwd-wc.usace.army.mil/tmt/documents/wmp/

2.7. 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% peak 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 *Special Project Operations & Studies* (**Appendix A**). When reservoirs are not being operated to provide special protection for fish passage, projects may be operated within the full normal operating range.

2.7.1. Fish Spill Management

The Corps will implement fish spill provisions as described in the *FOP* (**Appendix E**), including special TDG conditions for juvenile fish passage. During spill for fish passage season, TDG levels will be monitored and fish will be evaluated for signs of gas bubble trauma by the Corps, NOAA Fisheries, other fish agencies, Tribes, and/or State water quality agencies. Project spill levels will be adjusted as needed based on daily physical and biological monitoring results, and coordinated with TMT and other relevant agencies and tribes.

2.7.2. Special Operations – Fish-Related Requests/Recommendations

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 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.

2.7.3. 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 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 TMT (Water Management Plan, Appendix 2), will be followed.

2.7.4. Non-Corps Activities

All non-Corps personnel intending to conduct any activity at a Corps facility (e.g., fish handling or minor facility modifications) must have prior written approval from the Corps. This approval must be requested in writing to the Chief, Operations Division, at the appropriate Corps District office that oversees the project. If the activity may 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.

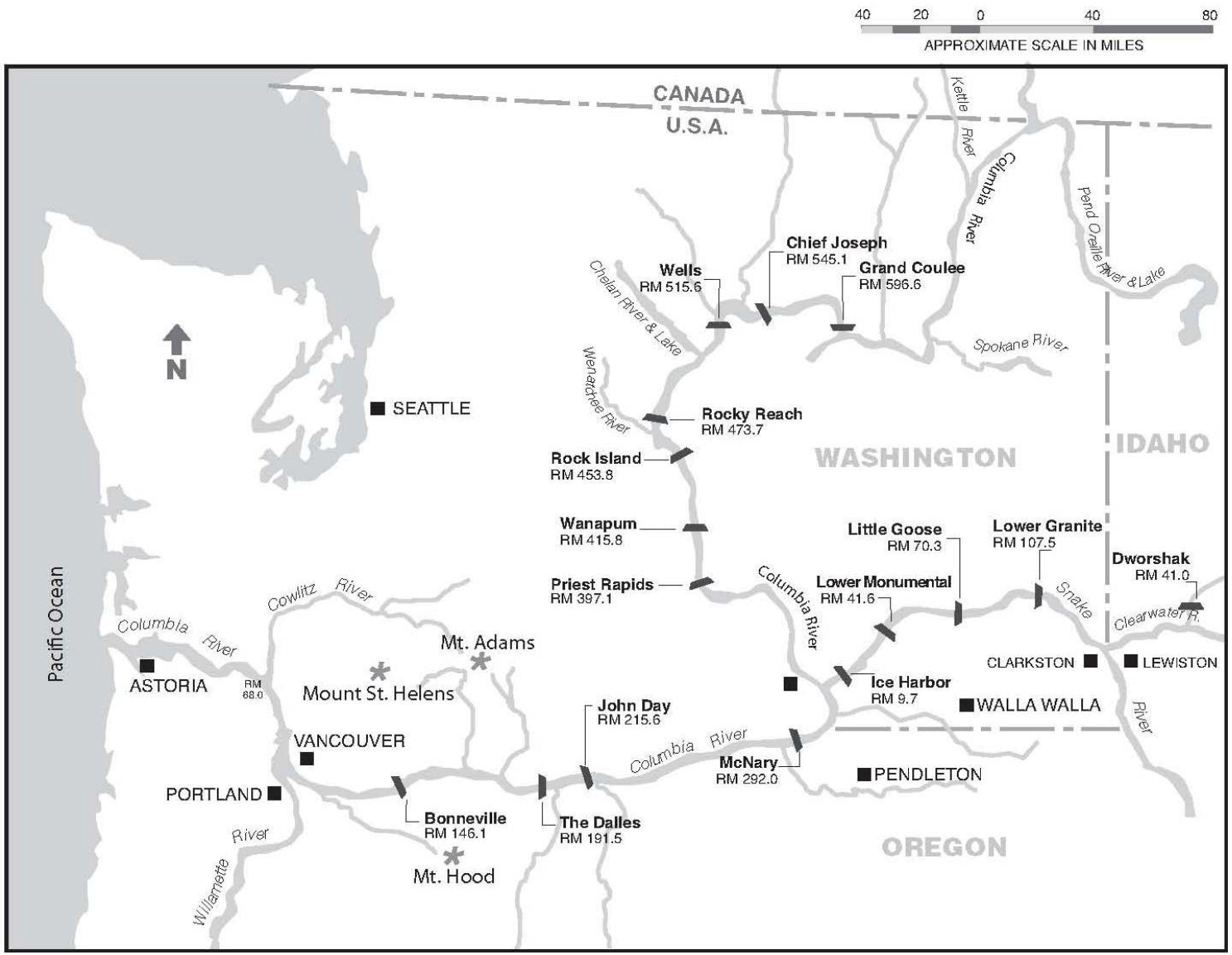

Figure OVE-1. Map of the Federal Columbia River Power System (FCRPS).

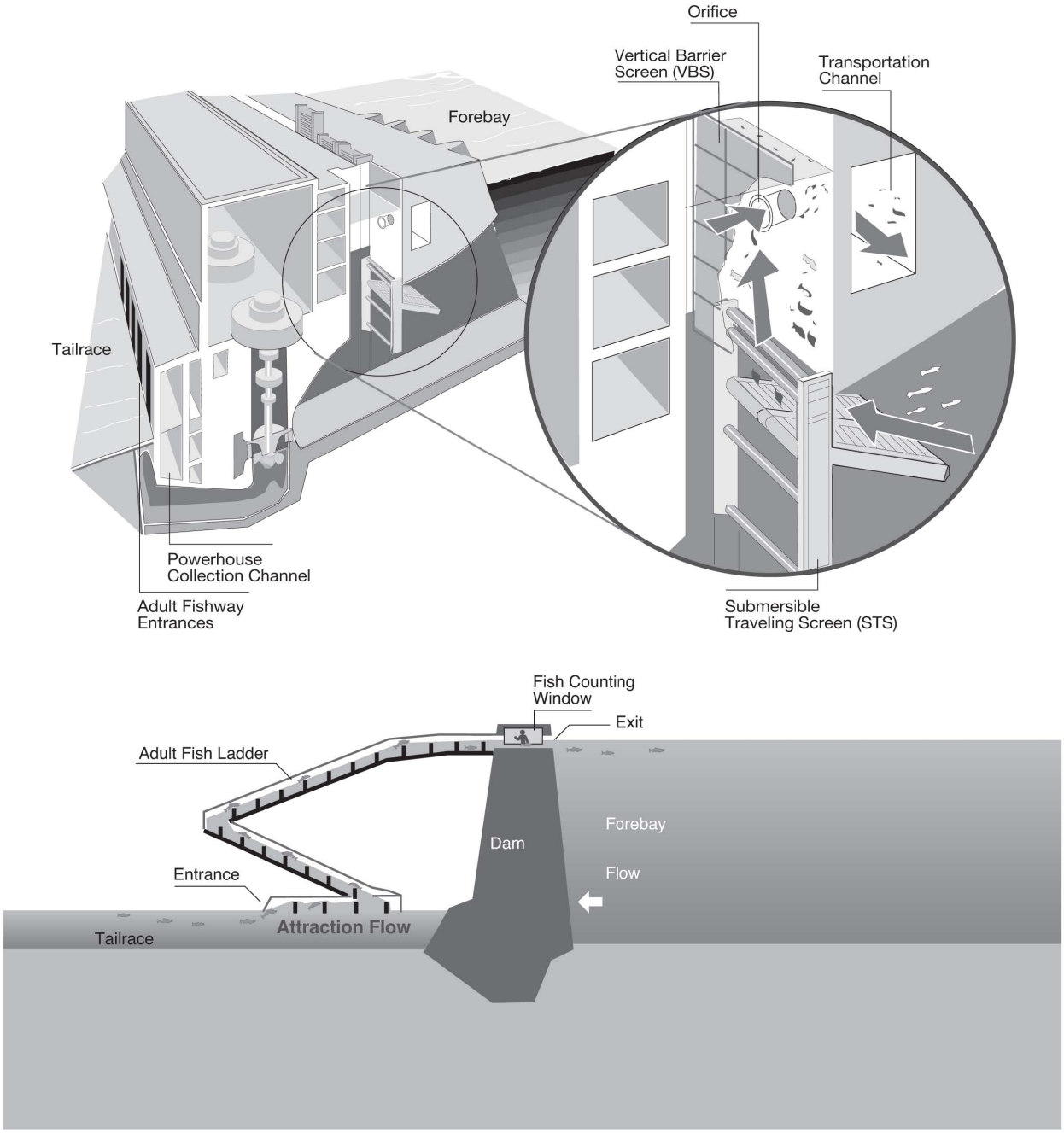

Figure OVE-2 Example Design of Fish Passage Structures at FCRPS Corps Hydropower Projects.

Table OVE-1. Project Information and Operating Criteria for FCRPS Projects on the Lower Columbia and Lower Snake Rivers. [1]

Lower Columbia River				
PROJECT	**Bonneville**	**The Dalles**	**John Day**	**McNary**
Project Acronym [2]	BON	TDA	JDA	MCN
River Mile (RM)	Columbia River - RM 146.1	Columbia River - RM 191.5	Columbia River - RM 215.6	Columbia River - RM 292
Reservoir	Lake Bonneville	Lake Celilo	Lake Umatilla	Lake Wallula
Minimum Instantaneous Flow (kcfs)	80 kcfs	Dec-Feb: 12.5 \ Mar-Nov: 50	Dec-Feb: 12.5 / Mar-Nov: 50	Dec–Feb: 12.5 \ Mar–Nov: 50
Forebay Normal Operating Range (ft)	71.5'-76.5'	155.0'-160.0'	Nov-Jun: 260-265' Jul-Oct: 265-268'	337'-340'
Tailrace Rate of Change Limit (ft)	Apr-Sep: 1.5'/hr, 4'/day Oct-Mar: 3'/hr, 7'/day	3'/hr	3'/hr	1.5'/hr
POWERHOUSE				
Powerhouse Length (ft)	PH1: 1,027' \ PH2: 986'	2,089'	1,975'	1,422'
Turbine Units (#)	PH1: 10 \ PH2: 8 + 2 Fish Units	22 + 2 Fish Units	16	14
Turbine Generating Capacity (MW)	PH1: 535 MW \ PH2: 558 MW	1,808 MW	2,160 MW	980 MW
Powerhouse Hydraulic Capacity (kcfs)	PH1: 136 kcfs \ PH2: 152 kcfs	375 kcfs	322 kcfs	232 kcfs
SPILLWAY				
Spillway Length (ft)	1,450'	1,447'	1,228'	1,310'
Spillbays (#)	18	23	20	22
Spillway Weirs (#)	0	0	2 (Bays 18-19)	2 (Bays 19-20)
Spillway Hydraulic Capacity (kcfs)	1,600 kcfs	2,290 kcfs	2,250 kcfs	2,200 kcfs
NAVIGATION LOCK				
Nav. Lock Length x Width (ft)	675' x 86'	650' x 86'	650' x 86'	683' x 86'
Nav. Lock Maximum Lift (ft)	70'	90'	113'	75'

Lower Snake River				
PROJECT	**Ice Harbor**	**Lower Monumental**	**Little Goose**	**Lower Granite**
Project Acronym *	IHR	LMN	LGS	LWG
River Mile (RM)	Snake River - RM 9.7	Snake River - RM 41.6	Snake River - RM 70.3	Snake River - RM 107.5
Reservoir	Lake Sacajawea	Lake Herbert G. West	Lake Bryan	Lake Lower Granite
Minimum Instantaneous Flow (kcfs)	Dec-Feb: 0 \ Mar-Jul: 9.5 \ Aug-Nov: 7.5	Dec-Feb: 0 \ Mar-Nov: 11.5	Dec-Feb: 0 \ Mar-Nov: 11.5	Dec-Feb: 0 \ Mar-Nov: 11.5
Forebay Normal Operating Range (ft)	437'-440'	537'-540'	633'-638'	733'-738'
Tailrace Rate of Change Limit (ft)	1.5'/hr	1.5'/hr	1.5'/hr	1.5'/hr
POWERHOUSE				
Powerhouse Length (ft)	671'	656'	656'	656'
Turbine Units (#)	6	6	6	6
Turbine Generating Capacity (MW)	603 MW	810 MW	810 MW	810 MW
Powerhouse Hydraulic Capacity (kcfs)	106 kcfs	130 kcfs	130 kcfs	130 kcfs
SPILLWAY				
Spillway Length (ft)	590'	498'	512'	512'
Spillbays (#)	10	8	8	8
Spillway Weirs (#)	1 (Bay 2)	1 (Bay 8)	1 (Bay 1)	1 (Bay 1)
Spillway Hydraulic Capacity (kcfs)	850 kcfs	850 kcfs	850 kcfs	850 kcfs
NAVIGATION LOCK				
Nav. Lock Length x Width (ft)	675' x 86'	666' x 86'	668' x 86'	674' x 86'
Nav. Lock Maximum Lift (ft)	100'	100'	101'	105'

1. Project operating limits and constraints established based on physical plant limitations, legal limits of the authorized purpose(s), and/or to maximize efficiency and benefit of FCRPS reservoir operations. Flexibility of these limits is pursuant to general provisions of the applicable law and any other agreements or contracts. More information available in project-specific sections of the **Fish Passage Plan** and online at:
BON, TDA, JDA - http://www.nwp.usace.army.mil/Locations/ColumbiaRiver.aspx; MCN, IHR, LMN, LGS, LWG - http://www.nww.usace.army.mil/Locations.aspx

2. Project acronym as designated by U.S. Army Corps of Engineers, Northwestern Division, Columbia Basin Water Management Division. Due to the large number of hydropower projects managed by NWD, this acronym may differ from other acronyms used in the region. For example, a common acronym for Lower Granite is LGR. However, this acronym is assigned to another NWD project, thus the official Corps NWD acronym is LWG.

OFFICIAL COORDINATION REQUEST FOR
NON-ROUTINE OPERATIONS & 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,

2014 Fish Passage Plan

Section 2 – Bonneville Dam

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Bonneville Dam

River Mile (RM)	Columbia River – RM 146.1
Reservoir	Lake Bonneville
Minimum Instantaneous Flow (kcfs)	80 kcfs
Forebay Normal Operating Range (ft)	71.5’ – 76.5’
Tailrace Rate of Change Limit (ft)	Apr-Sep: 1.5’/hr, 4’/day Oct-Mar: 3’/hr, 7’/day
Powerhouse Length (ft)	PH1: 1,027’ PH2: 986’
Powerhouse Hydraulic Capacity (kcfs)	PH1: 136 kcfs PH2: 152 kcfs
Turbine Units (#)	PH1: 10 Main Units (1-10 S. Morgan Smith Kaplan) PH2: 8 Main Units (11-18 Allis-Chalmers Kaplan) + 2 Fish Units (Sulzer/Escher-Wyss Kaplan)
Turbine Generating Capacity (MW)	Rated: 1,093 MW (PH1: 535 MW + PH2: 558 MW) Maximum: 1,238 MW (PH1: 600 MW + PH2: 638 MW)
Gatewell Orifice Diameter (in)	12.5” orifices – 2/gatewell at Units 11-14 and F2; 1/gatewell at Units 15-18 and F1
Spillway Length (ft)	1,450’
Spillway Hydraulic Capacity (kcfs)	1,600 kcfs
Spillbays (#)	18
Spillway Weirs (#)	0
Navigation Lock Length x Width (ft)	675’ x 86’
Navigation Lock Max. Lift (ft)	70’

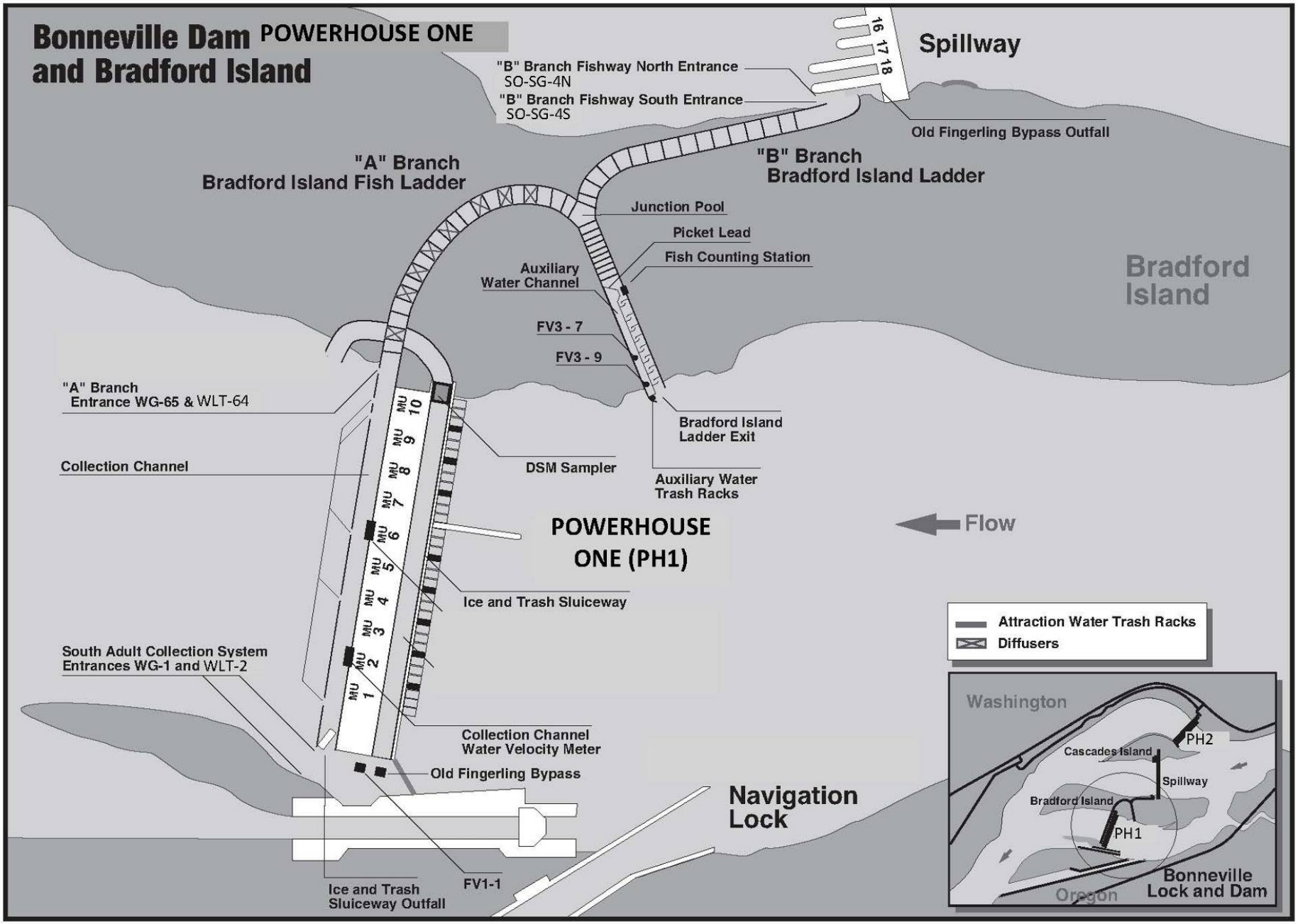


Figure BON-1. Bonneville Dam Powerhouse One and Bradford Island Fish Ladder.

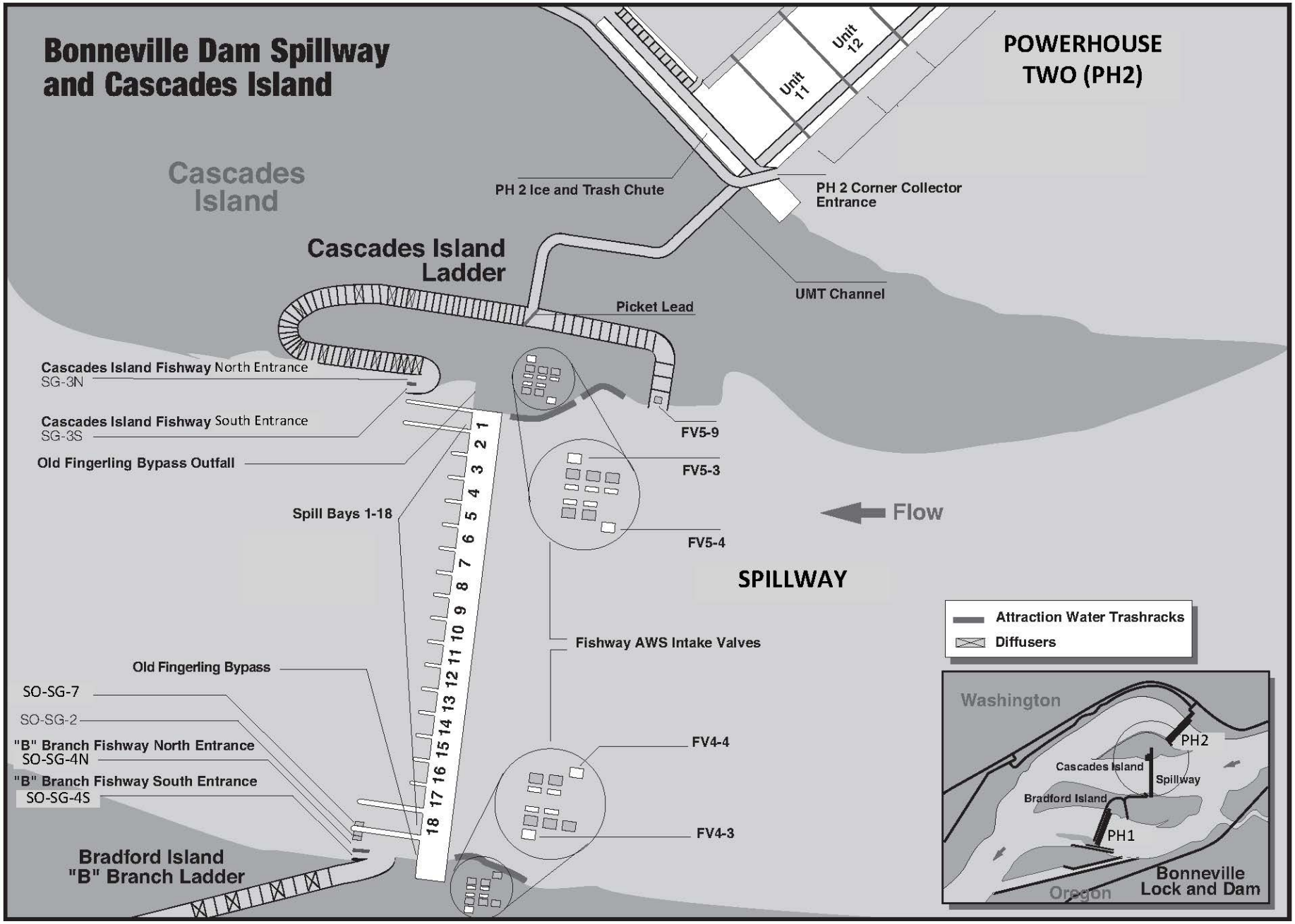


Figure BON-2. Bonneville Dam Spillway, Cascades Island Fish Ladder and Upstream Migrant Transportation Channel (UMT).

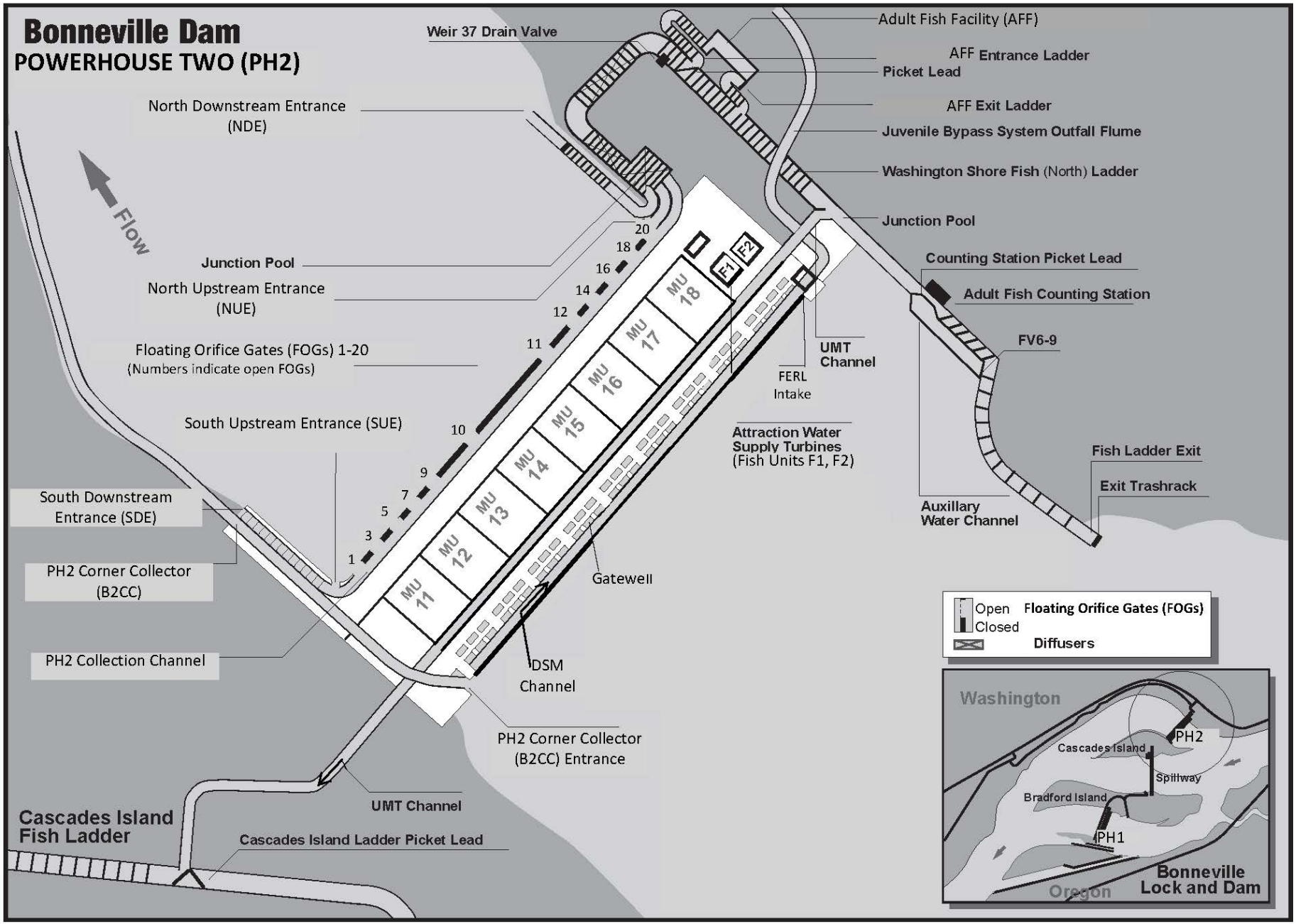


Figure BON-3. Bonneville Dam Powerhouse Two and Washington (North) Shore Fish Ladder.

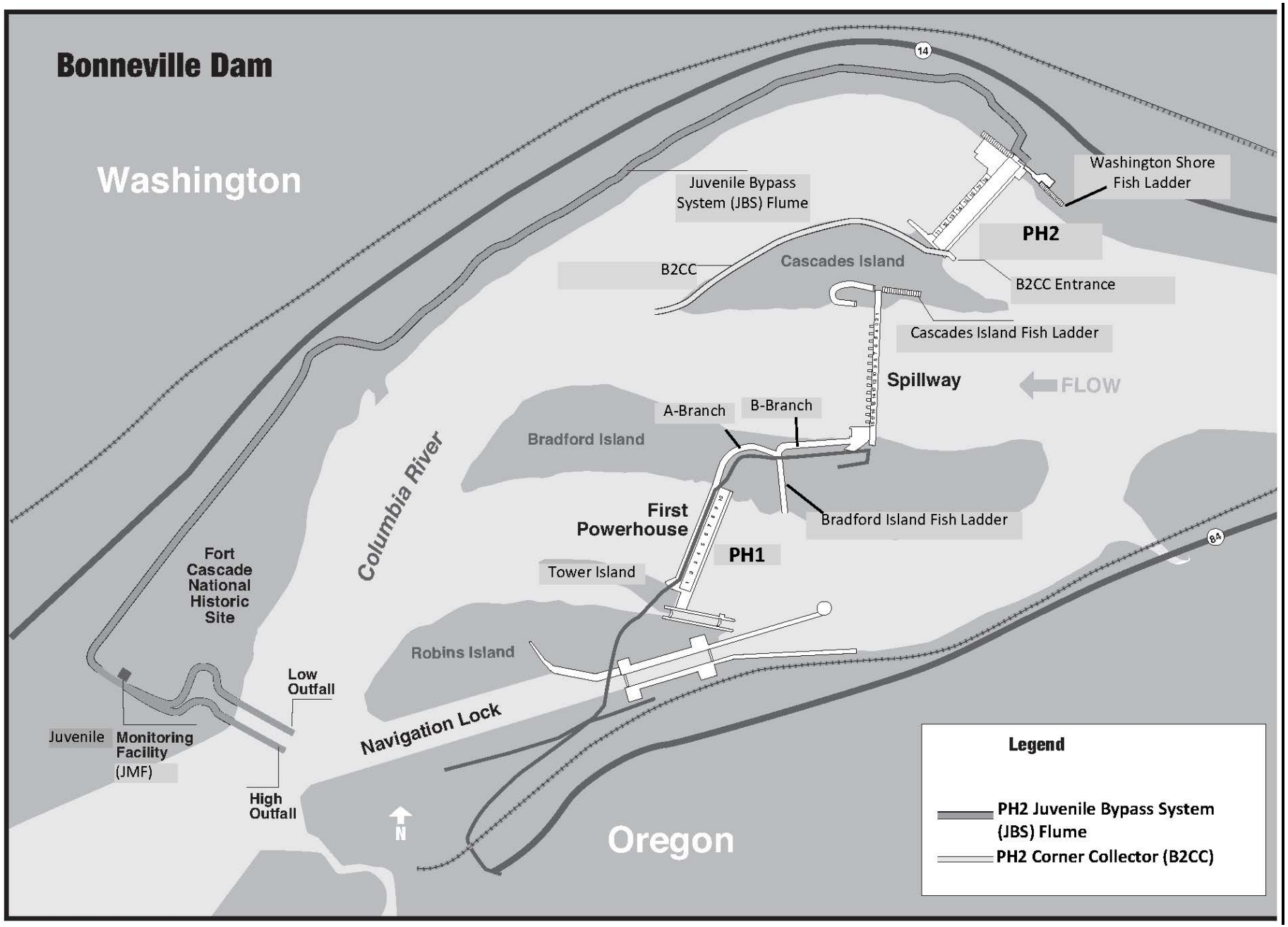


Figure BON-4. Bonneville Dam Juvenile Fish Bypass System (JBS).

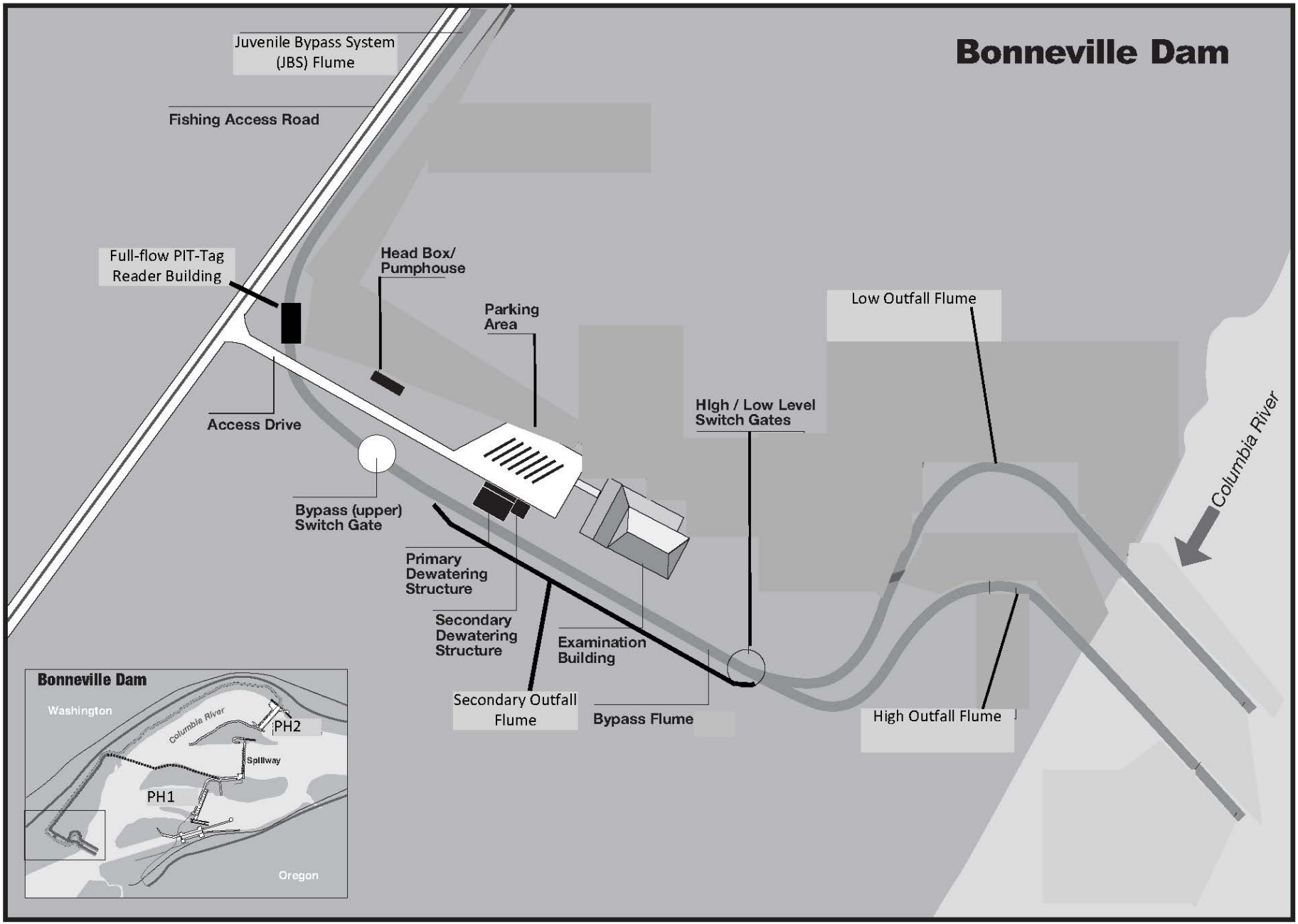
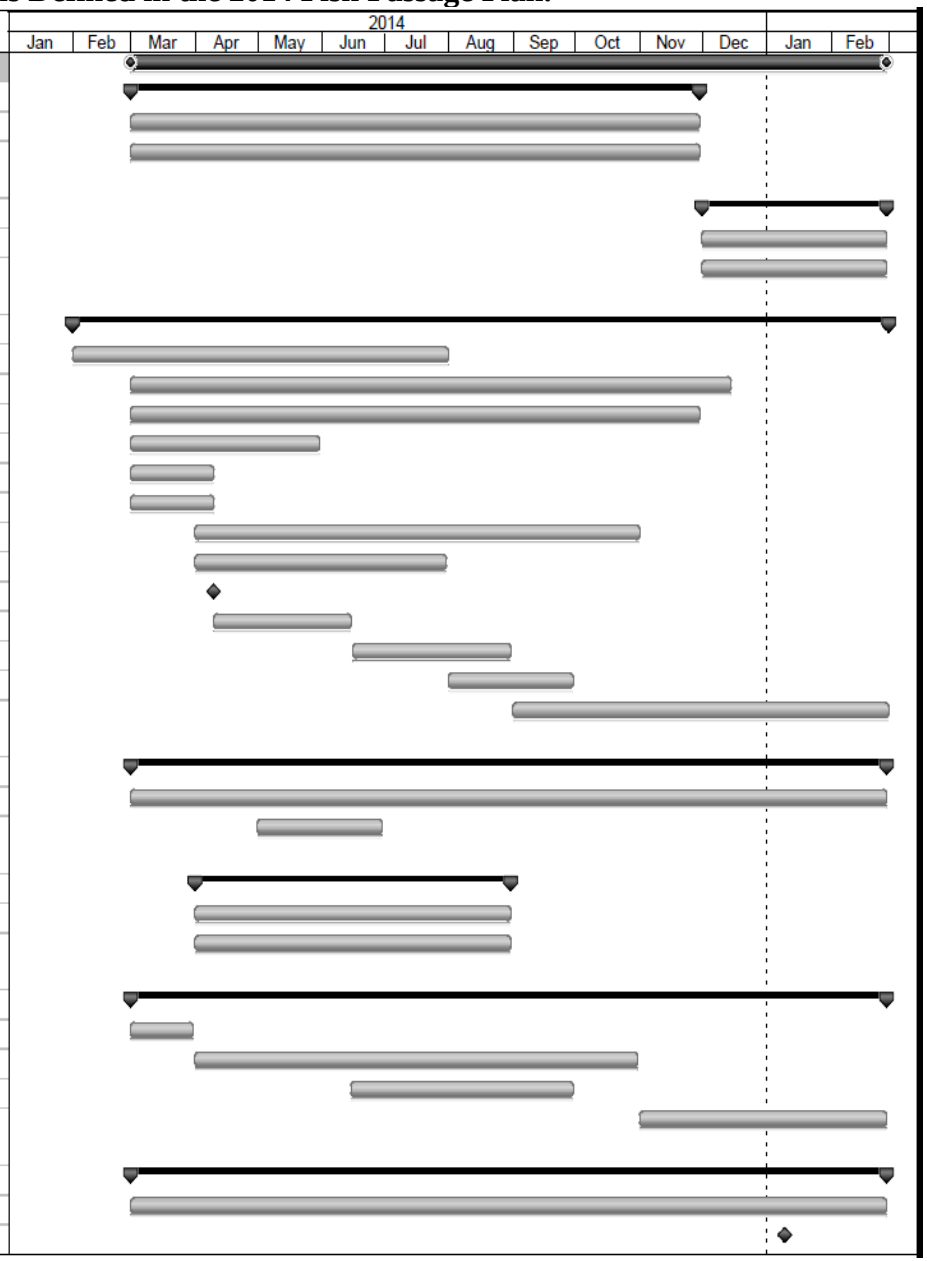


Figure BON-5. Bonneville Dam Juvenile Fish (Smolt) Monitoring Facility and Outfall Flumes.

Table BON-1. Bonneville Dam Schedule of Operations and Actions Defined in the 2014 Fish Passage Plan.

Task Name	Start Date	End Date	FPP Reference
2014 FPP Operations & Actions - Bonneville	**3/1/14**	**2/28/15**	**BON**
Fish Passage Facilities Operation	**3/1/14**	**11/30/14**	**2.4. and 2.5.**
Adult Fish Facilities	3/1/14	11/30/14	2.5.1.2.
Juvenile Fish Facilities	3/1/14	11/30/14	2.4.1.2.
Fish Passage Facilities Maintenance	**12/1/14**	**2/28/15**	**2.4. and 2.5.**
Juvenile Fish Facilities Winter Maintenance	12/1/14	2/28/15	2.4.1.1.
Adult Fish Facilities Winter Maintenance	12/1/14	2/28/15	2.5.1.1.
Project Operations for Fish Passage	**2/1/14**	**3/1/15**	
SLEDs at adult entrances (install ≤ Feb 1)	2/1/14	8/1/14	2.5.1.1.h.
STS operation	3/1/14	12/15/14	2.4.2.2.a.
Turbine operating priority order	3/1/14	11/30/14	Table BON-14
Pinniped Hazing	3/1/14	5/31/14	9.2.1.
Spill Bays 1 and 18 for adult attraction	3/1/14	4/10/14	2.2.4.1.
Kelt enumeration at JMF for B2CC trigger	3/1/14	4/10/14	2.4.2.3.
Turbine 1% operating range - hard constraint	4/1/14	10/31/14	5.2.
Avian Hazing	4/1/14	7/31/14	9.1.1.
Avian Wires installed no later than April 10	4/10/14	4/10/14	9.1.2.
Spring Spill Operations	4/10/14	6/15/14	FOP
Summer Spill Operations	6/16/14	8/31/14	FOP
No SLEDs at adult entrances (install ≥ Oct 1)	8/1/14	9/30/14	2.5.1.1.h.
Spill Bays 1 and/or 18 for adult attraction	9/1/14	3/1/15	2.2.4.1.
Special Operations & Studies (dates approx)	**3/1/14**	**2/28/15**	**Appendix A**
Adult Salmon Studies	3/1/14	2/28/15	2.2.1.
PH2 FGE Gatewell Velocity Testing	5/1/14	6/30/14	2.2.2.
TDG Monitoring	**4/1/14**	**8/31/14**	**2.3.1.**
TDG Monitoring - Tailrace	4/1/14	8/31/14	station CCIW
TDG Monitoring - Forebay	4/1/14	8/31/14	station BON
Adult Fish Counting	**3/1/14**	**2/28/15**	**Table BON-3**
Daytime Video 0400-2000 PST	3/1/14	3/31/14	
Daytime Visual 0500-2100 DST	4/1/14	10/31/14	
Night Video 2100-0500 DST	6/15/14	9/30/14	
Daytime Video 0400-2000 PST	11/1/14	2/28/15	
Reports	**3/1/14**	**2/28/15**	**3.3.**
Weekly Reports	3/1/14	2/28/15	
Annual Report	1/10/15	1/10/15	



1. FISH PASSAGE INFORMATION

The locations of fish passage facilities at Bonneville Lock & Dam are shown on the general site plan in **Figures BON-1** through **BON-5**. The schedule for project operations described in the Fish Passage Plan (FPP) and appendices is included 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 Bonneville Dam Powerhouse Two (PH2) consist of: 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. The Juvenile Monitoring Facility (JMF) is included in the bypass.

1.1.2.1. All eight PH2 main turbine units have STSs, VBSs, and streamlined trashracks.

1.1.2.2. Two smaller turbines (fish units) supply adult fishway auxiliary water and do not have STSs or streamlined trashracks, and have a fine trashrack with 0.75” clear opening.

1.1.2.3. The PH2 corner collector (B2CC) on the south side of the PH2 tailrace extends several hundred feet west and empties at the tip of Cascades Island.

1.1.3. Juvenile Migration Timing. The juvenile fish migration season occurs from March 1–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 Juvenile Monitoring Facility (JMF). Maintenance of juvenile fish facilities is scheduled for 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.

Table BON-2. Juvenile Salmonid Passage Timing at Bonneville Dam for Most Recent 10-Years (2004-2013) Based on Daily & Yearly Collection Data.*

Year	10%	50%	90%	# Days	10%	50%	90%	# Days
	Yearling Chinook				Subyearling Chinook * (Brights only**)			
2004	17-Apr	4-May	30-May	44	10-Jun	28-Jun	14-Jul	35
2005	19-Apr	7-May	25-May	37	15-Jun	28-Jun	20-Jul	36
2006	16-Apr	9-May	21-May	36	16-Jun	29-Jun	15-Jul	30
2007	20-Apr	11-May	23-May	34	19-Jun	8-Jul	22-Jul	34
2008	20-Apr	12-May	27-May	38	22-Jun	6-Jul	23-Jul	32
2009	19-Apr	11-May	26-May	38	20-Jun	30-Jun	19-Jul	30
2010	27-Apr	13-May	1-Jun	36	19-Jun	5-Jul	20-Jul	32
2011	17-Apr	10-May	18-May	32	24-Jun	14-Jul	2-Aug	40
2012	24-Apr	12-May	23-May	30	23-Jun	9-Jul	26-Jul	34
2013	28-Apr	12-May	21-May	24	29-Jun	9-Jul	16-Jul	18
MEDIAN	**19-Apr**	**11-May**	**24-May**	**36**	**15-Jun**	**29-Jun**	**19-Jul**	**35**
MIN	**16-Apr**	**4-May**	**18-May**	**24**	**6-Jun**	**22-Jun**	**14-Jul**	**30**
MAX	**28-Apr**	**13-May**	**1-Jun**	**44**	**21-Jun**	**9-Jul**	**15-Aug**	**70**
	Unclipped Steelhead				Clipped Steelhead			
2004	17-Apr	16-May	31-May	45	30-Apr	16-May	27-May	28
2005	23-Apr	11-May	29-May	37	26-Apr	15-May	30-May	35
2006	24-Apr	7-May	29-May	36	27-Apr	8-May	29-May	33
2007	29-Apr	16-May	3-Jun	36	8-May	17-May	4-Jun	28
2008	5-May	14-May	30-May	26	7-May	13-May	25-May	19
2009	30-Apr	13-May	29-May	30	4-May	13-May	26-May	23
2010	1-May	14-May	1-Jun	32	6-May	14-May	7-Jun	33
2011	23-Apr	15-May	31-May	39	24-Apr	12-May	29-May	36
2012	26-Apr	11-May	29-May	34	29-Apr	10-May	28-May	30
2013	22-Apr	12-May	3-Jun	43	28-Apr	9-May	28-May	31
MEDIAN	**2-Apr**	**13-May**	**30-May**	**37**	**29-Apr**	**13-May**	**28-May**	**30**
MIN	**17-Apr**	**7-May**	**29-May**	**26**	**24-Apr**	**8-May**	**25-May**	**19**
MAX	**5-May**	**16-May**	**3-Jun**	**45**	**8-May**	**17-May**	**7-Jun**	**36**
	Coho				Sockeye (Wild & Hatchery)			
2004	18-Apr	5-May	27-May	40	21-May	1-Jun	15-Jun	26
2005	22-Apr	9-May	27-May	36	15-May	23-May	1-Jun	18
2006	27-Apr	17-May	27-May	31	10-May	19-May	31-May	22
2007	26-Apr	13-May	31-May	36	16-May	25-May	7-Jun	23
2008	1-May	18-May	30-May	30	24-May	29-May	8-Jun	16
2009	29-Apr	22-May	1-Jun	35	15-May	26-May	5-Jun	22
2010	24-Apr	14-May	5-Jun	43	19-May	1-Jun	10-Jun	23
2011	11-Apr	14-May	24-May	44	4-May	17-May	4-Jun	32
2012	26-Apr	18-May	7-Jun	43	9-May	14-May	23-May	15
2013	16-Apr	14-May	1-Jun	47	14-May	20-May	26-May	13
MEDIAN	**25-Apr**	**14-May**	**30-May**	**37**	**15-May**	**24-May**	**4-Jun**	**22**
MIN	**11-Apr**	**5-May**	**24-May**	**30**	**4-May**	**14-May**	**23-May**	**13**
MAX	**1-May**	**22-May**	**7-Jun**	**47**	**24-May**	**1-Jun**	**15-Jun**	**32**

* Subyearling Chinook MEDIAN, MIN, MAX based on 1998-2006 data. Data 2007-present not included due to potential bias from missed sample days during high water temperature sampling protocols (**Appendix K**).

** Includes upriver brights only in order 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 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 PH2 collection channel and the north and south monoliths that join Washington Shore (North) ladder and 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 Fish Migration Timing and Count Schedule. Upstream migrants are present throughout the year and adult passage facilities are operated year-round. Adult salmon, steelhead, lamprey and shad are typically counted year-round (**Table BON-3**) and daily data are posted online at: http://www.nwp.usace.army.mil/Missions/Environment/Fishdata.aspx. Fish passage November 1–March 31 is relatively light and counting is done by video, primarily to monitor ESA-listed winter steelhead, and posted online every three days. Sturgeon and bull trout are relatively infrequent and counts are posted online periodically during the passage season in *Miscellaneous Fish Count*s and summarized in the *Annual Fish Passage Report*.

1.2.2.1. Peak timing of adult fish passage at Bonneville Dam is determined based on yearly counts through the most recent passage year, beginning in 1938 for adult salmon and steelhead, in 1999 for winter steelhead, and in 2001 for lamprey (**Table BON-4**).

1.2.2.2. Annual maintenance of adult fish facilities is scheduled December 1 through the end of February (winter maintenance period) to minimize the impact on upstream migrants and to minimize fallback of adult fall Chinook and steelhead.

Table BON-3. Adult Fish Count Schedule at Bonneville Dam (3/1/2014 – 2/28/2015).

Count Period	Counting Method and Hours *
March 1–31, 2014	Video 0400–2000 hours (PST)
April 1, 2014 – October 31, 2014	Visual 0500–2100 hours (DST)
June 15, 2014 – September 30, 2014	Night Video 2100–0500 hours (DST)
November 1, 2014 – February 28, 2015	Video 0400–2000 hours (PST)

*****In 2014, Daylight Saving Time (DST) is in effect from March 9 – November 2, and hours are adjusted forward one hour from Pacific Standard Time (PST). DST = PST+1.

Table BON-4. Adult Count Period and Peak Passage Timing at Bonneville Dam Based on Yearly Counts Since 1938 (except winter steelhead since 1999 and lamprey since 2001).

Species	Count Period	Earliest Peak	Latest Peak
Spring Chinook	Mar 14 – May 31	Apr 15	May 27
Summer Chinook	Jun 1 – Jul 31	Jun 3	Jul 31
Fall Chinook	Aug 1 – Nov 15	Aug 30	Sep 17
Sockeye	Jun 1 – Aug 15	Jun 20	Jul 13
Steelhead	Apr 1 – Mar 31	Jul 16	Sep 22
Winter Steelhead	Nov 16 – Mar 31	Mar 1	Mar 28
Coho	Jul 15 – Nov 15	Aug 29	Oct 11
Lamprey	Mar 15 – Nov 15	Jun 20	Jul 18

1.2.2.1. Time-of-day (diel) distributions of adult salmonid activity at Bonneville Dam fishway entrances and exits are summarized in **Figure BON-6** (see *Keefer & Caudill 2008* at: http://www.nwd-wc.usace.army.mil/tmt/documents/FPOM/2010/2013_FPOM_MEET/2013_JUN/).

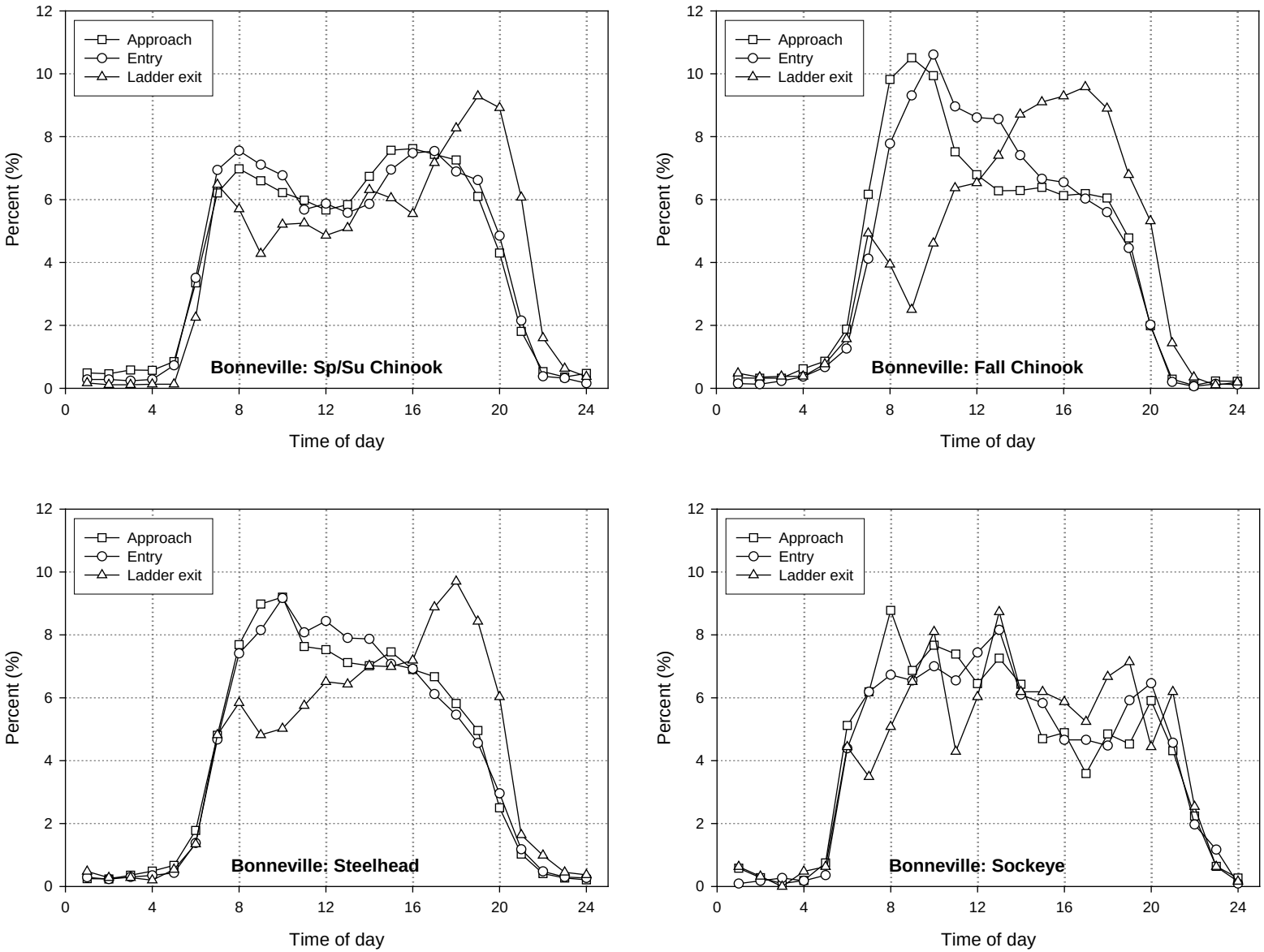


Figure BON-6. Diel Distribution of Adult Salmonids at Bonneville Dam Fishway Entrances and Exits (*Keefer & Caudill 2008*).

2. PROJECT OPERATION

2.1. General.

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

2.1.1. Powerhouse Unit Priority. Turbine operating priority is defined in **Table BON-14**. If a turbine is out of service, use the next turbine in the priority list.

2.1.1.1. Unit Priority during Split Flows. Before August 31, if adult and jack salmonid counts equal or exceed 30,000 fish/day, Project Fisheries will initiate coordination with the Fish Passage Operations & Maintenance (FPOM) team to discuss options for splitting flow between powerhouses to balance attraction flow and adult passage among the project's fishways. After August 31, when adult and jack salmonid counts equal or exceed 25,000 fish/day, the Project will operate two priority turbines at PH1 in an attempt to balance adult passage between both powerhouses (assuming no PH1 units are already operating). This operation will continue until adult and jack salmonid counts fall below 20,000 fish.

2.1.1.1.a. Turbine units at PH1 should be operated at the mid or upper 1% range whenever possible during split flow operations.

2.1.1.1.b. Turbine units at PH2 should be operated at the mid to lower 1% range whenever possible during split flow operations.

2.1.1.1.c. Split flow operations during summer spill may only occur if flow is > 120 kcfs.

2.1.2. 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 *Special Project Operations & Studies* (**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 **FPP Overview** for coordination protocols).

2.2. Spill Management.

2.2.1. See the *Fish Operations Plan* (FOP; **Appendix E**). Bonneville Dam spill patterns are defined in **Table BON-17**. Spill changes will be made through regional coordination at TMT.

2.2.2. 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 Corps Reservoir Control Center (RCC), dependent upon TDG monitoring at stations downstream of the dam, biological monitoring, and fish movement.

2.2.2.1. Nighttime spill hours are the daily complements of daytime spill hours defined in **Table BON-5**. The transition from daytime spill cap to nighttime spill cap and vice versa will normally take 15–20 minutes due to time required to start, synchronize and load multiple generators. The transition to daytime spill should not start until after the nighttime period.

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

Table BON-5. Daytime Spill Schedule for Bonneville Dam.

Date Range	Daytime Spill Hours	
	Start Hour	End Hour
Jan 1 – Jan 19	0700	1730
Jan 20 – Feb 14	0630	1800
Feb 15 – Mar 01	0600	1830
Mar 2 – Apr 02	0600	1930
Apr 3 – Apr 20	0500	2030
Apr 21 – May 16	0500	2100
May 17 – May 31	0430	2130
Jun 1 – Jun 30	0430	2130
Jul 1 – Jul 31	0430	2200
Aug 1 – Aug 15	0500	2145
Aug 16 – Aug 31	0500	2030
Sep 1 – Sep 16	0530	2000
Sep 17 – Oct 04	0600	1930
Oct 5 – Oct 19	0630	1900
Oct 20 – Oct 29	0630	1830
Oct 30 – Nov 30	0600	1700
Dec 1 – Dec 31	0630	1700

2.2.3. Juvenile Fish. From April 10–August 31, the minimum spill level is 50 kcfs to provide acceptable tailrace conditions for juvenile fish egress. However, during extreme low flow conditions, lower spill levels may be considered and coordinated through TMT. There is no minimum spill level September 1–April 9. See the *FOP* (**Appendix E**) for more information.

2.2.4. Adult Fish. To reduce adult fallback whenever PH1 is in operation from June 16 through August, daytime spill will be limited to 100 kcfs or less (**see section 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.

2.2.4.1. Attraction Flow. From September 1–November 30 and March 1–April 10 (beginning of spill for juvenile fish passage), spill from Bays 1 and 18 with each gate open 6" (1 stop) during daylight hours (**Table BON-5**). From December 1–February 28, spill only from the bay(s) adjacent to an operating fishway entrance with each spill gate open 6".

2.3. Total Dissolved Gas (TDG) Management.

2.3.1. Total dissolved gas (TDG) levels at all projects are monitored in accordance with the TDG Monitoring Plan, included in the *Water Management Plan* as Appendix 4, and available online at: http://www.nwd-wc.usace.army.mil/tmt/documents/wmp/.

2.3.2. 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.

2.3.3. Excessive TDG levels may harm fish and will be controlled to the extent possible, subject to river flow conditions. Control measures will include system spill allocation through the spill priority list issued 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 1 – February 28 (Winter Maintenance Period).

2.4.1.1.a. Remove debris from forebay, trash racks, and gatewell slots to maintain these areas debris-free.

2.4.1.1.b. Ice and trash sluiceway (ITS) operations after November 30 are defined in **section 2.5.1.1.**

2.4.1.1.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 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. However, there will be no avian abatement measures, other than avian lines, performed from September through March each year.

2.4.1.2. March 1 – November 30 (Juvenile Fish Passage Season).

2.4.1.2.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.

2.4.1.2.b. A slight oily sheen is commonly found in many gatewells, from sources such as lubricated lifting beams, etc. Unusual accumulations of oil (e.g., oil slick) in gate slots 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.

2.4.1.2.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.

2.4.1.2.d. At the ITS, set chain gate 1A and 1B at 70' msl. Ensure gates 3B, 6C, and 10B are operating according to **Table BON-6**.

d.1. If chain gates for Unit 1 are OOS, set chain gates 2A and 2B at 70' msl. Ensure gates 3B, 6C, and 10B are operating according to **Table BON-6.**

Table BON-6. Chain Gate Elevations (ft) at Bonneville Dam Powerhouse One (PH1) Ice and Trash Sluiceway (ITS).

Forebay Elevation (ft)	PH1 ITS Chain Gates			Forebay Elevation (ft)	PH1 ITS Chain Gates		
	3B	6C	10B		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 1 – February 28 (Winter Maintenance Period).

2.4.2.1.a. STSs 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. Unscreened units will be operated on a last-on, first-off basis. Beginning December 16, all STSs may be removed.

2.4.2.1.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.

2.4.2.1.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.

2.4.2.1.d. The PH2 Downstream Migrant (DSM2) channel may be dewatered only when required for maintenance and will be minimized to the extent practicable.

2.4.2.1.e. Remove debris from forebay, trash racks and gatewell slots to maintain these areas debris-free.

2.4.2.1.f. Inspect all gatewell orifices, orifice lighting systems and flushing systems, and clean and/or repair as necessary so that orifices and associated systems are fully functional.

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

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

2.4.2.1.i. 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.

2.4.2.1.j. Avian 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 1 – November 30 (Juvenile Fish Passage Season).

2.4.2.2.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.

2.4.2.2.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**.

2.4.2.2.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.

2.4.2.2.d. Operate STSs at angle of 60° from vertical.

2.4.2.2.e. Turbines without a full complement of STSs will not operate except when in compliance with other coordinated fish measures.

2.4.2.2.f. 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*.

2.4.2.2.g. 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.

g.1. No STS inspections will be scheduled when they will cause excessive TDG due to increased forced spill.

g.2. VBS inspections will occur immediately prior to peaks in juvenile fish migrations, which begin about May 1, mid-July, and September 1.

g.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.

g.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.

g.5. VBSs will be cleaned when drawdowns read 1.1' on any day (including weekends) and when drawdowns reach 0.9' on Thursdays.

g.6. If a screen has reached the cleaning threshold, all 3 screens in that unit will be cleaned.

g.7. Unit will be shutdown if VBS drawdown equals or exceeds 1.5' in 12-hour period.

2.4.2.2.h. Rake trashracks at Units 11 and 12 prior to March 1 and at least once/month throughout fish passage season.

2.4.2.2.i. If STS or VBS damage or plugging is detected, follow procedures in *Fish Facilities Maintenance* (**section 4**). In the event of overwhelming debris (as defined below) follow the procedures outlined below. Monitor gatewell drawdown daily.

i.1. TIE Crane in service:

i. 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).

ii. 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.

iii. 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.

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

i.2. TIE Crane OOS = use Gantry Crane:

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

ii. 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.

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

i.3. Screen Re-Installation Criteria: At the discretion of the Project Biologist and in consultation with FPOM, 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.

2.4.2.2.j. Gatewell Orifice Systems. All gatewell orifice systems should be operational.

j.1. Orifices automatically flush 3 times/day, one orifice every 10 minutes. Orifices with less than a clear flow jet will be flushed manually during the inspection.

j.2. Manually flush orifices known to have recurring plugging or other problems.

j.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.

2.4.2.2.k. Orifice Lights. Replace all non-operational orifice lights within 24 hours. Orifice lights shall remain lighted 24 hours/day.

k.1. DSM gallery lights should be off except when project or other staff is in the gallery.

2.4.2.2.l. Gatewell Cleaning. 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 50% clear, they will be cleaned at least once daily.

l.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.

l.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.

l.3. Coordinate gatewell cleaning with JMF personnel operating downstream juvenile sampling facilities.

l.4. 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.

2.4.2.2.m. Avian Lines. Reinstall or repair avian 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 April–August only.

2.4.2.3. Powerhouse Two Corner Collector (B2CC). Operate B2CC during spill season. Open and close the B2CC within 1 hour of the start and end of spill season, respectively.

a.1. Beginning March 1, 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.

2.4.2.4.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.

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

a.2. If the system is still unable to accommodate debris loads, 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.

a.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.

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

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

2.4.2.4.b. Operation. Maintain the channel elevation between 64.2–64.4' as measured at the staff gauge in front of the ERG (**Table BON-7**).

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) Operation.

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

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

2.4.2.5.c. 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.

2.4.2.5.d. 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.

2.4.2.5.e. Operate the outfall avian cannons March 1–November 1. The cannons will be operated 24 hours/day during fish passage season.

2.4.2.5.f. For specific monitoring facility guidance, see *Protocols for Juvenile Monitoring Facility Operations at Bonneville Dam* (**Appendix J**).

2.4.3. Spillway Operating Criteria.

2.4.3.1. December 1 –February 28 (Winter Maintenance Period).

2.4.3.1.a. Inspect and repair where necessary 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.

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

2.4.3.1.c. For spill guidance during winter maintenance periods, see the *FOP* (**Appendix E**) or **section 2.2**.

2.4.3.2. March 1 – November 30 (Juvenile Fish Passage Season). Spill will be provided according to guidance in the *FOP* (**Appendix E**) and **section 2.2**.

2.5. Adult Fish Passage Facilities.

2.5.1. All Adult Fish Passage Facilities Operating Criteria.

2.5.1.1. December 1 – end of February (Winter Maintenance Period).

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

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

2.5.1.1.c. Turbines will be operated in the priority order in **Table BON-14**.

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

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

2.5.1.1.f. Operate spillbays 1 and 18 as described in **section 2.2.3.1** and **Table BON-5**.

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

2.5.1.1.h. Sea Lion Exclusion Devices (SLEDs) will be installed at all adult fishway entrances no earlier than October 1 and no later than February 1, and will be removed by August 1 each year. All floating orifice gates (FOGs) can be left installed year-round.

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

2.5.1.1.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.

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

2.5.1.1.l. Reinstall counting station picket leads prior to watering up ladders during maintenance.

2.5.1.1.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 to provide steelhead kelt passage.

m.1. Set chain gate 1A and 1B at 70’ msl. Ensure gates 3B, 6C, and 10B are operating according to **Table BON-6**.

m.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.

2.5.1.1.n. In the appropriate year (when the fishway is out of service for winter maintenance), dredge AWS intakes to maintain the following elevations:

i. -22’ to -24’msl at PH2 Fish Unit intake;

ii. +63’ msl at BI exit, FV3-7 and FV3-9.

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

2.5.1.2.a. Maintain water depth over fish ladder weirs at 1.0’ ±0.1’ during non-shad passage season (< 5,000 shad/day/count station) and 1.3’ ±0.1’ during shad passage season (≥ 5,000 shad/day/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.

2.5.1.2.b. Water temperature will be measured in an adult fishway at each powerhouse. 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. Fish handling activities in the Adult Fish Facility (AFF) will implement protocols in **Appendix G**.

2.5.1.2.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.

2.5.1.2.d. 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.

2.5.1.2.e. Maximum head of 0.5' 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.

2.5.1.2.f. Staff gages and water level indicators will be readable at all water levels encountered during the fish passage season, including: 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 UMT entrance, NUE/NDE/SUE/SDE collection channel, NUE/SUE tailwater, and PH2 north forebay.

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

2.5.1.2.h. The current fish counting program is conducted 16 hours per day, year-round (**Table BON-3**). Count station crowders shall remain in 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.

h.1. The crowder shall be opened to full count slot width when not counting. The crowder shall be open as far as possible to allow accurate counting and shall not be closed to less than 18” while counting. 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. The crowder ranges are as follows:

i. Washington Shore = 22.8–38.4”;

ii. Cascades Island = currently out of service (max. opening approximately 36”);

iii. Bradford Island = 20.4–36.0”.

h.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.

h.3. Project biologists, FFU, and the fish count supervisor shall coordinate to achieve optimum count slot passage and/or count accuracy conditions.

h.4. If counting is temporarily discontinued due to unscheduled events, the crowder shall be fully opened.

h.5. The crowder may remain in operating position during the counters' hourly ten-minute break period.

h.6. Leave the fish passage slot lighted overnight.

2.5.1.2.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.

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

2.5.2. Main Dam Fish Ladders.

2.5.2.1. When spilling exclusively for adult attraction, spill only during daylight hours (**Table BON-5**). Spillbays 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 Fish Ladder.

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 Fish Ladder.

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.**

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'

2.5.3.1.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'.

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

2.5.3.2. Control of Fish Valve FV1-1.

2.5.3.2.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.

2.5.3.2.b. Differential. Low: collection channel/tailwater differential <1'.
High: collection channel/tailwater differential >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 Bradford Island 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. PH1 Collection Channel Diffusers. Diffuser valves are operated according to the pattern in **Table BON-12**.

Table BON-12. Collection Channel Diffuser Valve Operation 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).

2.5.4.1. During daytime spill hours (**Table BON-5**), operate all north (NUE, NDE) and south (SUE, SDE) entrances. Operate weir crests at elevation 1' (fully lowered) for tailwater elevations ≤14'. For tailwater elevations >14', operate weir crest 13' or greater below tailwater.

2.5.4.2. Operate all 12 active PH2 floating gate fishway entrances.

2.5.4.3. Lamprey Operations, June 1–August 31: During nighttime spill hours (**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 from 2200-0400 hours.

2.5.4.4. 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. 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.

2.5.4.5. Take soundings annually at the PH2 Fish Unit intake and the BI exit/AWS intake to determine sediment accumulation and plan for the appropriate dredging need. Fish Unit intake dredging is a key component to maintaining a reliable AWS system and should be prioritized during winter maintenance season (see **section 2.5.1.1.n**).

3. FACILITY MONITORING & 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/day, seven days/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/week.

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

3.1.5. 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:

i. Any out-of-criteria situations observed and subsequent corrective actions taken;

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

iii. Adult fishway control calibrations;

iv. STS and VBS inspections;

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

vi. When trapping is occurring in the AFF;

vii. Any unusual activities at the project that may affect fish passage.

3.3.2. Weekly Reports shall cover Sunday–Saturday and e-mailed to CENWP-OD, CENWD-PDW-R (RCC) and other interested parties as soon as possible the following week.

3.3.3. ***Memorandum for the Record*** **(MFR)** shall be prepared by Project biologists for any adverse or negative impact to fish or fishways. The MFR will be sent to FPOM by the next working day. Items that shall be included in the memo are:

i. Time and date of incident;

ii. Nature of activity that lead to fish impact;

iii. Agency responsible for the impact, or the name of the reporter if no responsible party can be identified;

iv. Fish numbers, species, origin, discernible external injuries, tags, etc.;

v. Future actions to avoid a similar impact;

vi. Any relevant photos.

3.3.4. Annual reports shall be prepared by Project biologists 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.

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 (STS). 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 Systems (JBS). The JBS 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.

4.2.1.2.a. 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.

4.2.1.3.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.

4.2.1.3.b. Certain turbine and spillway flows at the projects are secondarily used to attract adult fish to fishway entrances, to keep predator fish from accumulating near juvenile release sites, and/or to move juveniles downstream away from the project. During fish passage season, do not take units F1, F2, 1, 3, 11, and 18 out of service, when practicable.

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

4.2.1.3.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.

4.2.1.3.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 that sometimes break down during fish passage season (e.g., fish screens) 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 **Overview** for coordination form):

i. Description of the problem;

ii. Type of outage required;

iii. Impact on facility operation;

iv. Length of time for repairs;

v. Expected impacts on fish passage.

4.2.2.2. 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 Systems (JBS).

4.2.2.3.a. The JBS is 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.

4.2.2.3.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.

4.2.2.3.c. If automatic systems fail and the system is operated manually, facility inspections should increase to a frequency to ensure systems operate within criteria.

4.2.2.3.d. All STS gatewells will be inspected daily and cleaned before they become 50% covered with debris. If due to 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 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.

4.2.2.3.e. Powerhouse One (PH1). PH1 juvenile passage routes consist of the ITS and MGR turbines. The DSM is no longer in service.

4.2.2.3.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.

4.2.2.3.g. During fishway inspections, 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.

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

4.3.1.2.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.

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

4.3.1.3.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.

4.3.1.3.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.

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

4.3.1.4. Adult Fish Ladders and Counting Stations. Also see *Adult Fish Trapping Protocols* (**Appendix G**). Adult fish ladders will be dewatered once each year during winter maintenance. During this time, the ladders will be inspected for blocked orifices, projections into the fishway that may injure fish, weir stability, damaged picket leads, exit gate problems, loose diffusion gratings, unreadable or damaged staff gauges, defective diffusion valves, 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 (**Figure BON-6**). 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 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 RCC and Regional fish agencies through FPOM. Coordination procedures for non-routine maintenance of adult and juvenile facilities are the same. Any non-routine maintenance and fishway modifications will be handled individually.

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.

4.3.2.1.a. Powerhouse One (PH1). If any valves or other part of the system fails, the project shall attempt to maintain criteria by adjusting functioning valves. Conduit pressure must be monitored and not allowed to exceed the established limits.

4.3.2.1.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.

4.3.2.1.c. Powerhouse Two (PH2).

c.1. If either or both fishway auxiliary water turbines do not provide sufficient water to meet full criteria, the adult facilities will be operated according to *Emergency Operations for Bonneville PH2 AWS Systems Operations* (**Table Bon-13**) or until a fishway head of 1’ is achieved.

c.2. When one of the fish turbines has failed or been taken out of service, refer to **Table Bon-13** for turbine operations, floating orifices, diffuser gates, and main gates during emergency situations. **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.

c.3. If both fish unit turbines fail from September 1–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.

c.4. PH2 adult fishway diffusion system valves A3 and A4 have been removed due to damage. 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 PH2 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. Ladder components 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.

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

4.3.2.4.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.

4.3.2.4.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.

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

5. TURBINE UNIT OPERATION & MAINTENANCE

5.1. Turbine Unit Priority.

Powerhouse and turbine unit priority throughout the year is defined 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.

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

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

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

5.2. Turbine Unit Operating Range.

5.2.1. Turbine unit operations within ±1% of peak turbine efficiency (1% range) are specified in the *BPA Load Shaping Guidelines* (**Appendix C**) for implementation during the period of April 1 through October 31. Through regional coordination with FPOM and TMT, the 1% range guidelines during this period have been modified as defined below in **5.2.1.1** to minimize PH2 gatewell turbulence for bypassed juvenile salmonids until structural and/or other solutions are implemented. Turbine unit operating range limits are defined in **Tables BON-15 (PH1)** and **BON-16 (PH2)**.

5.2.1.1. From April 1 through October 31, turbine units will operate sequentially in the following order of operating ranges to pass increasing levels of flow:

5.2.1.1.a. PH2 units within 1% mid-range;

5.2.1.1.b. Then, PH1 units up to 1% upper limit;

5.2.1.1.c. Then, PH1 units up to BOP;

5.2.1.1.d. Then, additional flow in excess of what can be passed in the steps above will be passed in one of the three following ways, or as otherwise determined by Project Fisheries based on observed conditions:

d.1. April 1–April 9: PH2 units up to 1% upper limit.

d.2. April 10–June 15 (Spring Spill) w/ Juvenile Trigger[1]: When juvenile spring Chinook collection counts at BON JMF are greater than adult spring Chinook (excluding jacks) total passage counts for three consecutive days (juvenile trigger), Project Fisheries will notify the control room to maintain PH2 units within 1% mid-range as a hard constraint and pass additional flow as spill.

d.3. April 10–June 15 (Spring Spill) w/ Adult Trigger[2]: When adult spring Chinook total passage counts (excluding jacks) are greater than juvenile spring Chinook collection counts at BON JMF for two consecutive days (adult trigger), Project Fisheries will notify the control room to operate PH2 up to 1% upper limit in priority order from north to south: 18, 17, 16, 15, 14, 13, 12, 11.

d.4. June 16–October 31: PH2 units up to 1% upper limit.

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[1] **Juvenile spring Chinook:** reported as "CollCount" in SMP Smolt Data (query: current year, BO2, Combined Chinook Yearling), available online at: http://www.fpc.org/smolt/smpsubmitdataquery_2014v7.html

[2] **Adult spring Chinook:** reported as "Adult Chinook daily" in Corps Adult Fish Count Running Sum Report for Bonneville, available online at: http://www.nwp.usace.army.mil/Missions/Environment/Fish/Data.aspx

5.3. Turbine Unit Maintenance.

5.3.1. 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 few fish passing the project.

5.3.2. When PH1 is operating, Unit 1 provides important attraction flow for adult fish and 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.

5.3.3. In the event of long-term powerhouse outages, affected units will be exercised periodically. Each unit will be operated 4-8 hours every 2 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 minimum necessary to keep the unit in good working condition and may be performed at night, day or whenever unit cycling will have the least effect on fish as determined by the project biologist.

5.3.4. 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% range 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% range) 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 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.

5.3.5. The head gates 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*).

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

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

5.3.8. 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% range.

5.3.9. When a unit is idle, wicket gates will remain in a closed position unless tail logs are installed and fish salvage has been done in the draft tube or the project is holding a safety pool below the level of the wicket gates.

6. DEWATERING PLANS

6.1. Guidelines for All Dewaterings.

6.1.1. *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. Dewatering Plans are also available online at: http://www.nwd-wc.usace.army.mil/tmt/documents/FPOM/2010/

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. 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 notified of any dewaterings and may be invited if additional help is deemed necessary, and all safety considerations can be met.

6.1.5. Adult salmonids will be released into the forebay and juvenile salmonids will be released into the tailrace, depending on the age composition of fish in the tank. If a ladder is dewatered in the spring or summer, steelhead kelts will be released into the tailrace. If large numbers of sturgeon are present, it may be necessary to release them into either the forebay or tailrace, depending on the location of the recovery operation.

6.2. Juvenile Bypass Systems (JBS).

See the *Guidelines for Dewatering and Fish Handling Plans* (**Appendix F**) and *Dewatering Plans*, available online at: http://www.nwd-wc.usace.army.mil/tmt/documents/FPOM/2010/.

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 for at least 24 hours, and up to 96 hours, prior to dewatering. 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.[3] 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 steps in **Routine Maintenance (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 directly assist fish rescue operations, provide technical guidance, ensure fish safety and ensure rescue equipment/personnel are available if needed.

6.5. Turbines.

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

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.

[3] Head gates may also be referred to as “operating” gates at some projects. The terms are interchangeable.

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.

6.6. Navigation Lock.

6.6.1. The navigation lock is frequently dewatered for routine maintenance in late February/early March, in conjunction with navigation lock outages at The Dalles and John Day dams.

6.6.2. The area between the upstream bulkhead and the upstream gate is surveyed for fish as water levels allow. The lateral and pool areas on the floor of the lock are surveyed for fish from above. Most of these areas remain full of water, precluding the ability to implement successful fish salvage operations. Areas where water levels slowly decrease are accessed via crane when pool levels reach a depth of approximately 3 feet. The fill conduits are accessed and checked for fish only if needed and can be done safely. All salvaged fish are removed, transported via bag or tank and released to the river.

7. FOREBAY DEBRIS REMOVAL

7.1.1. 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.

7.1.2. Debris is removed by operating the PH1 ITS, B2CC, or passing it through the spillway with a special spill gate operation.

7.1.3. 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

8.1.1. 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.

8.1.2. Project Fisheries will be contacted as soon as possible after a hazardous material release and prior to any modification to fishway operations. Project biologist(s) 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 available in Control Room):

i. Ben Hausmann, Supervisory Fishery Biologist

ii. Andrew Traylor, Fishery Biologist

iii. Ida Royer, Fishery Biologist

iv. Brian Bissell, Fishery Biologist

v. Bern Klatte, Fisheries Section Supervisor, or Tammy Mackey, Fishery Biologist

9. HAZING ACTIVITIES

9.1. Avian Hazing (Piscivorous Birds).

9.1.1. From April 1 through July 31, piscivorous birds shall be hazed at Bonneville Dam 7 days/week for 8 hours/day between the hours of 0600-2000. Hours of hazing should vary so that birds do not acclimate to long periods without hazing.

9.1.2. Avian Wires. Avian wires shall be installed prior to 10 April each year.

9.1.3. Hazing techniques are detailed in the approved Operating Plan. The objective of the program is to reduce avian predation of migrating juvenile salmonids and lamprey by hazing or harassing piscivorous birds in a manner that impedes their ability to successfully forage on fish or forces them to leave the area.

9.1.4. Avian hazing shall occur primarily near dam locations where predation risk is high (e.g., tailrace areas where fish may be disoriented after passing the project or forebay areas where fish may be delayed from passing the project).

9.1.5. Birds shall be hazed near the spillway and powerhouse discharge areas, the juvenile bypass outfall(s), and where birds congregate or feed, ranging up to approximately 2,000 feet downstream of the dam and outfall site. Roosting and actively foraging birds shall also be hazed within the forebay boat restricted zones (BRZ).

9.1.6. During juvenile lamprey outmigration, Wildlife Service specialists may be requested to focus hazing at specific areas of the project where juvenile lamprey are known to pass.

9.2. Pinniped Hazing.

9.2.1. From March 1 through May 31, pinnipeds (primarily California sea lions and Steller sea lions) shall be hazed at Bonneville Dam 7 days/week for 8 hours/day between the hours of 0600-2000. Hours of hazing should vary so that pinnipeds do not acclimate to long periods without hazing, unless otherwise coordinated with the POC.

9.2.2. Hazing techniques are defined in the approved *Operating Plan* and in accordance with the *Marine Mammal Protection Act of 1972, Section 109 h.1.c*. The program objective is to reduce pinniped predation on adult salmonids, sturgeon and lamprey by hazing or harassing pinnipeds in a manner that impedes their ability to forage successfully or forces them to leave the area.

9.2.3. Pinnipeds hazing shall occur in the tailrace areas of the dam and spillway, Tanner Creek, and areas where pinnipeds haul out (except when otherwise coordinated for trapping efforts), ranging to approximately 1,500 feet downstream of the dam and outfall site.

9.2.4. Special activities will be coordinated each year with Federal, State and Tribal agencies in their hazing efforts from boats as needed, efforts to trap/take, and for special evaluations or tests.

Table BON-15. Bonneville Dam Powerhouse One Turbine Units 1–10 Output (MW) and Discharge (cfs) at Upper and Lower Limits of the 1% Peak Efficiency Operating Range and at the Best Operating Point (BOP) at Project Heads of 35-70 feet. [1]

Project Head (ft)	Powerhouse One (Units 1–10)					
	1% Lower Limit		1% Upper Limit		Best Operating Point (BOP)	
	(MW/unit)	(cfs/unit)	(MW/unit)	(cfs/unit)	(MW/unit)	(cfs/unit)
35	18.9	7,203	23.6	9,019	27.3	10,527
36	19.5	7,205	24.3	8,985	28.3	10,564
37	20.1	7,205	25	8,951	29.2	10,598
38	20.7	7,204	25.6	8,918	30.2	10,627
39	21.3	7,202	26.3	8,886	31.2	10,654
40	21.9	7,199	26.9	8,854	32.1	10,677
41	22.5	7,201	28	8,969	33.2	10,759
42	23.1	7,202	29.1	9,077	34.3	10,837
43	23.6	7,203	30.1	9,180	35.4	10,910
44	24.2	7,203	31.2	9,278	36.5	10,979
45	24.8	7,203	32.3	9,370	37.6	11,045
46	25.4	7,210	33.2	9,416	38.8	11,109
47	26	7,217	34.1	9,459	39.9	11,170
48	26.6	7,223	35	9,500	41	11,227
49	27.3	7,229	36	9,539	42.1	11,282
50	27.9	7,234	36.9	9,575	43.2	11,333
51	28.5	7,241	37.8	9,618	44.2	11,356
52	29.1	7,248	38.4	9,577	45.2	11,378
53	29.7	7,254	39	9,537	46.2	11,398
54	30.3	7,260	39.7	9,499	47.2	11,418
55	30.9	7,266	41.6	9,768	48.2	11,465
56	31.5	7,269	42.5	9,808	49.2	11,478
57	32.1	7,272	43.4	9,846	50.3	11,518
58	32.7	7,274	44.4	9,883	51.4	11,557
59	33.3	7,277	45.3	9,918	52.4	11,594
60	33.8	7,279	46.3	9,952	53.5	11,630
61	34.5	7,296	46.9	9,930	54.3	11,610
62	35.1	7,311	47.6	9,909	55.1	11,591
63	35.8	7,326	48.3	9,889	56	11,572
64	36.5	7,340	49	9,868	56.6	11,519
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	7,305	53.2	9,954		
70	39.5	7,294	54.1	9,979		

1. Table based on June 2000 data (HDC). Updated 2009 (removed STSs) and 2013 (added BOP).

Table BON-16. Bonneville Dam Powerhouse Two Turbine Units 11–18 Output (MW) and Discharge (cfs) Per Unit at the Lower, Mid-Range and Upper Limits of the 1% Peak Efficiency Operating Range. [1]

Project Head (ft)	Powerhouse Two (Units 11-18)											
	With STS						No STS					
	1% Lower Limit		1% Mid-Range		1% Upper Limit		1% Lower Limit		1% Mid-Range		1% Upper Limit	
	(MW)	(cfs)	13kcfs (MW)	15kcfs (MW)	(MW)	(cfs)	(MW)	(cfs)	13kcfs (MW)	15kcfs (MW)	(MW)	(cfs)
35	27.6	11,259	31.9	36.8	44.3	18,068	28.2	11,444	32.1	37.0	45.1	18,277
36	28.5	11,271	32.9	37.9	45.8	18,097	29.2	11,455	33.1	38.2	46.6	18,306
37	29.4	11,279	33.9	39.1	47.3	18,121	30.1	11,464	34.1	39.4	48.1	18,331
38	30.3	11,284	34.9	40.3	48.8	18,139	31.0	11,470	35.2	40.6	49.7	18,350
39	31.3	11,287	36.0	41.6	50.3	18,153	32.0	11,473	36.3	41.8	51.2	18,364
40	32.2	11,288	37.1	42.8	51.8	18,162	32.9	11,474	37.3	43.0	52.7	18,374
41	33.0	11,259	38.1	44.0	53.3	18,197	33.7	11,445	38.3	44.2	54.3	18,409
42	33.8	11,230	39.1	45.2	54.9	18,228	34.6	11,415	39.4	45.4	55.8	18,441
43	34.6	11,201	40.2	46.3	56.4	18,255	35.4	11,386	40.4	46.6	57.4	18,468
44	35.4	11,172	41.2	47.5	57.9	18,278	36.2	11,357	41.4	47.8	58.9	18,493
45	36.2	11,144	42.2	48.7	59.4	18,299	37.0	11,328	42.5	49.0	60.5	18,514
46	37.0	11,139	43.2	49.8	61.0	18,366	37.9	11,324	43.5	50.2	62.1	18,581
47	37.8	11,135	44.2	51.0	61.9	18,200	38.7	11,319	44.5	51.3	63.0	18,415
48	38.7	11,129	45.2	52.1	62.7	18,040	39.6	11,314	45.5	52.5	63.8	18,255
49	39.5	11,124	46.2	53.3	63.5	17,887	40.4	11,308	46.5	53.6	64.7	18,101
50	40.3	11,118	47.2	54.4	67.5	18,598	41.3	11,303	47.5	54.8	68.7	18,817
51	41.3	11,154	48.1	55.5	69.8	18,850	42.2	11,339	48.4	55.9	71.1	19,072
52	42.3	11,187	49.1	56.7	72.1	19,091	43.2	11,373	49.4	57.0	73.4	19,316
53	43.2	11,219	50.1	57.8	74.5	19,323	44.2	11,405	50.4	58.1	75.8	19,551
54	44.2	11,249	51.0	58.8	76.5	19,536	45.2	11,436	51.3	59.2	76.5	19,431
55	45.2	11,278	52.1	60.1	76.5	19,115	46.2	11,466	52.4	60.5	76.5	18,975
56	46.4	11,343	53.2	61.3	76.5	18,718	47.4	11,531	53.5	61.7	76.5	18,581
57	47.6	11,404	54.2	62.6	76.5	18,336	48.6	11,593	54.6	63.0	76.5	18,202
58	48.8	11,461	55.4	63.9	76.5	17,967	49.9	11,652	55.7	64.3	76.5	17,836
59	50.0	11,515	56.5	65.1	76.5	17,611	51.1	11,707	56.8	65.6	76.5	17,483
60	51.2	11,567	57.6	66.4	76.5	17,267	52.3	11,760	57.9	66.8	76.5	17,142
61	51.8	11,532	58.5	67.5	76.5	16,978	53.0	11,724	58.9	67.9	76.5	16,857
62	52.5	11,498	59.5	68.6	76.5	16,699	53.7	11,690	59.8	69.1	76.5	16,582
63	53.1	11,466	60.4	69.7	76.5	16,428	54.3	11,657	60.8	70.1	76.5	16,315
64	53.7	11,434	61.3	70.7	76.5	16,166	55.0	11,625	61.7	71.2	76.5	16,056
65	54.4	11,405	62.3	71.8	76.5	15,912	55.6	11,595	62.6	72.3	76.5	15,806
66	55.4	11,448	63.2	72.9	76.5	15,671	56.7	11,639	63.6	73.4	76.5	15,570
67	56.5	11,490	64.2	74.0	76.5	15,437	57.8	11,682	64.6	74.5	76.5	15,341
68	57.5	11,532	65.1	75.1	76.5	15,210	58.9	11,724	65.5	75.6	76.5	15,119
69	58.6	11,571	66.1	76.3	76.5	14,990	59.9	11,764	66.5	76.5	76.5	14,903
70	59.6	11,610	67.0	77.3	76.5	14,775	61.0	11,803	32.1	37.0	76.5	14,693

1. Table based on January 2001 data (HDC). Updated 2006 and 2014 (added Mid-Range).

Table BON-17. [*pg 1 of 9*] Bonneville Dam Spill Patterns in Vertical Gate Opening (ft) per Spill Bay (0.5 ft per 1 gate stop). [4] [5]

Total Spill	BON Spill Patterns – Vertical Gate Opening (ft) per Spill Bay (0.5 ft = 1 Gate Stop)																		Total Stops
(kcfs)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	(1 stop= 0.5')
2.3	0.5																	0.5	**2**
3.4	0.5	0.5																0.5	**3**
4.6	0.5	0.5															0.5	0.5	**4**
5.7	0.5	0.5														0.5	0.5	0.5	**5**
6.9	0.5	0.5		0.5												0.5	0.5	0.5	**6**
8	0.5	0.5		0.5	0.5											0.5	0.5	0.5	**7**
9.2	0.5	0.5		0.5	0.5									0.5		0.5	0.5	0.5	**8**
10.3	0.5	0.5		0.5	0.5							0.5		0.5		0.5	0.5	0.5	**9**
11.5	0.5	0.5		0.5	0.5					0.5		0.5		0.5		0.5	0.5	0.5	**10**
12.6	0.5	0.5		0.5	0.5			0.5		0.5		0.5		0.5		0.5	0.5	0.5	**11**
13.8	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**
14.9	0.5	0.5	0.5	0.5	0.5			0.5		0.5		0.5		0.5		0.5	1	0.5	**13**
16	0.5	1	0.5	0.5	0.5			0.5		0.5		0.5		0.5		0.5	1	0.5	**14**
17.2	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**
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	1	0.5	**16**
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	1	0.5	**17**
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	1	0.5	**18**
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	1	0.5	**19**
22.9	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**
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	0.5	**21**
25.2	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**
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	0.5	1	1	**23**
27.4	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**
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	0.5	1	1	1	**25**
29.7	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**
30.8	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**
31.9	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**
33.1	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**
34.2	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**

[4] "Total Spill" calculated based on forebay elevation 74.0 ft (updated 2007)..
[5] 3/10/2014 – Patterns changed to vertical feet per bay rather than # of gate stops per bay.

Total Spill	BON Spill Patterns – Vertical Gate Opening (ft) per Spill Bay (0.5 ft = 1 Gate Stop)																		Total Stops
(kcfs)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	(1 stop= 0.5')
35.3	1	1	1	1	0.5	1	1	0.5	1	0.5	0.5	1	1	0.5	1	1	1	1	**31**
36.4	1	1	1	1	0.5	1	1	0.5	1	1	0.5	1	1	0.5	1	1	1	1	**32**
37.6	1	1	1	1	1	1	1	0.5	1	1	0.5	1	1	0.5	1	1	1	1	**33**
38.7	1	1	1	1	1	1	1	1	1	1	0.5	1	1	0.5	1	1	1	1	**34**
39.8	1	1	1	1	1	1	1	1	1	1	0.5	1	1	1	1	1	1	1	**35**
40.9	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	**36**
42	1	1.5	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	**37**
43.2	1	1.5	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1.5	1	**38**
44.3	1	1.5	1	1	1	1	1	1	1	1	1	1	1	1	1	1.5	1.5	1	**39**
45.4	1	1.5	1.5	1	1	1	1	1	1	1	1	1	1	1	1	1.5	1.5	1	**40**
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	**41**
47.6	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**
48.6	1.5	1.5	1.5	1	1	1	1	1	1	1	1	1	1	1	1	1.5	2	1.5	**43**
49	2	2	2	0	2	0	0	2	0	2	0	0	2	2	0	2	2	2	**44**
50	2	2	2	0	2	0	0	2	0	2	0	0	2	2	0	2	2.5	2	**45**
52	2	2.5	2	0	2	0	0	2	0	2	0	0	2	2	0	2	2.5	2	**46**
53	2	2.5	2	0	2	0	0	2	0	2	0	0	2	2	0	2.5	2.5	2	**47**
54	2	2	2	0	2	0	2	2	0	2	0	0	2	2	0	2	2	2	**48**
55	2	2	2	0	2	0	2	2	0	2	0	0	2	2	0	2	2.5	2	**49**
56	2	2.5	2	0	2	0	2	2	0	2	0	0	2	2	0	2	2.5	2	**50**
57	2	2.5	2	0	2	0	2	2	0	2	0	0	2	2	0	2.5	2.5	2	**51**
58	2	2	2	0	2	0	2	2	0	2	2	0	2	2	0	2	2	2	**52**
59	2	2	2	0	2	0	2	2	0	2	2	0	2	2	0	2	2.5	2	**53**
61	2	2.5	2	0	2	0	2	2	0	2	2	0	2	2	0	2	2.5	2	**54**
62	2	2.5	2	0	2	0	2	2	0	2	2	0	2	2	0	2.5	2.5	2	**55**
63	2	2	2	2	2	0	2	2	0	2	2	0	2	2	0	2	2	2	**56**
64	2	2	2	2	2	0	2	2	0	2	2	0	2	2	0	2	2.5	2	**57**
65	2	2.5	2	2	2	0	2	2	0	2	2	0	2	2	0	2	2.5	2	**58**
66	2	2.5	2	2	2	0	2	2	0	2	2	0	2	2	0	2.5	2.5	2	**59**
67	2	2	2	2	2	0	2	2	0	2	2	0	2	2	2	2	2	2	**60**
68	2	2	2	2	2	0	2	2	0	2	2	0	2	2	2	2	2.5	2	**61**
70	2	2.5	2	2	2	0	2	2	0	2	2	0	2	2	2	2	2.5	2	**62**
71	2	2.5	2	2	2	0	2	2	0	2	2	0	2	2	2	2.5	2.5	2	**63**
72	2	2	2	2	2	2	2	2	0	2	2	0	2	2	2	2	2	2	**64**

Total Spill	BON Spill Patterns – Vertical Gate Opening (ft) per Spill Bay (0.5 ft = 1 Gate Stop)																		Total Stops
(kcfs)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	(1 stop= 0.5')
73	2	2	2	2	2	2	2	2	0	2	2	0	2	2	2	2	2.5	2	**65**
74	2	2.5	2	2	2	2	2	2	0	2	2	0	2	2	2	2	2.5	2	**66**
75	2	2.5	2	2	2	2	2	2	0	2	2	0	2	2	2	2.5	2.5	2	**67**
76	2	2	2	2	2	2	2	2	0	2	2	2	2	2	2	2	2	2	**68**
77	2	2	2	2	2	2	2	2	0	2	2	2	2	2	2	2	2.5	2	**69**
78	2	2.5	2	2	2	2	2	2	0	2	2	2	2	2	2	2	2.5	2	**70**
80	2	2.5	2	2	2	2	2	2	0	2	2	2	2	2	2	2.5	2.5	2	**71**
81	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	**72**
82	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2.5	2	**73**
83	2	2.5	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2.5	2	**74**
84	2	2.5	2	2	2	2	2	2	2	2	2	2	2	2	2	2.5	2.5	2	**75**
85	2	2.5	2.5	2	2	2	2	2	2	2	2	2	2	2	2	2.5	2.5	2	**76**
86	2	2.5	2.5	2	2	2	2	2	2	2	2	2	2	2	2	2.5	2.5	2.5	**77**
87	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**
88	2.5	2.5	2.5	2	2	2	2	2	2	2	2	2	2	2	2	2.5	3	2.5	**79**
89	2.5	3	2.5	2	2	2	2	2	2	2	2	2	2	2	2	2.5	3	2.5	**80**
90	2.5	3	2.5	2	2	2	2	2	2	2	2	2	2	2	2	2.5	3	3	**81**
91	3	3	2.5	2	2	2	2	2	2	2	2	2	2	2	2	2.5	3	3	**82**
92	3	3	2.5	2	2	2	2	2	2	2	2	2	2	2	2	3	3	3	**83**
94	3	3	3	2	2	2	2	2	2	2	2	2	2	2	2	3	3	3	**84**
95	3	3	3	2	2	2	2	2	2	2	2	2	2	2	2.5	3	3	3	**85**
96	3	3	3	2.5	2	2	2	2	2	2	2	2	2	2	2.5	3	3	3	**86**
97	3	3	3	2.5	2	2	2	2	2	2	2	2	2	2.5	2.5	3	3	3	**87**
98	3	3	3	2.5	2.5	2	2	2	2	2	2	2	2	2.5	2.5	3	3	3	**88**
99	3	3	3	2.5	2.5	2	2	2	2	2	2	2.5	2	2.5	2.5	3	3	3	**89**
100	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**
101	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**
103	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**
105	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**
107	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**
110	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**
110.5	3	3.5	3.5	3	3	2.5	2.5	2.5	2	2.5	2	2.5	2.5	2.5	3	3.5	3.5	3	**101**
111.6	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**
112.6	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**

Total Spill	BON Spill Patterns – Vertical Gate Opening (ft) per Spill Bay (0.5 ft = 1 Gate Stop)																		Total Stops
(kcfs)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	(1 stop= 0.5')
113.7	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**
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	**105**
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	3.5	3.5	**106**
116.7	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**
117.8	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**
118.8	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**
119.8	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**
120.9	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**
121.9	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**
122.9	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**
124	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**
124.9	3.5	3.5	3.5	3.5	3	3	3	3	2.5	2.5	3	3	3	3	3	3.5	4	4	**115**
126	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**
127	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**
128	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**
129	3.5	3.5	3.5	3.5	3	3	3	3	3	3	3	3	3	3	3.5	4	4	4	**119**
130	3.5	4	3.5	3.5	3	3	3	3	3	3	3	3	3	3	3.5	4	4	4	**120**
131	3.5	4	4	3.5	3	3	3	3	3	3	3	3	3	3	3.5	4	4	4	**121**
132	4	4	4	3.5	3	3	3	3	3	3	3	3	3	3	3.5	4	4	4	**122**
133	4	4	4	4	3	3	3	3	3	3	3	3	3	3	3.5	4	4	4	**123**
134	4	4	4	4	3	3	3	3	3	3	3	3	3	3	4	4	4	4	**124**
135	4	4	4	4	3	3.5	3	3	3	3	3	3	3	3	4	4	4	4	**125**
136.1	4	4	4	4	3.5	3.5	3	3	3	3	3	3	3	3	4	4	4	4	**126**
137.1	4	4	4	4	3.5	3.5	3	3	3	3	3	3	3.5	3	4	4	4	4	**127**
138.1	4	4	4	4	3.5	3.5	3	3	3	3	3	3	3.5	3.5	4	4	4	4	**128**
139.1	4	4	4	4	3.5	3.5	3	3	3	3	3	3	3.5	3.5	4	4	4.5	4	**129**
140.1	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**
141.1	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**
142.1	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**
143.1	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**
144	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**
145.1	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**
146.1	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**
147.1	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**

Total Spill	BON Spill Patterns – Vertical Gate Opening (ft) per Spill Bay (0.5 ft = 1 Gate Stop)																		Total Stops
(kcfs)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	(1 stop= 0.5')
148.1	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**
149.1	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**
150.1	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**
151.1	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**
152.1	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**
153.1	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**
154.1	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**
155.1	4	4.5	4.5	4	4	4	4	4	3.5	3.5	3.5	4	4	4	4	4.5	4.5	4	**145**
156.1	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**
157.1	4	4.5	4.5	4	4	4	4	4	4	3.5	4	4	4	4	4	4.5	4.5	4	**147**
158.1	4	4.5	4.5	4	4	4	4	4	4	4	4	4	4	4	4	4.5	4.5	4	**148**
159.1	4	4.5	4.5	4.5	4	4	4	4	4	4	4	4	4	4	4	4.5	4.5	4	**149**
160	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**
161	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**
162	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**
163	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**
163.9	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	4.5	4	**154**
164.9	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**
165.9	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**
166.8	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**
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	4.5	5	4	**158**
168.8	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**
169.8	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**
170.7	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**
171.7	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**
172.6	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**
173.6	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**
174.6	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**
175.6	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**
176.5	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**
177.5	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**
178.5	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**
179.4	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**
180.4	4	5	5	5	5	5	4.5	4.5	4.5	4.5	4.5	5	5	5	5	5	5	4	**171**

Total Spill	BON Spill Patterns – Vertical Gate Opening (ft) per Spill Bay (0.5 ft = 1 Gate Stop)																		Total Stops
(kcfs)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	(1 stop= 0.5')
181.3	4	5	5	5	5	5	4.5	5	4.5	4.5	4.5	5	5	5	5	5	5	4	**172**
182.3	4	5	5	5	5	5	4.5	5	4.5	5	4.5	5	5	5	5	5	5	4	**173**
183.3	4	5	5	5	5	5	4.5	5	5	5	4.5	5	5	5	5	5	5	4	**174**
184.2	4	5	5	5	5	5	5	5	5	5	4.5	5	5	5	5	5	5	4	**175**
185.2	4	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	4	**176**
186.1	4	5.5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	4	**177**
187.1	4	5.5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5.5	4	**178**
188	4	5.5	5	5	5	5	5	5	5	5	5	5	5	5	5	5.5	5.5	4	**179**
189	4	5.5	5.5	5	5	5	5	5	5	5	5	5	5	5	5	5.5	5.5	4	**180**
189.9	4	5.5	5.5	5	5.5	5	5	5	5	5	5	5	5	5	5	5.5	5.5	4	**181**
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	4	**182**
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	4	**183**
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	4	**184**
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	4	**185**
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	4	**186**
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	4	**187**
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	4	**188**
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	4	**189**
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	4	**190**
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	4	**191**
200.3	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**
201.2	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**
202.1	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**
203.1	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**
204	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**
204.9	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**
205.9	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**
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	5.5	4	**199**
207.7	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**
208.6	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**
209.6	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**
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	**203**
211.5	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**
212.4	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**

Total Spill	BON Spill Patterns – Vertical Gate Opening (ft) per Spill Bay (0.5 ft = 1 Gate Stop)																		Total Stops
(kcfs)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	(1 stop= 0.5')
213.4	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**
214.3	4.5	6	6	6	6	6	5.5	6	5.5	6	5.5	6	6	6	6	6	6	4.5	**207**
215.2	4.5	6	6	6	6	6	5.5	6	6	6	5.5	6	6	6	6	6	6	4.5	**208**
216.2	4.5	6	6	6	6	6	6	6	6	6	5.5	6	6	6	6	6	6	4.5	**209**
217.1	4.5	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	4.5	**210**
218	4.5	6	6	6	6.5	6	6	6	6	6	6	6	6	6	6	6	6	4.5	**211**
218.9	4.5	6	6	6	6.5	6	6	6	6	6	6	6	6.5	6	6	6	6	4.5	**212**
219.8	4.5	6	6	6	6.5	6	6	6	6	6	6	6.5	6.5	6	6	6	6	4.5	**213**
220.7	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**
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	4.5	**215**
222.6	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**
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	6.5	4.5	**217**
224.4	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**
225.3	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**
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	6.5	6.5	4.5	**220**
227.1	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**
228	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**
228.9	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**
229.9	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**
230.8	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**
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	4.5	**226**
232.6	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**
233.6	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**
234.5	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**
235.4	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**
236.3	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**
237.2	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**
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	6.5	5	**233**
239	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**
239.9	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**
240.8	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**
241.7	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**
242.6	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**
243.5	5	7	7	6.5	7	7	6.5	7	6.5	7	6.5	7	7	6.5	7	7	7	5	**239**

Total Spill	BON Spill Patterns – Vertical Gate Opening (ft) per Spill Bay (0.5 ft = 1 Gate Stop)																		Total Stops
(kcfs)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	(1 stop= 0.5')
244.4	5	7	7	7	7	7	6.5	7	6.5	7	6.5	7	7	6.5	7	7	7	5	**240**
245.3	5	7	7	7	7	7	6.5	7	6.5	7	6.5	7	7	7	7	7	7	5	**241**
246.2	5	7	7	7	7	7	7	7	6.5	7	6.5	7	7	7	7	7	7	5	**242**
247.1	5	7	7	7	7	7	7	7	6.5	7	7	7	7	7	7	7	7	5	**243**
248	5	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	5	**244**
248.8	5	7	7	7	7.5	7	7	7	7	7	7	7	7	7	7	7	7	5	**245**
249.7	5	7	7	7	7.5	7	7	7	7	7	7	7	7.5	7	7	7	7	5	**246**
250.6	5	7	7	7	7.5	7	7	7	7	7	7	7.5	7.5	7	7	7	7	5	**247**
251.5	5	7	7	7	7.5	7.5	7	7	7	7	7	7.5	7.5	7	7	7	7	5	**248**
252.4	5	7	7	7	7.5	7.5	7	7.5	7	7	7	7.5	7.5	7	7	7	7	5	**249**
253.3	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**
254.1	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**
255	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**
255.9	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**
256.8	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**
257.7	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**
258.6	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**
259.5	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**
260.3	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**
261.2	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**
262.1	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**
262.9	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**
263.8	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**
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	**263**
265.6	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**
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	7.5	7.5	5	**265**
267.3	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**
268.2	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**
269.1	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**
269.9	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**
270.8	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**
271.7	5	7.5	8	8	8	8	7.5	8	7.5	8	7.5	8	8	8	8	8	7.5	5	**271**
272.5	5	7.5	8	8	8	8	8	8	7.5	8	7.5	8	8	8	8	8	7.5	5	**272**
273.4	5	7.5	8	8	8	8	8	8	7.5	8	8	8	8	8	8	8	7.5	5	**273**

Total Spill	BON Spill Patterns – Vertical Gate Opening (ft) per Spill Bay (0.5 ft = 1 Gate Stop)																		Total Stops
(kcfs)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	(1 stop= 0.5')
274.3	5	7.5	8	8	8	8	8	8	8	8	8	8	8	8	8	8	7.5	5	**274**
275.1	5	7.5	8	8	8.5	8	8	8	8	8	8	8	8	8	8	8	7.5	5	**275**
276	5	7.5	8	8	8.5	8	8	8	8	8	8	8	8.5	8	8	8	7.5	5	**276**
276.9	5	7.5	8	8	8.5	8	8	8	8	8	8	8.5	8.5	8	8	8	7.5	5	**277**
277.7	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**
278.6	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**
279.5	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**
280.3	5	8	8	8	8.5	8.5	8	8.5	8	8	8	8.5	8.5	8	8	8	8	5	**281**
281.2	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**
282	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**
282.9	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**
283.8	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**
284.6	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**
285.5	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**
286.3	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**
287.2	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**
288.1	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**
288.9	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**
289.7	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**
290.6	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**
291.4	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**
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	**295**
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	8.5	8.5	5	**296**
294	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**
294.8	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**
295.7	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**
296.5	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**

2014 Fish Passage Plan

Section 3 – The Dalles Dam

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The Dalles Dam

Project Acronym	TDA
River Mile (RM)	Columbia River – RM 191.5
Reservoir	Lake Celilo
Minimum Instantaneous Flow (kcfs)	Dec–Feb: 12.5 kcfs \ Mar–Nov: 50 kcfs
Forebay Normal Operating Range (ft)	155.0’ – 160.0’
Tailrace Rate of Change Limit (ft)	3’/hr
Powerhouse Length (ft)	2,089’
Powerhouse Hydraulic Capacity (kcfs)	375 kcfs
Turbine Units	22 (BLH Kaplan) + 2 Fish Units
Turbine Generating Capacity (MW)	Rated: 1,808 MW (Units 1-14 @ 78 MW/unit + Units 15-22 @ 86 MW/unit) Maximum: 2,080 MW (Units 1-14 @ 90 MW/unit + Units 15-22 @ 99 MW/unit)
Gatewell Orifice Diameter (in)	One 6” orifice per gatewell
Spillway Length (ft)	1,447’
Spillway Hydraulic Capacity (kcfs)	2,290 kcfs
Spillbays (#)	23
Spillway Weirs (#)	0
Navigation Lock Length x Width (ft)	650’ x 86’
Navigation Lock Max. Lift (ft)	90’

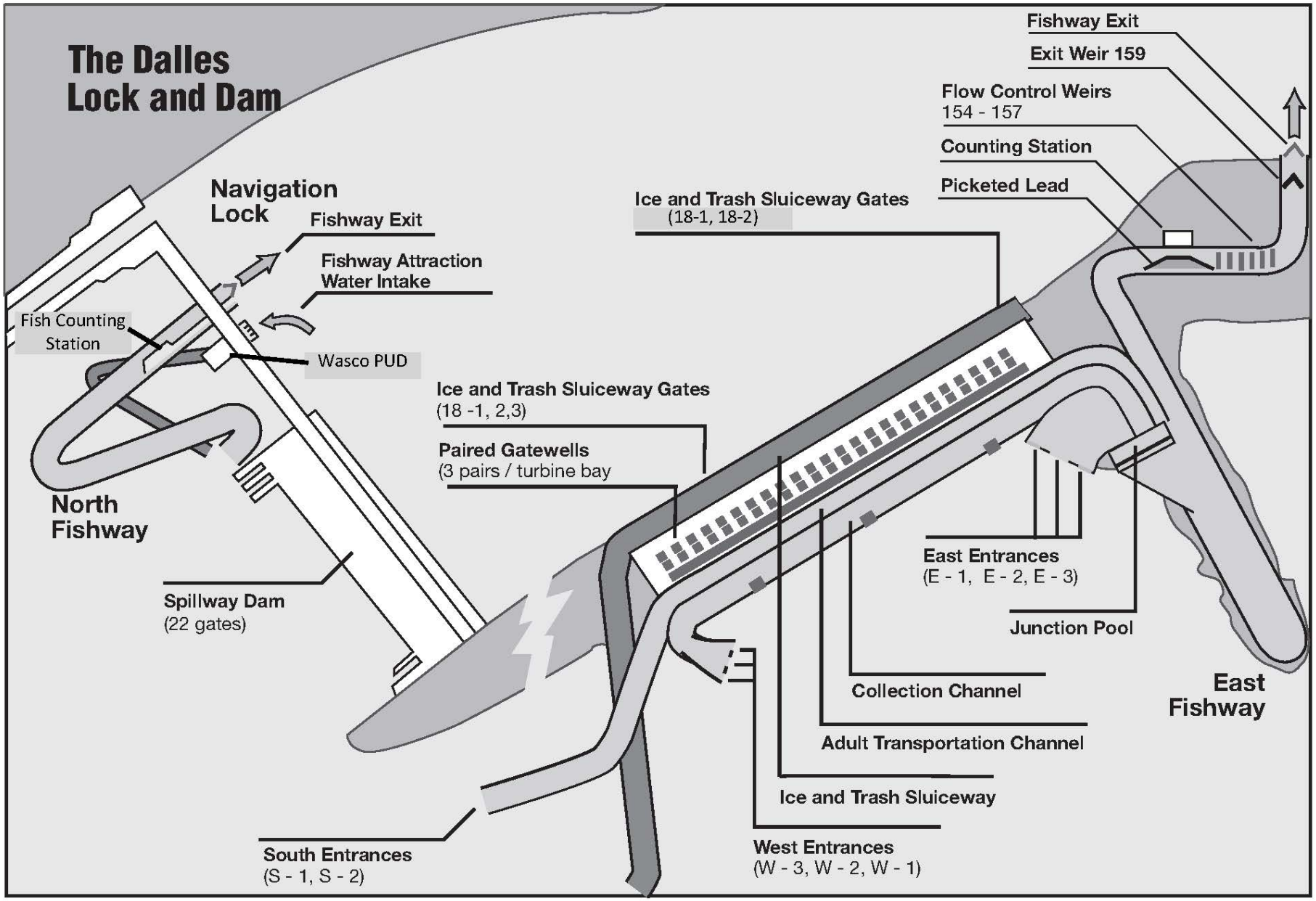


Figure TDA-1. The Dalles Dam General Site Plan.

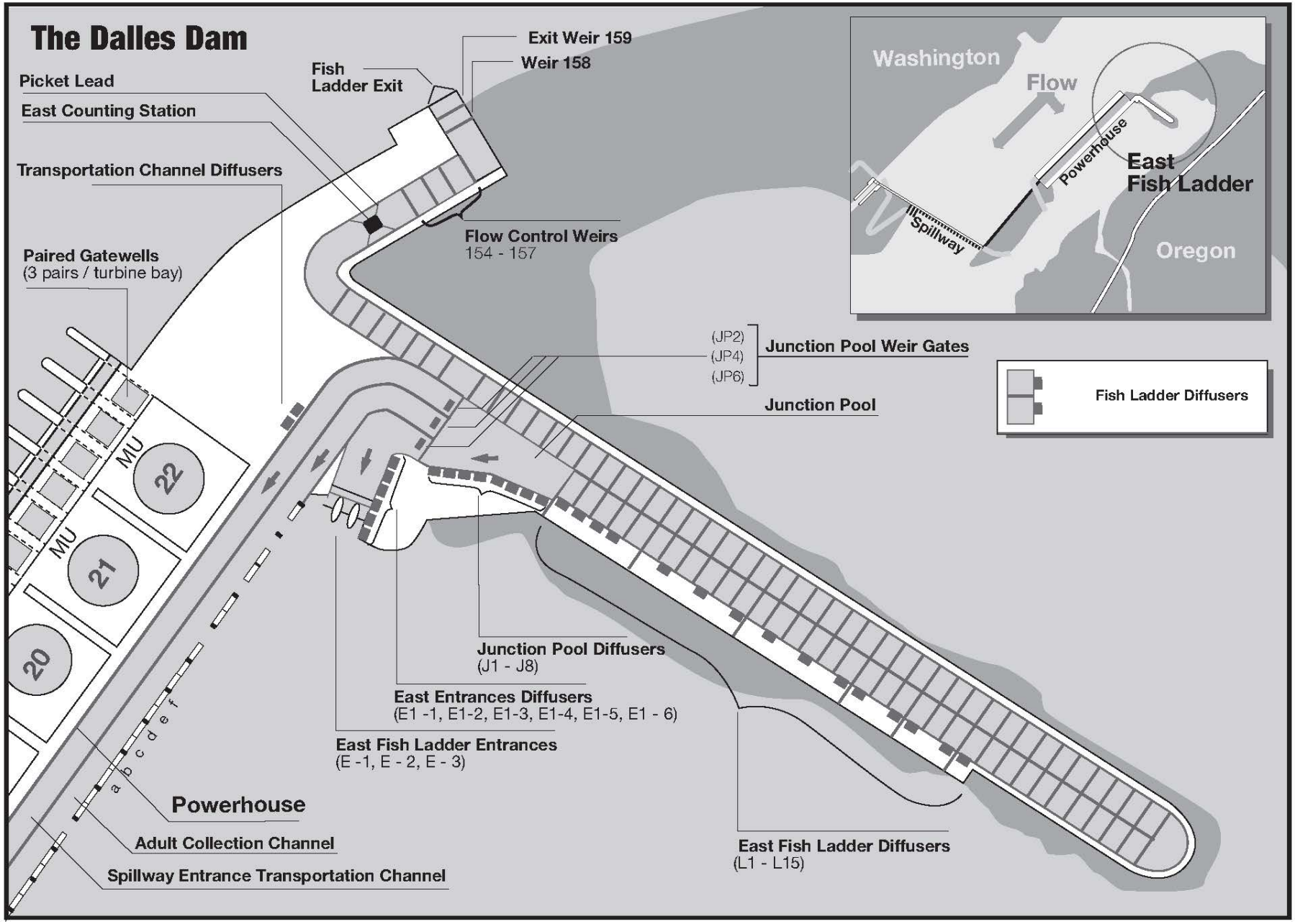


Figure TDA-2. The Dalles Dam East Fish Ladder.

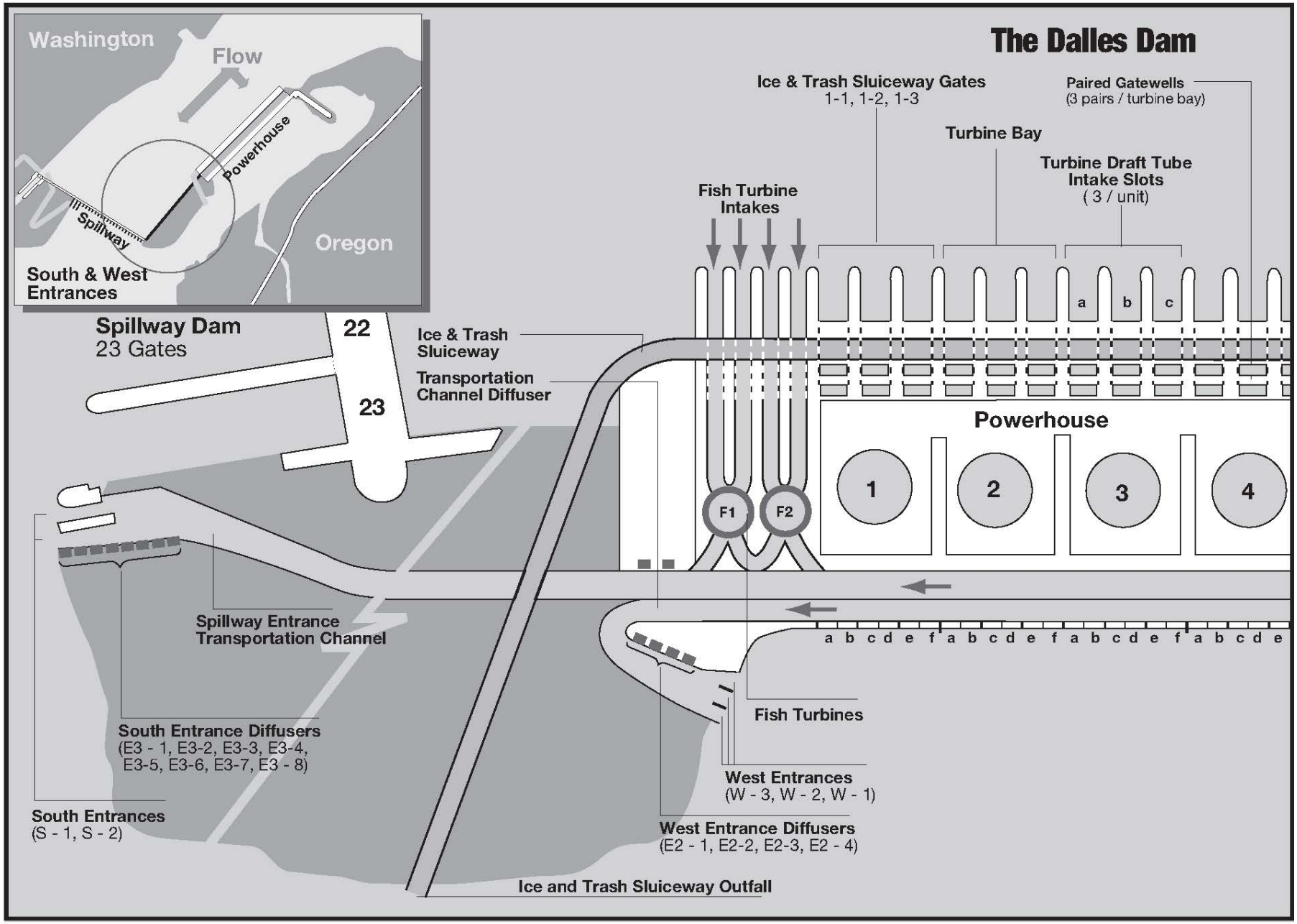


Figure TDA-3. The Dalles Dam South and West Fish Ladder Entrances.

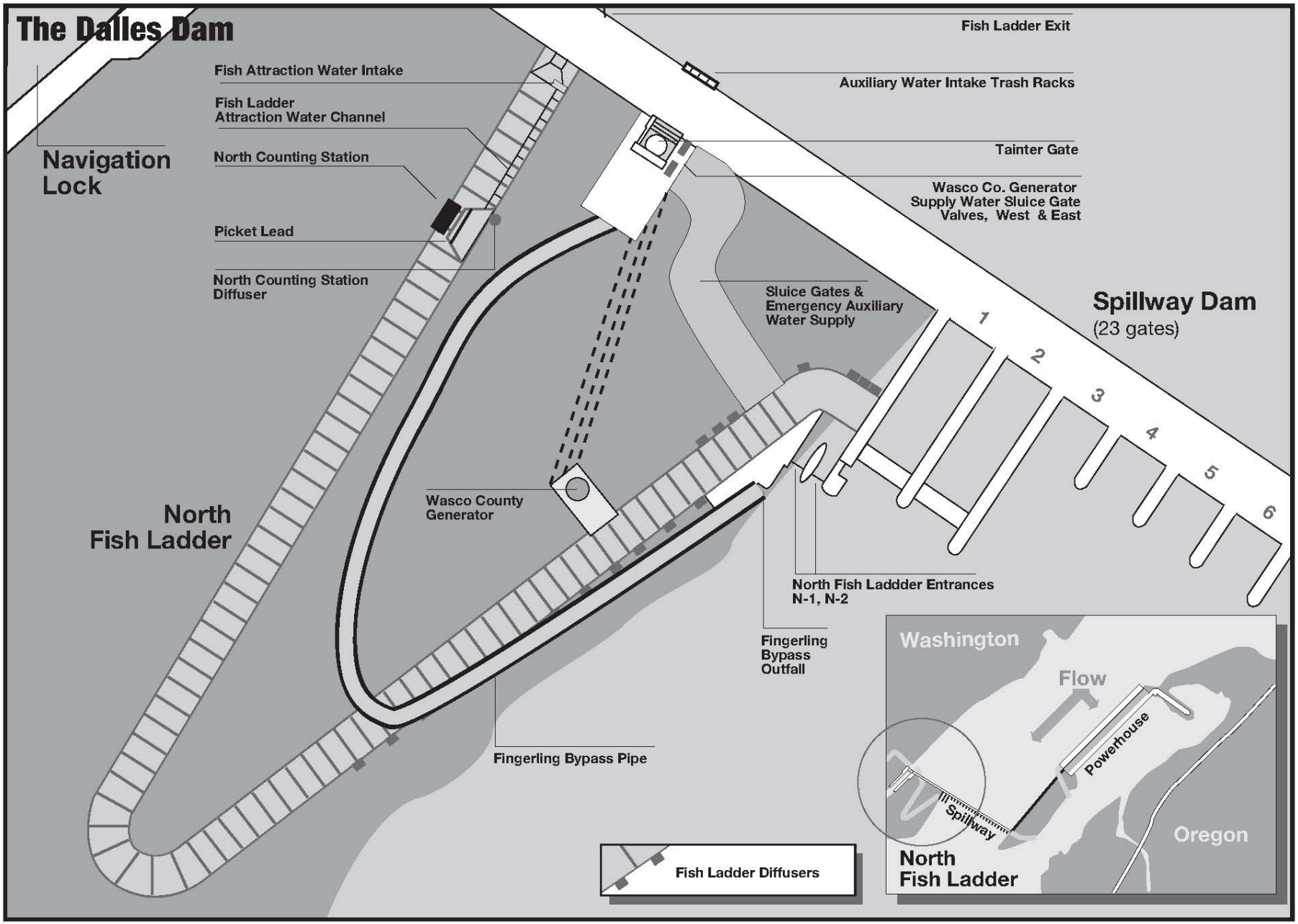
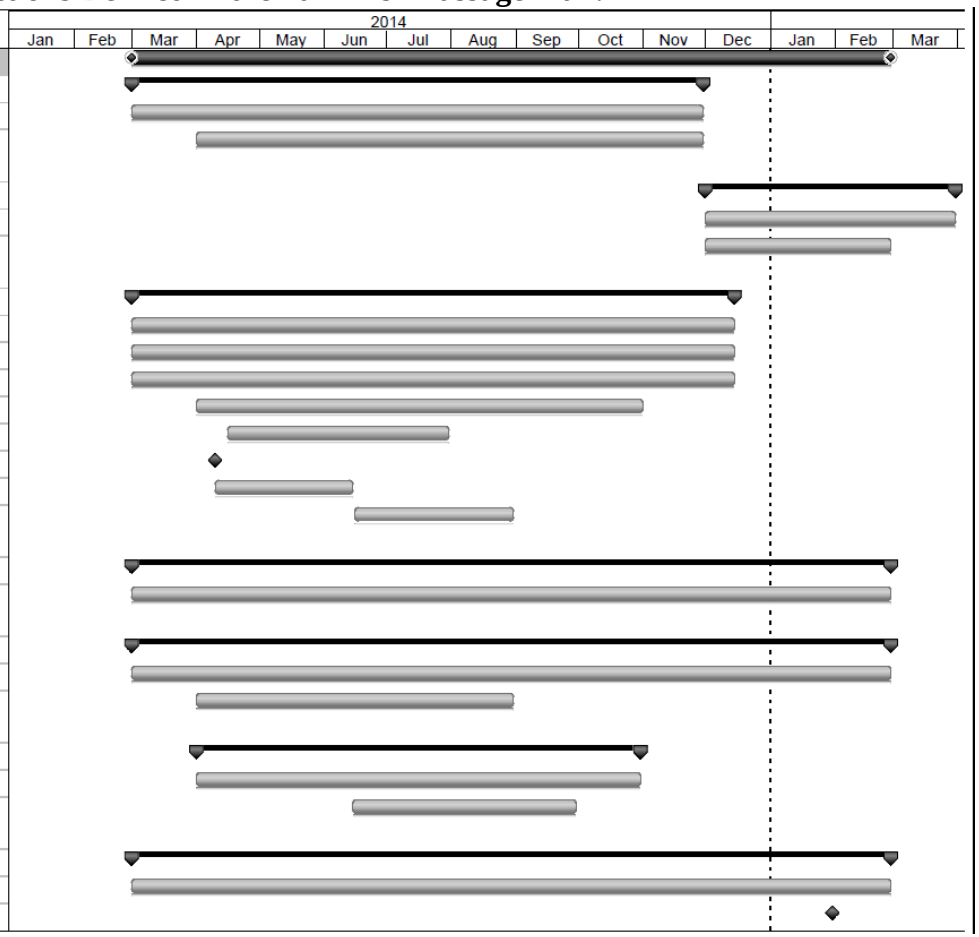


Figure TDA-4. The Dalles Dam North Fish Ladder and Spillway.

Table TDA-1. The Dalles Dam Schedule of Operations and Actions Defined in the 2014 Fish Passage Plan.

Task Name	Start Date	End Date	FPP Reference
2014 FPP Operations & Actions - The Dalles	**3/1/14**	**2/28/15**	**TDA**
Fish Passage Facilities Operation	**3/1/14**	**11/30/14**	**2.4. and 2.5.**
Adult Fish Facilities	3/1/14	11/30/14	2.5.1.2.
Juvenile Fish Facilities	4/1/14	11/30/14	2.4.1.2.
Fish Passage Facilities Maintenance	**12/1/14**	**3/31/15**	**2.4. and 2.5.**
Juvenile Fish Facilities Winter Maintenance	12/1/14	3/31/15	2.4.1.1.
Adult Fish Facilities Winter Maintenance	12/1/14	2/28/15	2.5.1.1.
Project Operations for Fish Passage	**3/1/14**	**12/15/14**	
Unit 1 and/or Unit 2 operate for fish passage	3/1/14	12/15/14	5.1.1.
ITS operation	3/1/14	12/15/14	2.4.2.2.a.
Turbine operating priority order	3/1/14	12/15/14	Table TDA-4
Turbine 1% operating range - hard constraint	4/1/14	10/31/14	5.2.3.
Avian Hazing	4/16/14	7/31/14	9.1.1.
Avian Wires installed no later than April 10	4/10/14	4/10/14	9.1.2.
Spring Spill Operations	4/10/14	6/15/14	FOP
Summer Spill Operations	6/16/14	8/31/14	FOP
Special Operations & Studies (dates approximate)	**3/1/14**	**2/28/15**	**Appendix A**
Adult Salmon Studies	3/1/14	2/28/15	3.2.1.
TDG Monitoring	**3/1/14**	**2/28/15**	**2.3.1.**
TDG Monitoring - Tailrace (year-round)	3/1/14	2/28/15	station TDDO
TDG Monitoring - Forebay	4/1/14	8/31/14	station TDA
Adult Fish Counting	**4/1/14**	**10/31/14**	**Table TDA-2**
Daytime Visual 0500-2100 DST	4/1/14	10/31/14	
Night Video 2100-0500 DST	6/15/14	9/30/14	
Reports	**3/1/14**	**2/28/15**	**3.3.**
Weekly Reports	3/1/14	2/28/15	
Annual Report	1/31/15	1/31/15	



1. FISH PASSAGE INFORMATION

The locations of fish passage facilities at The Dalles Dam are shown on the general site plans in **Figures TDA-1** through **TDA-4**. The schedule for project operations described in the Fish Passage Plan (FPP) and appendices is included in **Table TDA-1**.

1.1. Juvenile Fish Passage.

1.1.1. Juvenile Fish Passage Facilities. 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. 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. 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–November. Juvenile migration timing is monitored at the John Day Dam Smolt Monitoring Facility (SMF), and the 10-year passage timing data are reported in the current Fish Passage Plan (FPP) John Day Dam section in **Table JDA-2**. No juvenile monitoring is done at The Dalles Dam; therefore, refer to **Table JDA-2** and add approximately one day to the dates to estimate juvenile fish arrival at The Dalles Dam.

1.1.2.1. Diel passage at The Dalles Dam 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. Adult Fish Passage Facilities. 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 Fish Passage Timing and Count Schedule. Upstream migrants are present throughout the year and adult passage facilities are operated year-round. Adult salmon, steelhead, lamprey and shad are typically counted April 1 through October 31 (**Table TDA-2**) and daily data are posted online at: http://www.nwp.usace.army.mil/Missions/Environment/Fishdata.aspx. Sturgeon and bull trout are relatively infrequent and counts are posted online periodically during the passage season in *Miscellaneous Fish Count*s and summarized in the *Annual Fish Passage Report*.

1.2.2.1. Peak timing of adult fish passage at The Dalles Dam is determined based on yearly counts through the most recent passage year, beginning in 1957 for adult salmon and steelhead and in 2000 for lamprey (**Table TDA-3**).

1.2.2.2. Annual maintenance of adult facilities is scheduled December 1 through February (winter maintenance period) to minimize impacts on upstream migrants. One ladder is dewatered at a time unless otherwise coordinated through FPOM.

Table TDA-2. Adult Fish Count Schedule at The Dalles Dam (3/1/14 – 2/28/15).

Count Period	Counting Method and Hours *
April 1 – October 31	Visual 0500–2100 hours (DST)
June 15 – September 30	Night Video 2100–0500 hours (DST)

*****In 2014, Daylight Saving Time (DST) is in effect March 9 – November 2, and hours are adjusted forward one hour from Pacific Standard Time (PST). DST = PST+1.

Table TDA-3. Adult Fish Count Period and Peak Passage Timing at The Dalles Dam Based on Yearly Counts since 1957 (except lamprey since 2000).

Species	Count Period	Earliest Peak	Latest Peak
Spring Chinook	Feb 20 – Jun 3	Apr 13	May 13
Summer Chinook	Jun 4 – Aug 3	Jun 6	Aug 1
Fall Chinook	Aug 4 – Dec 7	Sep 2	Sep 23
Sockeye	Feb 20 – Dec 7	Jun 20	Jul 10
Steelhead	Feb 20 – Dec 7	Jul 9	Sep 23
Coho	Feb 20 – Dec 7	Sep 3	Oct 25
Lamprey	Feb 20 – Dec 7	Jul 12	Aug 1

1.2.2.3. Time-of-day (diel) distributions of adult salmonid activity at The Dalles Dam fishway entrances and exits are summarized in **Figure TDA-5** (see *Keefer & Caudill 2008* at: http://www.nwd-wc.usace.army.mil/tmt/documents/FPOM/2010/2013_FPOM_MEET/2013_JUN/).

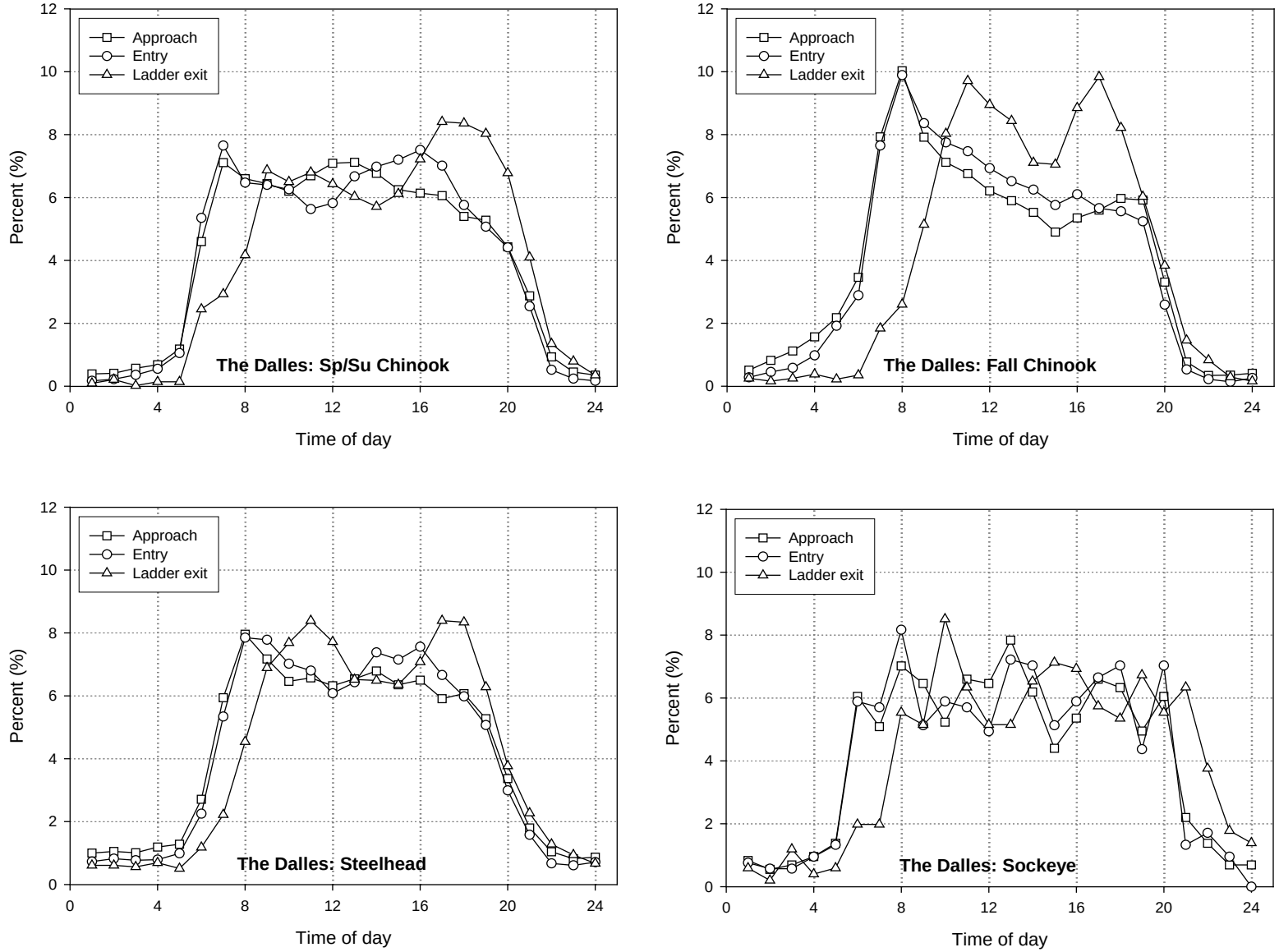


Figure TDA-5. Diel Distribution of Adult Salmonids at The Dalles Dam Fishway Entrances and Exits (*Keefer & Caudill 2008*).

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.

2.2.1. See the Fish Operations Plan (FOP), included in the Fish Passage Plan as **Appendix E**, for more information. Spill patterns are provided in **Table TDA-6**.

2.3. Total Dissolved Gas (TDG) Management.

2.3.1. Total dissolved gas (TDG) levels at all projects are monitored in accordance with the *TDG Monitoring Plan*, included in the *Water Management Plan* as Appendix 4, and available online at: http://www.nwd-wc.usace.army.mil/tmt/documents/wmp/.

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 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 – March 31 (Winter Maintenance Period)

2.4.1.1.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.

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

2.4.1.1.c. Inspect and correct any epoxy or concrete deficiencies on the Ice & Trash Sluiceway walls and floors, where accessible.

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

2.4.1.1.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 mid-April each year.

2.4.1.1.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.

2.4.1.1.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.

2.4.1.2. April 1 – November 30 (Juvenile Fish Passage Season).

2.4.1.2.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'. To determine if there is debris buildup on the trashracks between June 1 and June 15, inspect three units across the powerhouse that have the most prior operation and will not interfere with sluiceway operation. If so, trashracks will be raked. All trashracks can be raked using the Hammerhead crane.

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

2.4.1.2.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.

2.4.1.2.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.

2.4.1.2.e. Open ITS gates 1-1, 1-2, and 1-3 over operating Main Unit (MU) 1; sluiceway gates 8-2 and 8-3 over operating MU 8; and sluiceway gate 18-2 over operating MU 18. If any these MUs are out of service for more than 6 hours, 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 March 1 through December 15.

2.4.1.2.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.

2.4.1.2.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.

2.4.1.2.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.

2.4.1.2.i. Follow the spill patterns in **Table TDA-6** for juvenile fish passage.

2.5. Adult Fish Passage Facilities.

2.5.1. Operating Criteria.

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

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

2.5.1.1.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.

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

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

2.5.1.1.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.

2.5.1.1.f. December 1 through December 15, open ITS gates 1-2 and 1-3 over operating MU 1, and gates 18-1 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.

2.5.1.1.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 – November 30 (Adult Fish Passage Season).

2.5.1.2.a. All Adult Facilities.

a.1. Water depth over fish ladder weirs = 1.0’ ±0.1'. During shad passage season (>5,000 shad/day per Bonneville Dam count station) = 1.3’ ±0.1’. See paragraph **2.5.1.2.b.2.** and **3.** for exception.

a.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.

a.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.

a.4. Water velocity of 1.5–4.0 fps (2 fps optimum) shall be maintained for full length of the powerhouse collection channel and the lower ends of 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.

a.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.

a.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.

a.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.

a.8. The current fish counting program is conducted 16 hours per day, from April through October (see **Table TDA-2**). Count station crowders and picket leads shall remain in the operating position while visual counting, videotaping and/or PIT-tag antenna operation is being conducted.

i. The crowder shall be opened to full count slot width when not counting. The crowder shall be open as far as possible to allow accurate counting and shall not be closed to less than 18” while counting. This will usually occur during high turbidity conditions to allow count accuracy criteria to be achieved. Crowder ranges are as follows:

- TDA-East = 20–34”
- TDA-North = 18–38”

ii. 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.

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

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

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

vi. March 1–March 31, operate the ITS on a 24-hour basis. 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).

2.5.1.2.b. East Fishway.

b.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'.

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

b.3. Telescoping weir #158 will track 1.0' ±0.1' below weir #159 at all times during fishway operation.

2.5.1.2.c. North Fishway Entrance. Operate one entrance weir—N1. Project biologists will work in conjunction with Wasco County to maintain fishway entrances within established criteria.

2.5.1.2.d. Powerhouse.

d.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.

d.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.

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

i. JP6.....>7'

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

d.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 & 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. A third inspection will be made using the data logging system. Entrance conditions for the previous 24 hours will be checked daily for entrance 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.

3.2.1. 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:

i. Any out-of-criteria situations observed and subsequent corrective actions taken;

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

iii. Adult fishway control calibrations;

iv. STS and VBS inspections;

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

vi. Any unusual activities at the project that 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:

i. Time and date.

ii. Nature of activity that lead to fish impact.

iii. Agency responsible for the impact, or the reporter if no responsible party can be identified.

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

v. Future actions to avoid a similar impact.

vi. 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 (ITS) 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.

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). 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.

4.2.2. 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):

i. Description of the problem.

ii. Type of outage required.

iii. Impact on facility operation.

iv. Length of time for repairs**...**

v. 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.

4.2.2.1.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.

4.2.2.1.b. 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.

4.2.2.1.c. 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 necessary changes to accommodate 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.a. 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.

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

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

a.2. Close entrance weir S1.

a.3. Raise entrance weir E2 and E3 to 8’ depth.

a.4. Close entrance weir S2 in 1’ increments.

a.5. Close entrance weir W2 in 1’ increments.

a.6. Close entrance weir W1 in 1’ increments.

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

4.3.2.1.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:

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

b.2. Close west entrance.

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

4.3.2.1.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 & MAINTENANCE

5.1. Unit Priority.

5.1.1. Through the juvenile fish passage season, April 1 – November 30, *and* from March 1 – March 31 and December 1 – December 15 to aid adult steelhead fallbacks or kelts, either turbine unit 1 and/or unit 2 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 defined in **Table TDA-5** below (excluding synchronize unit operation).

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

PERIOD	PRIORITY
Fish Passage Season: April 1–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 – December 15	1 and/or 2, 18†
December 16 – February 28	1-22 in any order
March 1 – 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. Turbine Unit O&M.

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

5.2.2. Guidelines for operation of the turbine units within 1% of best efficiency at various head ranges are shown in **Table TDA-6.**

5.2.3. To the extent technically feasible, turbines will be operated within ±1% of peak turbine efficiency (1% range) from April 1 through October 31, as specified in the *BPA Load Shaping Guidelines* (**Appendix C**). 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.

5.2.4. 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.

5.2.5. 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.

5.2.6. 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.

5.2.7. Wicket gate opening for functional testing on a watered-up unit will be no more than 15 minutes total open time.

6. DEWATERING PLANS

6.1. General.

6.1.1. *Guidelines for Dewatering and Fish Handling Plans* (**Appendix** F) 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. *Dewatering Plans* are available online at: http://www.nwd-wc.usace.army.mil/tmt/documents/FPOM/2010/

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.

6.2. Juvenile Bypass Systems. [*not applicable for TDA*]

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:

6.3.1.5.a. Remove orifice blocking devices if used.

6.3.1.5.b. Activate automation for systems.

6.3.1.5.c. Assure all count station lighting is operational.

6.3.1.5.d. Open count station crowder

6.3.1.5.e. Close picket leads.

6.3.1.5.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.

6.6. Navigation Lock.

6.6.1. The navigation lock is frequently dewatered for routine maintenance in late February/early March, in conjunction with navigation lock outages at Bonneville and John Day dams.

6.6.2. The area between the upstream bulkhead and the upstream gate is surveyed for fish as water levels allow. The lateral and pool areas on the floor of the lock are surveyed for fish from above. Most of these areas remain full of water, precluding the ability to implement successful fish salvage operations. Areas where water levels slowly decrease are accessed via crane when pool levels reach a depth of approximately 3 feet. The fill conduits are accessed and checked for fish only if needed and can be done safely. All salvaged fish are removed, transported via bag or tank and released to the river.

7. FOREBAY DEBRIS REMOVAL

7.1.1. 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.

7.1.2. 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

8.1.1. 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.

8.1.2. 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 (home & mobile #s available in Control Room):

i. Bob Cordie

ii. Paul Keller

iii. Jeff Randall

iv. Erin Kovalchuk

v. Bern Klatte (503) 808-4318 or Tammy Mackey (503) 961-5733.

9. HAZING ACTIVITIES

9.1. Avian Hazing (Piscivorous Birds).

9.1.1. From April 16 through July 31, piscivorous birds shall be hazed at The Dalles Dam 7 days/week for 14 hours/day between the hours of 0600-2000. Hours of hazing should vary so that birds do not acclimate to long periods without hazing.

9.1.2. Avian Wires. Avian wires shall be installed prior to 10 April each year.

9.1.3. Hazing techniques are detailed in the approved Operating Plan. The objective of the program is to reduce avian predation of migrating juvenile salmonids and lamprey by hazing or harassing piscivorous birds in a manner that impedes their ability to successfully forage on fish or forces them to leave the area.

9.1.4. Avian hazing shall occur primarily near dam locations where predation risk is high (e.g., tailrace areas where fish may be disoriented after passing the project or forebay areas where fish may be delayed from passing the project).

9.1.4.1. Birds shall be hazed near the spillway and powerhouse discharge areas, the juvenile bypass outfall(s), and where birds congregate or feed, ranging up to approximately 2,000 feet downstream of the dam and outfall site. Roosting and actively foraging birds shall also be hazed within the forebay boat restricted zones.

9.1.4.2. During juvenile lamprey outmigration, Wildlife Service specialists may be requested to focus hazing at specific areas of the project where juvenile lamprey are known to pass.

Table TDA-5. The Dalles Dam Turbine Unit Output (MW) and Discharge (cfs) Per Unit at Upper and Lower Limits of the 1% Peak Efficiency Operating Range. [1]

Project Head (feet)	Turbine Units 1-14				Turbine Units 15-22			
	1% Lower Limit		1% Upper Limit		1% Lower Limit		1% 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

1. Table values based on information provided by HDC in 2001, 2002 (Table TDA-5 revised 2006).

Table TDA-6. [*pg 1 of 4*] The Dalles Dam Spill Patterns at 40% Spill for Juvenile Fish Passage.[1] *See notes at end of table.*

Total Spill (kcfs)	The Dalles Dam Spill Patterns at 40% Spill Vertical Gate Opening (ft) per Spillbay[2]																							Total Open (ft)	Total River (kcfs)	River Flow Low (kcfs)	River Flow High (kcfs)	% Spill Range[3] Low (%)	% Spill Range[3] High (%)	See Note
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23							
11.7							4	4																8	61.7	61.7	62.5	18.7%	19.0%	4
13.2							4.5	4.5																9	63.2	62.5	63.9	20.7%	21.1%	4
14.6							5	5																10	64.6	63.9	65.4	22.3%	22.8%	4
16.1							5.5	5.5																11	66.1	65.4	66.9	24.1%	24.6%	4
17.6							6	6																12	67.6	66.9	68.3	25.8%	26.3%	4
19.0							6.5	6.5																13	69.0	68.3	69.8	27.2%	27.8%	4
20.5							7	7																14	70.5	69.8	71.2	28.8%	29.4%	4
21.9							7.5	7.5																15	71.9	71.2	72.6	30.2%	30.8%	4
23.3							8	8																16	73.3	72.6	74.1	31.5%	32.1%	4
24.8							8.5	8.5																17	74.8	74.1	75.5	32.8%	33.5%	4
26.2							9	9																18	76.2	75.5	77.0	34.0%	34.7%	4
27.7							9.5	9.5																19	77.7	77.0	78.4	35.3%	36.0%	4
29.1							10	10																20	79.1	78.4	79.8	36.5%	37.1%	4
30.5							10.5	10.5																21	80.5	79.8	81.2	37.6%	38.2%	4
31.9							11	11																22	81.9	81.2	82.6	38.6%	39.3%	4
33.3							11.5	11.5																23	83.3	82.6	85.2	39.1%	40.3%	4
34.8							12	12																24	87.0	85.2	87.4	39.8%	40.9%	
35.1			4	4	4	4	4	4																24	87.8	87.4	90.0	39.0%	40.2%	
36.9			4.2	4.2	4.2	4.2	4.2	4.2																25.2	92.3	90.0	95.5	38.6%	41.0%	5
39.5			4.5	4.5	4.5	4.5	4.5	4.5																27	98.8	95.5	100.6	39.3%	41.4%	5
41.0		4	4	4	4	4	4	4																28	102.5	100.6	105.0	39.0%	40.7%	
43.0		4.2	4.2	4.2	4.2	4.2	4.2	4.2																29.4	107.5	105.0	111.4	38.6%	41.0%	5
46.1		4.5	4.5	4.5	4.5	4.5	4.5	4.5																31.5	115.3	111.4	116.1	39.7%	41.4%	5
46.8	4	4	4	4	4	4	4	4																32	117.0	116.1	120.0	39.0%	40.3%	
49.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2																33.6	123.0	120.0	127.4	38.6%	41.0%	5
52.7	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5																36	131.8	127.4	134.8	39.1%	41.4%	5
55.1	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7																37.6	137.8	134.8	142.0	38.8%	40.9%	5
58.5	5	5	5	5	5	5	5	5																40	146.3	142.0	149.3	39.2%	41.2%	5
60.9	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2																41.6	152.3	149.3	156.6	38.9%	40.8%	5
64.4	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5																44	161.0	156.6	163.9	39.3%	41.1%	5
66.7	5.7	5.7	5.7	5.7	5.7	5.7	5.7	5.7																45.6	166.8	163.9	171.1	39.0%	40.7%	
70.2	6	6	6	6	6	6	6	6																48	175.5	171.1	178.4	39.4%	41.0%	

Total Spill (kcfs)	The Dalles Dam Spill Patterns at 40% Spill Vertical Gate Opening (ft) per Spillbay [2]																							Total Open (ft)	Total River (kcfs)	River Flow Low (kcfs)	River Flow High (kcfs)	% Spill Range [3] Low (%)	% Spill Range [3] High (%)	See Note
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23							
72.5	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2																49.6	181.3	178.4	185.6	39.1%	40.6%	
76.0	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5																52	190.0	185.6	193.0	39.4%	40.9%	
78.4	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7																53.6	196.0	193.0	200.4	39.1%	40.6%	
81.9	7	7	7	7	7	7	7	7																56	204.8	200.4	207.6	39.4%	40.9%	
84.2	7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.2																57.6	210.5	207.6	214.8	39.2%	40.6%	
87.6	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5																60	219.0	214.8	221.9	39.5%	40.8%	
89.9	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7																61.6	224.8	221.9	229.0	39.3%	40.5%	
93.3	8	8	8	8	8	8	8	8																64	233.3	229.0	236.1	39.5%	40.7%	
95.6	8.2	8.2	8.2	8.2	8.2	8.2	8.2	8.2																65.6	239.0	236.1	243.4	39.3%	40.5%	
99.1	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5																68	247.8	243.4	250.6	39.5%	40.7%	
101.4	8.7	8.7	8.7	8.7	8.7	8.7	8.7	8.7																69.6	253.5	250.6	257.9	39.3%	40.5%	
104.9	9	9	9	9	9	9	9	9																72	262.3	257.9	265.1	39.6%	40.7%	
107.2	9.2	9.2	9.2	9.2	9.2	9.2	9.2	9.2																73.6	268.0	265.1	272.4	39.4%	40.4%	
110.7	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5																76	276.8	272.4	279.6	39.6%	40.6%	
113.0	9.7	9.7	9.7	9.7	9.7	9.7	9.7	9.7																77.6	282.5	279.6	286.6	39.4%	40.4%	
116.3	10	10	10	10	10	10	10	10																80	290.8	286.6	293.6	39.6%	40.6%	
118.6	10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2																81.6	296.5	293.6	300.6	39.5%	40.4%	
121.9	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5																84	304.8	300.6	307.6	39.6%	40.5%	
124.2	10.7	10.7	10.7	10.7	10.7	10.7	10.7	10.7																85.6	310.5	307.6	314.9	39.4%	40.4%	
127.7	11	11	11	11	11	11	11	11																88	319.3	314.9	322.0	39.7%	40.6%	
129.9	11.2	11.2	11.2	11.2	11.2	11.2	11.2	11.2																89.6	324.8	322.0	329.1	39.5%	40.3%	
133.4	11.5	11.5	11.5	11.5	11.5	11.5	11.5	11.5																92	333.5	329.1	336.4	39.7%	40.5%	
135.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7																93.6	339.3	336.4	343.5	39.5%	40.3%	
139.1	12	12	12	12	12	12	12	12																96	347.8	343.5	350.5	39.7%	40.5%	
141.3	12.2	12.2	12.2	12.2	12.2	12.2	12.2	12.2																97.6	353.3	350.5	357.4	39.5%	40.3%	
144.6	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5																100	361.5	357.4	364.3	39.7%	40.5%	
146.8	12.7	12.7	12.7	12.7	12.7	12.7	12.7	12.7																101.6	367.0	364.3	371.3	39.5%	40.3%	
150.2	13	13	13	13	13	13	13	13																104	375.5	371.3	378.4	39.7%	40.5%	
152.5	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2																105.6	381.3	378.4	385.4	39.6%	40.3%	
155.8	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5																108	389.5	385.4	392.3	39.7%	40.4%	
158.0	13.7	13.7	13.7	13.7	13.7	13.7	13.7	13.7																109.6	395.0	392.3	399.1	39.6%	40.3%	
161.3	14	14	14	14	14	14	14	14																112	403.3	399.1	406.0	39.7%	40.4%	6

Total Spill (kcfs)	The Dalles Dam Spill Patterns at 40% Spill Vertical Gate Opening (ft) per Spillbay [2]																							Total Open (ft)	Total River (kcfs)	River Flow Low (kcfs)	River Flow High (kcfs)	% Spill Range [3] Low (%)	% Spill Range [3] High (%)	See Note
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23							
163.5	14.2	14.2	14.2	14.2	14.2	14.2	14.2	14.2																113.6	408.8	406.0	413.0	39.6%	40.3%	
166.9	14.5	14.5	14.5	14.5	14.5	14.5	14.5	14.5																116	417.3	413.0	420.0	39.7%	40.4%	
169.1	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7																117.6	422.8	420.0	433.9	39.0%	40.3%	
175.0	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7				4												121.6	445.0					
180.8	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7				4		4										125.6	450.8					
186.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7				4		4	4									129.6	456.7					
192.5	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7				4		4	4		4							133.6	462.5					
198.4	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7				4		4	4		4			4				137.6	468.4					
204.2	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7				4		4	4		4			4	4			141.6	474.2					
210.1	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7				4		4	4		4			4	4	4		145.6	480.1					
215.9	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7				8		4	4		4			4	4	4		149.6	485.9					
221.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7				8		8	4		4			4	4	4		153.6	491.7					
227.5	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7				8		8	8		4			4	4	4		157.6	497.5					
233.3	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7				8		8	8		8			4	4	4		161.6	503.3					
239.1	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7				8		8	8		8			8	4	4		165.6	509.1					
245.0	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7				8		8	8		8			8	8	4		169.6	515.0					
250.8	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7				8		8	8		8			8	8	8		173.6	520.8					
256.5	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7				12		8	8		8			8	8	8		177.6	526.5					
262.2	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7				12		12	8		8			8	8	8		181.6	532.2					
267.9	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7				12		12	12		8			8	8	8		185.6	537.9					
273.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7				12		12	12		12			8	8	8		189.6	543.7					
279.4	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7				12		12	12		12			12	8	8		193.6	549.4					
285.1	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7				12		12	12		12			12	12	8		197.6	555.1					
293.3	14.7	14.7	15	15	15	15	15	15				12		12	12		12			12	12	12		203.4	563.3					
298.2	15	15	15.5	15.5	15.5	15.5	15.5	15.5				12		12	12		12			12	12	12		207	568.2					
302.5	15	15	16	16	16	16	16	16				12		12	12		12			12	12	12		210	572.5					
306.7	15	15	16.5	16.5	16.5	16.5	16.5	16.5				12		12	12		12			12	12	12		213	576.7					
310.6	15	15	17	17	17	17	17	17				12		12	12		12			12	12	12		216	580.6					
320.5	15	16	18	18	18	18	18	18				12		12	12		12			12	12	12		223	590.5					
328.4	15	16	19	19	19	19	19	19				12		12	12		12			12	12	12		229	598.4					
336.7	15	16	19	19	19	19	19	19				14		14	14		12			12	12	12		235	606.7					
343.7	15	16	19	19	19	19	19	19				15		15	15		14			12	12	12		240	613.7					

Total Spill (kcfs)	The Dalles Dam Spill Patterns at 40% Spill Vertical Gate Opening (ft) per Spillbay [2]																							Total Open (ft)	Total River (kcfs)	River Flow Low (kcfs)	River Flow High (kcfs)	% Spill Range [3] Low (%)	% Spill Range [3] High (%)	See Note
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23							
353.4	15	16	19	19	19	19	19	19				16		16	16		16			14	12	12		**247**	**623.4**					
358.8	15	16	19	19	19	19	19	19				17		17	17		17			14	12	12		**251**	**628.8**					
361.7	15	16	19	19	19	19	19	19				18		18	18		18			12	12	12		**253**	**631.7**					
367.0	15	16	19	19	19	19	19	19				19		19	19		19			12	12	12		**257**	**637.0**					**7**

1. Table updated 7/24/12 for flow (kcfs) and spill % calculated at forebay elevation 158.5 ft (median TDA Apr-Aug forebay elevation for years 2009-2012). Previous spill patterns based on 1.5 kcfs per 1 ft gate opening, which corresponded to forebay elevation 160 ft.
2. Highlighted spillbays are operationally restricted because of structural or wire rope issues. Highlighted bays will be used only if needed for dam safety.
3. Uniform spill patterns are critical to increasing juvenile fish survival through the tailrace. Uniform pattern fixed spill rates will result in hourly spill % within ranges in table.
4. TDA minimum generation requirement = 50 kcfs. Therefore, 40% spill is not achievable at total river flow <84 kcfs (minimum generation operation).
5. At certain flow ranges, spill could exceed ±1% of target spill of 40%. At total river flow 92,250–161,000 cfs, spill may range from 38.6–41.4% (up to ±1.4% of the 40% rate).
6. Minimum gate opening is 4 ft. At forebay elevation 160 ft, maximum gate opening through bays 1-8 is 14 ft, thus higher bays will be utilized prior to opening any of bays 1-8 more than 14.0 ft. At lower forebay elevations, gate openings can be increased up to 14.7 feet before utilizing higher bays.
7. If gate openings greater than shown in table are needed, to the extent feasible, incrementally increase gate openings. If all available spillbays are fully open and more flow is needed to limit pool surcharge, use restricted spillbays in following priority order: 10, 11, 13, 16, 18, 19, and 23. Fully open each bay as needed before moving to next.

Table TDA-7. Spillway Configuration at Various Flow Ranges.

Min Flow (cfs)	Max Flow (cfs)	Spillbay Gates	Gate Opening per Bay (ft)	Total Gate Opening (ft)	Total Spill (cfs)
62,000	65,000	7,8	4	8	12,000
65,000	71,000	7,8	6	12	18,000
71,000	77,000	7,8	8	16	24,000
77,000	85,000	7,8	10	20	30,000
85,000	97,500	7,8	12	24	36,000
85,000	97,500	1-8	4	24	36,000
97,500	112,500	1-8	4	28	42,000
112,500	127,500	1-8	4	32	48,000
127,500	142,500	1-8	4.5	36	54,000
142,500	157,500	1-8	5	40	60,000
157,500	172,500	1-8	5.5	44	66,000
172,500	187,500	1-8	6	48	72,000
187,500	202,500	1-8	6.5	52	78,000
202,500	217,500	1-8	7	56	84,000
217,500	232,500	1-8	7.5	60	90,000
232,500	247,500	1-8	8	64	96,000
247,500	262,500	1-8	8.5	68	102,000
262,500	277,500	1-8	9	72	108,000
277,500	292,500	1-8	9.5	76	114,000
292,500	307,500	1-8	10	80	120,000
307,500	322,500	1-8	10.5	84	126,000
322,500	337,500	1-8	11	88	132,000
337,500	352,500	1-8	11.5	92	138,000
352,500	367,500	1-8	12	96	144,000
367,500	382,500	1-8	12.5	100	150,000
382,500	397,500	1-8	13	104	156,000
397,500	412,500	1-8	13.5	108	162,000
412,500	438,000	1-8	14	112	168,000

2014 Fish Passage Plan

Section 4 – John Day Dam

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John Day Dam

Project Acronym	JDA
River Mile (RM)	Columbia River - RM 215.6
Reservoir	Lake Umatilla
Minimum Instantaneous Flow (kcfs)	Dec–Feb: 12.5 kcfs \ Mar–Nov: 50 kcfs
Forebay Normal Operating Range (ft)	Nov–Jun: 260'–265' \ Jul–Oct: 265'–268'
Tailrace Rate of Change Limit (ft)	3'/hr
Powerhouse Length (ft)	1,975'
Powerhouse Hydraulic Capacity (kcfs)	322 kcfs
Turbine Units (#)	16 (Units 1-16 BLH Kaplan)
Turbine Generating Capacity (MW)	Rated: 2,160 MW (135 MW/unit) \ Maximum: 2,480 MW (155 MW/unit)
Gatewell Orifice Diameter (in)	One 14" orifice per gatewell (3 per unit) = 48 total
Spillway Length (ft)	1,228'
Spillway Hydraulic Capacity (kcfs)	2,250 kcfs
Spillbays (#)	20
# Spillway Weirs (#)	2 (Bays 18 & 19)
Navigation Lock Length x Width (ft)	650' x 86'
Navigation Lock Max. Lift (ft)	113'

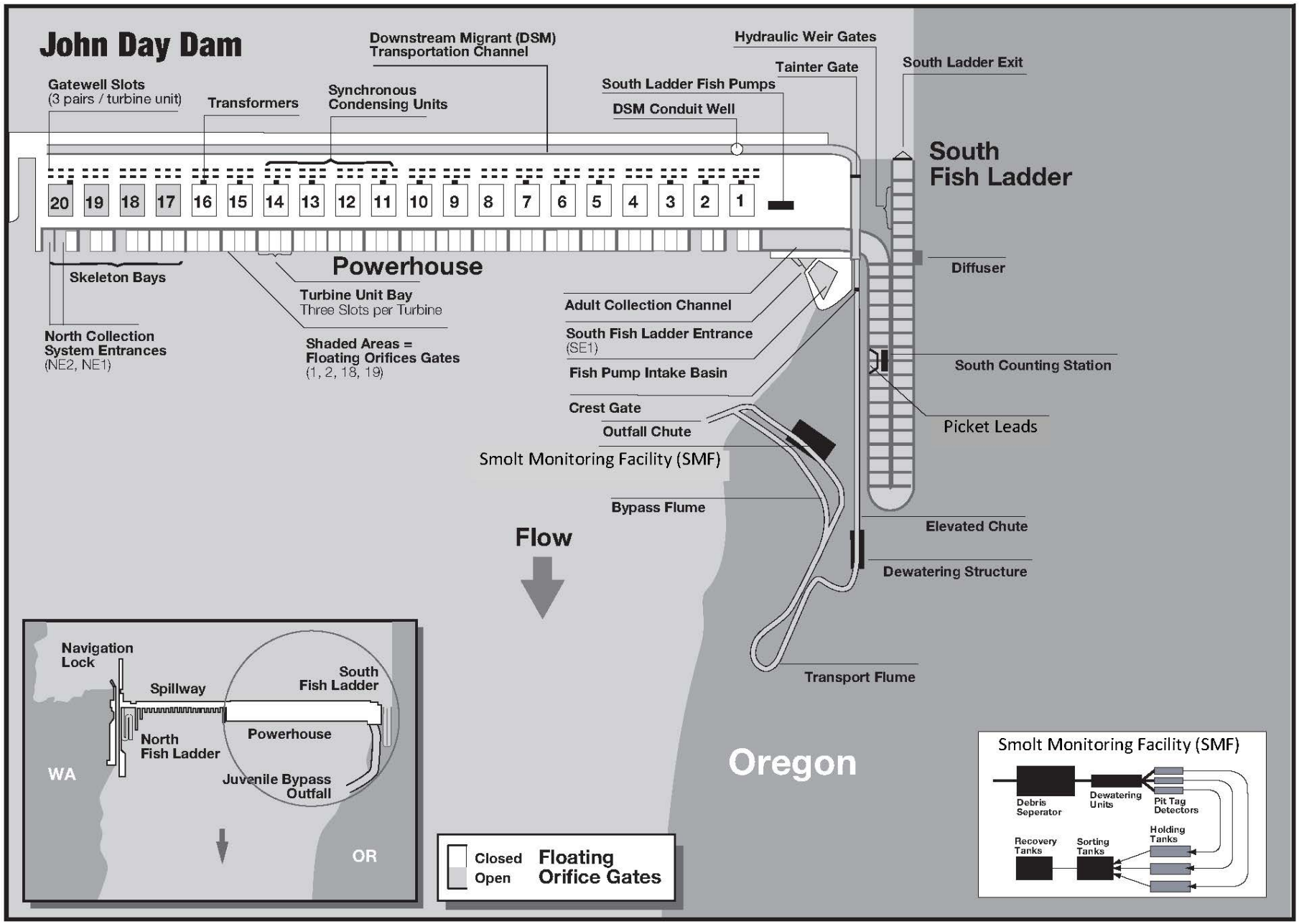


Figure JDA-1. John Day Dam South Fish Ladder, Powerhouse Collection System, and Juvenile Bypass System.

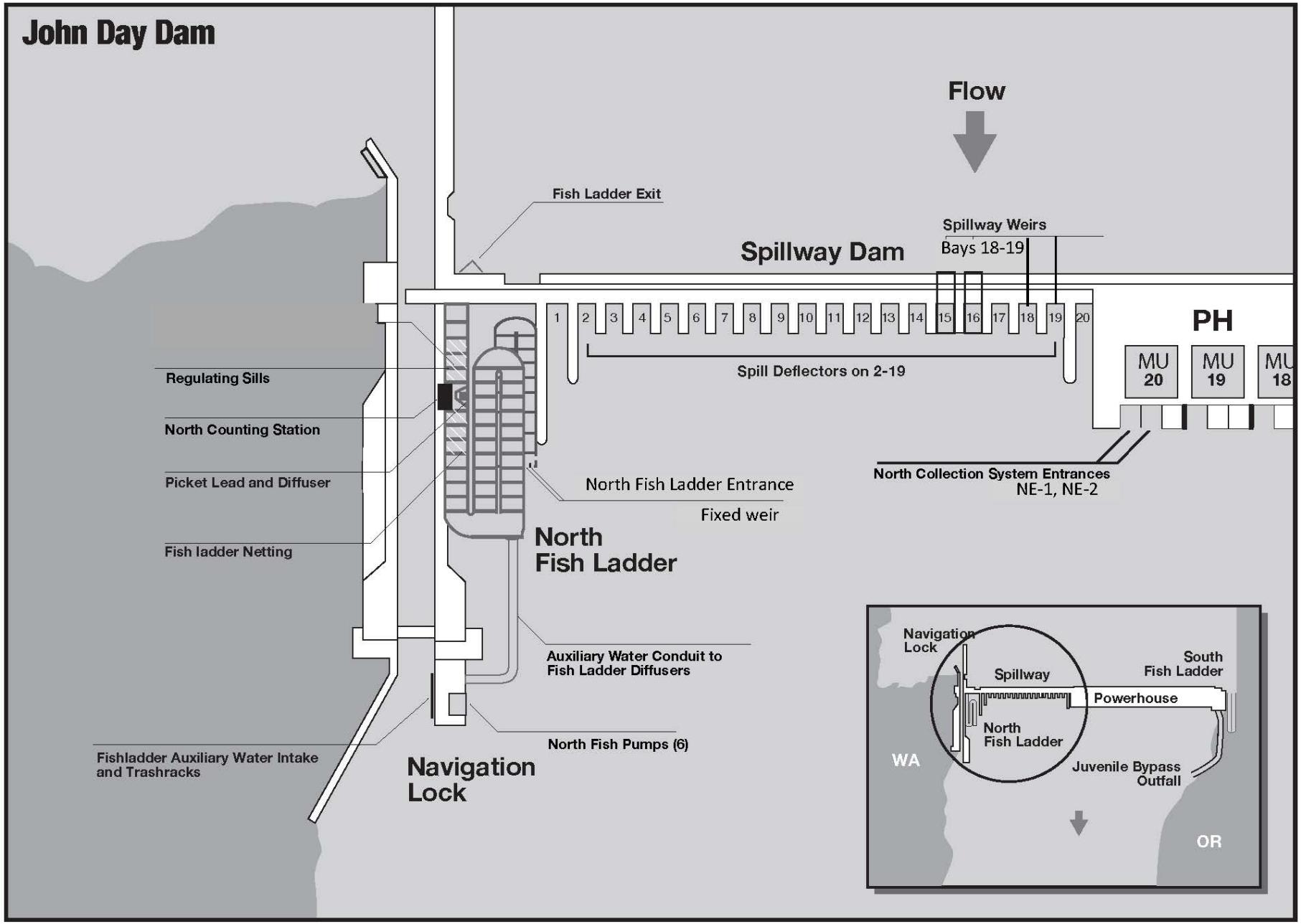
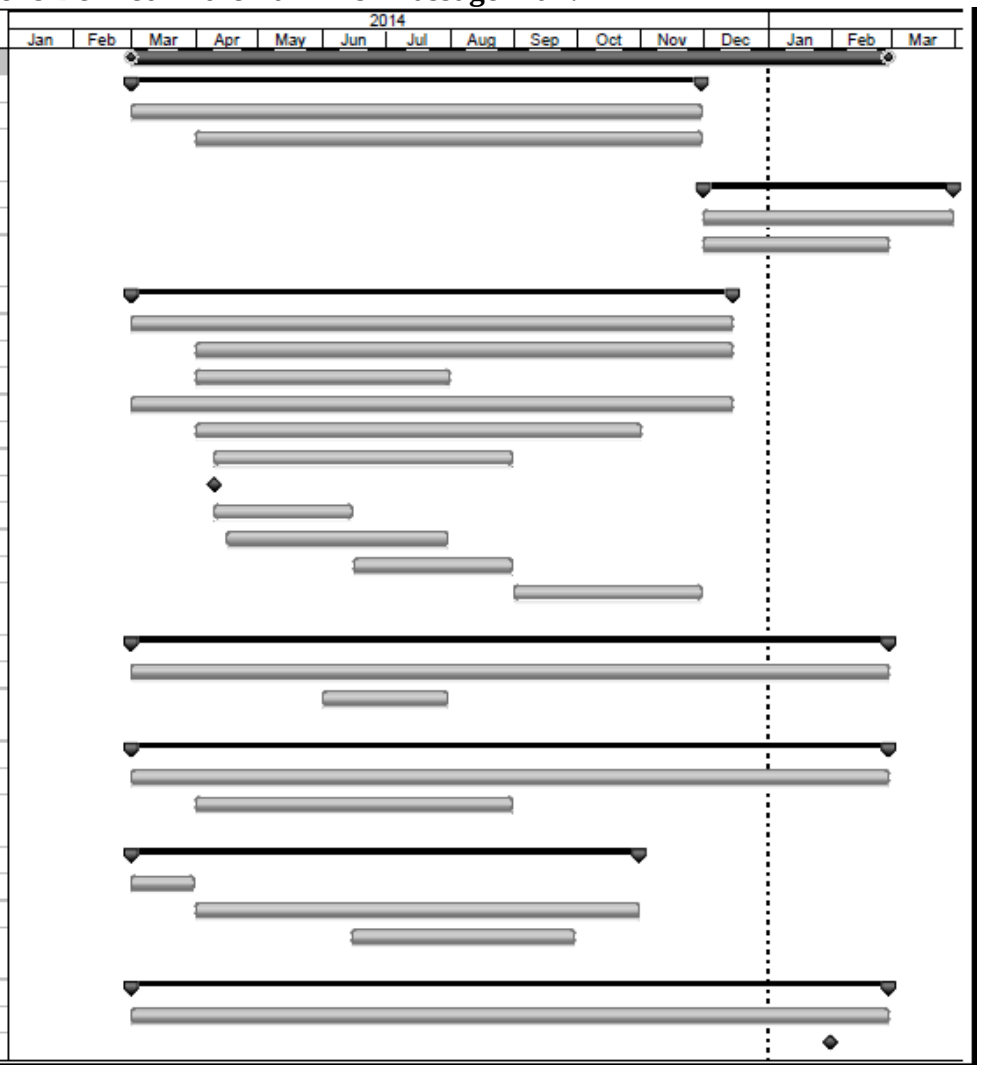


Figure JDA-2. John Day Dam Spillway and North Fish Ladder.

Table JDA-1. John Day Dam Schedule of Operations and Actions Defined in the 2014 Fish Passage Plan.

Task Name	Start Date	End Date	FPP Reference
2014 FPP Operations & Actions - John Day	3/1/14	2/28/15	JDA
Fish Passage Facilities Operation	3/1/14	11/30/14	2.4. and 2.5.
Adult Fish Facilities	3/1/14	11/30/14	2.5.1.2.
Juvenile Fish Facilities	4/1/14	11/30/14	2.4.1.2.
Fish Passage Facilities Maintenance	12/1/14	3/31/15	2.4. and 2.5.
Juvenile Fish Facilities Winter Maintenance	12/1/14	3/31/15	2.4.1.1.
Adult Fish Facilities Winter Maintenance	12/1/14	2/28/15	2.5.1.1.
Project Operations for Fish Passage	3/1/14	12/15/14	
Unit 1 and/or Unit 2 operate for fish passage	3/1/14	12/15/14	5.1.1.
STS operation	4/1/14	12/15/14	2.4.1.2.
Units 1-16 alternate monthly raking	4/1/14	8/1/14	2.4.1.2.b.
Turbine operating priority order	3/1/14	12/15/14	Table JDA-6
Turbine 1% operating range - hard constraint	4/1/14	10/31/14	5.2.1.
TSW operation	4/10/14	8/31/14	2.2.2
Avian Wires installed no later than April 10	4/10/14	4/10/14	9.1.2.
Spring Spill operations	4/10/14	6/15/14	FOP
Avian Hazing	4/16/14	7/31/14	9.1.1.
Summer Spill operations	6/16/14	8/31/14	FOP
Spill from Bay 2 for adult attraction	9/1/14	11/30/14	2.2.3.
Special Operations & Studies (dates approximate)	3/1/14	2/28/15	Appendix A
Adult Salmon Studies	3/1/14	2/28/15	4.2.1.
BiOp Performance Standard Test (Summer)	6/1/14	7/31/14	4.2.2.
TDG Monitoring	3/1/14	2/28/15	2.3.1.
TDG Monitoring - Tailrace (year-round)	3/1/14	2/28/15	station JHAW
TDG Monitoring - Forebay	4/1/14	8/31/14	station JDY
Adult Fish Counting	3/1/14	10/31/14	Table JDA-3
Daytime Video 0400-2000 PST	3/1/14	3/31/14	
Daytime Visual 0500-2100 DST	4/1/14	10/31/14	
Night Video 2100-0500 DST	6/15/14	9/30/14	
Reports	3/1/14	2/28/15	3.3.
Weekly Reports	3/1/14	2/28/15	
Annual Report	1/31/15	1/31/15	



1. FISH PASSAGE INFORMATION

The locations of fish passage facilities at John Day Dam are shown on the general site plans in **Figures JDA-1** and **JDA-2**. The schedule for project operations described in the Fish Passage Plan (FPP) and appendices is included in **Table JDA-1**.

1.1. Juvenile Fish Passage.

1.1.1. Juvenile Bypass Facilities Description. Juvenile fish bypass facilities at John Day Dam were completed in 1987. The Smolt Monitoring Facility (SMF) was completed in 1998 and includes 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 SMF 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 (SMF) Description. During the juvenile sampling season, flow with collected fish from the SMF is sent over the crest gate and down an elevated chute to the dewatering structure. Most of the flow is dewatered and the remaining 30 cfs of water is directed to the transport flume and past a switch gate. This gate directs fish to either the SMF 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 SMF for sampling (**Figure JDA-1**).

1.1.3. Juvenile Migration Timing. Juvenile passage timing has been determined by gatewell and SMF sampling at John Day Dam (**Table JDA-2**) Results to date of ongoing research show significant daytime passage during daytime operations. Bull trout, lamprey, juvenile sturgeon, and other listed salmonids are recorded in the by-catch of the SMF report. The juvenile bypass system (JBS) will operate through December 15. Sample collection in lab will operate through September 15. PIT-tag 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 JBS will be dewatered.

1.1.3.1. Juvenile fish peak passage occurs from 2300–2400 hours with a long period of elevated passage until dawn when passage decreases. Passage increases dramatically at dusk. 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 data indicate different passage patterns for the spillway and project when spill is occurring 24 hours/day.

Table JDA-2. Juvenile Salmonid Passage Timing at John Day Dam for Most Recent 10-Years (2004-2013) Based on Daily & Yearly Collection Data.

Year	10%	50%	90%	# Days	10%	50%	90%	# Days
	Yearling Chinook				Subyearling Chinook *			
2004	28-Apr	16-May	30-May	33	14-Jun	28-Jun	23-Jul	40
2005	25-Apr	12-May	22-May	28	19-Jun	5-Jul	27-Jul	39
2006	25-Apr	11-May	24-May	30	14-Jun	3-Jul	18-Jul	35
2007	2-May	13-May	25-May	24	25-Jun	8-Jul	17-Jul	23
2008	4-May	22-May	1-Jun	29	24-Jun	9-Jul	5-Aug	43
2009	27-Apr	17-May	1-Jun	36	17-Jun	1-Jul	17-Jul	31
2010	1-May	18-May	6-Jun	37	14-Jun	1-Jul	20-Jul	37
2011	2-May	17-May	28-May	27	16-Jun	14-Jul	3-Aug	49
2012	27-Apr	6-May	22-May	26	27-Jun	13-Jul	29-Jul	33
2013	27-Apr	12-May	24-May	28	20-Jun	3-Jul	15-Jul	26
MEDIAN	**27-Apr**	**14-May**	**26-May**	**30**	**16-Jun ***	**29-Jun ***	**28-Jul ***	**43 ***
MIN	**25-Apr**	**6-May**	**22-May**	**24**	**6-Jun ***	**27-Jun ***	**20-Jul ***	**31 ***
MAX	**4-May**	**22-May**	**6-Jun**	**37**	**27-Jun ***	**30-Jul ***	**22-Aug ***	**59 ***
	Unclipped Steelhead				Clipped Steelhead			
2004	30-Apr	23-May	2-Jun	34	7-May	20-May	29-May	23
2005	1-May	14-May	24-May	24	4-May	19-May	26-May	23
2006	24-Apr	13-May	29-May	36	28-Apr	10-May	29-May	32
2007	29-Apr	13-May	28-May	30	4-May	12-May	26-May	23
2008	6-May	21-May	1-Jun	27	7-May	16-May	30-May	24
2009	26-Apr	11-May	28-May	33	29-Apr	10-May	27-May	29
2010	27-Apr	12-May	8-Jun	43	3-May	11-May	9-Jun	38
2011	25-Apr	19-May	31-May	37	19-Apr	19-May	30-May	42
2012	25-Apr	1-May	19-May	25	25-Apr	3-May	15-May	21
2013	21-Apr	13-May	27-May	37	29-Apr	8-May	21-May	23
MEDIAN	**26-Apr**	**13-May**	**28-May**	**33**	**1-May**	**11-May**	**28-May**	**28**
MIN	**21-Apr**	**1-May**	**19-May**	**24**	**19-Apr**	**3-May**	**15-May**	**21**
MAX	**6-May**	**23-May**	**8-Jun**	**43**	**7-May**	**20-May**	**9-Jun**	**42**
	Coho				Sockeye (Wild & Hatchery)			
2004	12-May	27-May	12-Jun	32	20-May	1-Jun	12-Jun	24
2005	5-May	16-May	3-Jun	30	16-May	21-May	31-May	16
2006	10-May	26-May	12-Jun	27	7-May	20-May	30-May	24
2007	5-May	16-May	4-Jun	31	9-May	25-May	7-Jun	30
2008	11-May	25-May	6-Jun	27	22-May	29-May	6-Jun	16
2009	16-May	29-May	13-Jun	29	10-May	25-May	7-Jun	29
2010	9-May	3-Jun	16-Jun	39	11-May	29-May	9-Jun	30
2011	10-May	23-May	6-Jun	28	10-May	22-May	2-Jun	24
2012	6-May	21-May	5-Jun	31	2-May	11-May	25-May	24
2013	6-May	19-May	1-Jun	27	10-May	19-May	28-May	19
MEDIAN	**9-May**	**24-May**	**5-Jun**	**28**	**10-May**	**23-May**	**4-Jun**	**26**
MIN	**May 05**	**16-May**	**1-Jun**	**27**	**2-May**	**11-May**	**25-May**	**16**
MAX	**16-May**	**3-Jun**	**16-Jun**	**39**	**22-May**	**1-Jun**	**12-Jun**	**30**

*Subyearling Chinook MEDIAN, MIN, MAX based on 1998-2005 data. Data from 2006-present not included due to potential bias from missed sample days during high water temperature sampling protocols (**Appendix K**).

1.2. Adult Fish Passage.

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

1.2.2. Adult Fish Migration Timing and Count Schedule. Upstream migrants are present throughout the year and adult passage facilities are operated year-round. Adult salmon, steelhead, lamprey and shad are typically counted April 1 through October 31 (**Table JDA-3**), and daily data are posted online at: http://www.nwp.usace.army.mil/Missions/Environment/Fishdata.aspx. Sturgeon and bull trout are relatively infrequent and counts are posted online periodically during the passage season in *Miscellaneous Fish Count*s and summarized in the *Annual Fish Passage Report*.

1.2.2.1. Peak timing of adult fish passage at John Day Dam is determined based on yearly counts through the most recent passage year, beginning in 1968 for adult salmon and steelhead and in 2000 for lamprey (**Table JDA-4**).

1.2.2.2. Annual maintenance of adult passage facilities is scheduled December 1 through February (winter maintenance period) to minimize impacts on upstream migrants.

Table JDA-3. Adult Fish Count Schedule at John Day Dam (3/1/2014–2/28/2015).

Count Period	Counting Method and Hours *
March 1 – March 31	Video 0400–2000 hours (PST)
April 1 – October 31	Visual 0500–2100 hours (DST)
June 15 – September 30	Night Video 2100–0500 hours (DST)

*In 2014, Daylight Saving Time (DST) is in effect March 9 – November 2 and hours are adjusted forward 1 hour from Pacific Standard Time (PST). DST = PST+1.

Table JDA-4. Adult Count Period and Peak Passage Timing at John Day Dam Based on Yearly Counts since 1968 (except lamprey since 2000).

Species	Count Period	Earliest Peak	Latest Peak
Spring Chinook	Feb 20 – Jun 5	Apr 14	May 22
Summer Chinook	Jun 6 – Aug 5	Jun 7	Aug 2
Fall Chinook	Aug 6 – Dec 7	Sep 2	Sep 25
Steelhead	Feb 20 – Dec 7	Aug 25	Oct 6
Sockeye	Feb 20 – Dec 7	Jun 21	Jul 10
Coho	Feb 20 – Dec 7	Sep 4	Oct 26
Lamprey	Feb 20 – Dec 7	Jul 16	Aug 12

1.2.2.3. Time-of-day (diel) distributions of adult salmonid activity at John Day Dam fishway entrances and exits are summarized in **Figure JDA-3** (see *Keefer & Caudill 2008* at: http://www.nwd-wc.usace.army.mil/tmt/documents/FPOM/2010/2013_FPOM_MEET/2013_JUN/).

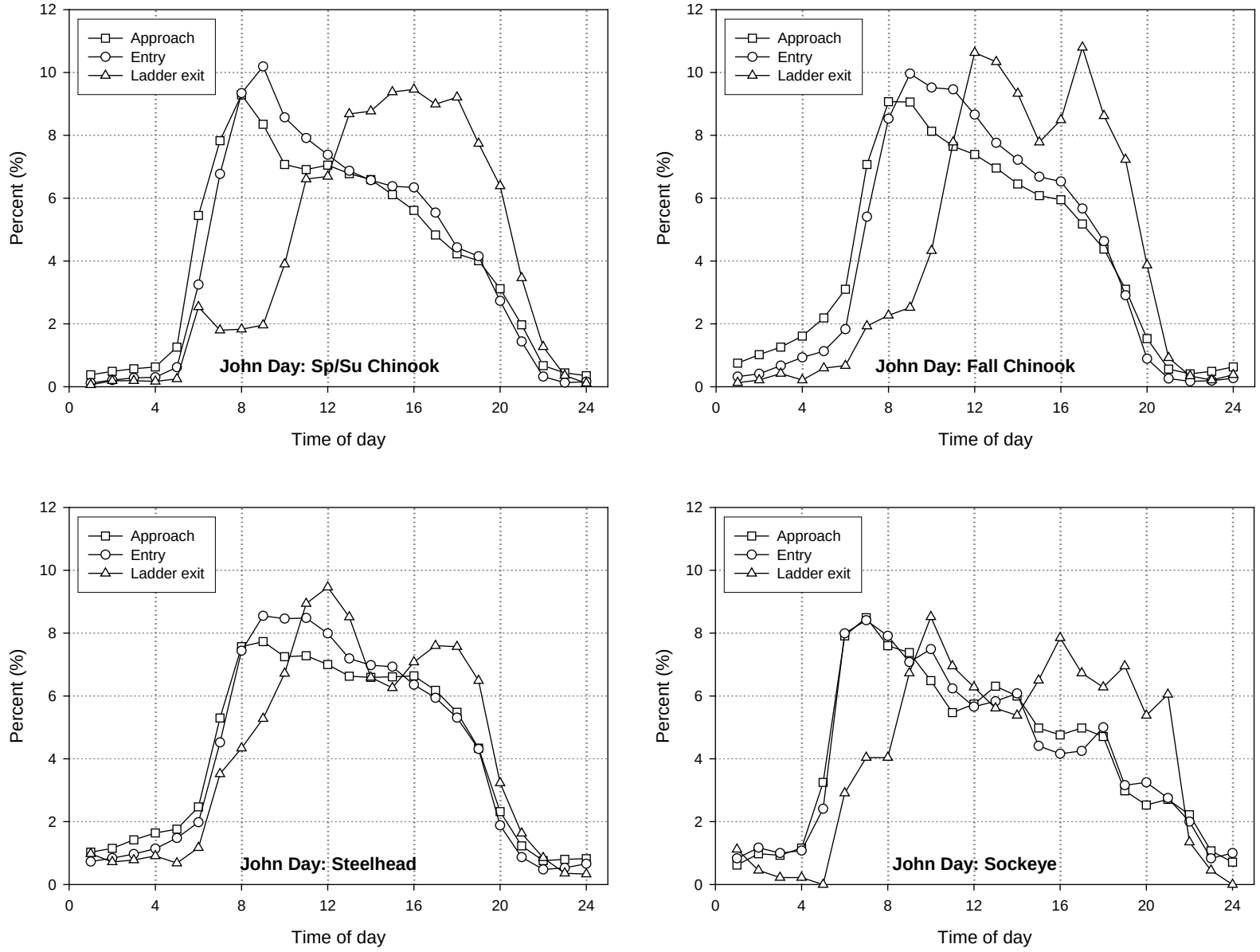


Figure JDA-3. Diel Distribution of Adult Salmonids at John Day Dam Fishway Entrances and Exits (*Keefer & Caudill 2008*).

2. PROJECT OPERATIONS

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.

2.2.1. See the Fish Operations Plan (FOP), included in the Fish Passage Plan as **Appendix E**, for more information. Spill patterns formulated with spillway deflectors in place are provided in **Table JDA-8** for spill with temporary spillway weirs (TSWs) installed in bays 18 and 19 and **Table JDA-9** for spill with no TSWs installed (bays 18 and 19 closed). These tables will be used for both adult and juvenile patterns. Minimum spill of 25% is to provide adequate tailrace egress for juvenile salmonids.

2.2.2. Temporary Spillway Weirs (TSWs). [1] Both TSWs will be installed as early as possible on the first day of spring spill operations and operated throughout the spring and summer spill seasons. During high flow events, TSW removal is recommended prior to river flows exceeding 685 kcfs. Both TSWs will be removed from service as late as possible on the last normal work day of the summer spill season (on or no later than August 31). Spill for juvenile fish passage will be maintained through August 31, in accordance with the FOP (**Appendix E**).

2.2.3. From September 1–November 30, spill from Bay 2 (1 stop = approximately 1.6 kcfs spill) is provided for adult attraction during daylight hours (**Table JDA-5**).

2.2.4. 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 rate is 30% from April 10–August 31.

[1] Spillway weirs provide surface passage routes via spillbay(s). Temporary, or Top, Spillway Weirs (*TSW*s) at Little Goose, McNary and John Day dams can be installed, uninstalled and moved between bays using the gantry crane. Removable Spillway Weirs (*RSW*s) at Lower Granite, Lower Monumental and Ice Harbor dams are "removed" by controlled descent to the bottom of the forebay.

Table JDA-5. Daytime Spill Schedule for John Day Dam.

Date Range	Daytime Spill Hours	
	Begin	End
Jan 1 – Jan 19	0700	1730
Jan 20 – Feb 14	0630	1800
Feb 15 – Mar 1	0600	1830
Mar 2 – Apr 2	0600	1930
Apr 3 – Apr 20	0500	2030
Apr 21 – May 16	0500	2100
May 17 – May 31	0430	2130
Jun 1 – Jun 30	0430	2130
Jul 1 – Jul 31	0430	2200
Aug 1 – Aug 15	0500	2145
Aug 16 – Aug 31	0500	2030
Sep 1 – Sep 16	0530	2000
Sep 17 – Oct 4	0600	1930
Oct 5 – Oct 19	0630	1900
Oct 20 – Oct 29	0630	1830
Oct 30 – Nov 30	0600	1700
Dec 1 – Dec 31	0630	1700

2.3. Total Dissolved Gas (TDG) Management.

2.3.1. Total dissolved gas (TDG) levels at all projects are monitored in accordance with the TDG *Monitoring Plan*, included in the *Water Management Plan* as Appendix 4, and available online at: http://www.nwd-wc.usace.army.mil/tmt/documents/wmp/.

2.3.2. 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 – March 31 (Winter Maintenance Period).

2.4.1.1.a. Remove debris from forebay, all trash racks, and gatewell slots, so these areas are debris-free by April 1.

2.4.1.1.b. Inspect all VBSs for damage, holes, debris accumulations, or protrusions (video inspection acceptable). Clean and repair when necessary.

2.4.1.1.c. Inspect and operate each STS.

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

2.4.1.1.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.

2.4.1.1.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.

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

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

2.4.1.1.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.

2.4.1.1.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.

2.4.1.1.k. Smolt Monitoring Facility (SMF): Insure all following items are fully operational:

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

k.2. All valves and auxiliary water systems;

k.3. Flushing water valves and their perforated plates;

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

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

k.6. PIT-tag detectors;

k.7. All sampling building systems, including holding tanks, valves, and conduits. (Note: A specific list can be found in the *SMF Operation & Maintenance Manual*.)

2.4.1.2. April 1 – November 30 (Juvenile Fish Passage Season). Juvenile fish protection devices, submersible traveling screens (STSs), will be in place prior to the beginning of the juvenile fish passage season. STSs 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.

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

2.4.1.2.b. From April 1 through August 1, units 1–5 will be raked monthly, and units 6–10 *or* units 11–16 will be alternately raked monthly. After August 1, units will be raked as necessary as determined by ROV inspection, or as needed to maintain gatewell drawdown in criteria.

2.4.1.2.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.

2.4.1.2.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.

2.4.1.2.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 accumulation of tumbleweeds in the forebay. Gatewell orifices of the unit being raked must be closed during the raking operation.

2.4.1.2.f. Inspect each STS, VBS, and orifices once per month or every 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, or 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.

2.4.1.2.g. Open all gatewell orifices April 1–December 15. Inspect orifice lights daily to ensure orifice lights are operating. Replace all burned out orifice lights within 24 hours. Close and open each orifice three times daily, or more frequently as determined by the project biologist, due to heavy debris accumulation in gatewells. If a unit goes out of service, orifices are to remain open in associated gatewells unless that gatewell is dewatered.

2.4.1.2.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**.

2.4.1.2.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 cleaning. After gatewell de-barking, cycle the orifice in that gatewell. Check gatewell drawdown.

2.4.1.2.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.

2.4.1.2.k. When using a dip basket for gatewell cleaning, coordinate with SMF personnel.

2.4.1.2.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.

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

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

2.4.1.2.o. Smolt Monitoring Facility (SMF). Ensure the proper function of sampling systems. Direct particular attention to the following:

o.1. Dewatering facilities, including the screens being free of holes or gaps, and the screen cleaner brush system;

o.2. All valves and auxiliary water systems;

o.3. Flushing water valves and their perforated plates;

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

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

o.6. PIT-tag detectors;

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

o.8. From April 1–September 15, the SMF will be monitored 24 hours/day, 7 days/week by Project fish personnel to ensure proper functioning and to 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).

o.9. Cycle the 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.

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

o.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.

o.12. During any high debris loading periods (likely during spring runoff) 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.

o.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 – March 31 (Winter Maintenance Period).

2.4.1.3.a. Submersible traveling screens (STS) 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 (JBS) channel will operate through December 15. Priority units will be left screened during this period to the extent practicable (barring operational failure) and screens will only be removed from non-priority units when necessary to begin maintenance. After December 15, all STSs may be removed.

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

2.4.1.3.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 – February (Winter Maintenance Period).

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

2.5.1.1.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.

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

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

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

2.5.1.1.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 – November 30 (Adult Fish Passage Season).

2.5.1.2.a. All Adult Facilities.

a.1. Water depth over fish ladder weirs 1.0' ±0.1'. When shad numbers exceed 5,000/day per count station at Bonneville Dam, water depth should be increased to 1.3' ±0.1'.

a.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.

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

a.4. Maintain water velocity at 1.5–4.0 feet per second (2 fps optimum) in all channels and the lower ends of fish ladders that are below the tailwater. Open floating orifice gates 1, 2, 18 and 19, and operate three fish pumps to maintain fishway criteria. The entrance gate should be submerged 8’ deep or greater to be in criteria. Fishway channel water velocities will be measured a minimum of three times weekly (daily preferred) during adult fish passage season (Mar 1 – Dec 1) as part of the fishway inspection program. Floats will be timed through all fishway channels that are supplemented by auxiliary water, and results reported in the project weekly fishway status report.

a.5. Maximum head of 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.

a.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.

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

a.8. The current fish counting program is conducted 16 hours per day from April through October (see **Table JDA-3**). The crowder shall be opened to full count slot width when not counting. The crowder shall be open as far as possible to allow accurate counting and shall not be closed to less than 18 inches while counting. This will usually occur during high turbidity conditions to maintain count accuracy.

i. 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". Crowder ranges are as follows:

- JDA-North = 18"–28"
- JDA-South = 18"–30"

ii. If passage is impaired by narrow count slot conditions, the count slot will be widened until proper passage conditions are achieved, despite count accuracy.

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

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

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

2.5.1.2.b. North Fishway.

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

b.2. 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.

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

2.5.1.2.d. Powerhouse.

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

d.2. Operate four powerhouse floating orifices (1, 2, 18, 19) and open associated auxiliary water diffusers (see also **2.5.1.2.a.4.**).

d.3. From 0400–2000 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 – February (Winter Maintenance Period).

2.5.1.3.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.

2.5.1.3.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.

2.5.1.3.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).

2.5.1.3.d. Maximum head of 0.5' 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/day, seven days/week.

3.1.4. More frequent inspections of some facility components will occur as described throughout this document.

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 are 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:

i. Any out-of-criteria situations observed and subsequent corrective actions taken;

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

iii. Adult fishway control calibrations;

iv. STS and VBS inspections;

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

vi. Any unusual activities which occurred at the project which may affect fish passage.

3.3.2. Weekly reports shall cover Sunday–Saturday period and shall be e-mailed to CENWP-OD, CENWD-PDW-RCC, and other interested parties as soon as possible the following week.

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:

i. Time and date;

ii. Nature of activity that lead to fish impact;

iii. Agency responsible for the impact or the reporter if no responsible party can be identified;

iv. Fish numbers, species, origin, discernible external injuries, tags, etc;

v. Future actions to avoid a similar impact;

vi. 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 Maintenance.

4.2.1. Routine Maintenance.

4.2.1.1. Submersible Traveling Screens (STS). The STS system may receive preventive maintenance or repair any time of the year as necessary. Most maintenance will occur during the winter maintenance period when all STSs may be removed from intakes. From April 1–December 15, a turbine unit cannot operate without a full complement of functioning STSs.

4.2.1.2. Juvenile Bypass System (JBS). The JBS facilities may receive preventive maintenance at any time of the year as necessary in coordination with FPOM. During the juvenile fish passage season, this will normally be out-of-water work (e.g., maintenance of automatic systems, air lines, electrical systems, and monitoring equipment). During the winter maintenance period, the system is dewatered and 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):

i. Description of the problem.

ii. Type of outage required.

iii. Impact on facility operation.

iv. Length of time for repairs.

v. 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 (JBS).

4.2.2.2.a. The JBS 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.

4.2.2.2.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.

4.2.2.2.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.

4.2.2.2.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.

4.2.2.3.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.

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

4.2.2.3.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 Maintenance.

4.3.2. 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**).

4.3.2.1. 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.

4.3.2.2. 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**).

4.3.2.3. 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 (e.g., 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 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 impacted. 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 impacted. North netting installed on ladders to prevent fish leaping will be

inspected daily and maintained as necessary. Inspection summaries will be included in the weekly activity report.

4.3.3. 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**).

4.3.3.1. 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.

4.3.3.1.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:

a.1. Increase discharge of remaining unit to maximum capacity;

a.2. Close NE-1;

a.3. Leave NE-2 at a depth of 8’;

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

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

a.6. If criteria still not achieved, reduce entrance weirs depth to 6’ then to 4’ if necessary until more auxiliary water becomes available. Then reverse above procedure.

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

i. Open SE-1 with the weir crest 6' below the tailwater surface;

ii. Close NE1 and NE2;

iii. Place cross-channel bulkheads in powerhouse collection channel between Units 2 and 3;

iv. Close floating orifice gate in front of Unit 2, leaving the floating orifice gate in front of Unit 1 open. (See also **2.5.1.2.a.4.**).

4.3.3.1.b. North Ladder. The six AWS pumps installed in 2011 are capable of achieving the optimal attraction criteria of 1.5' at all tailrace elevations. There is a built-in contingency as one of the six pumps is always spare; it will automatically started by PLC in case of another pump's failure.

4.3.3.2. Powerhouse and Spillway Fish Collection Systems. John Day Dam contains several types of fishway entrances. If failures occur, in most cases the entrance can be operated manually by project personnel until repaired. 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.

4.3.3.3. Adult Fish Ladders and Counting Stations. Pickets with excessive spacing (>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 FPOM.

4.3.3.4. 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 and develop a method of repair as coordinated with FPOM. Repair as quickly as possible unless coordinated differently.

5. TURBINE UNIT OPERATION & MAINTENANCE

5.1. Turbine Unit Priority.

5.1.1. Unit operating priority (**Table JDA-6**) includes that time when synchronous condensing occurs. Unit maintenance schedules will be reviewed by project and district biologists for fish impacts.

Table JDA-6. Turbine Unit Operating Priorities at John Day Dam.

Season	TSWs [1]	Unit Operating Priority*
Fish Passage Season March 1–November 30 (24 hours/day)	no TSWs	1-4 in any order, then 5-16 in any order.
	with TSWs [1]	5,1,3,16,14,12,10,8,15,2,11,7,4,13,9,6
Winter Maintenance Season December 1–February 28 (24 hours/day)	n/a	any unit

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

5.2. Turbine Unit O&M.

5.2.1. Operating points for turbine units within ±1% of peak turbine efficiency (1% range) at various heads are shown in **Table JDA-7**. To the extent technically feasible, units will be operated within the 1% range unless operation outside of that range is necessary to meet BPA load requirements consistent with *BPA System Load Shaping Guidelines* (**Appendix C**), or to comply with other coordinated fish measures. The *Guidelines* apply April 1–October 31. During the rest of the year, the project will continue to operate units within the 1% range except as specifically requested by BPA for power production.

5.2.2. 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.

5.2.3. 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.

5.2.4. Wicket gate opening for functional testing on a watered-up unit will be no more than 15 minutes total open time.

Table JDA-7. John Day Dam Turbine Unit Output (MW) and Discharge (cfs) Per Unit at Upper and Lower Limits of 1% Peak Efficiency Operating Range with and without STSs. [1]

Project Head (feet)	With STSs				No STSs			
	1% Lower Limit		1% Upper Limit		1% Lower Limit		1% Upper Limit	
	MW	cfs	MW	cfs	MW	cfs	MW	cfs
80	65.4	11,338	118.0	20,472	71.7	12,305	122.8	21,074
81	66.7	11,416	120.8	20,671	73.2	12,391	125.7	21,290
82	68.1	11,492	123.6	20,864	74.7	12,473	128.7	21,500
83	69.4	11,566	126.4	21,052	76.1	12,554	131.6	21,703
84	70.8	11,638	129.1	21,234	77.6	12,631	134.6	21,901
85	72.1	11,707	131.9	21,411	79.1	12,707	137.5	22,093
86	72.9	11,692	134.7	21,593	80.0	12,690	140.1	22,223
87	73.7	11,676	137.5	21,770	80.9	12,674	142.6	22,349
88	74.5	11,661	140.2	21,942	81.7	12,657	145.1	22,471
89	75.3	11,646	143.0	22,110	82.6	12,641	147.6	22,591
90	76.1	11,632	145.8	22,274	83.5	12,625	150.2	22,707
91	77.0	11,622	146.9	22,164	84.5	12,616	151.7	22,656
92	77.9	11,613	148.0	22,057	85.5	12,606	153.2	22,606
93	78.8	11,604	149.1	21,951	86.4	12,596	154.8	22,556
94	79.7	11,595	150.2	21,848	87.4	12,586	155.1	22,321
95	80.6	11,585	151.3	21,746	88.4	12,576	155.2	22,062
96	81.7	11,604	151.6	21,532	89.6	12,597	155.2	21,797
97	82.8	11,623	151.8	21,323	90.8	12,617	155.2	21,538
98	83.8	11,640	152.1	21,118	92.0	12,636	155.2	21,284
99	84.9	11,657	152.4	20,917	93.1	12,655	155.2	21,035
100	86.0	11,674	152.7	20,720	94.3	12,673	155.2	20,792
101	86.9	11,675	154.9	20,800	95.3	12,675	155.2	20,554
102	87.9	11,677	155.2	20,613	96.4	12,676	155.2	20,321
103	88.8	11,678	155.2	20,378	97.4	12,678	155.2	20,092
104	89.7	11,679	155.2	20,149	98.4	12,679	155.2	19,868
105	90.6	11,680	155.2	19,923	99.4	12,680	155.2	19,649
106	91.4	11,658	155.2	19,711	100.2	12,656	155.2	19,442
107	92.1	11,637	155.2	19,503	101.0	12,633	155.2	19,239
108	92.8	11,615	155.2	19,299	101.8	12,610	155.2	19,040
109	93.6	11,594	155.2	19,098	102.6	12,587	155.2	18,845
110	94.3	11,574	155.2	18,901	103.5	12,565	155.2	18,653

1. Table prepared by HDC November 2002. Table revised in 2005 to reflect information using a 2001 Unit 9 NS index test and a 1962 model test with STS adjustment Factor.

6. DEWATERING PLANS

Guidelines for dewatering and fish handling plans (**Appendix F**) have been developed and are followed for dewatering project facilities. Dewatering Plans are available online at: http://www.nwd-wc.usace.army.mil/tmt/documents/FPOM/2010/. 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 ensure that fish rescue equipment is available and will coordinate to provide adequate personnel to move fish out of the dewatered ladder.

6.1.1.3. Project personnel will install head gates to shut down ladder flow.[2] 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.

6.1.2. Non-Routine Maintenance. When possible, discontinue auxiliary water and operate ladder at reduced flow as long as possible for up to 72 hours prior to dewatering. Follow guidance in **section 6.4**.

[2] Head gates may also be referred to as “operating” gates at some projects. The terms are interchangeable.

6.2. Powerhouse Fish Collection System.

6.2.1. 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.

6.3. Juvenile Bypass System (JBS).

6.3.1. 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.

6.4. Turbines.

6.4.1. 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 head gates, spin the unit to move fish out of the draft tube.

6.4.2. 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.

6.4.3. 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.

6.4.4. 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.

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

6.5. Navigation Lock.

6.5.1. The navigation lock is frequently dewatered for routine maintenance in late February/early March, in conjunction with navigation lock outages at The Dalles and Bonneville dams.

6.5.2. The area between the upstream bulkhead and the upstream gate is surveyed for fish as water levels allow. The lateral and pool areas on the floor of the lock are surveyed for fish from

above. Most of these areas remain full of water, precluding the ability to implement successful fish salvage operations. Areas where water levels slowly decrease are accessed via crane when pool levels reach a depth of approximately 3 feet. The fill conduits are accessed and checked for fish only if needed and can be done safely. All salvaged fish are removed, transported via bag or tank and released to the river .

7. FOREBAY DEBRIS REMOVAL

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.

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.

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:

i. Miro Zyndol (541) 506-7860 or 980-9958. Home # available in Control Room.

ii. Bern Klatte (503) 808-4318 or Tammy Mackey (503) 961-5733.

9. HAZING ACTIVITIES

9.1. Avian Hazing (Piscivorous Birds).

9.1.1. From April 16–July 31, piscivorous birds shall be hazed at John Day Dam 7 days/week during all daylight hours (or up to 8 hours/day) between the hours of 0500–2000. Hours of hazing should vary so that birds do not acclimate to long periods without hazing.

9.1.2. Avian Wires. Avian wires shall be installed prior to 10 April each year.

9.1.3. Hazing techniques are detailed in the approved *Operating Plan*. The objective of the program is to reduce avian predation of migrating juvenile salmonids and lamprey by hazing or harassing piscivorous birds in a manner that impedes their ability to successfully forage on fish and/or forces them to leave the area.

9.1.4. Avian hazing shall occur primarily near dam locations where predation risk is high (e.g., tailrace areas where fish may be disoriented after passing the project or forebay areas where fish may be delayed from passing the project).

9.1.4.1. Birds shall be hazed near the spillway and powerhouse discharge areas, the juvenile bypass outfall(s), and where birds congregate or feed, ranging up to approximately 2,000 feet downstream of the dam and outfall site. Roosting and actively foraging birds shall also be hazed within the forebay boat restricted zones (BRZ).

9.1.4.2. During juvenile lamprey outmigration, Wildlife Service (WS) specialists may be requested to focus hazing at specific areas of the project where juvenile lamprey are known to pass.

9.1.5. Boat hazing shall occur in the John Day Dam tailrace outside of the BRZ for an 8-hour shift during daylight hours (approximately between 0630-1900 hours), or as needed and deemed safe by WS boat operators.

9.1.5.1. One boat will be provided and operated by WS. If the primary boat is out of service for repairs/maintenance, WS will provide a back-up boat on-site within 24 hours. The Corps will provide a secure location on-site for storage of WS boats and trailers.

9.1.5.2. In the event weather and/or other conditions preclude safe boat operation, WS specialists shall haze from dam structures and/or adjacent shorelines.

9.1.5.3. In accordance with Corps and other safety requirements, all boats must have a minimum of two crew members and must remain outside of the BRZ unless accompanied by a safety boat. Boat operators must meet all applicable Federal and State safety laws and requirements.

Table JDA-8. [*pg 1 of 12*] John Day Dam Spill Patterns with Temporary Spillway Weirs (TSWs) in Bays 18-19. *See notes at end of table.*

Total Spill	John Day Dam Spill Patterns with TSWs in Bays 18 & 19 # Gate Stops per Spillbay																				Total Stops
(kcfs)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18 TSW	19 TSW	20	(#)
19.4																		6.1	6.1		12.2
21.0																		6.1	6.1	1	13.2
21.8																		6.1	6.1	1.5	13.7
23.4		1																6.1	6.1	1.5	14.7
25.0		1	1															6.1	6.1	1.5	15.7
26.6		1	1														1	6.1	6.1	1.5	16.7
28.2		1	1													1	1	6.1	6.1	1.5	17.7
29.8		1	1												1	1	1	6.1	6.1	1.5	18.7
31.4		1	1											1	1	1	1	6.1	6.1	1.5	19.7
33.0		1	1										1	1	1	1	1	6.1	6.1	1.5	20.7
34.6		1	1									1	1	1	1	1	1	6.1	6.1	1.5	21.7
36.2		1	1								1	1	1	1	1	1	1	6.1	6.1	1.5	22.7
37.8		1	1							1	1	1	1	1	1	1	1	6.1	6.1	1.5	23.7
39.4		1	1						1	1	1	1	1	1	1	1	1	6.1	6.1	1.5	24.7
41.0		1	1					1	1	1	1	1	1	1	1	1	1	6.1	6.1	1.5	25.7
42.6		1	1				1	1	1	1	1	1	1	1	1	1	1	6.1	6.1	1.5	26.7
44.2		1	1	1			1	1	1	1	1	1	1	1	1	1	1	6.1	6.1	1.5	27.7
45.0		1	1	1			1	1	1	1	1	1	1	1	1	1	1.5	6.1	6.1	1.5	28.2
45.8		1.5	1	1			1	1	1	1	1	1	1	1	1	1	1.5	6.1	6.1	1.5	28.7
46.6		1.5	1.5	1			1	1	1	1	1	1	1	1	1	1	1.5	6.1	6.1	1.5	29.2
48.2		1.5	1.5	1	1		1	1	1	1	1	1	1	1	1	1	1.5	6.1	6.1	1.5	30.2
49.0		1.5	1.5	1	1		1	1	1	1	1	1	1	1	1	1.5	1.5	6.1	6.1	1.5	30.7
49.8		1.5	1.5	1.5	1		1	1	1	1	1	1	1	1	1	1.5	1.5	6.1	6.1	1.5	31.2
50.6		1.5	1.5	1.5	1		1	1	1	1	1	1	1	1	1	1.5	1.5	6.1	6.1	2	31.7
51.4		1.5	1.5	1.5	1		1	1	1	1	1	1	1	1	1	1.5	2	6.1	6.1	2	32.2
53.0		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	33.2
53.8		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	33.7
54.6		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	34.2
55.4		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	34.7
56.2		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	35.2
57.0		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	35.7
57.8		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	36.2
58.6		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	36.7
59.4		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	37.2
60.2		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	37.7
61.0		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	38.2
61.8		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	38.7
62.6		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	39.2
63.4		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	39.7
64.2		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	40.2
65.0		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	40.7
65.8		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	41.2
66.6		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	41.7
67.4		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	42.2
68.2		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	42.7

Total Spill	John Day Dam Spill Patterns with TSWs in Bays 18 & 19 # Gate Stops per Spillbay																				Total Stops
(kcfs)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18 TSW	19 TSW	20	(#)
69.0		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	43.2
69.8		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	43.7
70.6		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	44.2
71.4		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	44.7
72.2		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	45.2
73.0		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	45.7
73.8		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	46.2
74.6		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	46.7
75.4		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	47.2
76.2		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	47.7
77.0		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	48.2
77.8		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	48.7
78.6		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	49.2
79.4		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	49.7
80.2		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	50.2
81.0		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	50.7
81.8		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	51.2
82.6		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	51.7
83.4		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	52.2
84.2		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	52.7
85.0		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	53.2
85.8		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	53.7
86.6		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	54.2
87.4		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	54.7
88.2		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	55.2
89.0		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	55.7
89.8		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	56.2
90.6		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	56.7
91.4		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	57.2
92.2		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	57.7
93.0		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	58.2
93.8		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	58.7
94.6		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	59.2
95.4		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	59.7
96.2		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	60.2
97.0		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	60.7
97.8		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	61.2
98.6		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	61.7
99.4		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	62.2
100.2		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	62.7
101.0		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	63.2
101.8		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	63.7
102.6		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	64.2
103.4		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	64.7
104.2		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	65.2
105.0		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	65.7
105.8		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	66.2
106.6		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	66.7

Total Spill	John Day Dam Spill Patterns with TSWs in Bays 18 & 19 # Gate Stops per Spillbay																				Total Stops
(kcfs)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18 TSW	19 TSW	20	(#)
107.4		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	**67.2**
108.2		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	**67.7**
109.0		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	**68.2**
109.8		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	**68.7**
110.6		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	**69.2**
111.4		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	**69.7**
112.2		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	**70.2**
113.0		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	**70.7**
113.8		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	**71.2**
114.6		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	**71.7**
115.4		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	**72.2**
116.2		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	**72.7**
117.0		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	**73.2**
117.8		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	**73.7**
118.6		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	**74.2**
119.4		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	**74.7**
120.2		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	**75.2**
121.0		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	**75.7**
121.8		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	**76.2**
122.6		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	**76.7**
123.4		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	**77.2**
124.2		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	**77.7**
125.0		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	**78.2**
125.8		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	**78.7**
126.6		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	**79.2**
127.4		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	**79.7**
128.2		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	**80.2**
129.0		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	**80.7**
129.8		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	**81.2**
130.6		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	**81.7**
131.4		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	**82.2**
132.2		4	4.5	4	4	4	4	4	4	4	4	4	4	4	4.5	5	5	6.1	6.1	3.5	**82.7**
133.0		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	**83.2**
133.8		4	5	4	4	4	4	4	4	4	4	4	4	4.5	4.5	5	5	6.1	6.1	3.5	**83.7**
134.6		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	**84.2**
135.4		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	**84.7**
136.2		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	**85.2**
137.0		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	**85.7**
137.8		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	**86.2**
138.6		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	**86.7**
139.4		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	**87.2**
140.2		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	**87.7**
141.0		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	**88.2**
141.8		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	**88.7**
142.6		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	**89.2**
143.4		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	**89.7**
144.2		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	**90.2**
145.0		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	**90.7**

Total Spill	John Day Dam Spill Patterns with TSWs in Bays 18 & 19 # Gate Stops per Spillbay																				Total Stops
(kcfs)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18 TSW	19 TSW	20	(#)
145.8		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	**91.2**
146.6		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	**91.7**
147.4		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	**92.2**
148.2		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	**92.7**
149.0		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	**93.2**
149.8		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	**93.7**
150.6		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	**94.2**
151.4		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	**94.7**
152.2		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	**95.2**
153.0		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	**95.7**
153.8		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	**96.2**
154.6		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	**96.7**
155.4		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	**97.2**
156.2		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	**97.7**
157.0		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	**98.2**
157.8		4	5.5	5	5	5	5	5	5	5	5	5	5	5	5.5	6	6	6.1	6.1	4.5	**98.7**
158.6		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	**99.2**
159.4		4	6	5	5	5	5	5	5	5	5	5	5	5.5	5.5	6	6	6.1	6.1	4.5	**99.7**
160.2		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	**100.2**
161.0		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	**100.7**
161.8		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	**101.2**
162.6		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	**101.7**
163.4		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	**102.2**
164.2		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	**102.7**
165.0		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	**103.2**
165.8		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	**103.7**
166.6		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	**104.2**
167.4		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	**104.7**
168.2		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	**105.2**
169.0		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	**105.7**
169.8		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	**106.2**
170.6		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	**106.7**
171.4		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	**107.2**
172.2		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	**107.7**
173.0		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	**108.2**
173.8		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	**108.7**
174.6		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	**109.2**
175.4		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	**109.7**
176.2		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	**110.2**
177.0		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	**110.7**
177.8		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	**111.2**
178.6		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	**111.7**
179.4		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	**112.2**
180.2		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	**112.7**
181.0		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	**113.2**
181.8		4	6	6	6	6	6	6	6	6	6	6	6	6	6.5	6.5	7	6.1	6.1	5.5	**113.7**
182.6		4	6	6	6	6	6	6	6	6	6	6	6	6	6.5	7	7	6.1	6.1	5.5	**114.2**
183.4		4	6	6	6	6	6	6	6	6	6	6	6	6.5	6.5	7	7	6.1	6.1	5.5	**114.7**

Total Spill	John Day Dam Spill Patterns with TSWs in Bays 18 & 19 # Gate Stops per Spillbay																				Total Stops
(kcfs)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18 TSW	19 TSW	20	(#)
184.2		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	115.2
185.0		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	115.7
185.8		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	116.2
186.6		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	116.7
187.4		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	117.2
188.2		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	117.7
189.0		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	118.2
189.8		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	118.7
190.6		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	119.2
191.4		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	119.7
192.2		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	120.2
193.0		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	120.7
193.8		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	121.2
194.6		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	121.7
195.4		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	122.2
196.2		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	122.7
197.0		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	123.2
197.8		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	123.7
198.6		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	124.2
199.4		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	124.7
200.2		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	125.2
201.0		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	125.7
201.8		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	126.2
202.6		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	126.7
203.4		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	127.2
204.2		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	127.7
205.0		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	128.2
205.8		4	6	7	7	7	7	7	7	7	7	7	7	7	7.5	7.5	8	6.1	6.1	6.5	128.7
206.6		4	6	7	7	7	7	7	7	7	7	7	7	7	7.5	8	8	6.1	6.1	6.5	129.2
207.4		4	6	7	7	7	7	7	7	7	7	7	7	7.5	7.5	8	8	6.1	6.1	6.5	129.7
208.2		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	130.2
209.0		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	130.7
209.8		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	131.2
210.6		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	131.7
211.4		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	132.2
212.2		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	132.7
213.0		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	133.2
213.8		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	133.7
214.6		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	134.2
215.4		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	134.7
216.2		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	135.2
217.0		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	135.7
217.8		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	136.2
218.6		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	136.7
219.4		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	137.2
220.2		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	137.7
221.0		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	138.2
221.8		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	138.7

Total Spill	John Day Dam Spill Patterns with TSWs in Bays 18 & 19 # Gate Stops per Spillbay																				Total Stops
(kcfs)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18 TSW	19 TSW	20	(#)
222.6		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	139.2
223.4		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	139.7
224.2		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	140.2
225.0		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	140.7
225.8		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	141.2
226.6		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	141.7
227.4		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	142.2
228.2		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	142.7
229.0		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	143.2
229.8		4	6	8	8	8	8	8	8	8	8	8	8	8	8.5	8.5	9	6.1	6.1	7.5	143.7
230.6		4	6	8	8	8	8	8	8	8	8	8	8	8	8.5	9	9	6.1	6.1	7.5	144.2
231.4		4	6	8	8	8	8	8	8	8	8	8	8	8.5	8.5	9	9	6.1	6.1	7.5	144.7
232.2		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	145.2
233.0		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	145.7
233.8		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	146.2
234.6		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	146.7
235.4		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	147.2
236.2		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	147.7
237.0		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	148.2
237.8		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	148.7
238.6		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	149.2
239.4		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	149.7
240.2		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	150.2
241.0		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	150.7
241.8		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	151.2
242.6		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	151.7
243.4		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	152.2
244.2		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	152.7
245.0		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	153.2
245.8		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	153.7
246.6		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	154.2
247.4		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	154.7
248.2		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	155.2
249.0		4	6	8	9	9	9	8.5	9	8.5	9	9	9	9	9	9.5	10	6.1	6.1	8	155.7
249.8		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	156.2
250.6		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	156.7
251.4		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	157.2
252.2		4	6	8	9	9	9	9	9	9	9	9	9	9	9.5	9.5	10	6.1	6.1	8.5	157.7
253.0		4	6	8	9	9	9	9	9	9	9	9	9	9	9.5	10	10	6.1	6.1	8.5	158.2
253.8		4	6	8	9	9	9	9	9	9	9	9	9	9.5	9.5	10	10	6.1	6.1	8.5	158.7
254.6		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	159.2
255.4		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	159.7
256.2		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	160.2
257.0		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	160.7
257.8		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	161.2
258.6		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	161.7
259.4		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	162.2
260.2		4	6	8	9.5	9.5	9.5	9	9.5	9	9.5	9.5	9.5	9.5	9.5	10	11	6.1	6.1	8.5	162.7

Total Spill	John Day Dam Spill Patterns with TSWs in Bays 18 & 19 # Gate Stops per Spillbay																				Total Stops
(kcfs)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18 TSW	19 TSW	20	(#)
261.0		4	6	8	9.5	9.5	9.5	9	9.5	9	9.5	9.5	9.5	9.5	9.5	10	11	6.1	6.1	9	**163.2**
261.8		4	6	8	9.5	9.5	9.5	9	9.5	9	9.5	9.5	9.5	9.5	10	10	11	6.1	6.1	9	**163.7**
262.6		4	6	8	9.5	9.5	9.5	9.5	9.5	9	9.5	9.5	9.5	9.5	10	10	11	6.1	6.1	9	**164.2**
263.4		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	11	6.1	6.1	9	**164.7**
264.2		4	6	8	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5	10	11	11	6.1	6.1	9	**165.2**
265.0		4	6	8	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5	10	10	11	11	6.1	6.1	9	**165.7**
265.8		4	6	8	10	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5	10	10	11	11	6.1	6.1	9	**166.2**
266.6		4	6	8	10	9.5	9.5	9.5	9.5	9.5	9.5	10	9.5	10	10	11	11	6.1	6.1	9	**166.7**
267.4		4	6	8	10	9.5	10	9.5	9.5	9.5	9.5	10	9.5	10	10	11	11	6.1	6.1	9	**167.2**
268.2		4	6	8	10	9.5	10	9.5	9.5	9.5	10	10	9.5	10	10	11	11	6.1	6.1	9	**167.7**
269.0		4	6	8	10	9.5	10	9.5	9.5	9.5	10	10	10	10	10	11	11	6.1	6.1	9	**168.2**
269.8		4	6	8	10	10	10	9.5	9.5	9.5	10	10	10	10	10	11	11	6.1	6.1	9	**168.7**
270.6		4	6	8	10	10	10	9.5	10	9.5	10	10	10	10	10	11	11	6.1	6.1	9	**169.2**
271.4		4	6	8	10	10	10	9.5	10	9.5	10	10	10	10	10	11	11	6.1	6.1	9	**169.7**
272.2		4	6	8	10	10	10	9.5	10	9.5	10	10	10	10	10	11	11	6.1	6.1	9.5	**170.2**
273.0		4	6	8	10	10	10	9.5	10	9.5	10	10	10	10	11	11	11	6.1	6.1	9.5	**170.7**
273.8		4	6	8	10	10	10	10	10	9.5	10	10	10	10	11	11	11	6.1	6.1	9.5	**171.2**
274.6		4	6	8	10	10	10	10	10	10	10	10	10	10	11	11	11	6.1	6.1	9.5	**171.7**
275.4		4	6	8	10	10	10	10	10	10	10	10	10	10	11	11	11	6.1	6.1	9.5	**172.2**
276.2		4	6	8	10	10	10	10	10	10	10	10	10	11	11	11	11	6.1	6.1	9.5	**172.7**
277.0		4	6	8	11	10	10	10	10	10	10	10	10	11	11	11	11	6.1	6.1	9.5	**173.2**
277.8		4	6	8	11	10	10	10	10	10	10	11	10	11	11	11	11	6.1	6.1	9.5	**173.7**
278.6		4	6	8	11	10	11	10	10	10	10	11	10	11	11	11	11	6.1	6.1	9.5	**174.2**
279.4		4	6	8	11	10	11	10	10	10	11	11	10	11	11	11	11	6.1	6.1	9.5	**174.7**
280.2		4	6	8	11	10	11	10	10	10	11	11	11	11	11	11	11	6.1	6.1	9.5	**175.2**
281.0		4	6	8	11	11	11	10	10	10	11	11	11	11	11	11	11	6.1	6.1	9.5	**175.7**
281.8		4	6	8	11	11	11	10	11	10	11	11	11	11	11	11	11	6.1	6.1	9.5	**176.2**
282.6		4	6	8	11	11	11	10	11	10	11	11	11	11	11	11	12	6.1	6.1	9.5	**176.7**
283.4		4	6	8	11	11	11	10	11	10	11	11	11	11	11	11	12	6.1	6.1	10	**177.2**
284.2		4	6	8	11	11	11	10	11	10	11	11	11	11	11	11	12	6.1	6.1	10	**177.7**
285.0		4	6	8	11	11	11	11	11	10	11	11	11	11	11	11	12	6.1	6.1	10	**178.2**
285.8		4	6	8	11	11	11	11	11	11	11	11	11	11	11	11	12	6.1	6.1	10	**178.7**
286.6		4	6	8	11	11	11	11	11	11	11	11	11	11	11	12	12	6.1	6.1	10	**179.2**
287.4		4	6	8	11	11	11	11	11	11	11	11	11	11	11	12	12	6.1	6.1	10	**179.7**
288.2		4	6	8	11	11	11	11	11	11	11	11	11	11	11	12	12	6.1	6.1	10	**180.2**
289.0		4	6	8	11	11	11	11	11	11	11	11	11	11	11	12	12	6.1	6.1	10	**180.7**
289.8		4	6	8	11	11	11	11	11	11	11	11	11	11	11	12	12	6.1	6.1	10	**181.2**
290.6		4	6	8	11	11	11	11	11	11	11	11	11	11	11	12	12	6.1	6.1	10	**181.7**
291.4		4	6	8	11	11	11	11	11	11	11	11	11	11	11	12	12	6.1	6.1	10	**182.2**
292.2		4	6	8	11	11	11	11	11	11	11	11	11	11	11	12	12	6.1	6.1	10	**182.7**
293.0		4	6	8	11	11	11	11	11	11	11	11	11	11	11	12	12	6.1	6.1	10	**183.2**
293.8		4	6	8	11	11	11	11	11	11	11	11	11	11	11	12	12	6.1	6.1	10	**183.7**
294.6		4	6	8	11	11	11	11	11	11	11	11	11	11	11	12	12	6.1	6.1	10.5	**184.2**
295.4		4	6	8	11	11	11	11	11	11	11	11	11	11	12	12	12	6.1	6.1	10.5	**184.7**
296.2		4	6	8	11	11	11	11	11	11	11	11	11	11	12	12	12	6.1	6.1	10.5	**185.2**
297.0		4	6	8	11	11	11	11	11	11	11	11	11	11	12	12	12	6.1	6.1	10.5	**185.7**
297.8		4	6	8	11	11	11	11	11	11	11	11	11	11	12	12	12	6.1	6.1	10.5	**186.2**
298.6		4	6	8	11	11	11	11	11	11	11	11	11	12	12	12	12	6.1	6.1	10.5	**186.7**

Total Spill	John Day Dam Spill Patterns with TSWs in Bays 18 & 19 # Gate Stops per Spillbay																				Total Stops
(kcfs)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18 TSW	19 TSW	20	(#)
299.4		4	6	8	12	11	11	11	11	11	11	11	11	12	12	12	12	6.1	6.1	10.5	**187.2**
300.2		4	6	8	12	11	11	11	11	11	11	12	11	12	12	12	12	6.1	6.1	10.5	**187.7**
301.0		4	6	8	12	11	12	11	11	11	11	12	11	12	12	12	12	6.1	6.1	10.5	**188.2**
301.8		4	6	8	12	11	12	11	11	11	12	12	11	12	12	12	12	6.1	6.1	10.5	**188.7**
302.6		4	6	8	12	11	12	11	11	11	12	12	12	12	12	12	12	6.1	6.1	10.5	**189.2**
303.4		4	6	8	12	12	12	11	11	11	12	12	12	12	12	12	12	6.1	6.1	10.5	**189.7**
304.2		4	6	8	12	12	12	11	12	11	12	12	12	12	12	12	12	6.1	6.1	10.5	**190.2**
305.0 [a]		4	6	8	12	12	12	11	12	11	12	12	12	12	12	12	12	6.1	6.1	11	**190.7**
305.8		4	6	8	12	12	12	12	12	11	12	12	12	12	12	12	12	6.1	6.1	11	**191.2**
306.6		4	6	8	12	12	12	12	12	11	12	12	12	12	12	12	12	6.1	6.1	11	**191.7**
307.4		4	6	8	12	12	12	12	12	11	12	12	12	12	12	12	12	6.1	6.1	11	**192.2**
308.2		4	6	8	12	12	12	12	12	12	12	12	12	12	12	12	12	6.1	6.1	11	**192.7**
309.0		4	6	8	12	12	12	12	12	12	12	12	12	12	12	12	12	6.1	6.1	11	**193.2**
309.8		4	6	8	12	12	12	12	12	12	12	12	12	12	12	12	12	6.1	6.1	11	**193.7**
310.6		4	6	8	12	12	12	12	12	12	12	12	12	12	12	12	12	6.1	6.1	11	**194.2**
311.4		4	6	8	12	12	12	12	12	12	12	12	12	12	12	12	12	6.1	6.1	11	**194.7**
312.2		4	6	8	12	12	12	12	12	12	12	12	12	12	12	12	12	6.1	6.1	11	**195.2**
313.0		4	6	8	12	12	12	12	12	12	12	12	12	12	12	12	12	6.1	6.1	11	**195.7**
313.8		4	6	8	12	12	12	12	12	12	12	12	12	12	12	12	12	6.1	6.1	11	**196.2**
314.6		4	6	8	12	12	12	12	12	12	12	12	12	12	12	12	12	6.1	6.1	11	**196.7**
315.4 [b]		4	6	8	12	12	12	12	12	12	12	12	12	12	12	12	12	6.1	6.1	11	**197.2**
317.0	1	4	6	8	12	12	12	12	12	12	12	12	12	12	12	12	12	6.1	6.1	11	**198.2**
318.6	2	4	6	8	12	12	12	12	12	12	12	12	12	12	12	12	12	6.1	6.1	11	**199.2**
320.2	3	4	6	8	12	12	12	12	12	12	12	12	12	12	12	12	12	6.1	6.1	11	**200.2**
321.8	3	4	6	9	12	12	12	12	12	12	12	12	12	12	12	12	12	6.1	6.1	11	**201.2**
323.4	4	4	6	9	12	12	12	12	12	12	12	12	12	12	12	12	12	6.1	6.1	11	**202.2**
325.0	4	5	6	9	12	12	12	12	12	12	12	12	12	12	12	12	12	6.1	6.1	11	**203.2**
326.6	4	5	7	9	12	12	12	12	12	12	12	12	12	12	12	12	12	6.1	6.1	11	**204.2**
328.2	4	5	7	10	12	12	12	12	12	12	12	12	12	12	12	12	12	6.1	6.1	11	**205.2**
329.8	5	5	7	10	12	12	12	12	12	12	12	12	12	12	12	12	12	6.1	6.1	11	**206.2**
331.4	5	6	7	10	12	12	12	12	12	12	12	12	12	12	12	12	12	6.1	6.1	11	**207.2**
333.0	5	6	8	10	12	12	12	12	12	12	12	12	12	12	12	12	12	6.1	6.1	11	**208.2**
334.6	5	6	8	11	12	12	12	12	12	12	12	12	12	12	12	12	12	6.1	6.1	11	**209.2**
336.2	6	6	8	11	12	12	12	12	12	12	12	12	12	12	12	12	12	6.1	6.1	11	**210.2**
337.8	6	7	8	11	12	12	12	12	12	12	12	12	12	12	12	12	12	6.1	6.1	11	**211.2**
339.4	6	7	9	11	12	12	12	12	12	12	12	12	12	12	12	12	12	6.1	6.1	11	**212.2**
341.0	6	7	9	12	12	12	12	12	12	12	12	12	12	12	12	12	12	6.1	6.1	11	**213.2**
342.6	7	7	9	12	12	12	12	12	12	12	12	12	12	12	12	12	12	6.1	6.1	11	**214.2**
344.2	7	8	9	12	12	12	12	12	12	12	12	12	12	12	12	12	12	6.1	6.1	11	**215.2**
345.8	7	8	10	12	12	12	12	12	12	12	12	12	12	12	12	12	12	6.1	6.1	11	**216.2**
347.4	8	8	10	12	12	12	12	12	12	12	12	12	12	12	12	12	12	6.1	6.1	11	**217.2**
349.0	8	9	10	12	12	12	12	12	12	12	12	12	12	12	12	12	12	6.1	6.1	11	**218.2**
350.6	8	9	11	12	12	12	12	12	12	12	12	12	12	12	12	12	12	6.1	6.1	11	**219.2**
352.2	9	9	11	12	12	12	12	12	12	12	12	12	12	12	12	12	12	6.1	6.1	11	**220.2**
353.8	9	10	11	12	12	12	12	12	12	12	12	12	12	12	12	12	12	6.1	6.1	11	**221.2**
355.4	10	10	11	12	12	12	12	12	12	12	12	12	12	12	12	12	12	6.1	6.1	11	**222.2**
357.0	10	11	11	12	12	12	12	12	12	12	12	12	12	12	12	12	12	6.1	6.1	11	**223.2**

Total Spill	John Day Dam Spill Patterns with TSWs in Bays 18 & 19 # Gate Stops per Spillbay																				Total Stops
(kcfs)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18 TSW	19 TSW	20	(#)
358.6	10	11	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	6.1	6.1	11	224.2
360.2 [c]	11	11	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	6.1	6.1	11	225.2
361.8	11	11	13	12	12	12	12	12	12	12	12	12	12	12	12	12	12	6.1	6.1	11	226.2
363.4	11	11	13	12	12	12	12	12	12	12	12	12	12	12	12	12	13	6.1	6.1	11	227.2
365.0	11	11	13	13	12	12	12	12	12	12	12	12	12	12	12	12	13	6.1	6.1	11	228.2
366.6	11	11	13	13	12	12	12	12	12	12	12	12	12	12	13	12	13	6.1	6.1	11	229.2
368.2	11	11	13	13	13	12	12	12	12	12	12	12	12	12	13	12	13	6.1	6.1	11	230.2
369.8	11	11	13	13	13	12	12	13	12	12	12	12	12	12	13	12	13	6.1	6.1	11	231.2
371.4	11	11	13	13	13	12	12	13	12	13	12	12	12	12	13	12	13	6.1	6.1	11	232.2
373.0	11	11	13	13	13	12	12	13	12	13	12	13	12	12	13	12	13	6.1	6.1	11	233.2
374.6	11	11	13	13	13	13	12	13	12	13	12	13	12	12	13	12	13	6.1	6.1	11	234.2
376.2	11	11	13	13	13	13	12	13	12	13	12	13	12	12	13	13	13	6.1	6.1	11	235.2
377.8	11	11	13	13	13	13	13	13	12	13	12	13	12	12	13	13	13	6.1	6.1	11	236.2
379.4	11	11	13	13	13	13	13	13	12	13	12	13	12	13	13	13	13	6.1	6.1	11	237.2
381.0	11	11	13	13	13	13	13	13	13	13	12	13	12	13	13	13	13	6.1	6.1	11	238.2
382.6	11	11	13	13	13	13	13	13	13	13	13	13	12	13	13	13	13	6.1	6.1	11	239.2
384.2	11	11	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	6.1	6.1	11	240.2
385.8	11	11	14	13	13	13	13	13	13	13	13	13	13	13	13	13	13	6.1	6.1	11	241.2
387.4	11	11	14	13	13	13	13	13	13	13	13	13	13	13	13	13	14	6.1	6.1	11	242.2
389.0	11	11	14	14	13	13	13	13	13	13	13	13	13	13	13	13	14	6.1	6.1	11	243.2
390.6	11	11	14	14	13	13	13	13	13	13	13	13	13	13	14	13	14	6.1	6.1	11	244.2
392.2	11	11	14	14	14	13	13	13	13	13	13	13	13	13	14	13	14	6.1	6.1	11	245.2
393.8	11	11	14	14	14	13	13	14	13	13	13	13	13	13	14	13	14	6.1	6.1	11	246.2
395.4	11	11	14	14	14	13	13	14	13	14	13	13	13	13	14	13	14	6.1	6.1	11	247.2
397.0	11	11	14	14	14	13	13	14	13	14	13	14	13	13	14	13	14	6.1	6.1	11	248.2
398.6	11	11	14	14	14	14	13	14	13	14	13	14	13	13	14	13	14	6.1	6.1	11	249.2
400.2	11	11	14	14	14	14	13	14	13	14	13	14	13	13	14	14	14	6.1	6.1	11	250.2
401.8	11	11	14	14	14	14	14	14	13	14	13	14	13	13	14	14	14	6.1	6.1	11	251.2
403.4	11	11	14	14	14	14	14	14	13	14	13	14	13	14	14	14	14	6.1	6.1	11	252.2
405.0	11	11	14	14	14	14	14	14	14	14	13	14	13	14	14	14	14	6.1	6.1	11	253.2
406.6	11	11	14	14	14	14	14	14	14	14	14	14	13	14	14	14	14	6.1	6.1	11	254.2
408.2	11	11	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	6.1	6.1	11	255.2
409.8	11	11	15	14	14	14	14	14	14	14	14	14	14	14	14	14	14	6.1	6.1	11	256.2
411.4	11	11	15	14	14	14	14	14	14	14	14	14	14	14	14	14	15	6.1	6.1	11	257.2
413.0	11	11	15	15	14	14	14	14	14	14	14	14	14	14	14	14	15	6.1	6.1	11	258.2
414.6	11	11	15	15	14	14	14	14	14	14	14	14	14	14	15	14	15	6.1	6.1	11	259.2
416.2	11	11	15	15	15	14	14	14	14	14	14	14	14	14	15	14	15	6.1	6.1	11	260.2
417.8	11	11	15	15	15	14	14	15	14	14	14	14	14	14	15	14	15	6.1	6.1	11	261.2
419.4	11	11	15	15	15	14	14	15	14	15	14	14	14	14	15	14	15	6.1	6.1	11	262.2
421.0	11	11	15	15	15	14	14	15	14	15	14	15	14	14	15	14	15	6.1	6.1	11	263.2
422.6	11	11	15	15	15	15	14	15	14	15	14	15	14	14	15	14	15	6.1	6.1	11	264.2
424.2	11	11	15	15	15	15	14	15	14	15	14	15	14	14	15	15	15	6.1	6.1	11	265.2
425.8	11	11	15	15	15	15	15	15	14	15	14	15	14	14	15	15	15	6.1	6.1	11	266.2
427.4	11	11	15	15	15	15	15	15	14	15	14	15	14	15	15	15	15	6.1	6.1	11	267.2
429.0	11	11	15	15	15	15	15	15	15	15	14	15	14	15	15	15	15	6.1	6.1	11	268.2
430.6	11	11	15	15	15	15	15	15	15	15	15	15	14	15	15	15	15	6.1	6.1	11	269.2
432.2	11	11	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	6.1	6.1	11	270.2
433.8	11	11	16	15	15	15	15	15	15	15	15	15	15	15	15	15	15	6.1	6.1	11	271.2

Total Spill	John Day Dam Spill Patterns with TSWs in Bays 18 & 19 # Gate Stops per Spillbay																				Total Stops
(kcfs)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18 TSW	19 TSW	20	(#)
435.4	11	11	16	15	15	15	15	15	15	15	15	15	15	15	15	15	16	6.1	6.1	11	**272.2**
437.0	11	11	16	16	15	15	15	15	15	15	15	15	15	15	15	15	16	6.1	6.1	11	**273.2**
438.6	11	11	16	16	15	15	15	15	15	15	15	15	15	15	16	15	16	6.1	6.1	11	**274.2**
440.2	11	11	16	16	16	15	15	15	15	15	15	15	15	15	16	15	16	6.1	6.1	11	**275.2**
441.8	11	11	16	16	16	15	15	16	15	15	15	15	15	15	16	15	16	6.1	6.1	11	**276.2**
443.4	11	11	16	16	16	15	15	16	15	16	15	15	15	15	16	15	16	6.1	6.1	11	**277.2**
445.0	11	11	16	16	16	15	15	16	15	16	15	16	15	15	16	15	16	6.1	6.1	11	**278.2**
446.6	11	11	16	16	16	16	15	16	15	16	15	16	15	15	16	15	16	6.1	6.1	11	**279.2**
448.2	11	11	16	16	16	16	15	16	15	16	15	16	15	15	16	16	16	6.1	6.1	11	**280.2**
449.8	11	11	16	16	16	16	16	16	15	16	15	16	15	15	16	16	16	6.1	6.1	11	**281.2**
451.4	11	11	16	16	16	16	16	16	15	16	15	16	15	16	16	16	16	6.1	6.1	11	**282.2**
453.0	11	11	16	16	16	16	16	16	16	16	15	16	15	16	16	16	16	6.1	6.1	11	**283.2**
454.6	11	11	16	16	16	16	16	16	16	16	16	16	15	16	16	16	16	6.1	6.1	11	**284.2**
456.2	11	11	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	6.1	6.1	11	**285.2**
457.8	11	11	17	16	16	16	16	16	16	16	16	16	16	16	16	16	16	6.1	6.1	11	**286.2**
459.4	11	11	17	16	16	16	16	16	16	16	16	16	16	16	16	16	17	6.1	6.1	11	**287.2**
461.0	11	11	17	17	16	16	16	16	16	16	16	16	16	16	16	16	17	6.1	6.1	11	**288.2**
462.6	11	11	17	17	16	16	16	16	16	16	16	16	16	16	17	16	17	6.1	6.1	11	**289.2**
464.2	11	11	17	17	17	16	16	16	16	16	16	16	16	16	17	16	17	6.1	6.1	11	**290.2**
465.8	11	11	17	17	17	16	16	17	16	16	16	16	16	16	17	16	17	6.1	6.1	11	**291.2**
467.4	11	11	17	17	17	16	16	17	16	17	16	16	16	16	17	16	17	6.1	6.1	11	**292.2**
469.0	11	11	17	17	17	16	16	17	16	17	16	17	16	16	17	16	17	6.1	6.1	11	**293.2**
470.6	11	11	17	17	17	17	16	17	16	17	16	17	16	16	17	16	17	6.1	6.1	11	**294.2**
472.2	11	11	17	17	17	17	16	17	16	17	16	17	16	16	17	17	17	6.1	6.1	11	**295.2**
473.8	11	11	17	17	17	17	17	17	16	17	16	17	16	16	17	17	17	6.1	6.1	11	**296.2**
475.4	11	11	17	17	17	17	17	17	16	17	16	17	16	17	17	17	17	6.1	6.1	11	**297.2**
477.0	11	11	17	17	17	17	17	17	17	17	16	17	16	17	17	17	17	6.1	6.1	11	**298.2**
478.6	11	11	17	17	17	17	17	17	17	17	17	17	16	17	17	17	17	6.1	6.1	11	**299.2**
480.2	11	11	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	6.1	6.1	11	**300.2**
481.8	11	11	18	17	17	17	17	17	17	17	17	17	17	17	17	17	17	6.1	6.1	11	**301.2**
483.4	11	11	18	17	17	17	17	17	17	17	17	17	17	17	17	17	18	6.1	6.1	11	**302.2**
485.0	11	11	18	18	17	17	17	17	17	17	17	17	17	17	17	17	18	6.1	6.1	11	**303.2**
486.6	11	11	18	18	17	17	17	17	17	17	17	17	17	17	18	17	18	6.1	6.1	11	**304.2**
488.2	11	11	18	18	18	17	17	17	17	17	17	17	17	17	18	17	18	6.1	6.1	11	**305.2**
489.8	11	11	18	18	18	17	17	18	17	17	17	17	17	17	18	17	18	6.1	6.1	11	**306.2**
491.4	11	11	18	18	18	17	17	18	17	18	17	17	17	17	18	17	18	6.1	6.1	11	**307.2**
493.0	11	11	18	18	18	17	17	18	17	18	17	18	17	17	18	17	18	6.1	6.1	11	**308.2**
494.6	11	11	18	18	18	18	17	18	17	18	17	18	17	17	18	17	18	6.1	6.1	11	**309.2**
496.2	11	11	18	18	18	18	17	18	17	18	17	18	17	17	18	18	18	6.1	6.1	11	**310.2**
497.8	11	11	18	18	18	18	18	18	17	18	17	18	17	17	18	18	18	6.1	6.1	11	**311.2**
499.4	11	11	18	18	18	18	18	18	17	18	17	18	17	18	18	18	18	6.1	6.1	11	**312.2**
501.0	11	11	18	18	18	18	18	18	18	18	17	18	17	18	18	18	18	6.1	6.1	11	**313.2**
502.6	11	11	18	18	18	18	18	18	18	18	18	18	17	18	18	18	18	6.1	6.1	11	**314.2**
504.2	11	11	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	6.1	6.1	11	**315.2**
505.8	11	11	19	18	18	18	18	18	18	18	18	18	18	18	18	18	18	6.1	6.1	11	**316.2**
507.4	11	11	19	18	18	18	18	18	18	18	18	18	18	18	18	18	19	6.1	6.1	11	**317.2**
509.0	11	11	19	19	18	18	18	18	18	18	18	18	18	18	18	18	19	6.1	6.1	11	**318.2**
510.6	11	11	19	19	18	18	18	18	18	18	18	18	18	18	19	18	19	6.1	6.1	11	**319.2**

Total Spill	John Day Dam Spill Patterns with TSWs in Bays 18 & 19 # Gate Stops per Spillbay																				Total Stops
(kcfs)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18 TSW	19 TSW	20	(#)
512.2	11	11	19	19	19	18	18	18	18	18	18	18	18	18	19	18	19	6.1	6.1	11	**320.2**
513.8	11	11	19	19	19	18	18	19	18	18	18	18	18	18	19	18	19	6.1	6.1	11	**321.2**
515.4	11	11	19	19	19	18	18	19	18	19	18	18	18	18	19	18	19	6.1	6.1	11	**322.2**
517.0	11	11	19	19	19	18	18	19	18	19	18	19	18	18	19	18	19	6.1	6.1	11	**323.2**
518.6	11	11	19	19	19	19	18	19	18	19	18	19	18	18	19	18	19	6.1	6.1	11	**324.2**
520.2	11	11	19	19	19	19	18	19	18	19	18	19	18	18	19	19	19	6.1	6.1	11	**325.2**
521.8	11	11	19	19	19	19	19	19	18	19	18	19	18	18	19	19	19	6.1	6.1	11	**326.2**
523.4	11	11	19	19	19	19	19	19	18	19	18	19	18	19	19	19	19	6.1	6.1	11	**327.2**
525.0	11	11	19	19	19	19	19	19	19	19	18	19	18	19	19	19	19	6.1	6.1	11	**328.2**
526.6	11	11	19	19	19	19	19	19	19	19	19	19	18	19	19	19	19	6.1	6.1	11	**329.2**
528.2	11	11	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	6.1	6.1	11	**330.2**
529.8	11	11	20	19	19	19	19	19	19	19	19	19	19	19	19	19	19	6.1	6.1	11	**331.2**
531.4	11	11	20	19	19	19	19	19	19	19	19	19	19	19	19	19	20	6.1	6.1	11	**332.2**
533.0	11	11	20	20	19	19	19	19	19	19	19	19	19	19	19	19	20	6.1	6.1	11	**333.2**
534.6	11	11	20	20	19	19	19	19	19	19	19	19	19	19	20	19	20	6.1	6.1	11	**334.2**
536.2	11	11	20	20	20	19	19	19	19	19	19	19	19	19	20	19	20	6.1	6.1	11	**335.2**
537.8	11	11	20	20	20	19	19	20	19	19	19	19	19	19	20	19	20	6.1	6.1	11	**336.2**
539.4	11	11	20	20	20	19	19	20	19	20	19	19	19	19	20	19	20	6.1	6.1	11	**337.2**
541.0	11	11	20	20	20	19	19	20	19	20	19	20	19	19	20	19	20	6.1	6.1	11	**338.2**
542.6	11	11	20	20	20	20	19	20	19	20	19	20	19	19	20	19	20	6.1	6.1	11	**339.2**
544.2	11	11	20	20	20	20	19	20	19	20	19	20	19	19	20	20	20	6.1	6.1	11	**340.2**
545.8	11	11	20	20	20	20	20	20	19	20	19	20	19	19	20	20	20	6.1	6.1	11	**341.2**
547.4	11	11	20	20	20	20	20	20	19	20	19	20	19	20	20	20	20	6.1	6.1	11	**342.2**
549.0	11	11	20	20	20	20	20	20	20	20	19	20	19	20	20	20	20	6.1	6.1	11	**343.2**
550.6	11	11	20	20	20	20	20	20	20	20	20	20	19	20	20	20	20	6.1	6.1	11	**344.2**
552.2	11	11	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	6.1	6.1	11	**345.2**
553.8	11	11	21	20	20	20	20	20	20	20	20	20	20	20	20	20	20	6.1	6.1	11	**346.2**
555.4	11	11	21	20	20	20	20	20	20	20	20	20	20	20	20	20	21	6.1	6.1	11	**347.2**
557.0	11	11	21	21	20	20	20	20	20	20	20	20	20	20	20	20	21	6.1	6.1	11	**348.2**
558.6	11	11	21	21	20	20	20	20	20	20	20	20	20	20	21	20	21	6.1	6.1	11	**349.2**
560.2	11	11	21	21	21	20	20	20	20	20	20	20	20	20	21	20	21	6.1	6.1	11	**350.2**
561.8	11	11	21	21	21	20	20	21	20	20	20	20	20	20	21	20	21	6.1	6.1	11	**351.2**
563.4	11	11	21	21	21	20	20	21	20	21	20	20	20	20	21	20	21	6.1	6.1	11	**352.2**
565.0	11	11	21	21	21	20	20	21	20	21	20	21	20	20	21	20	21	6.1	6.1	11	**353.2**
566.6	11	11	21	21	21	21	20	21	20	21	20	21	20	20	21	20	21	6.1	6.1	11	**354.2**
568.2	11	11	21	21	21	21	20	21	20	21	20	21	20	20	21	21	21	6.1	6.1	11	**355.2**
569.8	11	11	21	21	21	21	21	21	20	21	20	21	20	20	21	21	21	6.1	6.1	11	**356.2**
571.4	11	11	21	21	21	21	21	21	20	21	20	21	20	21	21	21	21	6.1	6.1	11	**357.2**
573.0	11	11	21	21	21	21	21	21	21	21	20	21	20	21	21	21	21	6.1	6.1	11	**358.2**
574.6	11	11	21	21	21	21	21	21	21	21	21	21	20	21	21	21	21	6.1	6.1	11	**359.2**
576.2	11	11	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21	6.1	6.1	11	**360.2**
577.8	11	11	22	21	21	21	21	21	21	21	21	21	21	21	21	21	21	6.1	6.1	11	**361.2**
579.4	11	11	22	21	21	21	21	21	21	21	21	21	21	21	21	21	22	6.1	6.1	11	**362.2**
581.0	11	11	22	22	21	21	21	21	21	21	21	21	21	21	21	21	22	6.1	6.1	11	**363.2**
582.6	11	11	22	22	21	21	21	21	21	21	21	21	21	21	22	21	22	6.1	6.1	11	**364.2**
584.2	11	11	22	22	22	21	21	21	21	21	21	21	21	21	22	21	22	6.1	6.1	11	**365.2**
585.8	11	11	22	22	22	21	21	22	21	21	21	21	21	21	22	21	22	6.1	6.1	11	**366.2**
587.4	11	11	22	22	22	21	21	22	21	22	21	21	21	21	22	21	22	6.1	6.1	11	**367.2**

Total Spill	John Day Dam Spill Patterns with TSWs in Bays 18 & 19 # Gate Stops per Spillbay																				Total Stops
(kcfs)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18 TSW	19 TSW	20	(#)
589.0	11	11	22	22	22	21	21	22	21	22	21	22	21	21	22	21	22	6.1	6.1	11	**368.2**
590.6	11	11	22	22	22	22	21	22	21	22	21	22	21	21	22	21	22	6.1	6.1	11	**369.2**
592.2	11	11	22	22	22	22	21	22	21	22	21	22	21	21	22	22	22	6.1	6.1	11	**370.2**
593.8	11	11	22	22	22	22	22	22	21	22	21	22	21	21	22	22	22	6.1	6.1	11	**371.2**
595.4	11	11	22	22	22	22	22	22	21	22	21	22	21	22	22	22	22	6.1	6.1	11	**372.2**
597.0	11	11	22	22	22	22	22	22	22	22	21	22	21	22	22	22	22	6.1	6.1	11	**373.2**
598.6	11	11	22	22	22	22	22	22	22	22	22	22	21	22	22	22	22	6.1	6.1	11	**374.2**
600.2 [d]	11	11	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	6.1	6.1	11	**375.2**

a. Begin transition from juvenile fish patterns to flood patterns.
b. Gate 20 blocked at 10.3 ft opening.
c. Gate 1 blocked at 10.3 ft opening.
d. TSWs do not affect spillway flood capacity until flow ≥1,492 kcfs. Recommend remove TSWs before river flow >685 kcfs.

Table JDA-9. [*pg 1 of 9*] John Day Dam Spill Pattern with No Temporary Spillway Weirs (TSWs). ***See notes at end of table.***

Total Spill	John Day Dam Spill Patterns with No TSWs # Gate Stops per Spillbay																				Total Stops
(kcfs)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18 TSW	19 TSW	20	(#)
9.6		3	2	1														CLOSED	CLOSED		6
11.2		3	2	2														CLOSED	CLOSED		7
12.8		3	3	2														CLOSED	CLOSED		8
14.4		3	3	2	1													CLOSED	CLOSED		9
16.0		3	3	2	2													CLOSED	CLOSED		10
17.6		3	3	2	2	1												CLOSED	CLOSED		11
19.2		3	3	2	2	2												CLOSED	CLOSED		12
20.8		3	3	2	2	2	1											CLOSED	CLOSED		13
22.4		3	3	2	2	2	2											CLOSED	CLOSED		14
24.0		3	3	2	2	2	2	1										CLOSED	CLOSED		15
25.6		3	3	3	2	2	2	1										CLOSED	CLOSED		16
27.2		3	3	3	2	2	2	2										CLOSED	CLOSED		17
28.8		3	3	3	2	2	2	2	1									CLOSED	CLOSED		18
30.4		3	3	3	3	2	2	2	1									CLOSED	CLOSED		19
32.0		3	3	3	3	3	2	2	1									CLOSED	CLOSED		20
33.6		3	3	3	3	3	2	2	2									CLOSED	CLOSED		21
35.2		3	3	3	3	3	2	2	2	1								CLOSED	CLOSED		22
36.8		3	3	3	3	3	2	2	2	2								CLOSED	CLOSED		23
38.4		3	3	3	3	3	2	2	2	2	1							CLOSED	CLOSED		24
40.0		3	3	3	3	3	2	2	2	2	2							CLOSED	CLOSED		25
41.6		3	3	3	3	3	2	2	2	2	2	1						CLOSED	CLOSED		26
43.2		3	3	3	3	3	2	2	2	2	2	2						CLOSED	CLOSED		27
44.8		3	3	3	3	3	3	2	2	2	2	2						CLOSED	CLOSED		28
46.4		3	3	3	3	3	3	2	2	2	2	2	1					CLOSED	CLOSED		29
48.0		3	3	3	3	3	3	2	2	2	2	2	2					CLOSED	CLOSED		30
49.6		3	3	3	3	3	3	2	2	2	2	2	2	1				CLOSED	CLOSED		31
51.2		3	3	3	3	3	3	3	2	2	2	2	2	1				CLOSED	CLOSED		32
52.8		3	3	3	3	3	3	3	2	2	2	2	2	2				CLOSED	CLOSED		33
54.4		3	3	3	3	3	3	3	2	2	2	2	2	2	1			CLOSED	CLOSED		34
56.0		3	3	3	3	3	3	3	2	2	2	2	2	2	2			CLOSED	CLOSED		35
57.6		3	3	3	3	3	3	3	2	2	2	2	2	2	2	1		CLOSED	CLOSED		36
59.2		3	3	3	3	3	3	3	2	2	2	2	2	2	2	2		CLOSED	CLOSED		37
60.8		3	3	3	3	3	3	3	2	2	2	2	2	2	2	2	1	CLOSED	CLOSED		38
62.4		4	3	3	3	3	3	3	2	2	2	2	2	2	2	2	1	CLOSED	CLOSED		39
64.0		4	4	3	3	3	3	3	2	2	2	2	2	2	2	2	1	CLOSED	CLOSED		40
65.6		4	4	4	3	3	3	3	2	2	2	2	2	2	2	2	1	CLOSED	CLOSED		41
67.2		4	4	4	4	3	3	3	2	2	2	2	2	2	2	2	1	CLOSED	CLOSED		42
68.8		4	4	4	4	3	3	3	3	2	2	2	2	2	2	2	1	CLOSED	CLOSED		43
70.4		4	4	4	4	3	3	3	3	3	2	2	2	2	2	2	1	CLOSED	CLOSED		44
72.0		4	4	4	4	4	3	3	3	3	2	2	2	2	2	2	1	CLOSED	CLOSED		45

Total Spill (kcfs)	John Day Dam Spill Patterns with No TSWs # Gate Stops per Spillbay																				Total Stops (#)
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18 TSW	19 TSW	20	
73.6		4	5	4	4	4	3	3	3	3	2	2	2	2	2	2	1	CLOSED	CLOSED		46
75.2		4	5	4	4	4	3	3	3	3	2	2	2	2	2	2	2	CLOSED	CLOSED		47
76.8		4	5	4	4	4	3	3	3	3	3	2	2	2	2	2	2	CLOSED	CLOSED		48
78.4		4	5	4	4	4	3	3	3	3	3	3	2	2	2	2	2	CLOSED	CLOSED		49
80.0		4	5	5	4	4	3	3	3	3	3	3	2	2	2	2	2	CLOSED	CLOSED		50
81.6		4	5	5	4	4	4	3	3	3	3	3	2	2	2	2	2	CLOSED	CLOSED		51
83.2		4	5	5	4	4	4	3	3	3	3	3	3	2	2	2	2	CLOSED	CLOSED		52
84.8		4	5	5	4	4	4	3	3	3	3	3	3	3	2	2	2	CLOSED	CLOSED		53
86.4		4	5	5	4	4	4	3	3	3	3	3	3	3	3	2	2	CLOSED	CLOSED		54
88.0		4	5	5	4	4	4	3	3	3	3	3	3	3	3	3	2	CLOSED	CLOSED		55
89.6		4	5	5	4	4	4	4	3	3	3	3	3	3	3	3	2	CLOSED	CLOSED		56
91.2		4	5	5	4	4	4	4	4	3	3	3	3	3	3	3	2	CLOSED	CLOSED		57
92.8		4	5	5	5	4	4	4	4	3	3	3	3	3	3	3	2	CLOSED	CLOSED		58
94.4		4	5	5	5	4	4	4	4	4	3	3	3	3	3	3	2	CLOSED	CLOSED		59
96.0		4	5	5	5	4	4	4	4	4	4	3	3	3	3	3	2	CLOSED	CLOSED		60
97.6		4	5	5	5	4	4	4	4	4	4	3	3	3	3	3	3	CLOSED	CLOSED		61
99.2		4	5	5	5	4	4	4	4	4	4	4	3	3	3	3	3	CLOSED	CLOSED		62
100.8		4	4	4	4	4	4	4	4	4	4	4	3	4	4	4	4	CLOSED	CLOSED		63
102.4		4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	CLOSED	CLOSED		64
104.0		4	5	4	4	4	4	4	4	4	4	4	4	4	4	4	4	CLOSED	CLOSED		65
105.6		4	5	5	4	4	4	4	4	4	4	4	4	4	4	4	4	CLOSED	CLOSED		66
107.2		4	5	5	4	4	4	4	4	4	4	4	4	4	4	4	5	CLOSED	CLOSED		67
108.8		4	5	5	4	4	4	4	4	4	4	4	4	4	5	4	5	CLOSED	CLOSED		68
110.4		4	5	5	5	4	4	4	4	4	4	4	4	4	5	4	5	CLOSED	CLOSED		69
112.0		4	5	5	5	4	4	5	4	4	4	4	4	4	5	4	5	CLOSED	CLOSED		70
113.6		4	5	5	5	4	4	5	4	5	4	4	4	4	5	4	5	CLOSED	CLOSED		71
115.2		4	5	5	5	4	4	5	4	5	4	5	4	4	5	4	5	CLOSED	CLOSED		72
116.8		4	5	5	5	5	4	5	4	5	4	5	4	4	5	4	5	CLOSED	CLOSED		73
118.4		4	5	5	5	5	4	5	4	5	4	5	4	4	5	5	5	CLOSED	CLOSED		74
120.0		4	5	5	5	5	5	5	4	5	4	5	4	4	5	5	5	CLOSED	CLOSED		75
121.6		4	5	5	5	5	5	5	4	5	4	5	4	5	5	5	5	CLOSED	CLOSED		76
123.2		4	5	5	5	5	5	5	5	5	4	5	4	5	5	5	5	CLOSED	CLOSED		77
124.8		4	5	5	5	5	5	5	5	5	5	5	4	5	5	5	5	CLOSED	CLOSED		78
126.4		4	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	CLOSED	CLOSED		79
128.0		4	6	5	5	5	5	5	5	5	5	5	5	5	5	5	5	CLOSED	CLOSED		80
129.6		4	6	6	5	5	5	5	5	5	5	5	5	5	5	5	5	CLOSED	CLOSED		81
131.2		4	6	6	5	5	5	5	5	5	5	5	5	5	5	5	6	CLOSED	CLOSED		82
132.8		4	6	6	5	5	5	5	5	5	5	5	5	5	6	5	6	CLOSED	CLOSED		83
134.4		4	6	6	6	5	5	5	5	5	5	5	5	5	6	5	6	CLOSED	CLOSED		84
136.0		4	6	6	6	5	5	6	5	5	5	5	5	5	6	5	6	CLOSED	CLOSED		85
137.6		4	6	6	6	5	5	6	5	6	5	5	5	5	6	5	6	CLOSED	CLOSED		86
139.2		4	6	6	6	5	5	6	5	6	5	6	5	5	6	5	6	CLOSED	CLOSED		87
140.8		4	6	6	6	6	5	6	5	6	5	6	5	5	6	5	6	CLOSED	CLOSED		88

Total Spill (kcfs)	John Day Dam Spill Patterns with No TSWs # Gate Stops per Spillbay																				Total Stops (#)
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18 TSW	19 TSW	20	
142.4		4	6	6	6	6	5	6	5	6	5	6	5	5	6	6	6	CLOSED	CLOSED		89
144.0		4	6	6	6	6	6	6	5	6	5	6	5	5	6	6	6	CLOSED	CLOSED		90
145.6		4	6	6	6	6	6	6	5	6	5	6	5	6	6	6	6	CLOSED	CLOSED		91
147.2		4	6	6	6	6	6	6	6	6	5	6	5	6	6	6	6	CLOSED	CLOSED		92
148.8		4	6	6	6	6	6	6	6	6	6	6	5	6	6	6	6	CLOSED	CLOSED		93
150.4		4	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	CLOSED	CLOSED		94
152.0		4	6	7	6	6	6	6	6	6	6	6	6	6	6	6	6	CLOSED	CLOSED		95
153.6		4	6	7	6	6	6	6	6	6	6	6	6	6	6	6	7	CLOSED	CLOSED		96
155.2		4	6	7	6	6	6	6	6	6	6	6	6	6	7	6	7	CLOSED	CLOSED		97
156.8		4	6	7	7	6	6	6	6	6	6	6	6	6	7	6	7	CLOSED	CLOSED		98
158.4		4	6	7	7	6	6	7	6	6	6	6	6	6	7	6	7	CLOSED	CLOSED		99
160.0		4	6	7	7	6	6	7	6	7	6	6	6	6	7	6	7	CLOSED	CLOSED		100
161.6		4	6	7	7	6	6	7	6	7	6	7	6	6	7	6	7	CLOSED	CLOSED		101
163.2		4	6	7	7	7	6	7	6	7	6	7	6	6	7	6	7	CLOSED	CLOSED		102
164.8		4	6	7	7	7	6	7	6	7	6	7	6	6	7	7	7	CLOSED	CLOSED		103
166.4		4	6	7	7	7	7	7	6	7	6	7	6	6	7	7	7	CLOSED	CLOSED		104
168.0		4	6	7	7	7	7	7	6	7	6	7	6	7	7	7	7	CLOSED	CLOSED		105
169.6		4	6	7	7	7	7	7	7	7	6	7	6	7	7	7	7	CLOSED	CLOSED		106
171.2		4	6	7	7	7	7	7	7	7	7	7	6	7	7	7	7	CLOSED	CLOSED		107
172.8		4	6	7	7	7	7	7	7	7	7	7	7	7	7	7	7	CLOSED	CLOSED		108
174.4		4	6	8	7	7	7	7	7	7	7	7	7	7	7	7	7	CLOSED	CLOSED		109
176.0		4	6	8	7	7	7	7	7	7	7	7	7	7	7	7	8	CLOSED	CLOSED		110
177.6		4	6	8	7	7	7	7	7	7	7	7	7	7	8	7	8	CLOSED	CLOSED		111
179.2		4	6	8	8	7	7	7	7	7	7	7	7	7	8	7	8	CLOSED	CLOSED		112
180.8		4	6	8	8	7	7	8	7	7	7	7	7	7	8	7	8	CLOSED	CLOSED		113
182.4		4	6	8	8	7	7	8	7	8	7	7	7	7	8	7	8	CLOSED	CLOSED		114
184.0		4	6	8	8	7	7	8	7	8	7	8	7	7	8	7	8	CLOSED	CLOSED		115
185.6		4	6	8	8	8	7	8	7	8	7	8	7	7	8	7	8	CLOSED	CLOSED		116
187.2		4	6	8	8	8	7	8	7	8	7	8	7	7	8	8	8	CLOSED	CLOSED		117
188.8		4	6	8	8	8	8	8	7	8	7	8	7	7	8	8	8	CLOSED	CLOSED		118
190.4		4	6	8	8	8	8	8	7	8	7	8	7	8	8	8	8	CLOSED	CLOSED		119
192.0		4	6	8	8	8	8	8	8	8	7	8	7	8	8	8	8	CLOSED	CLOSED		120
193.6		4	6	8	8	8	8	8	8	8	8	8	7	8	8	8	8	CLOSED	CLOSED		121
195.2		4	6	8	8	8	8	8	8	8	8	8	8	8	8	8	8	CLOSED	CLOSED		122
196.8		4	6	8	8	8	8	8	8	8	8	8	8	8	8	8	9	CLOSED	CLOSED		123
198.4		4	6	8	8	8	8	8	8	8	8	8	8	8	9	8	9	CLOSED	CLOSED		124
200.0		4	6	8	9	8	8	8	8	8	8	8	8	8	9	8	9	CLOSED	CLOSED		125
201.6		4	6	8	9	8	8	9	8	8	8	8	8	8	9	8	9	CLOSED	CLOSED		126
203.2		4	6	8	9	8	8	9	8	9	8	8	8	8	9	8	9	CLOSED	CLOSED		127
204.8		4	6	8	9	8	8	9	8	9	8	9	8	8	9	8	9	CLOSED	CLOSED		128
206.4		4	6	8	9	9	8	9	8	9	8	9	8	8	9	8	9	CLOSED	CLOSED		129
208.0		4	6	8	9	9	8	9	8	9	8	9	8	8	9	9	9	CLOSED	CLOSED		130
209.6		4	6	8	9	9	9	9	8	9	8	9	8	8	9	9	9	CLOSED	CLOSED		131

Total Spill (kcfs)	John Day Dam Spill Patterns with No TSWs # Gate Stops per Spillbay																				Total Stops (#)
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18 TSW	19 TSW	20	
211.2		4	6	8	9	9	9	9	8	9	8	9	8	9	9	9	9	CLOSED	CLOSED		132
212.8		4	6	8	9	9	9	9	9	9	8	9	8	9	9	9	9	CLOSED	CLOSED		133
214.4		4	6	8	9	9	9	9	9	9	9	9	8	9	9	9	9	CLOSED	CLOSED		134
216.0		4	6	8	9	9	9	9	9	9	9	9	9	9	9	9	9	CLOSED	CLOSED		135
217.6		4	6	8	9	9	9	9	9	9	9	9	9	9	9	9	10	CLOSED	CLOSED		136
219.2		4	6	8	9	9	9	9	9	9	9	9	9	9	10	9	10	CLOSED	CLOSED		137
220.8		4	6	8	10	9	9	9	9	9	9	9	9	9	10	9	10	CLOSED	CLOSED		138
222.4		4	6	8	10	9	9	10	9	9	9	9	9	9	10	9	10	CLOSED	CLOSED		139
224.0		4	6	8	10	9	9	10	9	10	9	9	9	9	10	9	10	CLOSED	CLOSED		140
225.6		4	6	8	10	9	9	10	9	10	9	10	9	9	10	9	10	CLOSED	CLOSED		141
227.2		4	6	8	10	10	9	10	9	10	9	10	9	9	10	9	10	CLOSED	CLOSED		142
228.8		4	6	8	10	10	9	10	9	10	9	10	9	9	10	10	10	CLOSED	CLOSED		143
230.4		4	6	8	10	10	10	10	9	10	9	10	9	9	10	10	10	CLOSED	CLOSED		144
232.0		4	6	8	10	10	10	10	9	10	9	10	9	10	10	10	10	CLOSED	CLOSED		145
233.6		4	6	8	10	10	10	10	10	10	9	10	9	10	10	10	10	CLOSED	CLOSED		146
235.2		4	6	8	10	10	10	10	10	10	10	10	9	10	10	10	10	CLOSED	CLOSED		147
236.8		4	6	8	10	10	10	10	10	10	10	10	10	10	10	10	10	CLOSED	CLOSED		148
238.4		4	6	8	10	10	10	10	10	10	10	10	10	10	10	10	11	CLOSED	CLOSED		149
240.0		4	6	8	10	10	10	10	10	10	10	10	10	10	11	10	11	CLOSED	CLOSED		150
241.6		4	6	8	10	10	10	11	10	10	10	10	10	10	11	10	11	CLOSED	CLOSED		151
243.2		4	6	8	10	10	10	11	10	11	10	10	10	10	11	10	11	CLOSED	CLOSED		152
244.8		4	6	8	10	10	10	11	10	11	10	11	10	10	11	10	11	CLOSED	CLOSED		153
246.4		4	6	8	10	11	10	11	10	11	10	11	10	10	11	10	11	CLOSED	CLOSED		154
248.0		4	6	8	10	11	10	11	10	11	10	11	10	10	11	11	11	CLOSED	CLOSED		155
249.6		4	6	8	10	11	11	11	10	11	10	11	10	10	11	11	11	CLOSED	CLOSED		156
251.2		4	6	8	10	11	11	11	10	11	10	11	10	11	11	11	11	CLOSED	CLOSED		157
252.8		4	6	8	10	11	11	11	11	11	10	11	10	11	11	11	11	CLOSED	CLOSED		158
254.4		4	6	8	10	11	11	11	11	11	11	11	10	11	11	11	11	CLOSED	CLOSED		159
256.0		4	6	8	10	11	11	11	11	11	11	11	11	11	11	11	11	CLOSED	CLOSED		160
257.6		4	6	8	10	11	11	11	11	11	11	11	11	11	12	11	11	CLOSED	CLOSED		161
259.2		4	6	8	10	11	11	12	11	11	11	11	11	11	12	11	11	CLOSED	CLOSED		162
260.8		4	6	8	10	11	11	12	11	12	11	11	11	11	12	11	11	CLOSED	CLOSED		163
262.4		4	6	8	10	11	11	12	11	12	11	12	11	11	12	11	11	CLOSED	CLOSED		164
264.0		4	6	8	10	12	11	12	11	12	11	12	11	11	12	11	11	CLOSED	CLOSED		165
265.6		4	6	8	10	12	11	12	11	12	11	12	11	11	12	12	11	CLOSED	CLOSED		166
267.2		4	6	8	10	12	12	12	11	12	11	12	11	11	12	12	11	CLOSED	CLOSED		167
268.8		4	6	8	10	12	12	12	11	12	11	12	11	12	12	12	11	CLOSED	CLOSED		168
270.4		4	6	8	10	12	12	12	12	12	11	12	11	12	12	12	11	CLOSED	CLOSED		169
272.0		4	6	8	10	12	12	12	12	12	12	12	11	12	12	12	11	CLOSED	CLOSED		170
273.6		4	6	8	10	12	12	12	12	12	12	12	12	12	12	12	11	CLOSED	CLOSED		171
275.2		4	6	8	10	12	12	12	12	12	12	12	12	12	13	12	11	CLOSED	CLOSED		172
276.8		4	6	8	10	12	12	13	12	12	12	12	12	12	13	12	11	CLOSED	CLOSED		173
278.4		4	6	8	10	12	12	13	12	13	12	12	12	12	13	12	11	CLOSED	CLOSED		174

Total Spill (kcfs)	John Day Dam Spill Patterns with No TSWs # Gate Stops per Spillbay																				Total Stops (#)
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18 TSW	19 TSW	20	
280.0		4	6	8	10	12	12	13	12	13	12	13	12	12	13	12	11	*CLOSED*	*CLOSED*		**175**
281.6		4	6	8	10	12	12	13	12	13	12	13	12	12	13	13	11	*CLOSED*	*CLOSED*		**176**
283.2		4	6	8	10	12	13	13	12	13	12	13	12	12	13	13	11	*CLOSED*	*CLOSED*		**177**
284.8		4	6	8	10	12	13	13	12	13	12	13	12	13	13	13	11	*CLOSED*	*CLOSED*		**178**
286.4		4	6	8	10	12	13	13	13	13	12	13	12	13	13	13	11	*CLOSED*	*CLOSED*		**179**
288.0		4	6	8	10	12	13	13	13	13	13	13	12	13	13	13	11	*CLOSED*	*CLOSED*		**180**
289.6		4	6	8	10	12	13	13	13	13	13	13	13	13	13	13	11	*CLOSED*	*CLOSED*		**181**
291.2		4	6	8	10	12	13	13	13	13	13	13	13	13	14	13	11	*CLOSED*	*CLOSED*		**182**
292.8		4	6	8	10	12	13	14	13	13	13	13	13	13	14	13	11	*CLOSED*	*CLOSED*		**183**
294.4		4	6	8	10	12	13	14	13	14	13	13	13	13	14	13	11	*CLOSED*	*CLOSED*		**184**
296.0		4	6	8	10	12	13	14	13	14	13	14	13	13	14	13	11	*CLOSED*	*CLOSED*		**185**
297.6		4	6	8	10	12	13	14	13	14	13	14	13	13	14	14	11	*CLOSED*	*CLOSED*		**186**
299.2		4	6	8	10	12	14	14	13	14	13	14	13	13	14	14	11	*CLOSED*	*CLOSED*		**187**
300.8		4	6	8	10	12	14	14	13	14	13	14	13	14	14	14	11	*CLOSED*	*CLOSED*		**188**
302.4		4	6	8	10	12	14	14	14	14	13	14	13	14	14	14	11	*CLOSED*	*CLOSED*		**189**
304.0		4	6	8	10	12	14	14	14	14	14	14	13	14	14	14	11	*CLOSED*	*CLOSED*		**190**
305.6		4	6	8	10	12	14	14	14	14	14	14	14	14	14	14	11	*CLOSED*	*CLOSED*		**191**
307.2		4	6	8	10	12	14	14	14	14	14	14	14	14	15	14	11	*CLOSED*	*CLOSED*		**192**
308.8		4	6	8	10	12	14	15	14	14	14	14	14	14	15	14	11	*CLOSED*	*CLOSED*		**193**
310.4		4	6	8	10	12	14	15	14	15	14	14	14	14	15	14	11	*CLOSED*	*CLOSED*		**194**
312.0		4	6	8	10	12	14	15	14	15	14	15	14	14	15	14	11	*CLOSED*	*CLOSED*		**195**
313.6		4	6	8	10	12	14	15	14	15	14	15	14	14	15	15	11	*CLOSED*	*CLOSED*		**196**
315.2		4	6	8	10	12	14	15	14	15	14	15	14	15	15	15	11	*CLOSED*	*CLOSED*		**197**
316.8		4	6	8	10	12	14	15	15	15	14	15	14	15	15	15	11	*CLOSED*	*CLOSED*		**198**
318.4		4	6	8	10	12	14	15	15	15	15	15	14	15	15	15	11	*CLOSED*	*CLOSED*		**199**
320.0		4	6	8	10	12	14	15	15	15	15	15	15	15	15	15	11	*CLOSED*	*CLOSED*		**200**
321.6		4	6	8	10	12	14	15	15	15	15	15	15	15	16	15	11	*CLOSED*	*CLOSED*		**201**
323.2		4	6	8	10	12	14	16	15	15	15	15	15	15	16	15	11	*CLOSED*	*CLOSED*		**202**
324.8		4	6	8	10	12	14	16	15	16	15	15	15	15	16	15	11	*CLOSED*	*CLOSED*		**203**
326.4		4	6	8	10	12	14	16	15	16	15	16	15	15	16	15	11	*CLOSED*	*CLOSED*		**204**
328.0		4	6	8	10	12	14	16	15	16	15	16	15	15	16	16	11	*CLOSED*	*CLOSED*		**205**
329.6		4	6	8	10	12	14	16	15	16	15	16	15	16	16	16	11	*CLOSED*	*CLOSED*		**206**
331.2		4	6	8	10	12	14	16	16	16	15	16	15	16	16	16	11	*CLOSED*	*CLOSED*		**207**
332.8		4	6	8	10	12	14	16	16	16	16	16	15	16	16	16	11	*CLOSED*	*CLOSED*		**208**
334.4 [a]		4	6	8	10	12	14	16	16	16	16	16	16	16	16	16	11	*CLOSED*	*CLOSED*		**209**
336.0		4	6	8	10	12	15	16	16	16	16	16	16	16	16	16	11	*CLOSED*	*CLOSED*		**210**
337.6		4	6	8	10	13	15	16	16	16	16	16	16	16	16	16	11	*CLOSED*	*CLOSED*		**211**
339.2		4	6	8	11	13	15	16	16	16	16	16	16	16	16	16	11	*CLOSED*	*CLOSED*		**212**
340.8		4	6	9	11	13	15	16	16	16	16	16	16	16	16	16	11	*CLOSED*	*CLOSED*		**213**
342.4		4	7	9	11	13	15	16	16	16	16	16	16	16	16	16	11	*CLOSED*	*CLOSED*		**214**
344.0		5	7	9	11	13	15	16	16	16	16	16	16	16	16	16	11	*CLOSED*	*CLOSED*		**215**
345.6	1	5	7	9	11	13	15	16	16	16	16	16	16	16	16	16	11	*CLOSED*	*CLOSED*		**216**
347.2	1	5	7	9	11	13	16	16	16	16	16	16	16	16	16	16	11	*CLOSED*	*CLOSED*		**217**

Total Spill (kcfs)	John Day Dam Spill Patterns with No TSWs # Gate Stops per Spillbay																				Total Stops (#)
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18 TSW	19 TSW	20	
348.8	1	5	7	9	11	14	16	16	16	16	16	16	16	16	16	16	11	CLOSED	CLOSED		218
350.4	1	5	7	9	12	14	16	16	16	16	16	16	16	16	16	16	11	CLOSED	CLOSED		219
352.0	1	5	7	10	12	14	16	16	16	16	16	16	16	16	16	16	11	CLOSED	CLOSED		220
353.6	1	5	8	10	12	14	16	16	16	16	16	16	16	16	16	16	11	CLOSED	CLOSED		221
355.2	1	6	8	10	12	14	16	16	16	16	16	16	16	16	16	16	11	CLOSED	CLOSED		222
356.8	2	6	8	10	12	14	16	16	16	16	16	16	16	16	16	16	11	CLOSED	CLOSED		223
358.4	2	6	8	10	12	15	16	16	16	16	16	16	16	16	16	16	11	CLOSED	CLOSED		224
360.0	2	6	8	10	13	15	16	16	16	16	16	16	16	16	16	16	11	CLOSED	CLOSED		225
361.6	2	6	8	11	13	15	16	16	16	16	16	16	16	16	16	16	11	CLOSED	CLOSED		226
363.2	2	6	9	11	13	15	16	16	16	16	16	16	16	16	16	16	11	CLOSED	CLOSED		227
364.8	2	7	9	11	13	15	16	16	16	16	16	16	16	16	16	16	11	CLOSED	CLOSED		228
366.4	3	7	9	11	13	15	16	16	16	16	16	16	16	16	16	16	11	CLOSED	CLOSED		229
368.0	3	7	9	11	13	16	16	16	16	16	16	16	16	16	16	16	11	CLOSED	CLOSED		230
369.6	3	7	9	11	14	16	16	16	16	16	16	16	16	16	16	16	11	CLOSED	CLOSED		231
371.2	3	7	9	12	14	16	16	16	16	16	16	16	16	16	16	16	11	CLOSED	CLOSED		232
372.8	3	7	10	12	14	16	16	16	16	16	16	16	16	16	16	16	11	CLOSED	CLOSED		233
374.4	3	8	10	12	14	16	16	16	16	16	16	16	16	16	16	16	11	CLOSED	CLOSED		234
376.0	4	8	10	12	14	16	16	16	16	16	16	16	16	16	16	16	11	CLOSED	CLOSED		235
377.6	4	8	10	12	15	16	16	16	16	16	16	16	16	16	16	16	11	CLOSED	CLOSED		236
379.2	4	8	10	13	15	16	16	16	16	16	16	16	16	16	16	16	11	CLOSED	CLOSED		237
380.8	4	8	11	13	15	16	16	16	16	16	16	16	16	16	16	16	11	CLOSED	CLOSED		238
382.4	4	9	11	13	15	16	16	16	16	16	16	16	16	16	16	16	11	CLOSED	CLOSED		239
384.0	5	9	11	13	15	16	16	16	16	16	16	16	16	16	16	16	11	CLOSED	CLOSED		240
385.6	5	9	11	13	16	16	16	16	16	16	16	16	16	16	16	16	11	CLOSED	CLOSED		241
387.2	5	9	11	14	16	16	16	16	16	16	16	16	16	16	16	16	11	CLOSED	CLOSED		242
388.8	5	9	12	14	16	16	16	16	16	16	16	16	16	16	16	16	11	CLOSED	CLOSED		243
390.4	5	10	12	14	16	16	16	16	16	16	16	16	16	16	16	16	11	CLOSED	CLOSED		244
392.0	6	10	12	14	16	16	16	16	16	16	16	16	16	16	16	16	11	CLOSED	CLOSED		245
393.6	6	10	12	15	16	16	16	16	16	16	16	16	16	16	16	16	11	CLOSED	CLOSED		246
395.2	6	10	13	15	16	16	16	16	16	16	16	16	16	16	16	16	11	CLOSED	CLOSED		247
396.8 [b]	6	11	13	15	16	16	16	16	16	16	16	16	16	16	16	16	11	CLOSED	CLOSED		248
398.4	7	11	13	15	16	16	16	16	16	16	16	16	16	16	16	16	11	CLOSED	CLOSED		249
400.0	7	11	13	16	16	16	16	16	16	16	16	16	16	16	16	16	11	CLOSED	CLOSED		250
401.6	7	11	14	16	16	16	16	16	16	16	16	16	16	16	16	16	11	CLOSED	CLOSED		251
403.2	8	11	14	16	16	16	16	16	16	16	16	16	16	16	16	16	11	CLOSED	CLOSED		252
404.8	8	11	15	16	16	16	16	16	16	16	16	16	16	16	16	16	11	CLOSED	CLOSED		253
406.4	9	11	15	16	16	16	16	16	16	16	16	16	16	16	16	16	11	CLOSED	CLOSED		254
408.0	9	11	16	16	16	16	16	16	16	16	16	16	16	16	16	16	11	CLOSED	CLOSED		255
409.6	10	11	16	16	16	16	16	16	16	16	16	16	16	16	16	16	11	CLOSED	CLOSED		256
411.2 [c]	11	11	16	16	16	16	16	16	16	16	16	16	16	16	16	16	11	CLOSED	CLOSED		257
412.8	11	11	17	16	16	16	16	16	16	16	16	16	16	16	16	16	11	CLOSED	CLOSED		258
414.4	11	11	17	17	16	16	16	16	16	16	16	16	16	16	16	16	11	CLOSED	CLOSED		259
416.0	11	11	17	17	16	16	16	16	16	16	16	16	16	16	17	16	11	CLOSED	CLOSED		260

Total Spill	John Day Dam Spill Patterns with No TSWs # Gate Stops per Spillbay																				Total Stops
(kcfs)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18 TSW	19 TSW	20	(#)
417.6	11	11	17	17	17	16	16	16	16	16	16	16	16	16	17	16	11	*CLOSED*	*CLOSED*		**261**
419.2	11	11	17	17	17	16	16	17	16	16	16	16	16	16	17	16	11	*CLOSED*	*CLOSED*		**262**
420.8	11	11	17	17	17	16	16	17	16	17	16	16	16	16	17	16	11	*CLOSED*	*CLOSED*		**263**
422.4	11	11	17	17	17	16	16	17	16	17	16	17	16	16	17	16	11	*CLOSED*	*CLOSED*		**264**
424.0	11	11	17	17	17	17	16	17	16	17	16	17	16	16	17	16	11	*CLOSED*	*CLOSED*		**265**
425.6	11	11	17	17	17	17	16	17	16	17	16	17	16	16	17	17	11	*CLOSED*	*CLOSED*		**266**
427.2	11	11	17	17	17	17	17	17	16	17	16	17	16	16	17	17	11	*CLOSED*	*CLOSED*		**267**
428.8	11	11	17	17	17	17	17	17	16	17	16	17	16	17	17	17	11	*CLOSED*	*CLOSED*		**268**
430.4	11	11	17	17	17	17	17	17	17	17	16	17	16	17	17	17	11	*CLOSED*	*CLOSED*		**269**
432.0	11	11	17	17	17	17	17	17	17	17	17	17	16	17	17	17	11	*CLOSED*	*CLOSED*		**270**
433.6	11	11	17	17	17	17	17	17	17	17	17	17	17	17	17	17	11	*CLOSED*	*CLOSED*		**271**
435.2	11	11	18	17	17	17	17	17	17	17	17	17	17	17	17	17	11	*CLOSED*	*CLOSED*		**272**
436.8	11	11	18	18	17	17	17	17	17	17	17	17	17	17	17	17	11	*CLOSED*	*CLOSED*		**273**
438.4	11	11	18	18	17	17	17	17	17	17	17	17	17	17	18	17	11	*CLOSED*	*CLOSED*		**274**
440.0	11	11	18	18	18	17	17	17	17	17	17	17	17	17	18	17	11	*CLOSED*	*CLOSED*		**275**
441.6	11	11	18	18	18	17	17	18	17	17	17	17	17	17	18	17	11	*CLOSED*	*CLOSED*		**276**
443.2	11	11	18	18	18	17	17	18	17	18	17	17	17	17	18	17	11	*CLOSED*	*CLOSED*		**277**
444.8	11	11	18	18	18	17	17	18	17	18	17	18	17	17	18	17	11	*CLOSED*	*CLOSED*		**278**
446.4	11	11	18	18	18	18	17	18	17	18	17	18	17	17	18	17	11	*CLOSED*	*CLOSED*		**279**
448.0	11	11	18	18	18	18	17	18	17	18	17	18	17	17	18	18	11	*CLOSED*	*CLOSED*		**280**
449.6	11	11	18	18	18	18	18	18	17	18	17	18	17	17	18	18	11	*CLOSED*	*CLOSED*		**281**
451.2	11	11	18	18	18	18	18	18	17	18	17	18	17	18	18	18	11	*CLOSED*	*CLOSED*		**282**
452.8	11	11	18	18	18	18	18	18	18	18	17	18	17	18	18	18	11	*CLOSED*	*CLOSED*		**283**
454.4	11	11	18	18	18	18	18	18	18	18	18	18	17	18	18	18	11	*CLOSED*	*CLOSED*		**284**
456.0	11	11	18	18	18	18	18	18	18	18	18	18	18	18	18	18	11	*CLOSED*	*CLOSED*		**285**
457.6	11	11	19	18	18	18	18	18	18	18	18	18	18	18	18	18	11	*CLOSED*	*CLOSED*		**286**
459.2	11	11	19	19	18	18	18	18	18	18	18	18	18	18	18	18	11	*CLOSED*	*CLOSED*		**287**
460.8	11	11	19	19	18	18	18	18	18	18	18	18	18	18	19	18	11	*CLOSED*	*CLOSED*		**288**
462.4	11	11	19	19	19	18	18	18	18	18	18	18	18	18	19	18	11	*CLOSED*	*CLOSED*		**289**
464.0	11	11	19	19	19	18	18	19	18	18	18	18	18	18	19	18	11	*CLOSED*	*CLOSED*		**290**
465.6	11	11	19	19	19	18	18	19	18	19	18	18	18	18	19	18	11	*CLOSED*	*CLOSED*		**291**
467.2	11	11	19	19	19	18	18	19	18	19	18	19	18	18	19	18	11	*CLOSED*	*CLOSED*		**292**
468.8	11	11	19	19	19	19	18	19	18	19	18	19	18	18	19	18	11	*CLOSED*	*CLOSED*		**293**
470.4	11	11	19	19	19	19	18	19	18	19	18	19	18	18	19	19	11	*CLOSED*	*CLOSED*		**294**
472.0	11	11	19	19	19	19	19	19	18	19	18	19	18	18	19	19	11	*CLOSED*	*CLOSED*		**295**
473.6	11	11	19	19	19	19	19	19	18	19	18	19	18	19	19	19	11	*CLOSED*	*CLOSED*		**296**
475.2	11	11	19	19	19	19	19	19	19	19	18	19	18	19	19	19	11	*CLOSED*	*CLOSED*		**297**
476.8	11	11	19	19	19	19	19	19	19	19	19	19	18	19	19	19	11	*CLOSED*	*CLOSED*		**298**
478.4	11	11	19	19	19	19	19	19	19	19	19	19	19	19	19	19	11	*CLOSED*	*CLOSED*		**299**
480.0	11	11	20	19	19	19	19	19	19	19	19	19	19	19	19	19	11	*CLOSED*	*CLOSED*		**300**
481.6	11	11	20	20	19	19	19	19	19	19	19	19	19	19	19	19	11	*CLOSED*	*CLOSED*		**301**
483.2	11	11	20	20	19	19	19	19	19	19	19	19	19	19	20	19	11	*CLOSED*	*CLOSED*		**302**
484.8	11	11	20	20	20	19	19	19	19	19	19	19	19	19	20	19	11	*CLOSED*	*CLOSED*		**303**

Total Spill (kcfs)	John Day Dam Spill Patterns with No TSWs # Gate Stops per Spillbay																				Total Stops (#)
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18 TSW	19 TSW	20	
486.4	11	11	20	20	20	19	19	20	19	19	19	19	19	19	20	19	11	*CLOSED*	*CLOSED*		**304**
488.0	11	11	20	20	20	19	19	20	19	20	19	19	19	19	20	19	11	*CLOSED*	*CLOSED*		**305**
489.6	11	11	20	20	20	19	19	20	19	20	19	20	19	19	20	19	11	*CLOSED*	*CLOSED*		**306**
491.2	11	11	20	20	20	20	19	20	19	20	19	20	19	19	20	19	11	*CLOSED*	*CLOSED*		**307**
492.8	11	11	20	20	20	20	19	20	19	20	19	20	19	19	20	20	11	*CLOSED*	*CLOSED*		**308**
494.4	11	11	20	20	20	20	20	20	19	20	19	20	19	19	20	20	11	*CLOSED*	*CLOSED*		**309**
496.0	11	11	20	20	20	20	20	20	19	20	19	20	19	20	20	20	11	*CLOSED*	*CLOSED*		**310**
497.6	11	11	20	20	20	20	20	20	20	20	19	20	19	20	20	20	11	*CLOSED*	*CLOSED*		**311**
499.2	11	11	20	20	20	20	20	20	20	20	20	20	19	20	20	20	11	*CLOSED*	*CLOSED*		**312**
500.8	11	11	20	20	20	20	20	20	20	20	20	20	20	20	20	20	11	*CLOSED*	*CLOSED*		**313**
502.4	11	11	21	20	20	20	20	20	20	20	20	20	20	20	20	20	11	*CLOSED*	*CLOSED*		**314**
504.0	11	11	21	21	20	20	20	20	20	20	20	20	20	20	20	20	11	*CLOSED*	*CLOSED*		**315**
505.6	11	11	21	21	20	20	20	20	20	20	20	20	20	20	21	20	11	*CLOSED*	*CLOSED*		**316**
507.2	11	11	21	21	21	20	20	20	20	20	20	20	20	20	21	20	11	*CLOSED*	*CLOSED*		**317**
508.8	11	11	21	21	21	20	20	21	20	20	20	20	20	20	21	20	11	*CLOSED*	*CLOSED*		**318**
510.4	11	11	21	21	21	20	20	21	20	21	20	20	20	20	21	20	11	*CLOSED*	*CLOSED*		**319**
512.0	11	11	21	21	21	20	20	21	20	21	20	21	20	20	21	20	11	*CLOSED*	*CLOSED*		**320**
513.6	11	11	21	21	21	21	20	21	20	21	20	21	20	20	21	20	11	*CLOSED*	*CLOSED*		**321**
515.2	11	11	21	21	21	21	20	21	20	21	20	21	20	20	21	21	11	*CLOSED*	*CLOSED*		**322**
516.8	11	11	21	21	21	21	21	21	20	21	20	21	20	20	21	21	11	*CLOSED*	*CLOSED*		**323**
518.4	11	11	21	21	21	21	21	21	20	21	20	21	20	21	21	21	11	*CLOSED*	*CLOSED*		**324**
520.0	11	11	21	21	21	21	21	21	21	21	20	21	20	21	21	21	11	*CLOSED*	*CLOSED*		**325**
521.6	11	11	21	21	21	21	21	21	21	21	21	21	20	21	21	21	11	*CLOSED*	*CLOSED*		**326**
523.2	11	11	21	21	21	21	21	21	21	21	21	21	21	21	21	21	11	*CLOSED*	*CLOSED*		**327**
524.8	11	11	22	21	21	21	21	21	21	21	21	21	21	21	21	21	11	*CLOSED*	*CLOSED*		**328**
526.4	11	11	22	22	21	21	21	21	21	21	21	21	21	21	21	21	11	*CLOSED*	*CLOSED*		**329**
528.0	11	11	22	22	21	21	21	21	21	21	21	21	21	21	22	21	11	*CLOSED*	*CLOSED*		**330**
529.6	11	11	22	22	22	21	21	21	21	21	21	21	21	21	22	21	11	*CLOSED*	*CLOSED*		**331**
531.2	11	11	22	22	22	21	21	22	21	21	21	21	21	21	22	21	11	*CLOSED*	*CLOSED*		**332**
532.8	11	11	22	22	22	21	21	22	21	22	21	21	21	21	22	21	11	*CLOSED*	*CLOSED*		**333**
534.4	11	11	22	22	22	21	21	22	21	22	21	22	21	21	22	21	11	*CLOSED*	*CLOSED*		**334**
536.0	11	11	22	22	22	22	21	22	21	22	21	22	21	21	22	21	11	*CLOSED*	*CLOSED*		**335**
537.6	11	11	22	22	22	22	21	22	21	22	21	22	21	21	22	22	11	*CLOSED*	*CLOSED*		**336**
539.2	11	11	22	22	22	22	22	22	21	22	21	22	21	21	22	22	11	*CLOSED*	*CLOSED*		**337**
540.8	11	11	22	22	22	22	22	22	21	22	21	22	21	22	22	22	11	*CLOSED*	*CLOSED*		**338**
542.4	11	11	22	22	22	22	22	22	22	22	21	22	21	22	22	22	11	*CLOSED*	*CLOSED*		**339**
544.0	11	11	22	22	22	22	22	22	22	22	22	22	21	22	22	22	11	*CLOSED*	*CLOSED*		**340**
545.6	11	11	22	22	22	22	22	22	22	22	22	22	22	22	22	22	11	*CLOSED*	*CLOSED*		**341**
547.2	11	11	23	22	22	22	22	22	22	22	22	22	22	22	22	22	11	*CLOSED*	*CLOSED*		**342**
548.8	11	11	23	23	22	22	22	22	22	22	22	22	22	22	22	22	11	*CLOSED*	*CLOSED*		**343**
550.4	11	11	23	23	22	22	22	22	22	22	22	22	22	22	23	22	11	*CLOSED*	*CLOSED*		**344**
552.0	11	11	23	23	23	22	22	22	22	22	22	22	22	22	23	22	11	*CLOSED*	*CLOSED*		**345**
553.6	11	11	23	23	23	22	22	23	22	22	22	22	22	22	23	22	11	*CLOSED*	*CLOSED*		**346**

Total Spill (kcfs)	John Day Dam Spill Patterns with No TSWs # Gate Stops per Spillbay																				Total Stops (#)
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18 TSW	19 TSW	20	
555.2	11	11	23	23	23	22	22	23	22	23	22	22	22	22	23	22	11	*CLOSED*	*CLOSED*		**347**
556.8	11	11	23	23	23	22	22	23	22	23	22	23	22	22	23	22	11	*CLOSED*	*CLOSED*		**348**
558.4	11	11	23	23	23	23	22	23	22	23	22	23	22	22	23	22	11	*CLOSED*	*CLOSED*		**349**
560.0	11	11	23	23	23	23	22	23	22	23	22	23	22	22	23	23	11	*CLOSED*	*CLOSED*		**350**
561.6	11	11	23	23	23	23	23	23	22	23	22	23	22	22	23	23	11	*CLOSED*	*CLOSED*		**351**
563.2	11	11	23	23	23	23	23	23	22	23	22	23	22	23	23	23	11	*CLOSED*	*CLOSED*		**352**
564.8	11	11	23	23	23	23	23	23	23	23	22	23	22	23	23	23	11	*CLOSED*	*CLOSED*		**353**
566.4	11	11	23	23	23	23	23	23	23	23	23	23	22	23	23	23	11	*CLOSED*	*CLOSED*		**354**
568.0	11	11	23	23	23	23	23	23	23	23	23	23	23	23	23	23	11	*CLOSED*	*CLOSED*		**355**
569.6	11	11	24	23	23	23	23	23	23	23	23	23	23	23	23	23	11	*CLOSED*	*CLOSED*		**356**
571.2	11	11	24	24	23	23	23	23	23	23	23	23	23	23	23	23	11	*CLOSED*	*CLOSED*		**357**
572.8	11	11	24	24	23	23	23	23	23	23	23	23	23	23	24	23	11	*CLOSED*	*CLOSED*		**358**
574.4	11	11	24	24	24	23	23	23	23	23	23	23	23	23	24	23	11	*CLOSED*	*CLOSED*		**359**
576.0	11	11	24	24	24	23	23	24	23	23	23	23	23	23	24	23	11	*CLOSED*	*CLOSED*		**360**
577.6	11	11	24	24	24	23	23	24	23	24	23	23	23	23	24	23	11	*CLOSED*	*CLOSED*		**361**
579.2	11	11	24	24	24	23	23	24	23	24	23	24	23	23	24	23	11	*CLOSED*	*CLOSED*		**362**
580.8	11	11	24	24	24	24	23	24	23	24	23	24	23	23	24	23	11	*CLOSED*	*CLOSED*		**363**
582.4	11	11	24	24	24	24	23	24	23	24	23	24	23	23	24	24	11	*CLOSED*	*CLOSED*		**364**
584.0	11	11	24	24	24	24	24	24	23	24	23	24	23	23	24	24	11	*CLOSED*	*CLOSED*		**365**
585.6	11	11	24	24	24	24	24	24	23	24	23	24	23	24	24	24	11	*CLOSED*	*CLOSED*		**366**
587.2	11	11	24	24	24	24	24	24	24	24	23	24	23	24	24	24	11	*CLOSED*	*CLOSED*		**367**
588.8	11	11	24	24	24	24	24	24	24	24	24	24	23	24	24	24	11	*CLOSED*	*CLOSED*		**368**
590.4	11	11	24	24	24	24	24	24	24	24	24	24	24	24	24	24	11	*CLOSED*	*CLOSED*		**369**
592.0	11	11	25	24	24	24	24	24	24	24	24	24	24	24	24	24	11	*CLOSED*	*CLOSED*		**370**
593.6	11	11	25	25	24	24	24	24	24	24	24	24	24	24	24	24	11	*CLOSED*	*CLOSED*		**371**
595.2	11	11	25	25	24	24	24	24	24	24	24	24	24	24	25	24	11	*CLOSED*	*CLOSED*		**372**
596.8	11	11	25	25	25	24	24	24	24	24	24	24	24	24	25	24	11	*CLOSED*	*CLOSED*		**373**
598.4	11	11	25	25	25	24	24	25	24	24	24	24	24	24	25	24	11	*CLOSED*	*CLOSED*		**374**
600.0 [d]	11	11	25	25	25	24	24	25	24	25	24	24	24	24	25	24	11	*CLOSED*	*CLOSED*		**375**

a. Begin transition from juvenile fish patterns to flood patterns.
b. Gate 20 blocked at 10.3 ft opening.
c. Gate 1 blocked at 10.3 ft opening.
d. TSWs do not affect spillway flood capacity until flow ≥1,492 kcfs. Recommend remove TSWs before river flow >685 kcfs.

2014 Fish Passage Plan

Section 5 – McNary Dam

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McNary Dam

Project Acronym	MCN
River Mile (RM)	Columbia River – RM 292
Reservoir	Lake Wallula
Minimum Instantaneous Flow (kcfs)	Dec–Feb: 12.5 kcfs \ Mar–Nov: 50 kcfs
Forebay Normal Operating Range (ft)	337’ – 340’
Tailrace Rate of Change Limit (ft)	1.5’/hr
Powerhouse Length (ft)	1,422’
Powerhouse Hydraulic Capacity (kcfs)	232 kcfs
Turbine Units (#)	14 Main Units (S. Morgan Smith Kaplan)
Turbine Unit Generating Capacity (MW)	Rated: 980 MW (70 MW/unit) \ Maximum: 1,127 MW (80.5 MW/unit)
Gatewell Orifice Diameter (in)	Two 12” orifices per gatewell (6 per unit)
Spillway Length (ft)	1,310’
Spillway Hydraulic Capacity (kcfs)	2,200 kcfs
Spillbays (#)	22
Spillway Weirs (#)	2 (Bays 19-20)
Navigation Lock Length x Width (ft)	650’ x 84’ (Usable Space)
Navigation Lock Maximum Lift (ft)	75’
FISH STRUCTURE/OPERATION START DATE	
Fish Lock	1953 (1st Generation)
Adult Fish Counts – WA Shore & OR Shore	1954
Juvenile Bypass System (JBS)	1980 (1st Generation); 1994 (current)
Submersible Traveling Screens (STS)	1980 (Prototype Mesh)
Extended-Length Submersible Bar Screens (ESBS)	1997
Juvenile Fish Transportation Program - Corps	1981-2012
Temporary Spillway Weir (TSW)	2007
Bypass Outfall Flume Relocation	2012

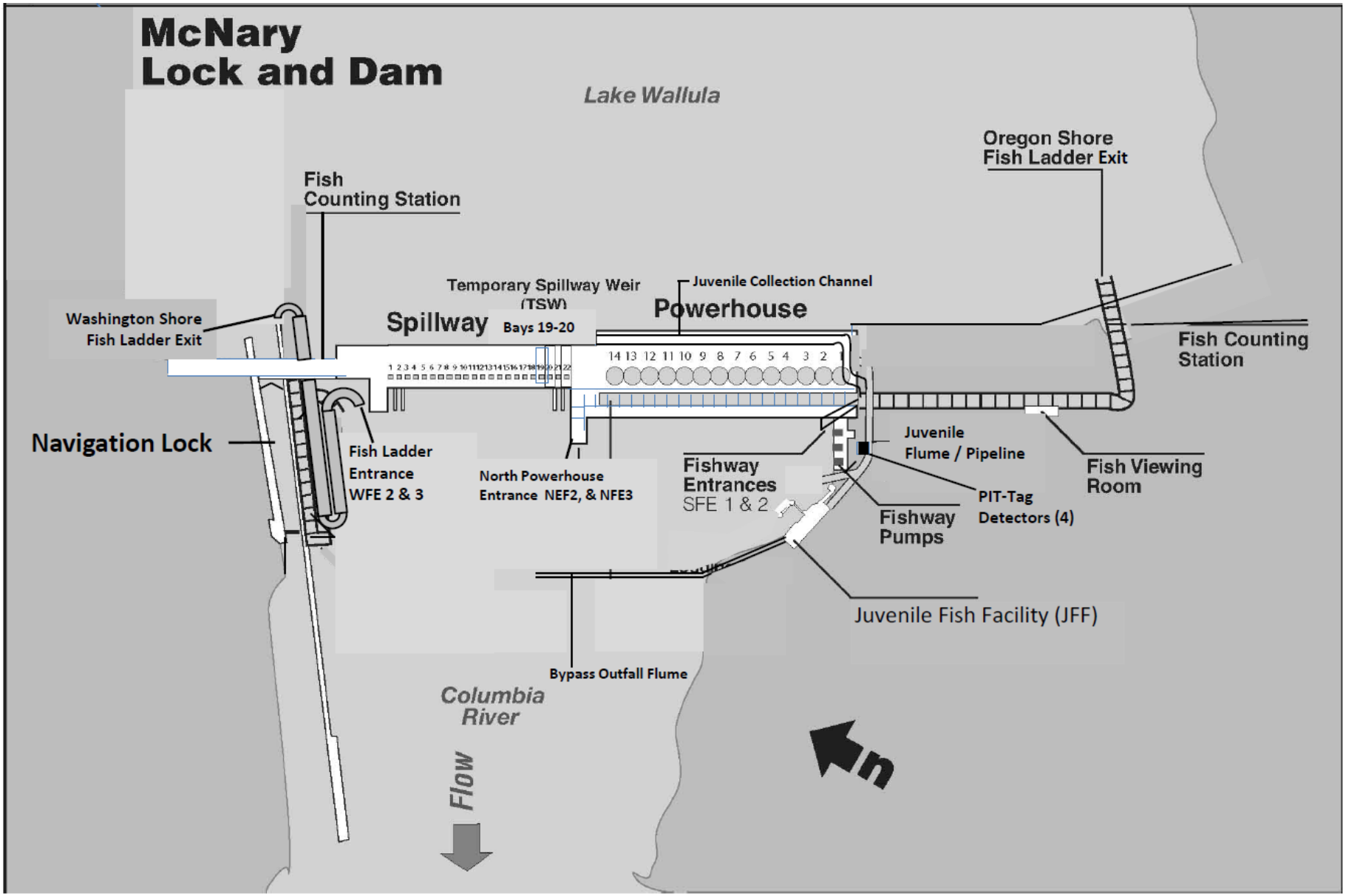
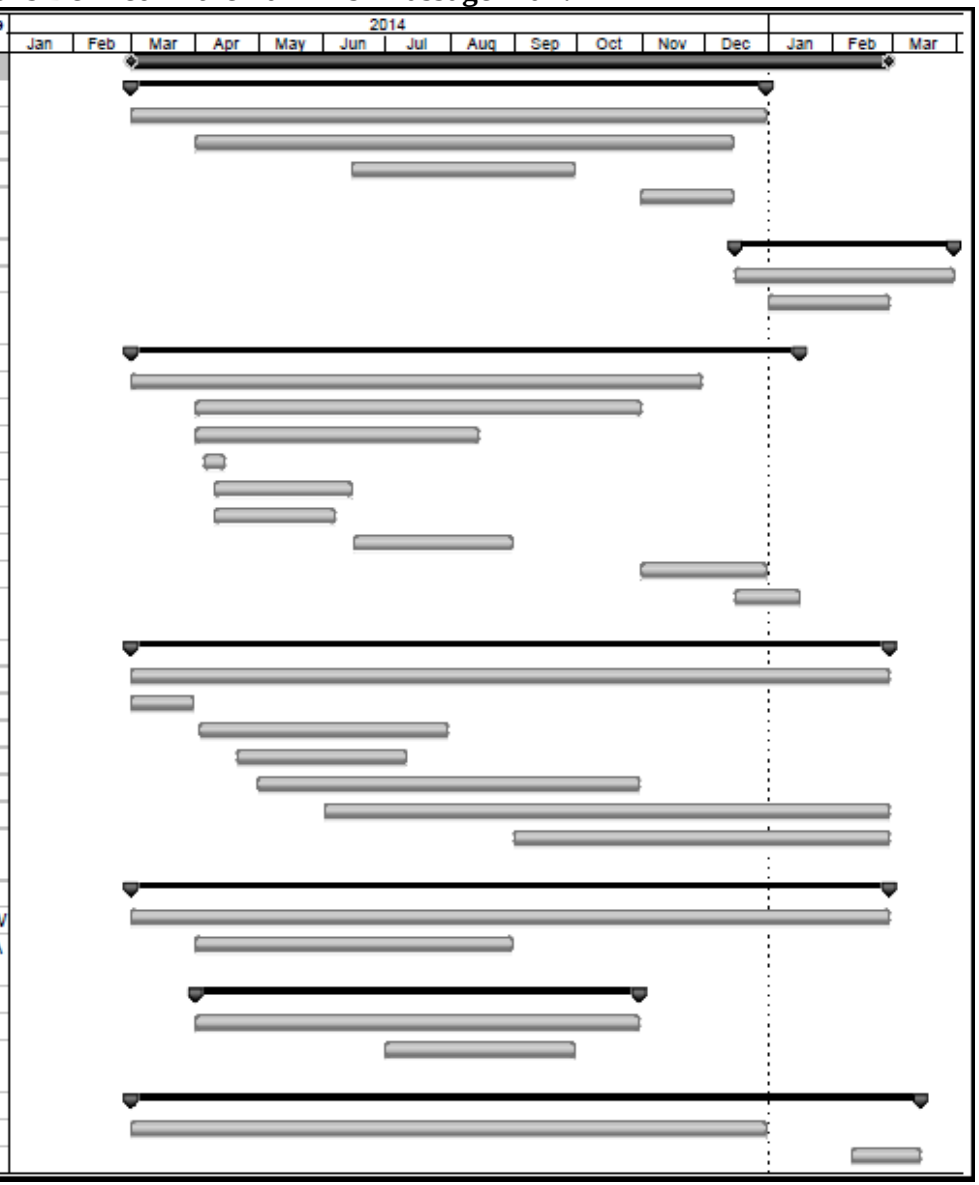


Figure MCN-1. McNary Lock & Dam General Site Plan.

Table MCN-1. McNary Dam Schedule of Operations and Actions Defined in the 2014 Fish Passage Plan.

Task Name	Start Date	End Date	FPP Reference
2014 FPP Operations & Actions - McNary Dam	**3/1/14**	**2/28/15**	**MCN**
Fish Passage Facilities Operation	**3/1/14**	**12/31/14**	**2.3.**
Adult Fish Facilities	3/1/14	12/31/14	2.3.2.2.
Juvenile Fish Facilities	4/1/14	12/15/14	2.3.1.2.
Adult Facilities Operations for Lamprey	6/15/14	9/30/14	2.3.2.2.j.
Juvenile Facilities Operations for Cold Weather	11/1/14	12/15/14	2.3.1.2.l.
Fish Passage Facilities Maintenance	**12/16/14**	**3/31/15**	**2.3.**
Juvenile Fish Facilities Winter Maintenance	12/16/14	3/31/15	2.3.1.1.
Adult Fish Facilities Winter Maintenance	1/1/15	2/28/15	2.3.2.1.
Project Operations for Fish Passage	**3/1/14**	**1/16/15**	
Turbine operating priority order	3/1/14	11/30/14	Table MCN-5
Turbine 1% operating range - hard constraint	4/1/14	10/31/14	4.1.2.
Inspect and cyle orifices ≥ twice per day	4/1/14	8/15/14	2.3.1.2.c.6.
Install ESBSs	4/5/14	4/15/14	2.3.1.2.b.1.
Spring Spill Operations	4/10/14	6/15/14	FOP
Spillway Weir in service	4/10/14	6/7/14	2.3.1.2.h.
Summer Spill Operations	6/16/14	8/31/14	FOP
Priority turbine unit maintenance	11/1/14	12/31/14	4.2.
Inspect/Rake ≤ 4 trashracks	12/16/14	1/16/15	2.3.1.1.
Special Operations & Studies (dates approximate)	**3/1/14**	**2/28/15**	**Appendix A**
Adult Salmon Studies	3/1/14	2/28/15	5.2.2
Adult Steelhead Direct Injury & Survival	3/1/14	3/31/14	5.2.1.
BiOp Performance Standard Tests	4/3/14	7/31/14	5.2.3.
Forebay Range for Waterfowl Nesting	4/21/14	7/11/14	5.1.4.
Adult Lamprey Studies	5/1/14	10/31/14	5.2.4-.6.
Units 9 and 12 Rewind	6/2/14	2/28/15	5.1.6.
Adult Steelhead TSW Passage Efficiency	9/1/14	2/28/15	5.2.7.
TDG Monitoring	**3/1/14**	**2/28/15**	**2.3.1.**
TDG Monitoring - Tailrace	3/1/14	2/28/15	station MCPW
TDG Monitoring - Forebay	4/1/14	8/31/14	station MCNA
Adult Fish Counting	**4/1/14**	**10/31/14**	**Table MCN-3**
Daytime Visual 0400-2000 PST	4/1/14	10/31/14	
Night Video 2100-0500 DST	7/1/14	9/30/14	
Reports	**3/1/14**	**3/15/15**	**2.3.**
Weekly Reports	3/1/14	12/31/14	
Annual Report	2/10/15	3/15/15	



1. FISH PASSAGE INFORMATION

The locations of fish passage facilities at McNary Lock & Dam are shown on the general site plan in **Figure MCN-1**. The schedule for project operations described in the Fish Passage Plan (FPP) is included in **Table MCN-1**.

1.1. Juvenile Fish Passage.

1.1.1. Juvenile Fish Passage Facilities. The juvenile sampling facilities at McNary Dam consist of extended-length submersible bar screens (ESBSs) with flow vanes, vertical barrier screens (VBSs), gatewell orifices, a concrete collection channel with emergency bypass outlets, primary and secondary dewatering structures, a pipeline/corrugated metal flume for routing juvenile fish to the sampling facilities or bypassing them back to the river, and a full-flow PIT tag detection system. Juvenile sampling facilities at McNary include: a separator to separate adult from juvenile fish and juvenile fish by size; a flume system routing juvenile fish either through the secondary bypass system or to the sample system; covered raceways and tanks for holding sampled fish; sampling facilities; an office and sampling building with fish marking facilities; and PIT tag detection and deflection systems.

1.1.2. Juvenile Migration Timing. Juvenile passage timing at McNary Dam (**Table MCN-2**) is calculated based on juvenile fish collection data over the most recent 10-year period and do not reflect bypass (FGE) or spillway passage. Salmon, steelhead, bull trout, lamprey, and other species are routinely counted. Maintenance of juvenile fish passage facilities that may impact juvenile fish or facility operations should be conducted during the winter maintenance season.

Table MCN-2. Juvenile Salmonid Passage Timing at McNary Dam for Most Recent 10-Years (2004-2013) Based on Daily & Yearly Collection Data.

Year	10%	50%	90%	# Days	10%	50%	90%	# Days
	Yearling Chinook				Subyearling Chinook			
2004	27-Apr	11-May	31-May	34	22-Jun	30-Jun	18-Jul	26
2005	3-May	15-May	29-May	26	16-Jun	25-Jun	3-Jul	17
2006	21-Apr	9-May	19-May	28	14-Jun	6-Jul	19-Jul	35
2007	1-May	11-May	25-May	24	22-Jun	6-Jul	28-Jul	36
2008	9-Apr	15-May	27-May	48	22-Jun	8-Jul	9-Aug	48
2009	2-May	15-May	25-May	23	18-Jun	4-Jul	22-Jul	34
2010	3-May	17-May	27-May	24	18-Jun	4-Jul	4-Aug	47
2011	29-Apr	8-May	23-May	24	24-Jun	24-Jul	19-Aug	56
2012	29-Apr	11-May	25-May	26	22-Jun	18-Jul	22-Aug	61
2013	1-May	9-May	29-May	28	16-Jun	4-Jul	22-Jul	36
MEDIAN	**30-Apr**	**11-May**	**26-May**	**26**	**20-Jun**	**5-Jul**	**25-Jul**	**36**
MIN	**9-Apr**	**8-May**	**19-May**	**23**	**14-Jun**	**25-Jun**	**3-Jul**	**17**
MAX	**3-May**	**17-May**	**31-May**	**48**	**24-Jun**	**24-Jul**	**22-Aug**	**61**
	Unclipped Steelhead				Clipped Steelhead			
2004	23-Apr	13-May	4-Jun	42	23-Apr	10-May	31-May	38
2005	1-May	17-May	27-May	26	19-Apr	15-May	29-May	40
2006	19-Apr	7-May	27-May	38	23-Apr	1-May	23-May	30
2007	27-Apr	11-May	25-May	28	29-Apr	9-May	23-May	24
2008	1-May	15-May	29-May	28	3-May	11-May	23-May	20
2009	25-Apr	7-May	23-May	28	27-Apr	7-May	23-May	26
2010	1-May	13-May	2-Jun	32	1-May	9-May	29-May	28
2011	19-Apr	7-May	27-May	38	19-Apr	1-May	17-May	28
2012	24-Apr	5-May	25-May	31	23-Apr	1-May	17-May	24
2013	23-Apr	11-May	2-Jun	40	25-Apr	3-May	19-May	24
MEDIAN	**24-Apr**	**11-May**	**27-May**	**31.5**	**24-Apr**	**8-May**	**23-May**	**27**
MIN	**19-Apr**	**5-May**	**23-May**	**26**	**19-Apr**	**1-May**	**17-May**	**20**
MAX	**1-May**	**17-May**	**4-Jun**	**42**	**3-May**	**15-May**	**31-May**	**40**
	Coho				Sockeye (Wild & Hatchery)			
2004	15-May	31-May	18-Jun	34	15-May	31-May	14-Jun	30
2005	5-May	21-May	6-Jun	32	11-May	19-May	31-May	20
2006	9-May	27-May	2-Jun	24	3-May	17-May	29-May	26
2007	3-May	21-May	8-Jun	36	11-May	21-May	31-May	20
2008	13-May	25-May	6-Jun	24	15-May	25-May	6-Jun	22
2009	13-May	23-May	12-Jun	30	5-May	21-May	2-Jun	28
2010	9-May	31-May	12-Jun	34	11-May	29-May	2-Jun	22
2011	24-Apr	19-May	8-Jun	45	4-May	13-May	31-May	27
2012	7-May	23-May	4-Jun	28	1-May	11-May	21-May	20
2013	3-May	21-May	8-Jun	36	29-Apr	15-May	27-May	28
MEDIAN	**8-May**	**23-May**	**8-Jun**	**33**	**8-May**	**20-May**	**31-May**	**24**
MIN	**24-Apr**	**19-May**	**2-Jun**	**24**	**29-Apr**	**11-May**	**21-May**	**20**
MAX	**15-May**	**31-May**	**18-Jun**	**45**	**15-May**	**31-May**	**14-Jun**	**30**

1.2. Adult Fish Passage.

1.2.1. Adult Fish Passage Facilities. McNary Dam adult fish passage facilities 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 and Counting. Upstream migrants are present at the project throughout the year and adult passage facilities are operated year-round. Maintenance of adult facilities is scheduled for January–February, typically one shore at a time, to minimize impacts on upstream migrants. Adult salmon, steelhead, shad and lamprey are counted (**Table MCN-3**) and daily data are posted online at: http://www.nwp.usace.army.mil/Missions/Environment/Fishdata.aspx. Yearly counts are used to determine peak adult migration timing (**Table MCN-4**). Sturgeon and bull trout are relatively infrequent and counts are posted online periodically during the passage season in *Miscellaneous Fish Count*s and summarized in the *Annual Fish Passage Report*.

Table MCN-3. Adult Fish Counting Schedule at McNary Dam (3/1/14 - 2/28/15).

Count Period	Counting Method and Hours *
April 1 – October 31	Visual 0400–2000 hours (PST)
July 1 – September 30	Night Video 2000–0400 hours (PST)

*All count hours are shown in Pacific Standard Time (PST). Note that during Daylight Saving Time (DST) from Mar 9–Nov 2, 2014, count hours will be one hour later (DST = PST+1).

Table MCN-4. Adult Fish Count Period and Peak Passage Timing at McNary Dam (based on yearly counts since 1954).

Species	Count Period	Earliest Peak	Latest Peak
Spring Chinook	Apr 1 – Jun 8	Apr 20	May 26
Summer Chinook	Jun 9 – Aug 8	Jun 13	Jul 26
Fall Chinook	Aug 9 – Oct 31	Sep 10	Sep 28
Steelhead	Apr 1 – Oct 31	Jul 9	Oct 13
Sockeye	Apr 1 – Oct 31	Sep 5	Oct 11
Coho	Apr 1 – Oct 31	Jul 23	Oct 5
Lamprey	Apr 1 – Oct 31	Jul 21	Aug 12

1.2.3. Time-of-day (diel) distributions of adult salmonid activity at McNary Dam fishway entrances and exits are summarized in **Figure MCN-2** (see *Keefer & Caudill 2008* at: http://www.nwd-wc.usace.army.mil/tmt/documents/FPOM/2010/2013_FPOM_MEET/2013_JUN/).

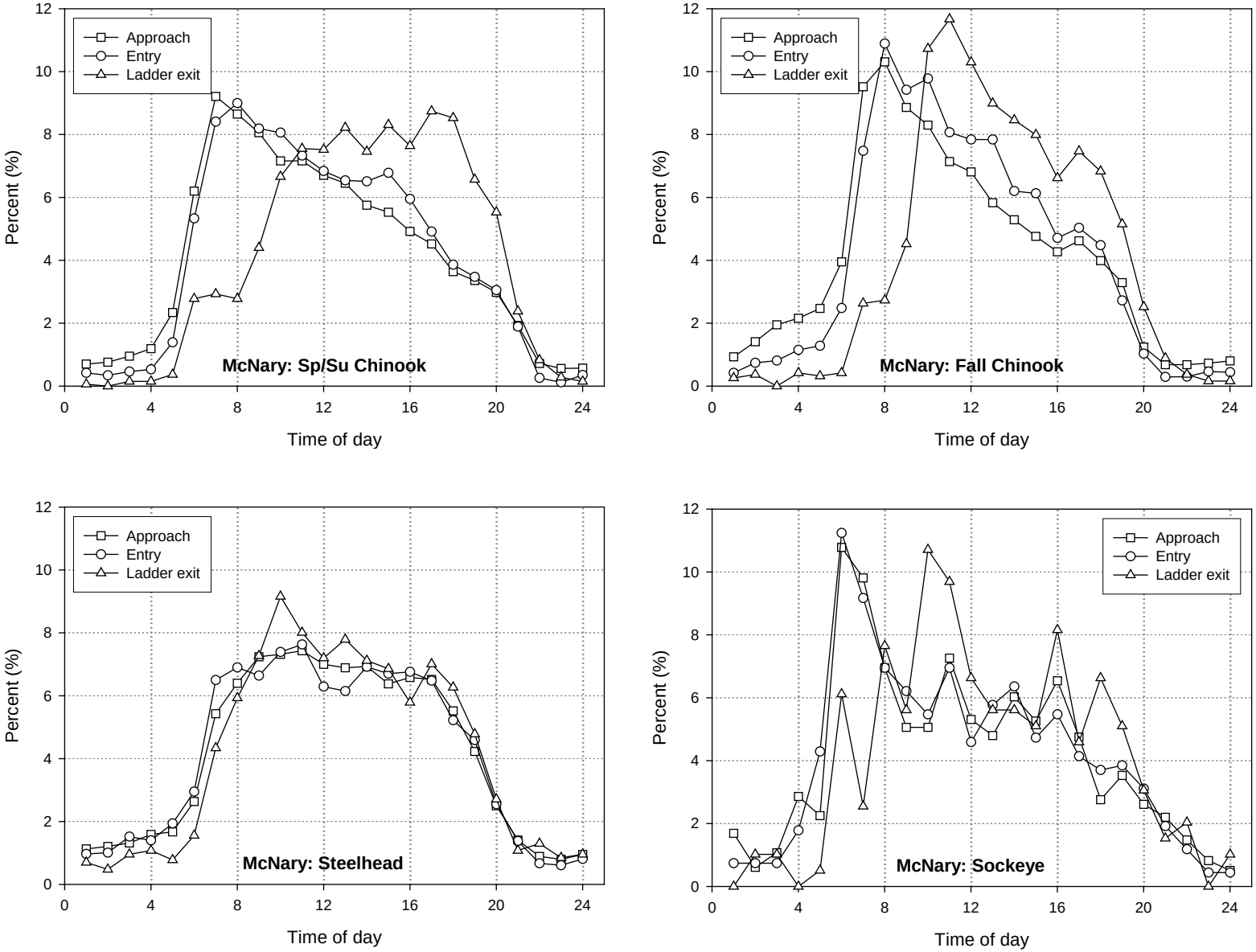


Figure MCN-2. Diel Distribution of Adult Salmonids at McNary Dam Fishway Entrances and Exits (*Keefer & Caudill 2008*).

2. PROJECT OPERATIONS

2.1. Spill Management.

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

2.1.1. Involuntary Spill. Involuntary spill occurs when river flow exceeds powerhouse capacity, there is insufficient load (lack of load), forced or scheduled turbine outages, or a failure of a key component of the juvenile fish facility requires spill to provide juvenile fish passage. Spill at McNary Dam shall be distributed in accordance with the spill patterns for fish passage (**Table MCN-7**) or the appropriate pattern during and after TSW removal (**Tables MCN-10** and **MCN-9**, respectively).

2.2. Total Dissolved Gas (TDG) Management.

Total dissolved gas (TDG) levels at all projects are monitored in accordance with the TDG Monitoring Plan, included in the *Water Management Plan* as Appendix 4, available online at: http://www.nwd-wc.usace.army.mil/tmt/documents/wmp/.

2.3. Operating Criteria.

2.3.1. Juvenile Fish Passage Facilities. Operate from April 6 through December 15 for juvenile fish bypass sampling and for bypassing adult fallbacks. Operate according to the criteria listed below and in Appendix J (Smolt Facility Protocols, McNary Section), for the bypassing and collection (for research purposes) of juvenile salmonids.

2.3.1.1. Winter Maintenance Period (December 16 – March 31). Check and perform maintenance as required on the items listed below. Prior to January 16, 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 ensure to the extent practicable that racked units are distributed evenly across the powerhouse.

2.3.1.1.a. Forebay Area and Intakes.

a.1. Remove debris from forebay and trashracks.

a.2. Rake trashracks.

a.3. Remove debris from gatewell slots.

a.4. Measure and log drawdown in gatewell slots.

a.5. Inspect and repair gatewell dip net as needed.

2.3.1.1.b. ESBSs, Flow Vanes and VBSs.

b.1. After ESBSs are removed at the end of the season, inspect them for the presence of juvenile salmonid mortalities and all other incidental fish mortalities. Inspect

ESBSs within a week after removal, or as soon as practical. All mortalities are to be counted, or otherwise estimated, for each ESBS and reported to CENWW-OD-T.

b.2. Maintenance completed on all ESBSs.

b.3. Inspect ESBSs for good running order and operate debris cleaner one trial run (dogged off at deck level).

b.4. Inspect flow vanes to make sure they are in good condition and all surfaces are smooth. Repair as needed.

b.5. Inspect all VBSs at least once per year by either raising the VBS and visually inspecting or inspecting with an underwater video camera.

2.3.1.1.c. Collection Channel.

c.1. Orifice lights are operational.

c.2. Orifices clean and valves operating correctly.

c.3. Orifice air backflush system works correctly.

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

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

2.3.1.1.d. Dewatering Structure and Flume.

d.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.

d.2. Cleaning brush systems are maintained and operating correctly.

d.3. All valves in good condition and operating correctly.

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

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

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

2.3.1.1.e. Sampling Facilities.

e.1. Flume switch gate is maintained and operational.

e.2. Flume is smooth with no rough edges.

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

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

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

e.6. Crowders maintained and operating properly.

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

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

e.9. All sampling equipment should be maintained and operating correctly.

e.10. 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.

2.3.1.1.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.

2.3.1.1.g. Maintenance Records. Record all maintenance and inspections.

2.3.1.2. Juvenile Fish Passage Period (April 1 – December 15).

2.3.1.2.a. Forebay Area and Intakes.

a.1. Remove debris from forebay.

a.2. Inspect gatewell slots daily for debris, fish buildup, and contaminating substances (particularly oil). Clean gatewells before they become 50% covered with debris. If due to the volume of the debris, it is not possible to keep the gatewell at least 50% clear, clean gatewells at least once daily. If flow through an orifice or fish sampling results indicate that an orifice may be partially obstructed with debris, close the orifice(s) and backflush 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.

a.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.

a.4. Remove debris from forebay and trashracks as required to minimize fish impacts. 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.

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

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

2.3.1.2.b. ESBSs and VBSs.

b.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.

b.2. Operate ESBSs with debris cleaners in automatic mode. Set cleaning frequency to 60 minutes. Increase or decrease cleaning frequency if needed to maintain clean screens.

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

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

b.5. If an ESBS is damaged or fails during the juvenile fish passage season, follow procedures detailed under unscheduled maintenance of ESBSs (section **3.1.2.1**). In no case should a turbine unit be operated with a missing or 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 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).

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

b.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.

b.8. Between the spring and summer periods, inspect at least four VBSs in two different turbine units that were operated frequently during the spring. If debris accumulation is noted, inspect other VBSs and clean debris as necessary.

b.9. Inspect all VBSs at least once per year and when pulled for cleaning. Repair as needed.

2.3.1.2.c. Collection Channel.

c.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, and preferably 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.

c.2. Orifice lights operational and lighted 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 (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.

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

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

c.5. Orifice valves are either fully open or closed.

c.6. Cycle 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 cycled 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.

c.7. Netting along handrails maintained in good condition (no holes or gaps).

c.8. Plastic covers over orifice chutes in good condition.

2.3.1.2.d. Dewatering Structure.

d.1. No gaps between panels or missing silicone in side and inclined screens.

d.2. Trash sweeps operating correctly.

d.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.

d.4. If automated cleaning system problems occur, project personnel shall operate cleaners at least once per shift unless determined differently by the project biologist.

d.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.

d.6. Lights at the dewatering structure should be turned off at night, unless needed for personnel access, to encourage fish to move downstream volitionally.

2.3.1.2.e. Sampling Facilities. Note: Normal operations when not sampling fish is to operate the juvenile bypass facilities in full flow bypass to the river. During this operation, fish may be periodically routed through the sampling 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 juvenile fish bypass season is normally done every other day per **Appendix J**.

e.1. There should be no holes or gaps between screen panels. All silicone sealer should be in good condition.

e.2. Crowder screen brushes should be in good operating condition.

e.3. Assure that retainer screens in raceways and tanks are clean with no holes or protruding wires.

e.4. Operate wet separator and fish distribution system as designed.

e.5. Project personnel shall release ice blocks through each 10” bypass line, 1-3 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.

e.6. Inform PSMFC, in advance if possible, of situations that cause the PIT-tag system to become inoperable (e.g., power outages) or that could result in confounding the interpretation of PIT-tag data (e.g., bypassing fish from raceways to the river, operating in primary bypass mode without an operational full-flow detector, emergency dewatering).

2.3.1.2.f. Avian Predation Areas (Forebay, Tailrace, and Collection Channel).

f.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.

f.2. Harassment program in place to deter avian predation in areas actively used by birds and not covered by bird wires or other devices.

f.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.

2.3.1.2.g. Inspection and Record Keeping. Inspect all facilities according to fish facilities monitoring plan. Record all inspections.

2.3.1.2.h. TSW Operation.[1] Spring spill for fish passage will begin with temporary spillway weirs (TSWs) operating in bays 19 and 20 and spill will be distributed in the "Spill Pattern for Fish Passage" (**Table MCN-7**). Both TSWs will be in service through June 7 and removed on June 8 or the next available work day. During removal of the TSWs, spill will be distributed in the "Spill Pattern During TSW Removal" (**Table MCN-10**) to ensure worker safety. Upon completion of the TSW removal when both TSWs are not in service, spill will be distributed in the "Spill Pattern After Both TSWs Removed" (**Table MCN-9**) for the remainder of the fish passage spill season.

2.3.1.2.i. Emergency Bypass during Freezing Conditions.

i.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.

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

ii. 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.

[1] Spillway weirs provide surface passage routes via spillbay(s). Temporary, or Top, Spillway Weirs (*TSW*s) at Little Goose, McNary and John Day dams can be installed, uninstalled and moved between bays using the gantry crane. Removable Spillway Weirs (*RSW*s) at Lower Granite, Lower Monumental and Ice Harbor dams are "removed" by controlled descent to the bottom of the forebay.

2.3.1.2.j. Emergency Bypass During Late Season Mechanical Failure. After November 30, if a mechanical failure forces the McNary JFF juvenile channel into emergency bypass mode, the McNary Fisheries staff may leave the juvenile channel in emergency bypass mode until the beginning of the winter maintenance season when the juvenile channel is fully dewatered.

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 – end of February).

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

2.3.2.1.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.

2.3.2.1.c. Inspect for and clean debris from the fish ladder exits. All trashracks and picketed leads must be clean and installed correctly.

2.3.2.1.d. Calibrate all water level measuring devices, as necessary, for proper facility operations.

2.3.2.1.e. Inspect all spill gates and ensure that they are operable.

2.3.2.1.f. Fish pumps maintained and ready for operation.

2.3.2.1.g. Maintain adult PIT-tag system as required. Coordinate with PSMFC.

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

2.3.2.2.a. Fishway Ladders. Water depth over weirs: 1.0’–1.3'.

2.3.2.2.b. Counting Windows. The crowder shall be opened to full count slot width when not counting. The crowder shall be open as far as possible to allow accurate counting and shall not be closed to less than 18 inches while counting, to the extent possible. This will usually occur during high turbidity conditions to allow count accuracy criteria to be achieved. All equipment should be maintained and in good condition. The

counting window and backboard should be cleaned as needed to maintain good visibility. Crowder ranges at MCN are as follows:

i. Washington Shore = 19 $^{3}/_{16}$" (not adjustable)

ii. Oregon Shore downstream = 13 $^{1}/_{8}$" – 17 $^{5}/_{8}$"

iii. Oregon Shore upstream = 13 $^{1}/_{2}$" – 17 $^{1}/_{8}$"

2.3.2.2.c. Head on all Fishway Entrances. Head range: 1'–2'.

2.3.2.2.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.

d.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.

2.3.2.2.e. North Shore Entrances (WFE 2 & 3).

e.1. Operate 2 downstream gates.

e.2. Weir depth: 8' or greater below tailwater.

2.3.2.2.f. North Powerhouse Entrances (NFE 2 & 3).

f.1. Operate 2 downstream gates.

f.2. Weir depth: 8' or greater below tailwater.

2.3.2.2.g. Floating Orifice Gates (FOGs). Operate twelve FOGs (1, 3, 4, 8, 14, 21, 26, 32, 37, 41, 43, and 44).

2.3.2.2.h. South Shore Entrances (SFE 1 & 2).

h.1. Operate 2 downstream gates.

h.2. Weir depth: 8' or greater below tailwater.

2.3.2.2.i. Head on Trashracks.

i.1. Maximum head of 0.5' on ladder exits.

i.2. Maximum head on picketed leads shall be 0.5'. Normal head differential on clean leads is 0.3'.

i.3. Trashracks and picketed leads installed correctly.

2.3.2.2.j. Lamprey Passage Season June 15–September 30 (modifications with removal of segmental gate stationary section).

j.1. Implement nighttime (2100–0400 hours) segmental gate operations:

i. Lower the SFE 1 entrance weir to the lowest elevation (244 fmsl).

ii. Lower the NFE 2 & 3 entrance weir to the lowest elevation (252 fmsl).

j.2. Daytime operations from 0400–2100 hours:

i. Extend telescoping segmental gates SFE 1 and NFE 2 & 3 depth: 8’ or greater below tailwater.

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

2.3.2.2.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.

2.3.2.2.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).

2.3.2.2.m. Facility Inspections.

m.1. Powerhouse operators shall inspect facilities once per day shift and check computer monitor information at least once during each back shift.

m.2. Project biologists shall inspect facilities three times per week. Inspect all facilities according to fish facilities monitoring program.

m.3. Picketed leads shall be inspected during all inspections to ensure they are clean and in the correct position (all the way down).

m.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.

m.5. Inspect fishways daily for foreign substances (particularly oil). If substances are found, corrective actions should be undertaken immediately.

m.6. Record all inspections.

2.3.3. Facility Monitoring & 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 – December 31, Project biologists shall prepare weekly reports 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 weekly reports shall cover Friday–Thursday and shall be emailed to CENWW-OD-T by noon the following Monday. The reports shall include:

i. Any out-of-criteria situations observed and subsequent corrective actions taken;

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

iii. Adult fishway control calibrations;

iv. ESBS and VBS inspections;

v. Any unusual activities that occurred at the project that may affect fish passage.

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 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 the *Guidelines for Dewatering and Fish Handling Plans* (**Appendix F**).

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 – 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 is required. The Operations Manager may determine that work must be initiated prior to notifying CENWW-OD-T if a delay will result in an unsafe situation for people, property, or fish. Information required by CENWW-OD-T includes (see also **FPP Overview Section 1** for coordination form):

i. Description of outage;

ii. Type of outage required;

iii. Impact on facility operation;

iv. Length of time for repairs; and

v. Potential fish impacts and proposed mitigation measures.

3.1.2.2. Extended-Length Submersible Bar Screens (ESBSs). The ESBSs deflect fish and water up the gatewell slots as part of the fish bypass system and are inspected periodically throughout the juvenile passage season with a video monitoring system. If an ESBS is found to be damaged, it will be removed and either replaced with a spare, or repaired and returned to service. A turbine unit shall not be operated with a known damaged or nonfunctioning screen 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 a 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.

3.1.2.3. Vertical Barrier Screens (VBSs). Each gatewell has a VBS located vertically between the bulkhead slot and the operating gate slot to guide fish away from the turbine intake. The VBSs are designed to distribute flow evenly through the screens to minimize fish impingement and/or descaling. The gatewell water surface elevations are routinely measured to determine head differential across the VBSs caused by debris. 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% 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 debris hosed off. The turbine unit shall remain operating at the lower end of 1% 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 passing 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 1 workday of the head differential reaching 1.5', the turbine unit loading will be lowered to the lower end of the 1% 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.

3.1.2.4. 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.

3.1.2.5. 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 sampling 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, the project will notify CENWW-OD-T. 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. The emergency bypass system is not equipped with PIT-tag detectors.

3.1.2.6. Bypass Outfall Pipe/Flume. The corrugated metal bypass pipeflume routes juveniles to either the sampling facilities or to the river below the project through the primary bypass pipe. If a problem interferes with the flume's operation, the project can open the emergency bypass system in the collection system and all of the fish in the bypass system

will be diverted into the ice and trash sluiceway and passed to the river through the north powerhouse ice and trash sluiceway exit.

3.1.2.7. Sampling Facilities. The sampling facilities can be operated to collect and hold juveniles for research and sampling purposes, enumerate fish through the sampling system, or bypass part or all of the fish back to the river (secondary bypass). If part of the facility malfunctions or is damaged, the switch gate in the bypass flume will be used to bypass fish directly to the river (primary bypass) until repairs can be made. .

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 & 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 diffusers below weir 253 (diffusers 1 through 7 and main unit diffusers). Diffuser 7 is where both systems meet and is supplied by either gravity flow or pumped flow. Gravity flow diffusers are regulated by rotovalves and pumped flow diffusers by sluice gates.

3.2.2.3.a. If a rotovalve fails, the nearest closed rotovalve will be opened to supply flow. If more rotovalves fail than there are closed valves, the sluice gates in diffusers 3 through 7 will be opened more to provide required flows.

3.2.2.3.b. If any sluice gates fail, the nearest sluice gates will be opened further to make up the flow.

3.2.2.3.c. If one pump fails, the other two pumps will be operated to maintain facilities within criteria.

3.2.2.3.d. If two pumps fail and are expected to be out of service short-term, then NFE3 will be closed and SFE1, SFE2, and NFE2 will be operated as deep as possible to maintain the 1–2' head differential.

3.2.2.3.e. If two pumps fail and are expected to be out of service long-term, then the middle eight of twelve open floating orifices (4,8,14,21,26,32,37,41) should be closed and monitored 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 1–2' head differential.

3.2.2.3.f. 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.

3.2.2.3.g. 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 1–2' head differential. If a depth of 6' on both gates cannot be maintained, SFE2 will be closed.

3.2.2.3.h. If both the gravity flow and pumped auxiliary water supply systems 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. Fishway entrances consist of main entrance weirs with hoists and automatic controls, and floating orifices that self-regulate with tailwater fluctuations. If any 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 winter maintenance to ensure 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 (section **3.1.2**). If possible, a video inspection should be made as soon as possible to determine 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 otherwise coordinated.

4. TURBINE UNITS OPERATION & MAINTENANCE

4.1. Turbine Unit Operation.

From March 1 – November 30, turbine units will be operated in priority order to enhance adult and juvenile fish passage and juvenile bypass (**Table MCN-5**). During this time period, turbine units available for operation will be operated as needed to meet generation requirements in the following priority order: 1, then 14 through 2 in descending order. Unit operating priority may be coordinated differently to allow for fish research, construction, or project maintenance activities. Unit operation during warm water events are described below in paragraph **4.1.1.**

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

Operation	Unit Priority
March 1–November 30 Fish Passage Season, Fish Bypass	1, then 14 through 2 in descending order [a]
Warm Water Operations [b]	"Warm Water Operations" STOP Units in the following order: Unit 1 available: every other unit starting w/ 2 and move north. 2, 4, 6, 8, 10, 12, 14, 3, 5, 7, 9, 11, 13, then 1 Unit 1 OOS: every other unit starting w/ 3 and move north. 3, 5, 7, 9, 11, 13, 2, 4, 6, 8, 10, 12, 14

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

b. See section **4.1.1**. below for criteria and protocols during Warm Water Operations. Shut down units in a staggered manner (every other unit) starting with Unit 2 moving northward. If Unit 1 is OOS, start with Unit 3 and move northward. This order may be adjusted if necessary as coordinated by the Project Biologist.

4.1.1. Warm Water Operations. At the request of McNary Fisheries, the project will implement the following protocols during "*Warm Water Operations*" when water temperatures at the McNary Juvenile Fish Facility (JFF) exceed 68°F in order to minimize thermal stress on

salmonid species. The project and CENWW will coordinate these protocols with fish agencies and tribes through FPOM and other entities as necessary. The purpose of these protocols is to provide precautionary measures to avoid or minimize any direct or delayed mortality resulting from additional thermal stress when handling juvenile salmonid fishes.

4.1.1.1. Operation in Secondary Bypass or Sample Mode. When any of the criteria listed below occur, the project will begin to shut down turbine units in a staggered priority, stopping every other unit starting with unit 2, and ascending as necessary to avoid temperature shocks within the juvenile channel (i.e., shutting down units 2, 4, 6, 8, 10, 12 and 14 as necessary). If possible, unit 1 shall be left in operation to provide attraction flow to the two entrances of the Oregon shore fish ladder. The Project Biologist will coordinate with CENWW to modify this sequence if necessary to provide equal or better levels of protection to salmonid fishes. Starting and stopping of two or more units at a time should be avoided if possible during periods of warm water, especially during the hours of 1000–2400. Turbine operations during periods of warm water will begin when *any* of the following criteria occur:

i. Water temperatures in the McNary JFF >68°F; or

ii. Water temperatures elsewhere at the project (e.g., gatewells) that are likely to induce thermal stress in juvenile salmonids; or

iii. Temperature gradients >5°F; or

iv. Sample mortality >3%; or

v. System mortality >6%.

4.1.1.2. Continued Mortality. If juvenile salmonid populations continue to experience high mortality after implementing the above procedures, collection for fish condition sampling by smolt monitoring staff should continue for up to 8 hours a day. The project shall switch to primary bypass, routing fish past the JFF and through the outfall bypass line, except for daily monitoring, for the duration of the event.

4.1.2. Turbine Unit Operating Range. Turbine units will be operated within ±1% of peak efficiency from April 1 – October 31, as specified in *BPA's Load Shaping Guidelines* (**Appendix C**). Turbine unit output and discharge at the lower and upper 1% limits (with and without ESBSs) for various heads are defined in **Table MCN-6**. If operation outside the 1% range is necessary, Project personnel shall record the information and provide to BPA on a weekly basis according to the load shaping guidelines. Operation outside of 1% range may be necessary to:

i. Meet BPA load requirements. Load requests will be made in accordance with BPA's policy, statutory requirements and load shaping guidelines (**Appendix C**);

ii. If the draft tube is to be dewatered, the unit will be operated at full load (>1%) for a minimum of 15 minutes prior to installing tail logs. If not possible to load, the unit will be run at speed-no-load (<1%) for a minimum of 15 minutes. This is to reduce the number of fish in the unit prior to installing stop logs;

iii. Operate a turbine unit solely to provide station service; or

iv. Comply with other coordinated fish measures.

Table MCN-6. McNary Dam Turbine Unit Output (MW) and Discharge (cfs) Per Unit at Upper and Lower Limits of the 1% Peak Efficiency Operating Range. *

Project Head (feet)	With ESBSs				Without ESBSs			
	1% Lower Limit		1% Upper Limit		1% Lower Limit		1% 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

* Table revised to reflect new information using the 1998 index test and 1955 Prototype Hill Curve.

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.

4.3. Head Gates. [2]

Head gates will normally remain in the standard operating position, except as required for maintenance activities.

4.3.1. 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.

4.3.2. 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:

i. Using a boat to physically encircle debris with a log boom to pull it to the spillway where operators can spill it or to the shore to be removed by crane;

ii. removing the debris from the top of the dam using a crane and scoop;

iii. passing debris through the spillway with special powerhouse and/or spill operations; or

iv. Using a boom, spreader bar or other device, suspended from a crane, to move the debris to the spillway, in coordination with special powerhouse and spill operations (if needed).

[2] Head gates may also be referred to as “operating” gates. The terms are interchangeable.

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. Except in an emergency, the project shall contact CENWW-OD-T and the John Day Dam Control Room and Fishery Biologist at least one workday in advance of debris passage operations that will be commencing. Using information provided by the project, CENWW-OD-T will notify FPOM. The special operation will be detailed in a teletype issued by RCC. In an emergency operation, notification may be provided as indicated in section **5.1.1.**

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. Implement as necessary to pass woody debris that is accumulating in the forebay, 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 4*] McNary Dam Spill Patterns with TSWs for Fish Passage. [a]

Total Spill [a]	MCN Spill Patterns with TSWs for Fish Passage – # Gate Stops per Spillbay [b]																						Total Stops
(kcfs)	1 [c]	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19 TSW	20 TSW	21	22 [c]	(#)
21.2																			5.5	5.5	1		**12**
23.2																		1	5.5	5.5	1		**13**
25.2																		1	5.5	5.5	1	1	**14**
27.1																		1	5.5	5.5	2	1	**15**
29.0																		2	5.5	5.5	2	1	**16**
31.0																	1	2	5.5	5.5	2	1	**17**
32.9																	2	2	5.5	5.5	2	1	**18**
34.9															1		2	2	5.5	5.5	2	1	**19**
36.8															1		2	2	5.5	5.5	2	2	**20**
38.7															2		2	2	5.5	5.5	2	2	**21**
40.7															2	1	2	2	5.5	5.5	2	2	**22**
42.6															2	2	2	2	5.5	5.5	2	2	**23**
44.6														1	2	2	2	2	5.5	5.5	2	2	**24**
46.5														2	2	2	2	2	5.5	5.5	2	2	**25**
48.5											1		2		2	2	2	2	5.5	5.5	2	2	**26**
50.4											2		2		2	2	2	2	5.5	5.5	2	2	**27**
52.4									1		2		2		2	2	2	2	5.5	5.5	2	2	**28**
54.3									2		2		2		2	2	2	2	5.5	5.5	2	2	**29**
56.3									2	1	2		2		2	2	2	2	5.5	5.5	2	2	**30**
58.2									2	2	2		2		2	2	2	2	5.5	5.5	2	2	**31**
60.2									2	2	2		2	1	2	2	2	2	5.5	5.5	2	2	**32**
62.1									2	2	2		2	2	2	2	2	2	5.5	5.5	2	2	**33**
64.1									2	2	2	1	2	2	2	2	2	2	5.5	5.5	2	2	**34**
66.0									2	2	2	2	2	2	2	2	2	2	5.5	5.5	2	2	**35**
68.0							1		2	2	2	2	2	2	2	2	2	2	5.5	5.5	2	2	**36**
69.9							2		2	2	2	2	2	2	2	2	2	2	5.5	5.5	2	2	**37**
71.9					1		2		2	2	2	2	2	2	2	2	2	2	5.5	5.5	2	2	**38**
73.8					2		2		2	2	2	2	2	2	2	2	2	2	5.5	5.5	2	2	**39**
75.3	2.5	2	3.5		2		2		2		2		2	1	2		2	2	5.5	5.5	2	2	**40**
77.3	2.5	2	3.5		2		2		2		2		2	1	2	1	2	2	5.5	5.5	2	2	**41**
79.3	2.5	2	3.5		2	1	2		2		2		2	1	2	1	2	2	5.5	5.5	2	2	**42**
81.3	2.5	2	3.5		2	1	2		2	1	2		2	1	2	1	2	2	5.5	5.5	2	2	**43**
83.3	2.5	2	3.5		2	1	2		2	1	2	1	2	1	2	1	2	2	5.5	5.5	2	2	**44**
85.3	2.5	2	3.5		2	1	2	1	2	1	2	1	2	1	2	1	2	2	5.5	5.5	2	2	**45**
87.3	2.5	2	3.5	1	2	1	2	1	2	1	2	1	2	1	2	1	2	2	5.5	5.5	2	2	**46**

Total Spill [a]	MCN Spill Patterns with TSWs for Fish Passage – # Gate Stops per Spillbay [b]																						Total Stops
(kcfs)	1 [c]	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19 TSW	20 TSW	21	22 [c]	(#)
89.0	2.5	2	3.5	1	2	1	2	1	2	1	2	1	2	1	2	1	2	2	5.5	5.5	2.5	2.5	**47**
90.9	2.5	2	3.5	1	2	1	2	1	2	1	2	1	2	2	2	1	2	2	5.5	5.5	2.5	2.5	**48**
90.9	2.5	2	3.5	1	2	1	2	1	2	1	2	1	2	2	2	1	2	2	5.5	5.5	2.5	2.5	**48**
92.8	2.5	2	3.5	1	2	1	2	1	2	1	2	1	2	2	2	2	2	2	5.5	5.5	2.5	2.5	**49**
94.7	2.5	2	3.5	1	2	2	2	1	2	1	2	1	2	2	2	2	2	2	5.5	5.5	2.5	2.5	**50**
96.6	2.5	2	3.5	1	2	2	2	1	2	2	2	1	2	2	2	2	2	2	5.5	5.5	2.5	2.5	**51**
98.5	2.5	2	3.5	1	2	2	2	1	2	2	2	2	2	2	2	2	2	2	5.5	5.5	2.5	2.5	**52**
100.4	2.5	2	3.5	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	5.5	5.5	2.5	2.5	**53**
102.3	2.5	2	3.5	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	5.5	5.5	2.5	2.5	**54**
103.9	2.5	2.5	4	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	5.5	5.5	2.5	2.5	**55**
105.6	2.5	2.5	4	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	5.5	5.5	3.5	2.5	**56**
107.3	2.5	2.5	4	2	2	2	2	2	2	2	2	2	2	2	2	2.5	2.5	3	5.5	5.5	2.5	2.5	**57**
109.0	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	5.5	2.5	2.5	**58**
110.7	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	5.5	2.5	2.5	**59**
112.4	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	5.5	2.5	2.5	**60**
114.1	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	5.5	2.5	2.5	**61**
115.8	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	5.5	2.5	2.5	**62**
117.5	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	5.5	2.5	2.5	**63**
119.2	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	5.5	3	2.5	**64**
120.9	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	5.5	3	2.5	**65**
122.6	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	5.5	3	2.5	**66**
124.3	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	5.5	3	2.5	**67**
126.0	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	5.5	3	2.5	**68**
127.7	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	5.5	3	2.5	**69**
129.3	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	5.5	3	2.5	**70**
131.0	2.5	2.5	5	3	3	3	3	3	3	3	3	3	3	2.5	3	3	3	3	5.5	5.5	3	2.5	**71**
132.7	3	3	5	3	3	3	3	3	3	3	3	3	3	2.5	3	3	3	3	5.5	5.5	3	2.5	**72**
134.4	3	3	5	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	5.5	5.5	3	3	**73**
136.0	3	3	5	3	3	3	3	3	3	3	3	3	3	3	3	3	3	4	5.5	5.5	3	3	**74**
137.6	3	3	5	3	3	3	3	3	3	3	3	3	3	3	3	3	4	4	5.5	5.5	3	3	**75**
139.2	3	4	5	3	3	3	3	3	3	3	3	3	3	3	3	3	4	4	5.5	5.5	3	3	**76**
140.8	4	4	5	3	3	3	3	3	3	3	3	3	3	3	3	3	4	4	5.5	5.5	3	3	**77**
142.4	4	4	5	3	3	3	4	3	3	3	3	3	3	3	3	3	4	4	5.5	5.5	3	3	**78**
144.0	4	4	5	3	3	3	4	3	3	3	4	3	3	3	3	3	4	4	5.5	5.5	3	3	**79**
145.6	4	4	5	3	4	3	4	3	3	3	4	3	3	3	3	3	4	4	5.5	5.5	3	3	**80**
147.2	4	4	5	3	4	3	4	3	3	3	4	3	3	3	4	3	4	4	5.5	5.5	3	3	**81**

Total Spill [a]	MCN Spill Patterns with TSWs for Fish Passage – # Gate Stops per Spillbay [b]																						Total Stops
(kcfs)	1 [c]	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19 TSW	20 TSW	21	22 [c]	(#)
148.8	4	4	5	3	4	3	4	3	4	3	4	3	3	3	4	3	4	4	5.5	5.5	3	3	**82**
150.4	4	4	5	3	4	3	4	3	4	3	4	3	4	3	4	3	4	4	5.5	5.5	3	3	**83**
152.0	4	4	5	3	4	4	4	3	4	3	4	3	4	3	4	3	4	4	5.5	5.5	3	3	**84**
153.6	4	4	5	3	4	4	4	3	4	4	4	3	4	3	4	3	4	4	5.5	5.5	3	3	**85**
155.2	4	4	5	3	4	4	4	3	4	4	4	4	4	3	4	3	4	4	5.5	5.5	3	3	**86**
156.8	4	4	5	3	4	4	4	4	4	4	4	4	4	3	4	3	4	4	5.5	5.5	3	3	**87**
158.4	4	4	5	3	4	4	4	4	4	4	4	4	4	3	4	4	4	4	5.5	5.5	3	3	**88**
160.0	4	4	5	4	4	4	4	4	4	4	4	4	4	3	4	4	4	4	5.5	5.5	3	3	**89**
161.6	4	4	5	4	4	4	4	4	4	4	4	4	4	3	4	4	4	4	5.5	5.5	4	3	**90**
163.2	4	4	5	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	5.5	5.5	4	3	**91**
164.8	4	4	5	4	4	4	4	4	4	4	4	4	4	4	4	4	4	5	5.5	5.5	4	3	**92**
166.4	4	4	5	4	4	4	4	4	4	4	4	4	4	4	4	4	5	5	5.5	5.5	4	3	**93**
168.0	4	5	5	4	4	4	4	4	4	4	4	4	4	4	4	4	5	5	5.5	5.5	4	3	**94**
169.6	5	5	5	4	4	4	4	4	4	4	4	4	4	4	4	4	5	5	5.5	5.5	4	3	**95**
171.2	5	5	5	4	4	4	5	4	4	4	4	4	4	4	4	4	5	5	5.5	5.5	4	3	**96**
172.8	5	5	5	4	4	4	5	4	4	4	5	4	4	4	4	4	5	5	5.5	5.5	4	3	**97**
174.4	5	5	5	4	5	4	5	4	4	4	5	4	4	4	4	4	5	5	5.5	5.5	4	3	**98**
176.0	5	5	5	4	5	4	5	4	4	4	5	4	4	4	5	4	5	5	5.5	5.5	4	3	**99**
177.6	5	5	5	4	5	4	5	4	5	4	5	4	4	4	5	4	5	5	5.5	5.5	4	3	**100**
179.2	5	5	5	4	5	4	5	4	5	4	5	4	5	4	5	4	5	5	5.5	5.5	4	3	**101**
180.8	5	5	5	4	5	4	5	4	5	4	5	4	5	4	5	4	5	5	5.5	5.5	5	3	**102**
182.4	5	5	5	4	5	5	5	4	5	4	5	4	5	4	5	4	5	5	5.5	5.5	5	3	**103**
184.0	5	5	5	4	5	5	5	4	5	5	5	4	5	4	5	4	5	5	5.5	5.5	5	3	**104**
185.6	5	5	5	4	5	5	5	4	5	5	5	5	5	4	5	4	5	5	5.5	5.5	5	3	**105**
187.2	5	5	5	4	5	5	5	5	5	5	5	5	5	4	5	4	5	5	5.5	5.5	5	3	**106**
188.8	5	5	5	4	5	5	5	5	5	5	5	5	5	4	5	5	5	5	5.5	5.5	5	3	**107**
190.4	5	5	5	5	5	5	5	5	5	5	5	5	5	4	5	5	5	5	5.5	5.5	5	3	**108**
192.0	5	5	6	5	5	5	5	5	5	5	5	5	5	4	5	5	5	5	5.5	5.5	5	3	**109**
193.6	5	5	6	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5.5	5.5	5	3	**110**
195.2	5	5	6	5	5	5	5	5	5	5	5	5	5	5	5	5	5	6	5.5	5.5	5	3	**111**
196.8	5	5	6	5	5	5	5	5	5	5	5	5	5	5	5	5	6	6	5.5	5.5	5	3	**112**
198.4	5	5	6	5	5	5	5	5	5	5	5	5	5	5	6	5	6	6	5.5	5.5	5	3	**113**
200.0	5	5	6	5	5	5	5	5	5	5	5	5	6	5	6	5	6	6	5.5	5.5	5	3	**114**
201.6	5	5	6	5	5	5	5	5	5	5	5	5	6	5	6	6	6	6	5.5	5.5	5	3	**115**
203.2	5	5	6	6	5	5	5	5	5	5	5	5	6	5	6	6	6	6	5.5	5.5	5	3	**116**
204.8	5	5	6	6	5	5	5	5	5	5	5	5	6	5	6	6	6	6	5.5	5.5	6	3	**117**

Total Spill [a]	MCN Spill Patterns with TSWs for Fish Passage – # Gate Stops per Spillbay [b]																						Total Stops
(kcfs)	1 [c]	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19 TSW	20 TSW	21	22 [c]	(#)
206.4	5	5	6	6	5	5	5	5	5	5	5	6	6	5	6	6	6	6	5.5	5.5	6	3	**118**
208.0	5	5	6	6	5	5	5	5	5	5	5	5	6	6	6	6	6	6	5.5	5.5	6	4	**119**
211.2	5	5	6	6	6	5	5	5	5	5	5	6	6	6	6	6	6	6	5.5	5.5	6	4	**121**
214.4	5	5	6	6	6	5	6	5	5	5	6	6	6	6	6	6	6	6	5.5	5.5	6	4	**123**
217.6	5	5	6	6	6	6	6	5	6	5	6	6	6	6	6	6	6	6	5.5	5.5	6	4	**125**
220.8	5	5	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	5.5	5.5	6	4	**127**
224.0	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	5.5	5.5	6	4	**129**
230.4	6	6	6	6	6	6	6	6	6	6	7	6	7	6	7	6	7	6	5.5	5.5	6	4	**133**
233.6	6	6	6	6	6	6	7	6	7	6	7	6	7	6	7	6	7	6	5.5	5.5	6	4	**135**
236.8	6	6	7	6	7	6	7	6	7	6	7	6	7	6	7	6	7	6	5.5	5.5	6	4	**137**
240.0	7	6	7	6	7	6	7	6	7	6	7	6	7	6	7	6	7	7	5.5	5.5	6	4	**139**
243.2	7	6	7	6	7	6	7	6	7	6	7	6	7	7	7	7	7	7	5.5	5.5	6	4	**141**
246.4	7	6	7	6	7	6	7	6	7	7	7	7	7	7	7	7	7	7	5.5	5.5	6	4	**143**
249.6	7	6	7	6	7	7	7	7	7	7	7	7	7	7	7	7	7	7	5.5	5.5	6	4	**145**
252.8	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	5.5	5.5	6	4	**147**
256.0	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	5.5	5.5	6	6	**149**
259.2	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	5.5	5.5	7	7	**151**

a. Total Spill calculated based on forebay elevation 339 ft = ~1.8 kcfs spill per 1 gate stop.
b. Bays 19-20 with TSWs = ~5.5 stops (at fb el 339). Raise tainter gates ~3-5 ft above water surface to ensure free flow through TSW.
c. Bays 1 & 22 *MAY* require special open/close sequence (pending field test verification). Open: Bays 2–21, then 1 & 22 after 2-21 have operated ≥10 minutes.
Close: Bays 1 & 22, then 2–21.

Table MCN-8. McNary Dam Spill Patterns with TSWs for Navigation. [a]

Total Spill [a]	MCN Spill Patterns with TSWs for Navigation – # Gate Stops per Spillbay [b]																						Total Stops
(kcfs)	1 [c]	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19 TSW	20 TSW	21	22 [c]	(#)
21.2																			5.5	5.5	1		12
23.2																		1	5.5	5.5	1		13
25.2		1																1	5.5	5.5	1		14
27.1		2																1	5.5	5.5	1		15
28.8		3																1	5.5	5.5	1		16
30.8		3																1	5.5	5.5	1	1	17
32.4		4																1	5.5	5.5	1	1	18
34.7		3	2															1	5.5	5.5	1	1	19
36.3		4	2															1	5.5	5.5	1	1	20
38.0		4	3															1	5.5	5.5	1	1	21
40.0		4	3													1		1	5.5	5.5	1	1	22
41.6		4	4													1		1	5.5	5.5	1	1	23
43.6		4	4												1	1		1	5.5	5.5	1	1	24
45.6		4	4										1		1	1		1	5.5	5.5	1	1	25
47.5		4	4										2		1	1		1	5.5	5.5	1	1	26
49.5		4	4								1		2		1	1		1	5.5	5.5	1	1	27
51.5		4	4						1		1		2		1	1		1	5.5	5.5	1	1	28
53.4		4	4						1		2		2		1	1		1	5.5	5.5	1	1	29
55.3		4	4						1		2		2		1	1		1	5.5	5.5	2	1	30
57.2		4	4						1		2		2		1	1		2	5.5	5.5	2	1	31
59.1		4	4						2		2		2		1	1		2	5.5	5.5	2	1	32
61.0		4	4						2		2		2		1	2		2	5.5	5.5	2	1	33
62.9		4	4						2		2		2		2	2		2	5.5	5.5	2	1	34
64.5		5	4						2		2		2		2	2		2	5.5	5.5	2	1	35
66.4		5	4						2		2		2		2	2		2	5.5	5.5	2	2	36

a. Total Spill calculated based on forebay elevation 339 ft = ~1.8 kcfs spill per 1 gate stop.
b. Bays 19-20 with TSWs =~5.5 stops (at fb el 339). Raise tainter gates ~3-5 ft above water surface to ensure free flow through TSW.
c. Bays 1 & 22 *MAY* require special open/close sequence (pending field test verification). Open: Bays 2–21, then 1 & 22 after 2-21 have operated ≥10 minutes. Close: Bays 1 & 22, then 2–21.

Table MCN-9. [*pg 1 of 5*]. McNary Dam Spill Patterns with No TSWs. [a]

Total Spill [a]	MCN Spill Patterns with *No* TSWs – # Gate Stops per Spillbay																						Total Stops
(kcfs)	1 [b]	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22 [b]	(#)
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

Total Spill [a]	MCN Spill Patterns with *No* TSWs – # Gate Stops per Spillbay																						Total Stops
(kcfs)	1 [b]	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22 [b]	(#)
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**
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**

Total Spill [a]	MCN Spill Patterns with *No* TSWs – # Gate Stops per Spillbay																						Total Stops
(kcfs)	1 [b]	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22 [b]	(#)
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**
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**

Total Spill [a]	MCN Spill Patterns with *No* TSWs – # Gate Stops per Spillbay																						Total Stops
(kcfs)	1 [b]	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22 [b]	(#)
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**
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**

Total Spill [a]	MCN Spill Patterns with *No* TSWs – # Gate Stops per Spillbay																						Total Stops
(kcfs)	1 [b]	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22 [b]	(#)
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**
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**

a. Total Spill calculated based on forebay elevation 339 ft = ~1.8 kcfs spill per 1 gate stop.
b. Bays 1 & 22 *MAY* require special open/close sequence (pending field test verification). Open: Bays 2–21, then 1 & 22 after 2-21 have operated ≥10 minutes. Close: Bays 1 & 22, then 2–21.

Table MCN-10. [*pg 1 of 4*]. McNary Dam Spill Pattern During TSW Removal. [a]

Total Spill [a]	MCN Spill Patterns During Removal of TSWs – # Gate Stops per Spillbay																						Total Stops
(kcfs)	1 [b]	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19 TSW	20 TSW	21	22 [b]	(#)
23.4									2		2		2		2	2	2						12
25.4									2	1	2		2		2	2	2						13
27.3									2	2	2		2		2	2	2						14
29.3									2	2	2		2	1	2	2	2						15
31.2									2	2	2		2	2	2	2	2						16
33.2									2	2	2	1	2	2	2	2	2						17
35.1									2	2	2	2	2	2	2	2	2						18
37.1							1		2	2	2	2	2	2	2	2	2						19
39.0							2		2	2	2	2	2	2	2	2	2						20
41.0					1		2		2	2	2	2	2	2	2	2	2						21
42.9					2		2		2	2	2	2	2	2	2	2	2						22
44.4	2.5	2	3.5		2		2		2		2		2	1	2		2						23
46.4	2.5	2	3.5		2		2		2		2		2	1	2	1	2						24
48.4	2.5	2	3.5		2	1	2		2		2		2	1	2	1	2						25
50.4	2.5	2	3.5		2	1	2		2	1	2		2	1	2	1	2						26
52.4	2.5	2	3.5		2	1	2		2	1	2	1	2	1	2	1	2						27
54.4	2.5	2	3.5		2	1	2	1	2	1	2	1	2	1	2	1	2						28
56.4	2.5	2	3.5	1	2	1	2	1	2	1	2	1	2	1	2	1	2						29
58.3	2.5	2	3.5	1	2	1	2	1	2	1	2	1	2	2	2	1	2						30
60.2	2.5	2	3.5	1	2	1	2	1	2	1	2	1	2	2	2	2	2						31
62.1	2.5	2	3.5	1	2	2	2	1	2	1	2	1	2	2	2	2	2						32
64.0	2.5	2	3.5	1	2	2	2	1	2	2	2	1	2	2	2	2	2						33
65.9	2.5	2	3.5	1	2	2	2	1	2	2	2	2	2	2	2	2	2						34
67.8	2.5	2	3.5	1	2	2	2	2	2	2	2	2	2	2	2	2	2						35
69.7	2.5	2	3.5	2	2	2	2	2	2	2	2	2	2	2	2	2	2						36
71.3	2.5	2.5	4	2	2	2	2	2	2	2	2	2	2	2	2	2	2						37
73.0	2.5	2.5	4	2	2	2	2	2	2	2	2	2	2	2	2	2.5	2.5						38
74.7	2.5	2.5	4	2	2	2	2.5	2	2	2	2.5	2	2	2	2	2.5	2.5						39
76.4	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						40
78.1	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						41
79.8	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						42
81.5	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						43
83.2	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						44
84.1	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						44.5
85.8	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						45.5

Total Spill [a]	MCN Spill Patterns During Removal of TSWs – # Gate Stops per Spillbay																						Total Stops
(kcfs)	1 [b]	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19 TSW	20 TSW	21	22 [b]	(#)
87.4	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						46.5
89.1	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						47.5
90.8	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						48.5
92.5	2.5	2.5	4.5	3	3	3	3	2.5	3	2.5	3	2.5	3	2.5	3	3	3						49.5
94.2	2.5	2.5	5	3	3	3	3	2.5	3	3	3	2.5	3	2.5	3	3	3						50.5
95.9	2.5	2.5	5	3	3	3	3	3	3	3	3	3	3	2.5	3	3	3						51.5
97.6	3	3	5	3	3	3	3	3	3	3	3	3	3	2.5	3	3	3						52.5
98.4	3	3	5	3	3	3	3	3	3	3	3	3	3	3	3	3	3						53
100.0	3	3	5	3	3	3	3	3	3	3	3	3	3	3	3	3	4						54
101.6	3	4	5	3	3	3	3	3	3	3	3	3	3	3	3	3	4						55
103.2	4	4	5	3	3	3	3	3	3	3	3	3	3	3	3	3	4						56
104.8	4	4	5	3	3	3	4	3	3	3	3	3	3	3	3	3	4						57
106.4	4	4	5	3	3	3	4	3	3	3	4	3	3	3	3	3	4						58
108.0	4	4	5	3	4	3	4	3	3	3	4	3	3	3	3	3	4						59
109.6	4	4	5	3	4	3	4	3	3	3	4	3	3	3	4	3	4						60
111.2	4	4	5	3	4	3	4	3	4	3	4	3	3	3	4	3	4						61
112.8	4	4	5	3	4	3	4	3	4	3	4	3	4	3	4	3	4						62
114.4	4	4	5	3	4	4	4	3	4	3	4	3	4	3	4	3	4						63
116.0	4	4	5	3	4	4	4	3	4	4	4	3	4	3	4	3	4						64
117.6	4	4	5	3	4	4	4	3	4	4	4	4	4	3	4	3	4						65
119.2	4	4	5	3	4	4	4	4	4	4	4	4	4	3	4	3	4						66
120.8	4	4	5	3	4	4	4	4	4	4	4	4	4	3	4	4	4						67
122.4	4	4	5	4	4	4	4	4	4	4	4	4	4	3	4	4	4						68
124.0	4	4	5	4	4	4	4	4	4	4	4	4	4	4	4	4	4						69
125.6	4	4	5	4	4	4	4	4	4	4	4	4	4	4	4	4	5						70
127.2	4	5	5	4	4	4	4	4	4	4	4	4	4	4	4	4	5						71
128.8	5	5	5	4	4	4	4	4	4	4	4	4	4	4	4	4	5						72
130.4	5	5	5	4	4	4	5	4	4	4	4	4	4	4	4	4	5						73
132.0	5	5	5	4	4	4	5	4	4	4	5	4	4	4	4	4	5						74
133.6	5	5	5	4	5	4	5	4	4	4	5	4	4	4	4	4	5						75
135.2	5	5	5	4	5	4	5	4	4	4	5	4	4	4	5	4	5						76
136.8	5	5	5	4	5	4	5	4	5	4	5	4	4	4	5	4	5						77
138.4	5	5	5	4	5	4	5	4	5	4	5	4	5	4	5	4	5						78
140.0	5	5	5	4	5	5	5	4	5	4	5	4	5	4	5	4	5						79
141.6	5	5	5	4	5	5	5	4	5	5	5	4	5	4	5	4	5						80
143.2	5	5	5	4	5	5	5	4	5	5	5	5	5	4	5	4	5						81

Total Spill [a]	MCN Spill Patterns During Removal of TSWs – # Gate Stops per Spillbay																						Total Stops
(kcfs)	1 [b]	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19 TSW	20 TSW	21	22 [b]	(#)
144.8	5	5	5	4	5	5	5	5	5	5	5	5	5	4	5	4	5						82
146.4	5	5	5	4	5	5	5	5	5	5	5	5	5	4	5	5	5						83
148.0	5	5	5	5	5	5	5	5	5	5	5	5	5	4	5	5	5						84
149.6	5	5	6	5	5	5	5	5	5	5	5	5	5	4	5	5	5						85
151.2	5	5	6	5	5	5	5	5	5	5	5	5	5	5	5	5	5						86
152.8	5	5	6	5	5	5	5	5	5	5	5	5	5	5	5	5	6						87
154.4	5	6	6	5	5	5	5	5	5	5	5	5	5	5	5	5	6						88
156.0	6	6	6	5	5	5	5	5	5	5	5	5	5	5	5	5	6						89
157.6	6	6	6	5	5	5	6	5	5	5	5	5	5	5	5	5	6						90
159.2	6	6	6	5	5	5	6	5	5	5	6	5	5	5	5	5	6						91
160.8	6	6	6	5	6	5	6	5	5	5	6	5	5	5	5	5	6						92
162.4	6	6	6	5	6	5	6	5	5	5	6	5	5	5	6	5	6						93
164.0	6	6	6	5	6	5	6	5	6	5	6	5	5	5	6	5	6						94
165.6	6	6	6	5	6	5	6	5	6	5	6	5	6	5	6	5	6						95
167.2	6	6	6	5	6	6	6	5	6	5	6	5	6	5	6	5	6						96
168.8	6	6	6	5	6	6	6	5	6	6	6	5	6	5	6	5	6						97
170.4	6	6	6	5	6	6	6	5	6	6	6	6	6	5	6	5	6						98
172.0	6	6	6	5	6	6	6	6	6	6	6	6	6	5	6	5	6						99
173.6	6	6	6	5	6	6	6	6	6	6	6	6	6	5	6	6	6						100
175.2	6	6	6	6	6	6	6	6	6	6	6	6	6	5	6	6	6						101
176.8	6	6	7	6	6	6	6	6	6	6	6	6	6	5	6	6	6						102
178.4	6	6	7	6	6	6	6	6	6	6	6	6	6	6	6	6	6						103
180.0	6	6	7	6	6	6	6	6	6	6	6	6	6	6	6	6	7						104
181.6	6	7	7	6	6	6	6	6	6	6	6	6	6	6	6	6	7						105
183.2	7	7	7	6	6	6	6	6	6	6	6	6	6	6	6	6	7						106
184.8	7	7	7	6	6	6	7	6	6	6	6	6	6	6	6	6	7						107
186.4	7	7	7	6	6	6	7	6	6	6	7	6	6	6	6	6	7						108
188.0	7	7	7	6	7	6	7	6	6	6	7	6	6	6	6	6	7						109
189.6	7	7	7	6	7	6	7	6	6	6	7	6	6	6	7	6	7						110
191.2	7	7	7	6	7	6	7	6	7	6	7	6	6	6	7	6	7						111
192.8	7	7	7	6	7	6	7	6	7	6	7	6	7	6	7	6	7						112
194.4	7	7	7	6	7	7	7	6	7	6	7	6	7	6	7	6	7						113
196.0	7	7	7	6	7	7	7	6	7	7	7	6	7	6	7	6	7						114
197.6	7	7	7	6	7	7	7	6	7	7	7	7	7	6	7	6	7						115
199.2	7	7	7	6	7	7	7	7	7	7	7	7	7	6	7	6	7						116
200.8	7	7	7	6	7	7	7	7	7	7	7	7	7	6	7	7	7						117

Total Spill [a]	MCN Spill Patterns During Removal of TSWs – # Gate Stops per Spillbay																						Total Stops
(kcfs)	1 [b]	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19 TSW	20 TSW	21	22 [b]	(#)
202.4	7	7	7	7	7	7	7	7	7	7	7	7	7	6	7	7	7						**118**
204.1	7	7	8	7	7	7	7	7	7	7	7	7	7	6	7	7	7						**119**
205.7	7	7	8	7	7	7	7	7	7	7	7	7	7	7	7	7	7						**120**
207.4	7	7	8	7	7	7	7	7	7	7	7	7	7	7	7	7	8						**121**
209.1	7	8	8	7	7	7	7	7	7	7	7	7	7	7	7	7	8						**122**
210.8	8	8	8	7	7	7	7	7	7	7	7	7	7	7	7	7	8						**123**
212.5	8	8	8	7	7	7	8	7	7	7	7	7	7	7	7	7	8						**124**
214.2	8	8	8	7	7	7	8	7	7	7	8	7	7	7	7	7	8						**125**
215.9	8	8	8	7	8	7	8	7	7	7	8	7	7	7	7	7	8						**126**
217.6	8	8	8	7	8	7	8	7	7	7	8	7	7	7	8	7	8						**127**
219.3	8	8	8	7	8	7	8	7	8	7	8	7	7	7	8	7	8						**128**
221.0	8	8	8	7	8	7	8	7	8	7	8	7	8	7	8	7	8						**129**
222.7	8	8	8	7	8	8	8	7	8	7	8	7	8	7	8	7	8						**130**
224.4	8	8	8	7	8	8	8	7	8	8	8	7	8	7	8	7	8						**131**
226.1	8	8	8	7	8	8	8	7	8	8	8	8	8	7	8	7	8						**132**
227.8	8	8	8	7	8	8	8	8	8	8	8	8	8	7	8	7	8						**133**
229.5	8	8	8	7	8	8	8	8	8	8	8	8	8	7	8	8	8						**134**
231.2	8	8	8	8	8	8	8	8	8	8	8	8	8	7	8	8	8						**135**
232.8	8	8	9	8	8	8	8	8	8	8	8	8	8	7	8	8	8						**136**
234.5	8	8	9	8	8	8	8	8	8	8	8	8	8	8	8	8	8						**137**
236.1	8	8	9	8	8	8	8	8	8	8	8	8	8	8	8	8	9						**138**
237.7	8	9	9	8	8	8	8	8	8	8	8	8	8	8	8	8	9						**139**
239.3	9	9	9	8	8	8	8	8	8	8	8	8	8	8	8	8	9						**140**

a. Total Spill calculated based on forebay elevation 339 ft = ~1.8 kcfs spill per 1 gate stop.
b. Bays 1 & 22 *MAY* require special open/close sequence (pending field test verification). Open: Bays 2–21, then 1 & 22 after 2-21 have operated ≥10 minutes. Close: Bays 1 & 22, then 2–21.

2014 Fish Passage Plan

Section 6 – Ice Harbor Dam

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Ice Harbor Dam

Project Acronym *	IHR
River Mile (RM)	Snake River – RM 9.7
Reservoir	Lake Sacajawea
Minimum Instantaneous Flow (kcfs)	Dec–Feb: 0 kcfs \ Mar–Jul: 9.5 kcfs \ Aug–Nov: 7.5 kcfs
Forebay Normal Operating Range (ft)	437’ – 440’
Tailrace Rate of Change Limit (ft)	1.5’/hr
Powerhouse Length (ft)	671’
Powerhouse Hydraulic Capacity (kcfs)	106 kcfs
Turbine Units (#)	6 (Units 1-3 Smith Kaplan; Units 4-6 Allis Chalmers Kaplan)
Turbine Unit Generating Capacity (MW)	Rated: 603 MW (Units 1-3 @ 90 MW + Units 4-6 @ 111 MW) Maximum: 693 MW (Units 1-3 @ 103 MW + Units 4-6 @ 128 MW)
Spillway Length (ft)	590’
Spillway Hydraulic Capacity (kcfs)	850 kcfs
Spillbays (#)	10
Spillway Weirs (#)	1 (Bay 2)
Navigation Lock Length x Width (ft)	650’ x 84’ (Usable Space)
Navigation Lock Max. Lift (ft)	100’
FISH STRUCTURE/OPERATION START DATE	
Juvenile Bypass System (JBS)	1961 (1st Generation)
Orifices (12” diameter)	1965 (2nd Generation)
Transportation Research Program - NMFS	1965
Submersible Traveling Screens (STS)	1994
Juvenile Fish Transportation Program - Corps	1981
Removable Spillway Weir (RSW)	2005
Adult Fish Counts	1969 (South Shore & North Shore)

*Project acronym as designated by US Army Corps of Engineers, Northwestern Division, Columbia Basin Water Management Division. Due to the large number of projects managed by NWD, the acronym may differ from other more commonly used acronyms. For example, Ice Harbor is often abbreviated as ICE. However, that acronym was already assigned for another NWD project, therefore the official Corps NWD acronym for Ice Harbor is IHR

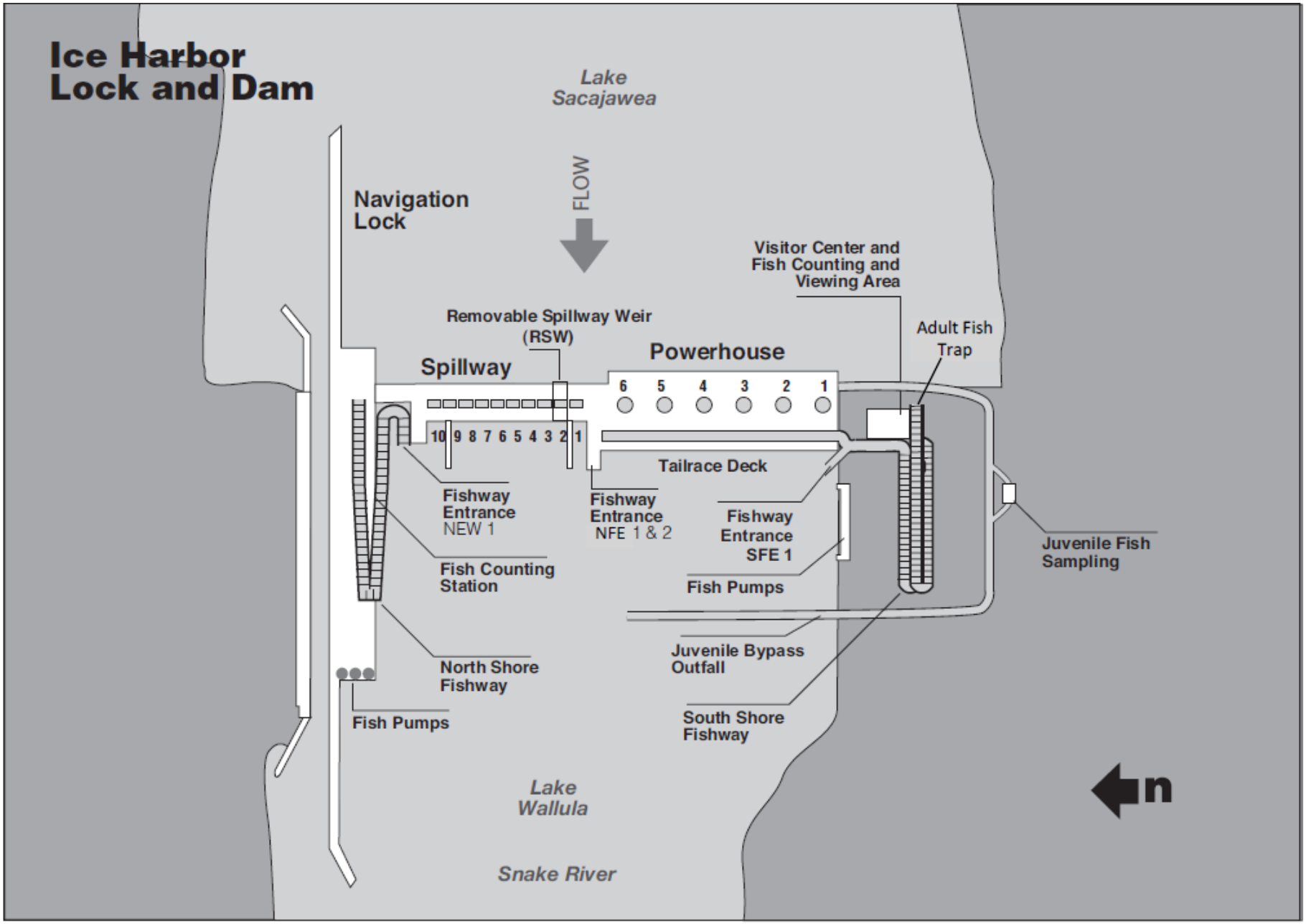
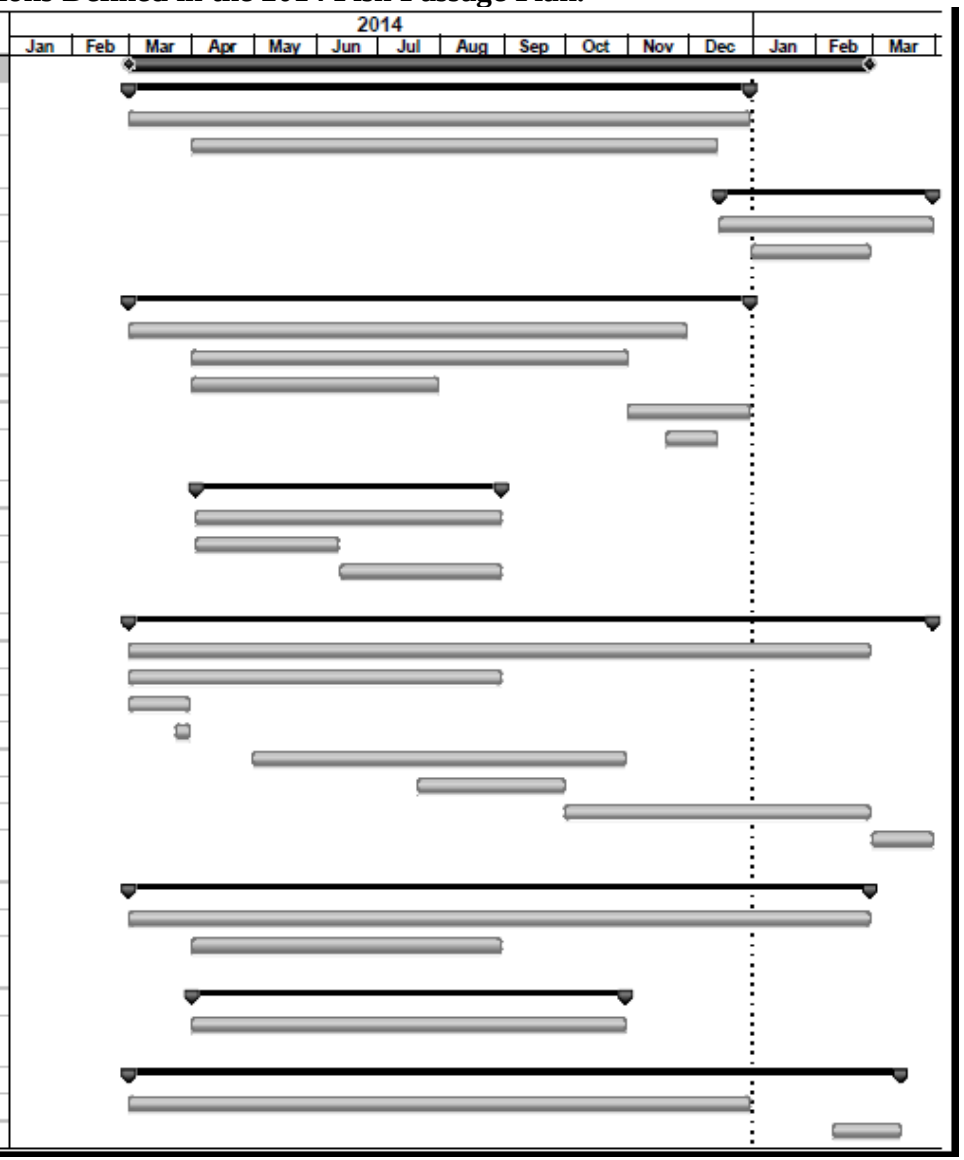


Figure IHR-1. Ice Harbor Lock and Dam General Site Plan.

Table IHR-1. Ice Harbor Dam Schedule of Operations and Actions Defined in the 2014 Fish Passage Plan.

Task Name	Start Date	End Date	FPP Reference
2014 FPP Operations & Actions - Ice Harbor	**3/1/14**	**2/28/15**	**IHR**
Fish Passage Facilities Operation	**3/1/14**	**12/31/14**	**2.3.**
Adult Fish Facilities	3/1/14	12/31/14	2.3.2.2
Juvenile Fish Facilities	4/1/14	12/15/14	2.3.1
Fish Passage Facilities Maintenance	**12/16/14**	**3/31/15**	**2.3**
Juvenile Fish Facilities Winter Maintenance	12/16/14	3/31/15	2.3.1.1
Adult Fish Facilities Winter Maintenance	1/1/15	2/28/15	2.3.2.1
Turbine Operations for Fish Passage	**3/1/14**	**12/31/14**	**4.1., 2.3.1.**
Turbine operating priority order	3/1/14	11/30/14	Table IHR-4
1% operating range - hard constraint	4/1/14	10/31/14	4.1.3.
Backflush orifices ≥ once per 8-hrs	4/1/14	7/31/14	2.3.1.2.c.6.
Priority turbine unit maintenance	11/1/14	12/31/14	4.3.
STS removal if cold-weather criteria apply	11/20/14	12/15/14	2.3.1.2.b.9
Spill Operations for Fish Passage	**4/3/14**	**8/31/14**	**2.3.1.2., App E**
Spillway Weir in service (end date approx)	4/3/14	8/31/14	2.3.1.2.g.
Spring Spill Operations (end date approx)	4/3/14	6/12/14	FOP
Summer Spill Operations (dates approx)	6/13/14	8/31/14	FOP
Special Operations & Studies (dates approximate)	**3/1/14**	**3/31/15**	**App A**
Adult Salmon Studies	3/1/14	2/28/15	6.2.2.
Sensor Fish Turbine Characterization Study	3/1/14	8/31/14	6.2.1.
Units 4-6 MU Digital Governor Replacement	3/1/14	3/31/14	6.1.3.
Units 4-6 Steady State Model Validation Test	3/24/14	3/31/14	6.1.3.
Adult Lamprey Passage Studies	5/1/14	10/31/14	6.2.3.-.5.
Transformer Oil Replacement	7/21/14	10/1/14	6.1.5.
Units 1-3 MU Digital Governor Replacement	10/1/14	2/28/15	6.1.3.
Units 1-3 Steady State Model Validation Test	3/1/15	3/31/15	6.1.3.
TDG Monitoring	**3/1/14**	**2/28/15**	**2.2.**
TDG Monitoring - Tailrace (year-round)	3/1/14	2/28/15	station IDSW
TDG Monitoring - Forebay	4/1/14	8/31/14	station IHRA
Adult Fish Counting	**4/1/14**	**10/31/14**	**Table IHR-2**
Daytime Visual 0400-2000 PST	4/1/14	10/31/14	
Reports	**3/1/14**	**3/15/15**	**2.3.3.**
Weekly Reports	3/1/14	12/31/14	
Annual Report	2/10/15	3/15/15	



1. FISH PASSAGE INFORMATION

The locations of fish passage facilities and other dam structures at Ice Harbor Lock and Dam are shown on the general site plan in **Figure IHR-1**. The schedule of project operations described in the Fish Passage Plan (FPP) and appendices is included 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 (see **FPP Section 7 - Lower Monumental Dam, Table LMN-2**). Salmon, steelhead, bull trout, lamprey, and other species are routinely counted when sampling occurs at Ice Harbor Dam. 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.

1.2.2. Adult Migration Timing and Counting. Upstream migrants are present throughout the year and adult passage facilities are operated year-round. Maintenance of adult facilities is scheduled for January–February, typically one shore at a time, to minimize impacts on upstream migrants. Adult salmon, steelhead, shad, and lamprey are counted (**Table IHR-2**) and daily data are posted online at: http://www.nwp.usace.army.mil/Missions/Environment/Fishdata.aspx. Yearly counts are used to determine peak adult migration timing (**Table IHR-3**). Sturgeon and bull trout are relatively infrequent and counts are posted online periodically during the passage season in *Miscellaneous Fish Counts* and summarized in the *Annual Fish Passage Report*.

Table IHR-2. Adult Fish Counting Schedule at Ice Harbor Dam (3/1/2014-2/28/2015).

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

*All count hours are shown in Pacific Standard Time (PST). Note that during Daylight Saving Time (DST) from Mar 9–Nov 2, 2014, count hours will be one hour later (DST = PST+1).

Table IHR-3. Adult Fish Count Period and Peak Passage Timing at Ice Harbor Dam (based on yearly counts since 1962).

Species	Count Period	Earliest Peak	Latest Peak
Spring Chinook	Apr 1 – Jun 11	Apr 22	May 26
Summer Chinook	Jun 12 – Aug 11	Jun 12	Jul 23
Fall Chinook	Aug 12 – Oct 31	Sep 2	Sep 30
Steelhead	Apr 1 – Oct 31	Sep 15	Oct 12
Sockeye	Apr 1 – Oct 31	Jul 1	Sep 22
Lamprey	Apr 1 – Oct 31	Jul 21	Sep 3

1.2.2.1. Time-of-day (diel) distributions of adult salmonid activity at Ice Harbor Dam fishway entrances and exits are summarized in **Figure IHR-2** (see *Keefer & Caudill 2008* at: http://www.nwd-wc.usace.army.mil/tmt/documents/FPOM/2010/2013_FPOM_MEET/2013_JUN/).

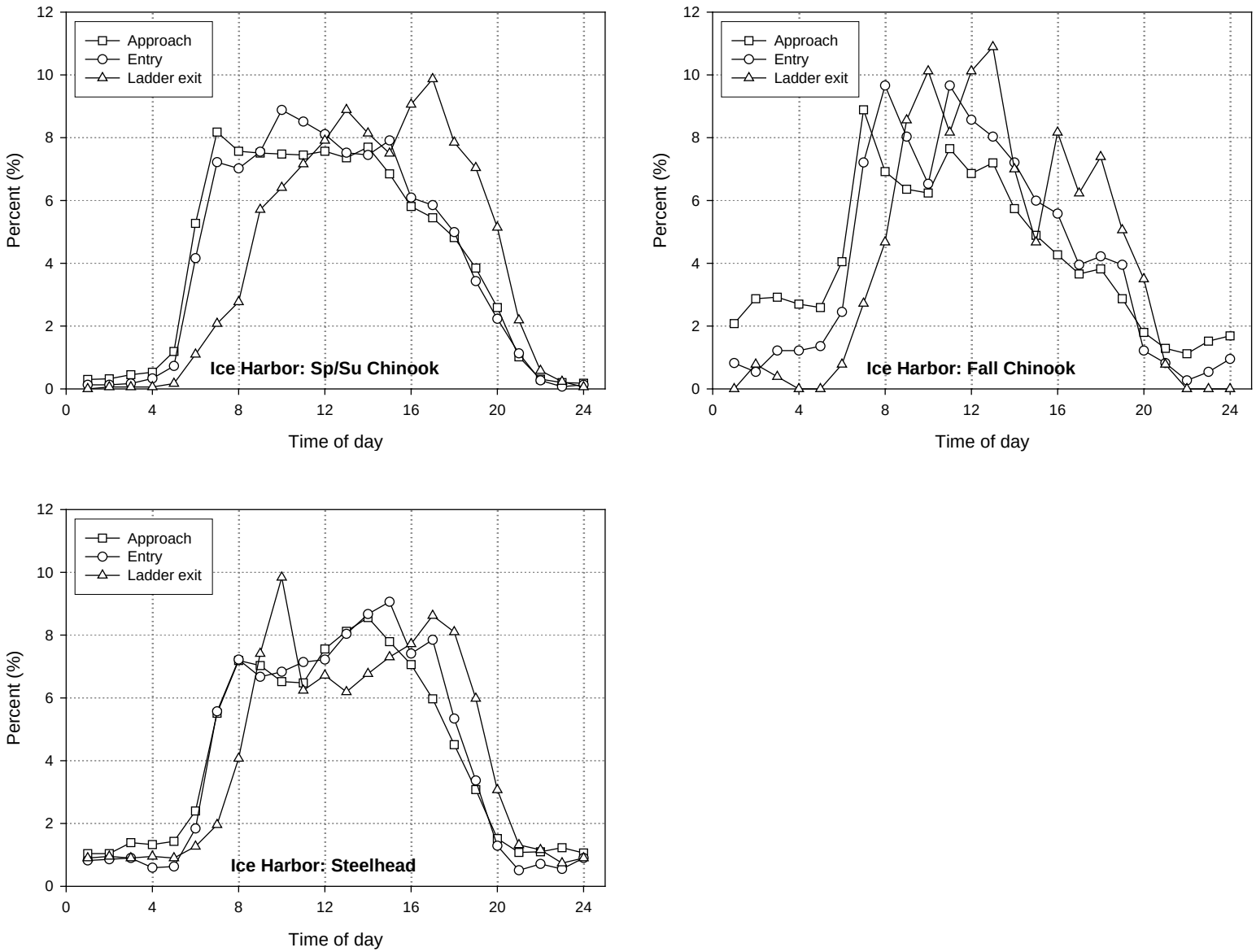


Figure IHR-2. Diel Distribution of Adult Salmonids at Ice Harbor Dam Fishway Entrances and Exits (*Keefer & Caudill 2008*).

2. PROJECT OPERATIONS

2.1. Spill Management.

See the 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. Total Dissolved Gas (TDG) Management.

Total dissolved gas (TDG) levels at all projects are monitored in accordance with the TDG Monitoring Plan, included in the Water Management Plan as Appendix 4 and available online at: http://www.nwd-wc.usace.army.mil/tmt/documents/wmp/.

2.3. Operating Criteria.

2.3.1. Juvenile Fish Passage Facilities. Operate from April 1–October 31 for juvenile fish passage and from November 1–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–March 31). Check and perform maintenance as required on the items listed below.

2.3.1.1.a. Forebay Area and Intakes.

a.1. Remove debris from forebay and gatewell slots.

a.2. Rake trashracks just prior to the operating season.

a.3. Measure gatewell drawdown in slots after cleaning trashracks with STSs in place.

a.4. Inspect and repair gatewell dip net as needed.

2.3.1.1.b. Submersible Traveling Screens (STSs), Vertical Barrier Screens (VBSs).

b.1. Maintenance completed on all screens.

b.2. Inspect STSs prior to installation and operate one trial run (dogged off on deck) to ensure proper operation.

b.3. Log trial run.

b.4. Inspect all VBSs at least once per year with underwater video camera. Repair as needed.

2.3.1.1.c. Collection Channel.

c.1. Water-up valve capable of operating when needed.

c.2. Orifice lights are operational.

c.3. Orifices clean and valves operating correctly.

c.4. Orifice air backflush system works correctly.

c.5. Netting along handrails maintained and in good condition.

c.6. Netting or covers over orifice chutes maintained and in good condition.

2.3.1.1.d. Dewatering Structure and Flume.

d.1. Inclined screen should be clean and in good condition with no gaps between screen panels, damaged panels, or missing silicone.

d.2. Screen cleaning system (brush and air flush) maintained and operating correctly.

d.3. Overflow weirs should be maintained, tested, and operating correctly.

d.4. All valves should be operating correctly.

d.5. Flume interior should be smooth with no rough edges.

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

2.3.1.1.e. Sampling Facilities.

e.1. Flume dewatering structure maintained in good operating condition with no holes or gaps between dewatering screen panels. Silicone sealer in good condition.

e.2. Flume drop gate should be maintained and in good operating condition.

e.3. The wet separator and fish distribution system should be maintained and ready for operation as designed.

e.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.

e.5. All valves and switch gates maintained and in good operating condition.

e.6. All sampling equipment maintained and in good operating condition.

e.7. Maintain juvenile PIT-tag system as required. Coordinate with PSMFC.

2.3.1.1.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.

2.3.1.1.g. Maintenance Records. Record all maintenance and inspections.

2.3.1.2. Juvenile Fish Passage Period (April 1–December 15).

2.3.1.2.a. Forebay Area and Intakes.

a.1. Remove debris from forebay.

a.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.

a.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.

a.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.

a.5. Dip bulkhead gatewell slots to remove fish prior to installing bulkhead for dewatering bulkhead slot.

2.3.1.2.b. STSs and VBSs.

b.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.

b.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.

b.3. Inspect each STS once per month by means of underwater video. Spot check VBSs at the same time.

b.4. Record STS amp readings daily.

b.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.

b.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.

b.7. Make formal determination at end of season as to adequacy of STS screen mesh and replacement if necessary.

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

b.9. When extreme cold weather is forecasted to occur for an extended period of time (defined as forecasted temperatures <20°F for ≥24 hours) between Thanksgiving and December 15, 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.

2.3.1.2.c. Collection Channel.

c.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).

c.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.

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

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

c.5. Orifice valves are either fully open or closed.

c.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.

c.7. Water-up valve capable of operating when needed.

c.8. The netting along handrails should be maintained in good condition with no holes or gaps in the netting.

c.9. Netting or covers over orifice chutes in good condition.

2.3.1.2.d. Dewatering Structure.

d.1. Trash sweep operating correctly. The Project Fisheries Biologist shall determine the frequency of sweep. It should be set as necessary to maintain a clean screen, with a minimum operation of at least once every 4 hours. If automated cleaning system problems occur, operate manually at least once per work shift, or more as necessary, to maintain a clean screen.

d.2. Clean trapezoidal section at least once per day, and more frequently if required, to maintain a clean condition.

d.3. Check overflow weirs to make sure they are operating correctly, perform maintenance as required.

d.4. There should be no gaps between screen panels in the inclined screen or holes in the screen panels.

d.5. Lights at the dewatering structure should be turned off at night, unless needed for personnel access, to encourage fish to move downstream volitionally.

2.3.1.2.e. Sampling Facilities.

e.1. All screens should be inspected to make sure there are no holes or sharp edges.

e.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° F unless authorized by an ESA permit. Provide information in weekly report.

e.3. Crowder screen brushes should be maintained in good operating condition with no holes or sharp edges in the crowder screen.

e.4. Operate pre-anesthetic system as designed.

e.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).

2.3.1.2.f. Avian Predation Areas (Forebay and Tailrace).

f.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.

f.2. Harassment program in place to deter avian predation in areas actively used by birds and not covered by bird wires or other devices.

f.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.

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

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

g.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.

g.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.

2.3.1.2.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–February 28).

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

[1] Spillway weirs provide surface passage routes via spillbay(s). Temporary, or Top, Spillway Weirs (*TSW*s) at Little Goose, McNary and John Day dams can be installed, uninstalled and moved between bays using the gantry crane. Removable Spillway Weirs (*RSW*s) at Lower Granite, Lower Monumental and Ice Harbor dams are "removed" by controlled descent to the bottom of the forebay.

2.3.2.1.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.

2.3.2.1.c. Inspect for and clean debris from the fish ladder exits. All trashracks and picketed leads must be clean and installed correctly.

2.3.2.1.d. Calibrate all water level measuring devices, as necessary, for proper facility operations.

2.3.2.1.e. Inspect all spill gates and ensure that they are operable.

2.3.2.1.f. Fish pumps maintained and ready for operation.

2.3.2.1.g. Maintain adult PIT-tag system as required. Coordinate with PSMFC.

2.3.2.1.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–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.*

2.3.2.2.a. Fishway Ladders. Water depth over weirs: 1' to 1.3'.

2.3.2.2.b. Counting Windows. The crowder shall be opened to full count slot width when not counting. The crowder shall be open as far as possible to allow accurate counting and shall not be closed to less than 18” while counting. This will usually occur during high turbidity conditions to allow count accuracy criteria to be achieved. All equipment should be maintained and in good condition. The counting window and backboard should be cleaned as needed to maintain good visibility. Crowder ranges at IHR are as follows:

i. North = 19.5” (fixed width)

ii. South = 19.5” (fixed width)

2.3.2.2.c. Head on all Fishway Entrances. Head range: 1' to 2'.

2.3.2.2.d. North Shore Entrance (NEW 1). Elevation at top of gate on sill = 332.25'.

d.1. Operate downstream gate closest to shore.

d.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.

d.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.

2.3.2.2.e. North Powerhouse Entrances (NFE 1&2). Elevation at top of gate on sill = 332.25'.

e.1. Operate 1 downstream gate.

e.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*.]

2.3.2.2.f. Floating Orifice Gates. Operate 4 floating orifices, OG1, 4, 10, and 12.

2.3.2.2.g. South Shore Entrance (SFE-1). Elevation of top of gate when on sill = 332.25'.

g.1. Operate entrance closest to powerhouse.

g.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.]*

2.3.2.2.h. Channel Velocity. 1.5–4.0 feet per second (fps). 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.

2.3.2.2.i. Head on Trashracks.

i.1. Maximum head of 0.5' on ladder exits.

i.2. Maximum head on picketed leads shall be 0.3'.

i.3. Trashracks and picketed leads installed correctly.

2.3.2.2.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.

2.3.2.2.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).

2.3.2.2.l. Facility Inspections.

l.1. Powerhouse operators shall inspect facilities once per day shift and check computer monitor information at least once during each back shift.

l.2. Project biologists shall inspect facilities three times per week. Inspect all facilities according to fish facilities monitoring program.

l.3. Picketed leads shall be inspected during all inspections to ensure they are clean and in the correct position (all the way down).

l.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.

l.5. Inspect fishways daily for foreign substances (particularly oil). If substances are found, corrective actions should be undertaken immediately.

l.6. Record all inspections.

2.3.3. Juvenile and Adult Fish Facility Monitoring & Reporting.

2.3.3.1. Project biologists shall inspect fish passage facilities at the frequencies listed in the juvenile and adult fish facilities operating criteria sections.

2.3.3.2. Weekly Reports. March 1–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:

i. Any out-of-criteria situations observed and subsequent corrective actions taken;

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

iii. Adult fishway control calibrations;

iv. STS and VBS inspections;

v. Any unusual activities at the project that may have affected fish passage.

2.3.3.3. 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 actions

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

2.3.3.4. 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.

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 the *Guidelines for Dewatering and Fish Handling Plans* (**Appendix F**).

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:

i. Description of the problem.

ii. Type of outage required.

iii. Impact on facility operation.

iv. Length of time for repairs.

v. Expected impacts on fish passage and proposed measures to mitigate them.

3.1.2.2. Submersible Traveling Screens (STSs). 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.

3.1.2.3. 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.

3.1.2.4. 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’ differential it initiates continuous screen cleaning. If the sensors detect a differential of 0.30’ 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.

3.1.2.5. 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**.

3.1.2.6. 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 & MAINTENANCE

4.1. Turbine Unit Operation.

When in operation, units will be operated to enhance adult and juvenile fish passage from March 1–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 eddying 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.

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. Single Unit Operation. Ice Harbor should not operate a single unit on the *Ice Harbor-Franklin No.2 115 kV* line. This line is connected to the *Sacajawea 500/115kV* transformer and the operation of a single unit on the line jeopardizes BPA system reliability. Therefore, 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.

4.1.2.1. 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.

Operation	Season	Unit Priority (see Section 4.1)
Single Unit Operation w/ NO Switching **Switching must occur prior to returning to normal operating priority below.*	Year-Round	1,2,6,5
Multiple Unit Operation	Fish Passage Season March 1 – November 30	1,3,6,4,2,5
		If Unit 1 OOS and switching has not occurred: 2,3,6,4,5
	Winter Maintenance Period December 1 – February 28	Any order

4.1.3. Turbine Unit Operating Ranges. From April 1–October 31, turbine units will be operated within ±1% of peak turbine efficiency (1% range) as specified in *BPA's Load Shaping Guidelines* (**Appendix C**). Turbine unit output and discharge at the lower and upper 1% limits (with and without STSs) for various heads are defined in **Tables IHR-5, IHR-6, IHR-**7. If operation outside the 1% range is necessary, Project personnel shall record the information and provide to BPA on a weekly basis according to the guidelines. Operation outside of the 1% range may be necessary to:

i. Meet BPA load requirements. Load requests will be made in accordance with BPA's policy, statutory requirements and load shaping guidelines (**Appendix C**);

ii. If the draft tube is to be dewatered, the unit will be operated at full load (>1%) for a minimum of 15 minutes prior to installing tail logs. If not possible to load, the unit will be run at speed-no-load (<1%) for a minimum of 15 minutes. This is to reduce the number of fish in the scroll case prior to installing stop logs;

iii. Operate a turbine unit solely to provide station service; or

iv. Comply with other coordinated fish measures.

4.1.3.1.a. From November 1–March 31, turbine units will continue to be operated within the 1% range except when BPA load requests require units to be operated outside 1%.

4.1.4. Minimum Generation / Power System Reliability. All of the lower Snake River powerhouses may be required to keep one generating turbine unit online 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 Units 1 and 3-6, and 11.3–13.1 kcfs through 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 range. When inspection or repair work can be scheduled ahead of time, the following process will be followed:

i. 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.

ii. Project personnel shall also contact CENWW-OD-T and RCC by the same time period and inform them of the intended work.

iii. RCC will coordinate the work activities through TMT.

iv. After coordination with TMT, RCC shall issue a teletype through the CBT issuing instructions to project and BPA personnel for the scheduled work.

v. Spill will be increased by one gate 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.

vi. 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.)

vii. 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.

viii. 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.

4.3.5. 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.

4.3.6. Unwatering turbine units should be accomplished in accordance with project dewatering plans. If the turbine unit scroll case and/or draft tube is to be dewatered, operate unit with full load for a minimum of 15 minutes prior to installing tail logs or lowering head gates.[2] 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 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.

4.3.7. 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

[2] Head gates may also be referred to as “operating” gates at some projects. The terms are interchangeable.

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. Debris Spill Coordination.

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. Project personnel shall provide CENWW-OD-T the reason for the debris spill request including an explanation of project facilities impacted by debris, the date and time of the requested spill, and any special powerhouse or other operations required to move the debris to the spillway. Using information provided by the project, CENWW-OD-T shall coordinate the special operations with RCC, NOAA Fisheries and FPOM. When a debris spill is coordinated and approved, RCC shall issue a teletype detailing the specifics of the special operations.

5.2. Emergency Spill.

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. Ice Harbor Dam Turbine Units 1 and 3 Output (MW) and Discharge (cfs) Per Unit at Upper and Lower Limits of the 1% Efficiency Range with and without STSs. [1]

Project Head (feet)	Turbine Units 1 and 3							
	with STSs				No STSs			
	1% Lower Limit		1% Upper Limit		1% Lower Limit		1% 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**

1. Data based on 1978 model test and 2006 Unit 3 index test (table revised 2008).

Table IHR-6. Ice Harbor Dam Turbine Units 4, 5 and 6 Output (MW) and Discharge (cfs) Per Unit at Upper and Lower Limits of the 1% Efficiency Range with and without STSs. [1]

Project Head (feet)	Turbine Units 4, 5 and 6							
	with STSs				No STSs			
	1% Lower Limit		1% Upper Limit		1% Lower Limit		1% 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**

1. Data based on 1978 model test and 2006 Unit 6 index test (table revised 2008).

Table IHR-7. Ice Harbor Dam Turbine Unit 2 Output (MW) and Discharge (cfs) at Upper and Lower Limits of the 1% Efficiency Range with and without STSs. [1]

Head (feet)	Turbine Unit 2							
	with STSs				No STSs			
	1% Lower Limit		1% Upper Limit		1% Lower Limit		1% 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**

1. Data based on 1978 Model Test and 2008 Unit 2 Index Test (new table 2008).

Table IHR-8. [*pg 1 of 2*] Ice Harbor Dam Spill Patterns with No RSW. [a, b]

Total Spill (kcfs)	IHR Spill Patterns – No RSW [a] # Gate Stops per Spillbay										Total Stops (#)
	Bay 1	Bay 2 RSW	Bay 3	Bay 4	Bay 5	Bay 6	Bay 7	Bay 8	Bay 9	Bay 10	
8.5		*CLOSED*	5								**5**
10.2		*CLOSED*	5							1	**6**
11.9		*CLOSED*	5						1	1	**7**
13.6		*CLOSED*	5						1.5	1.5	**8**
15.4		*CLOSED*	5						2	2	**9**
17.0		*CLOSED*	5		5						**10**
18.7		*CLOSED*	5		5					1	**11**
20.4		*CLOSED*	5.5		5.5					1	**12**
22.1		*CLOSED*	5.5		5.5				1	1	**13**
23.8		*CLOSED*	5.5		5.5				1.5	1.5	**14**
25.5		*CLOSED*	5		5		5				**15**
27.2		*CLOSED*	5		5		5			1	**16**
28.9		*CLOSED*	5.5		5.5		5			1	**17**
30.5		*CLOSED*	5.5		5.5		5.5			1.5	**18**
32.0		*CLOSED*	6		6		6			1	**19**
34.0		*CLOSED*	5		5		5		5		**20**
35.7		*CLOSED*	5		5		5		5	1	**21**
37.3		*CLOSED*	5.5		5		5		5.5	1	**22**
39.0		*CLOSED*	5.5		5.5		5.5		5.5	1	**23**
40.6		*CLOSED*	6		5.5		5.5		6	1	**24**
42.1		*CLOSED*	6		6		6		6	1	**25**
44.2		*CLOSED*	5	5	5		5		5	1	**26**
45.8		*CLOSED*	5.5	5	5		5		5.5	1	**27**
47.5		*CLOSED*	5.5	5	5.5		5.5		5.5	1	**28**
49.1		*CLOSED*	5.5	5.5	5.5		5.5		6	1	**29**
50.7		*CLOSED*	5.5	5.5	6		6		6	1	**30**
52.2		*CLOSED*	6	6	6		6		6	1	**31**
54.0		*CLOSED*	6	6	6.5		6.5		6	1	**32**
55.8		*CLOSED*	6.5	6.5	6.5		6.5		6	1	**33**
57.5		*CLOSED*	6	6	5	5	5		6	1	**34**
59.1		*CLOSED*	6	6	5	5	6		6	1	**35**
60.7		*CLOSED*	6	6	6	5	6		6	1	**36**
62.3		*CLOSED*	6	6	6	6	6		6	1	**37**
64.1		*CLOSED*	6	6	6	6	7		6	1	**38**
65.7		*CLOSED*	6	6	6	6	7		7	1	**39**
67.4		*CLOSED*	6	6	6	7	7		7	1	**40**
69.1		*CLOSED*	6	6	7	7	7		7	1	**41**
70.8		*CLOSED*	6	7	7	7	7		7	1	**42**
72.5		*CLOSED*	7	7	7	7	7		7	1	**43**

Total Spill (kcfs)	IHR Spill Patterns – No RSW [a] # Gate Stops per Spillbay										Total Stops (#)
	Bay 1	Bay 2 RSW	Bay 3	Bay 4	Bay 5	Bay 6	Bay 7	Bay 8	Bay 9	Bay 10	
74.1	6	*CLOSED*	6	6	6	6	7		6	1	**44**
75.8	6	*CLOSED*	6	6	6	7	7		6	1	**45**
77.5	6	*CLOSED*	6	6	7	7	7		6	1	**46**
79.2	6	*CLOSED*	6	7	7	7	7		6	1	**47**
80.9	6	*CLOSED*	7	7	7	7	7		6	1	**48**
82.5	6	*CLOSED*	6	6	6	6	6	6	6	1	**49**
84.2	6	*CLOSED*	6	6	6	6	7	6	6	1	**50**
85.9	6	*CLOSED*	6	6	6	7	7	6	6	1	**51**
87.6	6	*CLOSED*	6	6	6	7	7	6	7	1	**52**
89.3	6	*CLOSED*	6	6	7	7	7	6	7	1	**53**
91.0	6	*CLOSED*	6	7	7	7	7	6	7	1	**54**
92.7	6	*CLOSED*	7	7	7	7	7	6	7	1	**55**

a. Spill patterns calculated at ~1.7 kcfs per gate stop. .

Table IHR-9. [*pg 1 of 3*] Ice Harbor Dam Spill Patterns for 30% Spill with RSW. [a]

Total Outflow	Total Spill [b]		IHR Spill Patterns – 30% Spill with RSW [a] # Gate Stops per Spillbay										Total Stops
(kcfs)	(kcfs)	(%)	1	2 RSW	3	4	5	6	7	8	9	10	(#)
28.0	**8.4**	**30.0%**		RSW									**0**
33.7	**10.1**	**30.0%**		RSW								1	**1**
39.3	**11.8**	**30.0%**		RSW							1	1	**2**
45.0	**13.5**	**30.0%**		RSW						1	1	1	**3**
50.7	**15.2**	**30.0%**		RSW					1	1	1	1	**4**
56.3	**16.9**	**30.0%**		RSW				1	1	1	1	1	**5**
62.0	**18.6**	**30.0%**		RSW	5							1	**6**
67.7	**20.3**	**30.0%**		RSW	5						1	1	**7**
73.3	**22.0**	**30.0%**		RSW	5					1	1	1	**8**
79.0	**23.7**	**30.0%**		RSW	5				1	1	1	1	**9**
84.7	**25.4**	**30.0%**		RSW	5			1	1	1	1	1	**10**
90.3	**27.1**	**30.0%**		RSW	5		5					1	**11**
96.0	**28.8**	**30.0%**		RSW	5		5				1	1	**12**
101.7	**30.5**	**30.0%**		RSW	5		5			1	1	1	**13**
107.3	**32.2**	**30.0%**		RSW	5		5			1	1	2	**14**
113.0	**33.9**	**30.0%**		RSW	5		5			1	2	2	**15**
118.7	**35.6**	**30.0%**		RSW	5		5			2	2	2	**16**
120.4 [b]	**37.3**	**31.0%**		RSW	6		5			2	2	2	**17**
122.1	**39.0**	**31.9%**		RSW	6		6			2	2	2	**18**
123.8	**40.7**	**32.9%**		RSW	6		6		1	2	2	2	**19**
125.5	**42.4**	**33.8%**		RSW	6		6		2	2	2	2	**20**
127.2	**44.1**	**34.7%**		RSW	5		5		5	2	2	2	**21**
128.9	**45.8**	**35.5%**		RSW	5		5		6	2	2	2	**22**
130.6	**47.5**	**36.4%**		RSW	5		6		6	2	2	2	**23**
132.3	**49.2**	**37.2%**		RSW	6		6		6	2	2	2	**24**
134.0	**50.9**	**38.0%**		RSW	6		6		6	2	3	2	**25**
135.7	**52.6**	**38.8%**		RSW	6		6		6	2	4	2	**26**
137.4	**54.3**	**39.5%**		RSW	6		6		6	2	5	2	**27**
139.1	**56.0**	**40.3%**		RSW	6		6		6	2	6	2	**28**
140.8	**57.7**	**41.0%**		RSW	6		6	1	6	2	6	2	**29**
142.5	**59.4**	**41.7%**		RSW	6		6	2	6	2	6	2	**30**
144.2	**61.1**	**42.4%**		RSW	6		6	3	6	2	6	2	**31**
145.9	**62.8**	**43.0%**		RSW	6		6	4	6	2	6	2	**32**
147.6	**64.5**	**43.7%**		RSW	6		6	5	6	2	6	2	**33**
149.3	**66.2**	**44.3%**		RSW	6		6	6	6	2	6	2	**34**
151.0	**67.9**	**45.0%**		RSW	6		6	6	6	3	6	2	**35**
152.7	**69.6**	**45.6%**		RSW	6		6	6	6	4	6	2	**36**
154.4	**71.3**	**46.2%**		RSW	6		6	6	6	5	6	2	**37**
156.1	**73.0**	**46.8%**		RSW	6		6	6	6	6	6	2	**38**

Total Outflow	Total Spill [b]		IHR Spill Patterns – 30% Spill with RSW [a] # Gate Stops per Spillbay										Total Stops
(kcfs)	(kcfs)	(%)	1	2 RSW	3	4	5	6	7	8	9	10	(#)
157.8	**74.7**	**47.3%**		RSW	6	1	6	6	6	6	6	2	**39**
159.5	**76.4**	**47.9%**		RSW	6	2	6	6	6	6	6	2	**40**
161.2	**78.1**	**48.4%**		RSW	6	3	6	6	6	6	6	2	**41**
162.9	**79.8**	**49.0%**		RSW	6	4	6	6	6	6	6	2	**42**
164.6	**81.5**	**49.5%**		RSW	6	5	6	6	6	6	6	2	**43**
166.3	**83.2**	**50.0%**		RSW	6	6	6	6	6	6	6	2	**44**
168.0	**84.9**	**50.5%**		RSW	7	6	6	6	6	6	6	2	**45**
169.7	**86.6**	**51.0%**		RSW	7	7	6	6	6	6	6	2	**46**
171.4	**88.3**	**51.5%**		RSW	7	7	7	6	6	6	6	2	**47**
173.1	**90.0**	**52.0%**		RSW	7	7	7	7	6	6	6	2	**48**
174.8	**91.7**	**52.5%**		RSW	7	7	7	7	7	6	6	2	**49**
176.5	**93.4**	**52.9%**		RSW	7	7	7	7	7	7	6	2	**50**
178.2	**95.1**	**53.4%**		RSW	8	7	7	7	7	7	7	2	**51**
179.9	**96.8**	**53.8%**		RSW	8	7	7	7	7	7	7	2	**52**
181.6	**98.5**	**54.2%**		RSW	8	8	7	7	7	7	7	2	**53**
183.3	**100.2**	**54.7%**		RSW	8	8	8	7	7	7	7	2	**54**
185.0	**101.9**	**55.1%**		RSW	8	8	8	8	7	7	7	2	**55**
186.7	**103.6**	**55.5%**		RSW	8	8	8	8	8	7	7	2	**56**
188.4	**105.3**	**55.9%**		RSW	8	8	8	8	8	8	7	2	**57**
190.1	**107.0**	**56.3%**		RSW	8	8	8	8	8	8	8	2	**58**
191.8	**108.7**	**56.7%**		RSW	9	8	8	8	8	8	8	2	**59**
193.5	**110.4**	**57.1%**		RSW	9	9	8	8	8	8	8	2	**60**
195.2	**112.1**	**57.4%**		RSW	9	9	9	8	8	8	8	2	**61**
196.9	**113.8**	**57.8%**		RSW	9	9	9	9	8	8	8	2	**62**
198.6	**115.5**	**58.2%**		RSW	9	9	9	9	9	8	8	2	**63**
200.3	**117.2**	**58.5%**		RSW	9	9	9	9	9	9	8	2	**64**
202.0	**118.9**	**58.9%**		RSW	9	9	9	9	9	9	9	2	**65**
203.7	**120.6**	**59.2%**		RSW	10	9	9	9	9	9	9	2	**66**
205.4	**122.3**	**59.5%**		RSW	10	10	9	9	9	9	9	2	**67**
207.1	**124.0**	**59.9%**		RSW	10	10	10	9	9	9	9	2	**68**
208.8	**125.7**	**60.2%**		RSW	10	10	10	10	9	9	9	2	**69**
210.5	**127.4**	**60.5%**		RSW	10	10	10	10	10	9	9	2	**70**
212.2	**129.1**	**60.8%**		RSW	10	10	10	10	10	10	9	2	**71**
213.9	**130.8**	**61.2%**		RSW	10	10	10	10	10	10	10	2	**72**
215.6	**132.5**	**61.5%**		RSW	11	10	10	10	10	10	10	2	**73**
217.3	**134.2**	**61.8%**		RSW	11	11	10	10	10	10	10	2	**74**
219.0	**135.9**	**62.1%**		RSW	11	11	11	10	10	10	10	2	**75**
220.7	**137.6**	**62.3%**		RSW	11	11	11	11	10	10	10	2	**76**
222.4	**139.3**	**62.6%**		RSW	11	11	11	11	11	10	10	2	**77**
224.1	**141.0**	**62.9%**		RSW	11	11	11	11	11	11	10	2	**78**

Total Outflow	Total Spill [b]		IHR Spill Patterns – 30% Spill with RSW [a] # Gate Stops per Spillbay										Total Stops
(kcfs)	(kcfs)	(%)	1	2 RSW	3	4	5	6	7	8	9	10	(#)
225.8	**142.7**	**63.2%**		RSW	11	11	11	11	11	11	11	2	**79**
227.5	**144.4**	**63.5%**		RSW	12	11	11	11	11	11	11	2	**80**
229.2	**146.1**	**63.7%**		RSW	12	12	11	11	11	11	11	2	**81**
230.9	**147.8**	**64.0%**		RSW	12	12	12	11	11	11	11	2	**82**
232.6	**149.5**	**64.3%**		RSW	12	12	12	12	11	11	11	2	**83**
234.3	**151.2**	**64.5%**		RSW	12	12	12	12	12	11	11	2	**84**

a. Spill patterns calculated at ~1.7 kcfs per gate stop and RSW fixed at ~8.4 kcfs. Last revised May 17, 2011.

b. At "Total Outflow" >118.7 kcfs, resulting "Total Spill" is >30% due to powerhouse at maximum turbine capacity.

Table IHR-10. [*pg 1 of 3*] Ice Harbor Dam Spill Patterns for 45 kcfs/TDG Cap with RSW. [a]

Total Spill (kcfs)	IHR Spill Patterns – 45kcfs/TDG Cap with RSW [a] # Gate Stops per Spillbay										Total Stops (#)
	1	2 RSW [b]	3	4	5	6	7	8	9	10	
8.4 [b]		RSW									**0**
10.1		RSW								1	**1**
11.8		RSW							1	1	**2**
13.5		RSW						1	1	1	**3**
15.2		RSW					1	1	1	1	**4**
17.0		RSW				1	1	1	1	1	**5**
18.6		RSW		5						1	**6**
20.3		RSW		5					1	1	**7**
22.0		RSW		5				1	1	1	**8**
23.7		RSW		5			1	1	1	1	**9**
25.3		RSW		5		5					**10**
27.0		RSW		5		5				1	**11**
28.7		RSW		5		5			1	1	**12**
30.4		RSW		5		5		1	1	1	**13**
32.1		RSW		5		5	1	1	1	1	**14**
33.8		RSW		5		5	1	1	1	2	**15**
35.5		RSW		5		5	1	1	2	2	**16**
37.2		RSW		5		5	1	2	2	2	**17**
38.9		RSW		5		5	2	2	2	2	**18**
40.6		RSW		5		5	2	2	2	3	**19**
42.3		RSW		5		5	2	2	3	3	**20**
44.0		RSW		5		5	5	2	2	2	**21**
45.6		RSW		6		5	5	2	2	2	**22**
47.3		RSW		6		6	5	2	2	2	**23**
48.9		RSW		6		6	6	2	2	2	**24**
50.7		RSW		6	5	5	5	1	1	2	**25**
52.4		RSW		6	5	5	5	1	2	2	**26**
54.1		RSW		6	5	5	5	2	2	2	**27**
55.7		RSW		6	6	5	5	2	2	2	**28**
57.4		RSW		6	6	5	5	2	3	2	**29**
59.1		RSW		6	6	5	5	2	4	2	**30**
60.7		RSW		6	6	5	5	2	5	2	**31**
62.4		RSW		6	6	5	5	3	5	2	**32**
64.1		RSW		6	6	5	5	4	5	2	**33**
65.8		RSW		6	6	5	5	5	5	2	**34**
67.5		RSW	1	6	6	5	5	5	5	2	**35**
69.2		RSW	2	6	6	5	5	5	5	2	**36**
70.9		RSW	3	6	6	5	5	5	5	2	**37**
72.6		RSW	4	6	6	5	5	5	5	2	**38**

Total Spill (kcfs)	IHR Spill Patterns – 45kcfs/TDG Cap with RSW [a] # Gate Stops per Spillbay										Total Stops (#)
	1	2 RSW [b]	3	4	5	6	7	8	9	10	
74.2		RSW	5	6	6	5	5	5	5	2	**39**
75.9		RSW	6	6	6	5	5	5	5	2	**40**
77.5		RSW	6	6	6	6	5	5	5	2	**41**
79.2		RSW	6	6	6	6	6	5	5	2	**42**
80.9		RSW	6	6	6	6	6	6	5	2	**43**
82.5		RSW	6	6	6	6	6	6	6	2	**44**
84.1		RSW	7	6	6	6	6	6	6	2	**45**
85.7		RSW	7	7	6	6	6	6	6	2	**46**
87.3		RSW	7	7	7	6	6	6	6	2	**47**
88.9		RSW	7	7	7	7	6	6	6	2	**48**
90.5		RSW	7	7	7	7	7	6	6	2	**49**
92.1		RSW	7	7	7	7	7	7	6	2	**50**
93.7		RSW	7	7	7	7	7	7	7	2	**51**
95.3		RSW	8	7	7	7	7	7	7	2	**52**
96.9		RSW	8	8	7	7	7	7	7	2	**53**
98.5		RSW	8	8	8	7	7	7	7	2	**54**
100.1		RSW	8	8	8	8	7	7	7	2	**55**
101.7		RSW	8	8	8	8	8	7	7	2	**56**
103.3		RSW	8	8	8	8	8	8	7	2	**57**
104.9		RSW	8	8	8	8	8	8	8	2	**58**
106.6		RSW	9	8	8	8	8	8	8	2	**59**
108.3		RSW	9	9	8	8	8	8	8	2	**60**
110.0		RSW	9	9	9	8	8	8	8	2	**61**
111.7		RSW	9	9	9	9	8	8	8	2	**62**
113.4		RSW	9	9	9	9	9	8	8	2	**63**
115.2		RSW	9	9	9	9	9	9	8	2	**64**
116.9		RSW	9	9	9	9	9	9	9	2	**65**
118.4		RSW	10	9	9	9	9	9	9	2	**66**
119.9		RSW	10	10	9	9	9	9	9	2	**67**
121.4		RSW	10	10	10	9	9	9	9	2	**68**
122.9		RSW	10	10	10	10	9	9	9	2	**69**
124.4		RSW	10	10	10	10	10	9	9	2	**70**
125.9		RSW	10	10	10	10	10	10	9	2	**71**
127.4		RSW	10	10	10	10	10	10	10	2	**72**
129.1		RSW	11	10	10	10	10	10	10	2	**73**
130.8		RSW	11	11	10	10	10	10	10	2	**74**
132.5		RSW	11	11	11	10	10	10	10	2	**75**
134.2		RSW	11	11	11	11	10	10	10	2	**76**
135.9		RSW	11	11	11	11	11	10	10	2	**77**
137.6		RSW	11	11	11	11	11	11	10	2	**78**

Total Spill (kcfs)	IHR Spill Patterns – 45kcfs/TDG Cap with RSW [a] # Gate Stops per Spillbay										Total Stops (#)
	1	2 RSW [b]	3	4	5	6	7	8	9	10	
139.3		RSW	11	11	11	11	11	11	11	2	**79**
140.8		RSW	12	11	11	11	11	11	11	2	**80**
143.8		RSW	12	12	12	11	11	11	11	2	**82**
145.3		RSW	12	12	12	12	11	11	11	2	**83**
146.8		RSW	12	12	12	12	12	11	11	2	**84**
148.3		RSW	12	12	12	12	12	12	11	2	**85**
149.8		RSW	12	12	12	12	12	12	12	2	**86**
151.4		RSW	13	12	12	12	12	12	12	2	**87**
153.0		RSW	13	13	12	12	12	12	12	2	**88**
154.6		RSW	13	13	13	12	12	12	12	2	**89**
156.2		RSW	13	13	13	13	12	12	12	2	**90**
157.8		RSW	13	13	13	13	13	12	12	2	**91**
159.4		RSW	13	13	13	13	13	13	12	2	**92**
161.0		RSW	13	13	13	13	13	13	13	2	**93**
162.6		RSW	14	13	13	13	13	13	13	2	**94**
164.2		RSW	14	14	13	13	13	13	13	2	**95**
165.8		RSW	14	14	14	13	13	13	13	2	**96**
167.4		RSW	14	14	14	14	13	13	13	2	**97**
169.0		RSW	14	14	14	14	14	13	13	2	**98**
170.6		RSW	14	14	14	14	14	14	13	2	**99**
172.2		RSW	14	14	14	14	14	14	14	2	**100**

a. Spill patterns calculated at ~1.7 kcfs per gate stop and RSW fixed at ~8.4 kcfs. Expanded June 2010 for higher spill rates.

2014 Fish Passage Plan

Section 7 – Lower Monumental Dam

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Section 7 - Lower Monumental Dam

Project Acronym*	LMN
River Mile (RM)	Snake River RM 41.6
Reservoir	Lake Herbert G. West
Minimum Instantaneous Flow (kcfs)	Dec–Feb: 0 kcfs \ Mar–Nov: 11.5 kcfs
Forebay Normal Operating Range (ft)	537’ – 540’
Tailrace Rate of Change Limit (ft/hr)	1.5’/hr
Powerhouse Length (ft)	656’
Powerhouse Hydraulic Capacity (kcfs)	130 kcfs
Turbine Units (#)	6 (Units 1-3 BLH Kaplan; Units 4-6 Allis Chalmers Kaplan)
Turbine Unit Generating Capacity (MW)	Rated: 810 MW (Units 1-6 @135 MW) \ Maximum: 930 MW (Units 1-6 @155 MW)
Gatewell Orifice Diameter	12”
Spillway Length (ft)	498’
Spillway Hydraulic Capacity (kcfs)	850 kcfs
Spillbays (#)	8
Spillway Weirs (#)	1 Removable Spillway Weir (RSW) in Bay 8
Navigation Lock Length x Width (ft)	650’ x 84’ (Usable Space)
Navigation Lock Max. Lift (ft)	100’
FISH STRUCTURE/OPERATION START DATE	
Juvenile Bypass System (JBS)	1969 (1st Generation) / 1991 (current)
Submersible Traveling Screens (STS)	1992
Juvenile Fish Transportation Program - Corps	1993
Removable Spillway Weir (RSW)	2008
Bypass Outfall Flume Relocation	2012
Adult Fish Counts	1969 (South Shore & North Shore)

***Project acronym designated by US Army Corps of Engineers, Northwestern Division, Columbia Basin Water Management Division. Due to the large number of projects managed by NWD, this acronym may differ from other acronyms used in the region. For example, a common acronym for Lower Monumental is LMO. However, that acronym is assigned to another NWD project, thus the official Corps NWD acronym is LMN.

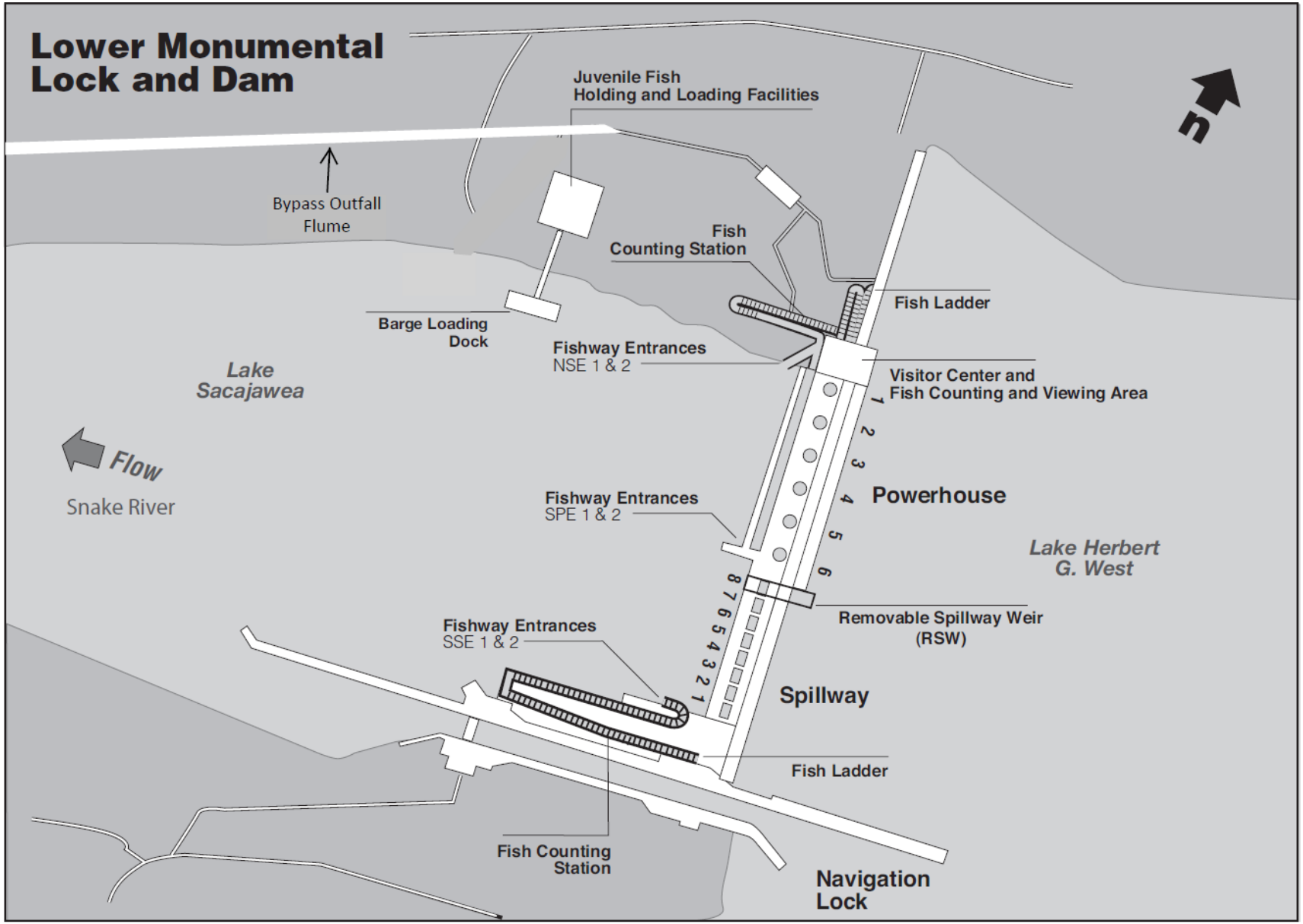
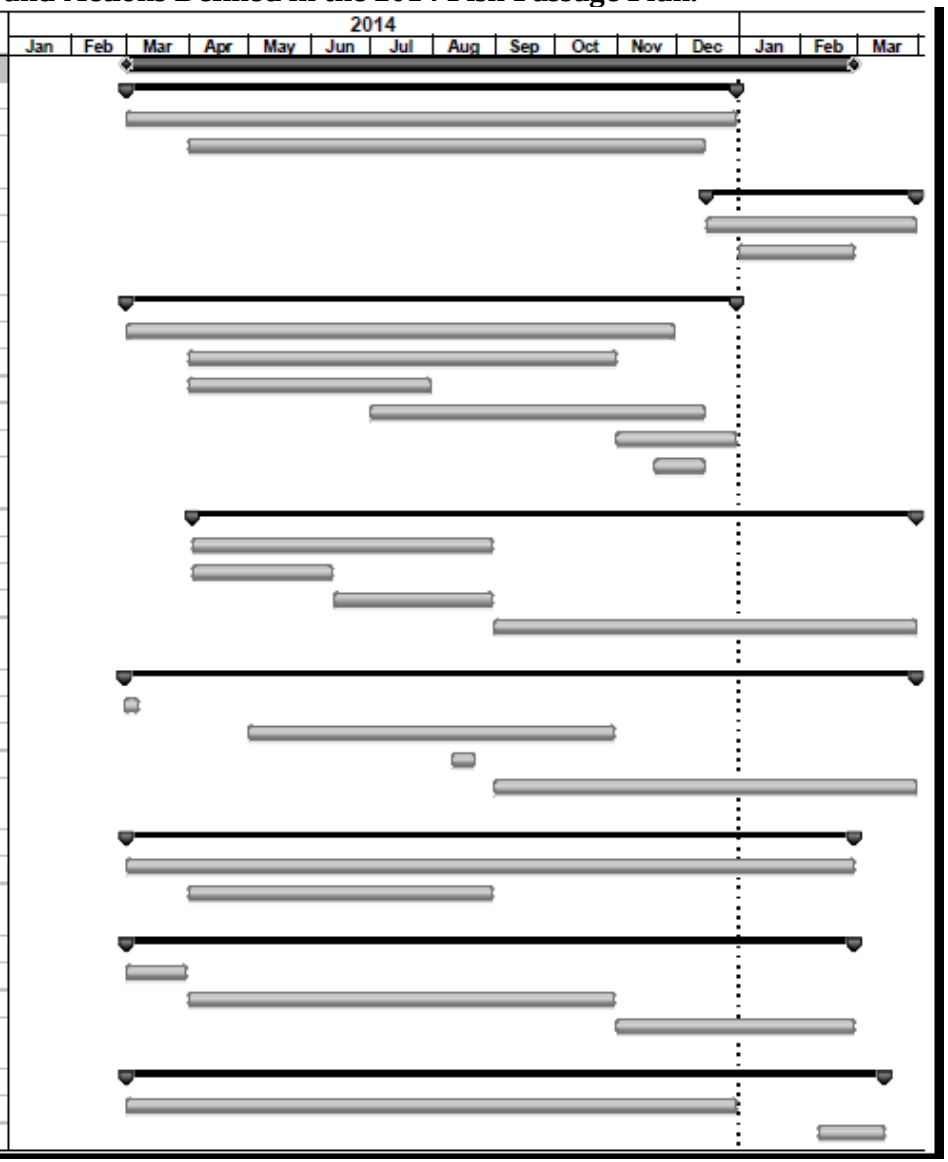


Figure LMN-1. Lower Monumental Lock & Dam General Site Plan.

Table LMN-1. Lower Monumental Dam Schedule of Operations and Actions Defined in the 2014 Fish Passage Plan.

Task Name	Start Date	End Date	FPP Reference
2014 FPP Operations & Actions - Lower Monumental	**3/1/14**	**2/28/15**	**LMN**
Fish Passage Facilities Operation	**3/1/14**	**12/31/14**	**2.3.**
Adult Fish Facilities	3/1/14	12/31/14	2.3.2.2
Juvenile Fish Facilities	4/1/14	12/15/14	2.3.1
Fish Passage Facilities Maintenance	**12/16/14**	**3/31/15**	**2.3**
Juvenile Fish Facilities Winter Maintenance	12/16/14	3/31/15	2.3.1.1
Adult Fish Facilities Winter Maintenance	1/1/15	2/28/15	2.3.2.1
Turbine Operations for Fish Passage	**3/1/14**	**12/31/14**	**4.1., 2.3.1.**
Turbine operating priority order	3/1/14	11/30/14	4.1.
1% operating range - hard constraint	4/1/14	10/31/14	4.1.1.
Backflush orifices ≥ once per 8-hrs	4/1/14	7/31/14	2.3.1.2.c.6.
One unit may operate w/ head gates in standard	7/1/14	12/15/14	4.3.2.
Priority turbine unit maintenance	11/1/14	12/31/14	4.3.1.
STS removal if cold-weather criteria apply	11/20/14	12/15/14	2.3.1.2.b.10
Spill Operations for Fish Passage	**4/3/14**	**3/31/15**	**2.3.1.2., App E**
Spillway Weir in service (end date approx)	4/3/14	8/31/14	2.3.1.2.g.
Spring Spill Operations (end date approx)	4/3/14	6/12/14	FOP
Summer Spill Operations (dates approx)	6/13/14	8/31/14	FOP
Spillway Weir Maintenance	9/1/14	3/31/15	2.3.1.2.h.
Special Operations & Studies (dates approximate)	**2/28/14**	**3/31/15**	**App A**
Units 4-6 Exciter Re-Commissioning	2/28/14	3/7/14	7.1.3.
Adult Lamprey Passage Studies	5/1/14	10/31/14	7.2.1.-2.
Transformer Maintenance	8/11/14	8/22/14	7.1.5.
Steady State Model Validation Testing	9/1/14	3/31/15	7.1.6.
TDG Monitoring	**3/1/14**	**2/28/15**	**2.2.**
TDG Monitoring - Tailrace (year-round)	3/1/14	2/28/15	station LMNW
TDG Monitoring - Forebay	4/1/14	8/31/14	station LMNA
Adult Fish Counting	**3/1/14**	**2/28/15**	**Table LMN-3**
Daytime Video 0400-2000 PST	3/1/14	3/31/14	
Daytime Visual 0400-2000 PST	4/1/14	10/31/14	
Daytime Video 0400-2000 PST	11/1/14	2/28/15	
Reports	**3/1/14**	**3/15/15**	**2.3.3.**
Weekly Reports	3/1/14	12/31/14	
Annual Report	2/10/15	3/15/15	



1. FISH PASSAGE INFORMATION

The locations of fish passage facilities and other dam structures at Lower Monumental Lock and Dam are illustrated in **Figure LMN-1**. Dates for fish operations, research and other special operations are shown in **Table LMN-1**.

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 a bypass flume to the tailrace. 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 (**Table LMN-2**) is based on juvenile fish collection numbers for the most recent 10-year period and do not reflect fish guidance efficiency (FGE) or passage via the RSW or spillway. 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-2. Juvenile Salmonid Passage Timing at Lower Monumental Dam for the Most Recent 10-Year Period (2004-2013) Based on Daily & Yearly Collection Data.

Year	10%	50%	90%	# Days	10%	50%	90%	# Days
	Yearling Chinook				Subyearling Chinook			
2004	16-Apr	22-Apr	18-May	32	16-May	26-Jun	13-Jul	58
2005	18-Apr	8-May	17-May	29	2-Jun	12-Jun	30-Jun	28
2006	1-May	10-May	20-May	19	26-May	8-Jun	1-Jul	36
2007	12-May	15-May	20-May	8	30-May	11-Jun	8-Jul	39
2008	18-May	21-May	28-May	10	5-Jun	14-Jun	5-Jul	30
2009	10-May	20-May	27-May	17	2-Jun	9-Jun	3-Jul	31
2010	18-May	21-May	8-Jun	21	8-Jun	12-Jun	7-Jul	29
2011	10-May	15-May	21-May	11	31-May	23-Jun	24-Jul	54
2012	6-May	12-May	24-May	18	6-Jun	19-Jun	6-Jul	30
2013	9-May	13-May	16-May	7	5-Jun	12-Jun	13-Jul	38
MEDIAN	**9-May**	**14-May**	**20-May**	**18**	**2-Jun**	**12-Jun**	**6-Jul**	**34**
MIN	**16-Apr**	**22-Apr**	**16-May**	**7**	**16-May**	**8-Jun**	**30-Jun**	**28**
MAX	**18-May**	**21-May**	**8-Jun**	**32**	**8-Jun**	**26-Jun**	**24-Jul**	**58**
	Unclipped Steelhead				Clipped Steelhead			
2004	17-Apr	16-May	1-Jun	45	23-Apr	15-May	4-Jun	42
2005	6-May	14-May	24-May	18	20-Apr	13-May	20-May	30
2006	2-May	16-May	25-May	23	29-Apr	9-May	22-May	23
2007	12-May	15-May	23-May	11	12-May	15-May	21-May	9
2008	20-May	21-May	31-May	11	18-May	21-May	28-May	10
2009	10-May	22-May	6-Jun	27	10-May	20-May	1-Jun	22
2010	18-May	26-May	11-Jun	24	8-May	23-May	9-Jun	32
2011	14-May	20-May	1-Jun	18	11-May	16-May	29-May	18
2012	8-May	19-May	2-Jun	25	7-May	15-May	27-May	20
2013	9-May	14-May	21-May	12	8-May	14-May	19-May	11
MEDIAN	**9-May**	**20-May**	**31-May**	**2121**	**8-May**	**15-May**	**27-May**	**2121**
MIN	**17-Apr**	**14-May**	**21-May**	**11**	**20-Apr**	**9-May**	**19-May**	**9**
MAX	**20-May**	**26-May**	**11-Jun**	**45**	**18-May**	**23-May**	**9-Jun**	**42**
	Coho				Sockeye (Wild & Hatchery)			
2004	15-May	29-May	8-Jun	24	16-May	25-May	3-Jun	18
2005	11-May	16-May	23-May	12	30-Apr	24-May	5-Jun	36
2006	14-May	22-May	31-May	17	4-May	21-May	29-May	25
2007	14-May	16-May	23-May	9	14-May	19-May	26-May	12
2008	20-May	20-May	24-May	4	21-May	22-May	3-Jun	13
2009	18-May	26-May	30-Jun	43	20-May	23-May	2-Jun	13
2010	19-May	5-Jun	14-Jun	26	23-May	3-Jun	16-Jun	24
2011	13-May	21-May	3-Jun	21	13-May	30-May	12-Jun	30
2012	9-May	22-May	5-Jun	27	9-May	22-May	3-Jun	25
2013	10-May	14-May	22-May	12	18-May	20-May	23-May	5
MEDIAN	**14-May**	**21-May**	**1-Jun**	**19**	**15-May**	**22-May**	**3-Jun**	**21**
MIN	**9-May**	**14-May**	**22-May**	**4**	**30-Apr**	**19-May**	**23-May**	**5**
MAX	**20-May**	**5-Jun**	**30-Jun**	**43**	**23-May**	**3-Jun**	**16-Jun**	**36**

1.2. Adult Fish Passage.

1.2.1. Facilities Description. Lower Monumental adult fish passage facilities are comprised of north and south shore ladders and collection systems with a common auxiliary water supply. The north shore ladder connects to 2 north shore entrances and the powerhouse collection system. The powerhouse collection system has 2 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 ladder has 2 downstream entrances (a former side entrance has been permanently closed). Three turbine-driven pumps provide auxiliary water from the north side of the powerhouse to the powerhouse diffusers via a supply conduit under the powerhouse collection channel, and to the south shore collection system diffuser via a supply conduit under the spillway. Excess water from the juvenile bypass system (approximately 200-240 cfs) is added to the auxiliary water supply for the powerhouse collection system.

1.2.2. Adult Migration Timing and Counting. Upstream migrants are present at the project throughout the year and adult passage facilities are operated year-round. Maintenance of adult facilities occurs in January–February, typically one shore at a time, to minimize impacts on upstream migrants. Adult salmon, steelhead, shad and lamprey are counted (**Table LMN-3**) and daily data are posted online at: http://www.nwp.usace.army.mil/Missions/Environment/Fishdata.aspx. Yearly fish counts are used to determine peak adult migration timing (**Table LMN-4**). Sturgeon and bull trout are relatively infrequent and counts are posted online periodically during the passage season in *Miscellaneous Fish Counts* and summarized in the *Annual Fish Passage Report*.

Table LMN-3. Adult Fish Counting Schedule at Lower Monumental Dam (3/1/14-2/28/15).

Count Period	Counting Method and Hours *
March 1–31, 2014	Video 0400–2000 hours (PST)
April 1, 2014 – October 31, 2014	Visual 0400–2000 hours (PST)
November 1, 2014 – February 28, 2015	Video 0400-2000 hours (PST)

*All count hours are shown in Pacific Standard Time (PST). Note that during Daylight Saving Time (DST) from Mar 9–Nov 2, 2014, count hours will be one hour later (DST = PST+1).

Table LMN-4. Adult Fish Count Period and Peak Passage Timing at Lower Monumental Dam (based on yearly counts since 1969).

Species	Count Period	Earliest Peak	Latest Peak
Spring Chinook	Apr 1 – Jun 13	Apr 20	May 27
Summer Chinook	Jun 14 – Aug 13	Jun 14	Jul 12
Fall Chinook	Aug 14 – Oct 31	Sep 4	Sep 30
Steelhead	Apr 1 – Oct 31	Sep 13	Oct 13
Sockeye	Apr 1 – Oct 31	Jun 24	Jul 25
Lamprey	Apr 1 – Oct 31	Jul 20	Jul 27

1.2.2.1. Time-of-day (diel) distributions of adult salmonid activity at fishway entrances and exits are summarized in **Figure LMN-2** (see *Keefer & Caudill 2008* at: http://www.nwd-wc.usace.army.mil/tmt/documents/FPOM/2010/2013_FPOM_MEET/2013_JUN/).

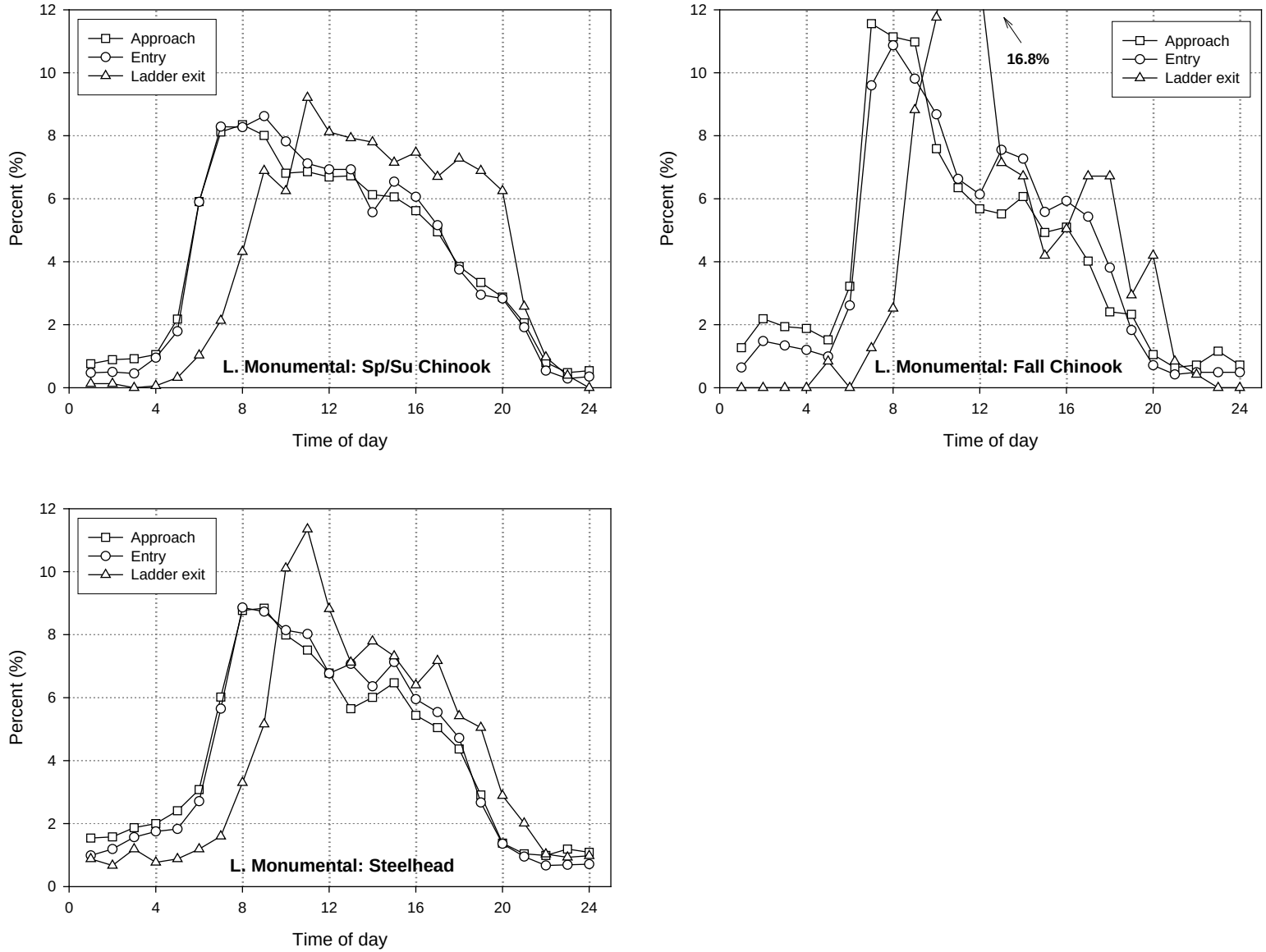


Figure LMN-2. Diel Distribution of Adult Salmonids at Lower Monumental Fishway Entrances and Exits (*Keefer & Caudill 2008*).

2. PROJECT OPERATIONS

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. Spill for Fish Passage. To improve tailrace juvenile egress conditions and minimize eddies, it is recommended that the Lower Monumental project be operated as shown in **Table LMN-5** while spilling for fish passage. If possible, involuntary spill under the flow levels shown should follow these project operations.

2.2. Total Dissolved Gas (TDG) Management.

2.2.1. TDG levels at all projects are monitored in accordance with the *TDG Monitoring Plan*, included in the *Water Management Plan* as Appendix 4 and available online at: http://www.nwd-wc.usace.army.mil/tmt/documents/wmp/.

2.3. Operating Criteria.

2.3.1. Juvenile Fish Passage Facilities. Operate from April 1–September 30 for juvenile fish bypass, collection and transportation, and from October 1–December 15 for bypassing adult fallbacks. Operate the juvenile facilities according to the criteria listed below and in the *Juvenile Fish Transportation Program* (**Appendix B**) for bypass, collection, and transport. The transportation program may be revised in accordance with ESA Section 10 permit and the NOAA Fisheries Biological Opinion.

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

2.3.1.1.a. Forebay Area and Intakes.

a.1. Remove debris from forebay and gatewell slots.

a.2. Rake trashracks just prior to the operating season.

a.3. Measure drawdown in gatewell slots after cleaning trashracks with STSs in place.

a.4. Inspect and repair gatewell dip net as needed.

2.3.1.1.b. Submersible Traveling Screens (STS) and Vertical Barrier Screens (VBS).

b.1. Maintenance completed on all screens.

b.2. Inspect STSs prior to installation and operate one trial run (dogged off on deck) to ensure proper operation.

b.3. Log results of trial run.

b.4. Inspect all VBSs with an underwater video camera at least once per year. Repair as needed.

2.3.1.1.c. Collection Channel.

c.1. Water-up valve capable of operating when needed.

c.2. Orifice lights are operational.

c.3. Orifices clean and valves operating correctly.

c.4. Orifice air backflush system works correctly.

2.3.1.1.d. Dewatering Structure and Flume.

d.1. Inclined screen clean and in good condition with no gaps between screen panels, damaged panels, or missing silicone.

d.2. Screen cleaning system (brush and air flush) maintained and operating correctly.

d.3. Overflow weirs should be maintained, tested and operating correctly.

d.4. All valves should be operating correctly.

d.5. Flume interior should be smooth with no rough edges.

2.3.1.1.e. Transportation Facilities.

e.1. Primary bypass flume switch gate maintained and in good operating condition.

e.2. Flume interior smooth with no rough edges.

e.3. Perforated plate edges smooth with no rough edges.

e.4. Wet separator and fish distribution system should be maintained and ready for operation as designed.

e.5. Brushes and screens on crowders in good condition with no holes in screens or rough edges.

e.6. Crowders maintained, tested, and operating correctly.

e.7. All valves, slide gates, and switch gates maintained and in good operating condition.

e.8. Retainer screens in place with no holes in screens or sharp wires protruding.

e.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.

e.10. All sampling equipment should be maintained and in good operating condition prior to watering up the facilities.

e.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.

e.12. Mini- and midi-tanks maintained and in good operating condition.

2.3.1.1.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.

2.3.1.1.g. Maintenance Records. Record all maintenance and inspections.

2.3.1.2. Juvenile Fish Passage Period (April 1–December 15). Check and perform maintenance as required on the items listed below.

2.3.1.2.a. Forebay Area and Intakes.

a.1. Remove debris from forebay.

a.2. Log gatewell drawdown differentials in bulkhead slots at least once a week.

a.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.

a.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.

a.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.

a.6. Coordinate cleaning efforts with personnel operating juvenile collection facilities.

a.7. Dip bulkhead gatewell slots to remove fish prior to installing bulkhead for dewatering bulkhead slot.

2.3.1.2.b. STSs, VBSs and Head Gates.

b.1. Operate STSs in cycle mode when average fork length of sub-yearling Chinook or sockeye is greater than 120 mm.

b.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.

b.3. Inspect each installed STS once per month by means of underwater video camera. Spot check VBSs at the same time.

b.4. Record STS amp readings daily.

b.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.

b.6. Half of the STSs may be pulled after October 1 for maintenance as long as unscreened turbine units are not operated.

b.7. Make formal determination at end of season as to adequacy of STS mesh and any replacement needs.

b.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.

b.9. Turbine units are to be operated with *raised* head 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.

b.10. When extreme cold weather is forecasted (temperatures below 20°F for ≥24 hours) between Thanksgiving and December 15, STSs may be removed. The project will first request special permission from CENWW-OD-T. CENWW-OD-T will inform NOAA Fisheries and FPOM of the action.

2.3.1.2.c. Collection Channel.

c.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).

c.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.

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

c.4. Orifice jets must hit no closer than 3’ from the back wall with the collection channel full.

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

c.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.

c.7. Water-up valve capable of operating when needed.

2.3.1.2.d. Dewatering Structure.

d.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.

d.2. Hand clean trapezoidal section once a day or as often as needed to maintain a clean condition.

d.3. Check overflow weirs to make sure they are operating correctly, perform maintenance as required.

d.4. There should be no gaps between screen panels or damaged panels in the inclined screen.

d.5. Lights at the dewatering structure should be turned off at night, unless needed for personnel access, to encourage fish to move downstream volitionally.

2.3.1.2.e. Transportation Facilities.

e.1. All screens should be inspected to make sure there are no holes or sharp edges.

e.2. Crowder screen brushes should be maintained in good operating condition, with no holes or sharp edges on crowder screens.

e.3. Inspect raceway and tank retainer screens to make sure they are clean with no holes or protruding wires.

e.4. Operate wet separator and fish distribution system as designed.

e.5. Truck and barge loading facilities in good operating condition.

e.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).

2.3.1.2.f. Avian Predation Areas (Forebay and Tailrace).

f.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.

f.2. Harassment program in place to deter avian predation in areas actively used by birds and not covered by bird wires or other devices.

f.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.

2.3.1.2.g. Removable Spillway Weir[1] (RSW) Operation.

g.1. The RSW in spillbay 8 will be in the raised position and operational on the first day of spill for fish passage.

g.2. When the RSW is in operation, the spillgate shall be raised to where it does not touch flow passing down the RSW.

g.3. 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.

g.4. Complete RSW stow (complete rotation to the landing pad) when inflows exceed 260,000 cfs, upstream river gage flows are increasing, and the NWS forecasts Lower Monumental inflow to exceed 300,000 cfs.

g.5. When the project is not spilling, the RSW may be operated for short periods of time upon request by the Project Biologist through CENWW if it appears the juvenile fish transportation facility and barge holding capacities will be exceeded, as described in the *Juvenile Fish Transportation Plan* (**Appendix B section 4.4.4**).

2.3.1.2.h. RSW Maintenance (September 1 – April 1).

h.1. Forebay debris removal: Prior to inspections listed below, if a debris raft is present in the forebay and will interfere with the defined operations, a debris spill will be coordinated in accordance with paragraph **5.1**. Debris in the RSW seals or between the transition plate and ogee will adversely affect the operation of the RSW.

h.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 divers or an ROV:

i. If divers are used, turbine units 5&6 and spillbays 7&8 will be removed from service. Units 5&6 outages will require a deviation from FPP priority order (**Table LMN-5**). Coordination of unit outages will follow normal outage notification guidelines. Up to a week before the inspection, bay 8 will need to be opened 1 or 2 stops to facilitate clearing of debris and silt from the transition plates. Spilling through bay 8 will be coordinated with RCC following normal guidelines.

ii. If an ROV is used, 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

[1] Spillway weirs provide surface passage routes via spillbay(s). Temporary, or Top, Spillway Weirs (*TSW*s) at Little Goose, McNary and John Day dams can be installed, uninstalled and moved between bays using the gantry crane. Removable Spillway Weirs (*RSW*s) at Lower Granite, Lower Monumental and Ice Harbor dams are "removed" by controlled descent to the bottom of the forebay.

clearing of debris and silt from the transition plates. Spilling water through bay 8 will be coordinated with RCC following normal guidelines.

h.3. Transition Plate bolts, umbilical and seal inspection will be performed by divers and will require the RSW 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 debris or silt that has accumulated on the transition plates or beak region that would slide off onto the ogee and cause problems when the RSW is stowed. Spill through bay 8 will occur up to a week before the inspection and will be coordinated with RCC through normal guidelines. This inspection will also require units 5&6 and bays 7&8 out of service. Units 5&6 outages will require a deviation from FPP priority order. Coordination of the unit outages will follow normal outage notification guidelines. 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. Reports of the inspection will be submitted to the CENWW biological staff.

h.4. Loss of 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. Required outages will be coordinated as listed above for the necessary actions.

2.3.1.2.i. Inspection and Record Keeping.

i.1. Inspect fish facilities at least once every 8 hours. Inspect all facilities according to fish facilities monitoring program.

i.2. Record all maintenance and inspections.

2.3.2. Adult Fish Passage Facilities. Operate adult fish passage facilities according to the following criteria.

2.3.2.1. Winter Maintenance Period (January 1–February 28).

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

2.3.2.1.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.

2.3.2.1.c. Inspect for and clean debris from the fish ladder exits. All trashracks and picketed leads must be clean and installed correctly.

2.3.2.1.d. Calibrate all water level measuring devices, as necessary, for proper facility operations.

2.3.2.1.e. Inspect all spill gates and ensure that they are operable.

2.3.2.1.f. Fish pumps maintained and ready for operation.

2.3.2.1.g. Maintain adult PIT-tag system as required. Coordinate with PSMFC.

2.3.2.2. Adult Fish Passage Period (March 1–December 31).

Note: Ice Harbor pool may be operated at minimum operating pool (MOP) elevation range 437'–438' msl as part of the Corps' efforts to improve migration conditions for juvenile salmonids. This may result in some of the Lower Monumental adult fishway entrances 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 pumped.

2.3.2.2.a. Fishway Ladders. Water depth over weirs: 1' to 1.3'.

2.3.2.2.b. Counting Windows. All counting slots at Lower Monumental Dam are fixed at a width of 19”. All equipment should be maintained and in good condition. The counting window and backboard should be cleaned as needed to maintain good visibility.

2.3.2.2.c. Head on all Fishway Entrances. Head range: 1' to 2'.

2.3.2.2.d. North Shore Entrances (NSE 1&2). Top of gate elevation on sill = 429'.

d.1. Operate both gates.

d.2. Weir depth: 8' or greater below tailwater.

2.3.2.2.e. Floating Orifice Gates. No floating orifice gates will be operated.

2.3.2.2.f. South Powerhouse Entrances (SPE 1&2). Top of gate elev. on sill =432'.

f.1. Operate both downstream gates.

f.2. Weir depth: 8' or greater below tailwater. At tailwaters below elevation 440', weirs should be on sill.

2.3.2.2.g. South Shore Entrances (SSE 1&2). Top of gate elev. on sill = 431'.

g.1. Operate both downstream gates.

g.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.

2.3.2.2.h. Channel Velocity. 1.5' to 4' per second.

h.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.

i. 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.

ii. 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.

2.3.2.2.i. Head on Trashracks.

i.1. Maximum head of 0.5' on ladder exits.

i.2. Maximum head on south shore picketed leads shall be 0.3'. Maximum head on north shore picketed leads shall be 0.4'.

i.3. Trashracks and picketed leads installed correctly.

2.3.2.2.j. Staff Gages and Water Level Indicators. All staff gages should be readable at all water levels encountered during fish passage period. Repair or clean as necessary.

2.3.2.2.k. Facility Inspections.

k.1. Powerhouse operators shall physically inspect facilities once per day shift and check computer monitor information at least once during each back shift.

k.2. Project biologists shall inspect facilities three times per week. Inspect all facilities according to fish facilities monitoring program.

k.3. Picketed leads shall be inspected during all inspections to ensure they are clean and in the correct position (all the way down).

k.4. Project personnel shall check fishway control system twice per month to ensure that it is within calibration. This may be done as part of routine fishway inspections.

k.5. Inspect fishways daily for foreign substances (particularly oil). If substances are found, corrective actions should be undertaken immediately.

k.6. Record all inspections.

2.3.3. Juvenile & Adult Fish Facility Monitoring and Reporting.

2.3.3.1. Project biologists shall inspect fish passage facilities at the frequencies listed in the juvenile and adult fish facilities operating criteria sections.

2.3.3.2. Weekly Reports. March 1–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:

i. Any out-of-criteria situations observed and subsequent corrective actions taken;

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

iii. Adult fishway control calibrations;

iv. STS and VBS inspections;

v. Any unusual activities at the project that may have affected fish passage.

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

2.3.3.4. 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 MOP operating range. 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 the Fish Operations Plan (FOP), included in the FPP as **Appendix E**.

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 and guidelines (**Appendix F**). 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 guidelines.

3.1. Juvenile Fish Passage Facilities Maintenance.

3.1.1. Scheduled Maintenance. Scheduled maintenance of juvenile facilities is conducted throughout the 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 (December 16–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:

i. Description of the problem;

ii. Type of outage required;

iii. Impact on facility operation;

iv. Length of time for repairs;

v. 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 Maintenance.

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–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 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 FPOM.

3.2.1.1. Auxiliary Water Supply System. The auxiliary water for the ladders and collection systems is supplied by three turbine-driven pumps on the north shore, with at least two pumps being required for normal operation. On a monthly basis, each pump, one pump at a time, may be taken out of service for up to two days for maintenance. The maintenance performed during this outage is routine monthly and quarterly maintenance as defined within the COE maintenance program. This maintenance will not be performed when river conditions will not allow the ladder to remain in criteria using only a two-pump operation.

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. 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 & MAINTENANCE

4.1. Turbine Unit Operation.

When in operation, turbine units will be operated to enhance adult and juvenile fish passage from March 1 through November 30. During this time period turbine units will be operated as needed to meet generation requirements in the priority order shown in **Table LMN-5**. Unit operating priority may be coordinated differently to allow for fish research, construction, or project maintenance activities. If a turbine unit is taken out of service for maintenance or repair, the next unit on the priority list shall be operated. Also see **Section 2.1, Spill Management**.

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. Unit 1 run priority is last-on/first-off for all flow conditions until blade link pin repairs are completed (currently scheduled for 2015–2016). Turbine unit 1 may be turned off at the power plant operator's discretion, when the flows are between 55kcfs-70kcfs.

Table LMN-5. Turbine Unit Operating Priority for Lower Monumental Dam.

Season	Unit Priority
Fish Passage Season March 1 – November 30	2, 3, 4, 5, 6 then 1*

* 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. *This unit priority sequence will remain in effect until unit 1 blade link pin repairs are completed in 2015 or 2016.*

4.1.1. Turbine Unit Operating Ranges. From April 1–October 31, turbine units will be operated within ±1% of peak turbine efficiency (1% range), as specified in *BPA's Load Shaping Guidelines* (**Appendix C**). Turbine unit output and discharge at the lower and upper 1% limits (with and without STSs) for various heads are defined in **Tables LMN-6** (unit 1), **LMN-7** (units 2-3) and **LMN-8** (units 4-6). If operation outside the 1% range is necessary, Project personnel shall record the information and provide to BPA on a weekly basis according to the load shaping guidelines. Operation outside of the 1% range may be necessary to:

i. Meet BPA load requirements. Load requests will be made in accordance with BPA's policy, statutory requirements and load shaping guidelines (**Appendix C**);

ii. If the draft tube is to be dewatered, the unit will be operated at full load (>1%) for a minimum of 15 minutes prior to installing tail logs. If not possible to load, the unit will be run at speed-no-load (<1%) for a minimum of 15 minutes. This is to reduce the number of fish in the scrollcase prior to installing stop logs;

iii. Operate a turbine unit solely to provide station service; or

iv. Comply with other coordinated fish measures.

4.1.1.1.a. From November 1–March 31, turbine units will continue to be operated within the 1% range except when BPA load requests require the units to be operated outside the 1% range.

4.1.2. Minimum Generation / 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 inflow 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. Lower Monumental Dam Turbine Unit 1 Output (MW) and Discharge (cfs) at Upper and Lower Limits of the 1% Efficiency Range with and without STSs. [1]

Project Head (feet)	Turbine Unit 1							
	With STS				No STS			
	1% Lower Limit		1% Upper Limit		1% Lower Limit		1% 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**

1. Unit 1 has fixed-pitch blades. Tables based on 1962 model test and 2005 U1 abbreviated index test.

Table LMN-7. Lower Monumental Dam Turbine Units 2 and 3 Output (MW) and Discharge (cfs) Per Unit at Upper and Lower Limits of the 1% Efficiency Range with and without STSs. [1]

Project Head (feet)	Turbine Units 2 and 3							
	With STS				No STS			
	1% Lower Limit		1% Upper Limit		1% Lower Limit		1% 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**

1. Tables revised to reflect new information using 2002 index test and original 1975 turbine model test. Table based on information provided by HDC in letter to NWW dated August 20, 2003 (Table revised 2005).

Table LMN-8. Lower Monumental Dam Turbine Units 4, 5 and 6 Output (MW) and Discharge (cfs) Per Unit at Upper and Lower Limits of the 1% Efficiency Range with and without STSs. [1]

Project Head (feet)	Turbine Units 4, 5, 6							
	With STS				Without STS			
	1% Lower Limit		1% Upper Limit		1% Lower Limit		1% 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**

1. Tables revised to reflect new information using 2002 index test and original 1975 turbine model test. Table based on information provided by HDC in letter to NWW dated August 20, 2003 (Table revised 2005).

4.2. Turbine Unit Outages during High River Flows.

During high spring flows, turbine unit outages for inspecting fish screens, repairing research equipment (e.g., hydroacoustic or radio-telemetry), 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.

4.3. Turbine Unit Maintenance.

4.3.1. The 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 from mid-July through late November. Maintenance of priority units for adult passage is normally completed in November–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 1% peak 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 three years, or more frequently if there is a known problem with a transformer, and normally take 2–3 workdays. To conduct the testing, the distribution lines must be disconnected from the transformers and normal generation stopped. One turbine unit will operate at speed-no-load to provide project power and operation of fish passage facilities. Spill may be provided to meet minimum required project discharges during the testing hours. Doble tests are normally scheduled for August or early September to minimize impacts on adult and juvenile fish passage. If Doble testing impacts priority units for fish passage, adult passage timing should be considered to minimize impacts to migrating adults.

4.3.2. Head Gates.[2] Turbine units are to be operated with raised head gates to improve fish passage conditions when STSs are installed, except as provided below. To facilitate annual maintenance, head gates are used to dewater the turbine units. To minimize turbine outage periods to the actual time required for maintenance (from July 1–December 15), head 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 head gates in the standard operating position, the turbine unit may be operated until 0700 hours of the next regular workday (normally Monday). Once maintenance is

[2] Head gates may also be referred to as "operating" gates at some projects. The terms are interchangeable.

completed, the turbine unit can be operated with the head gates in the standard operating position until 1200 hours of the first regular workday. If turbine maintenance or the raising of the head 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 head gates in the standard operating position shall be restricted to July 1–December 15, 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 head gates in the standard operating position and the turbine unit will be operated on last-on, first-off priority.

4.3.3. 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.

4.3.4. 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.

4.3.5. 6-Year Overhaul. One unit per year is selected for a 6-year overhaul at Lower Monumental. A 6-year maintenance outage requires unwatering the unit so that more in-depth maintenance other than annual checks can be performed. This level of maintenance requires additional consideration before the outage (pre-outage) and after the work is complete (post-outage). During the course of this work, many systems and sub-systems of the unit may be disassembled, replaced or repaired.

> **4.3.5.1.a. Scheduling:** The outage for the overhaul unit will be scheduled during a period which minimizes impacts to fish. The work will start as recommended in **4.3** above.
>
> **4.3.5.1.b. Pre-Outage Run Time:** Prior to a unit coming out-of-service (OOS) for 6-year overhaul, the unit may need to be run continuously for 48 hours, which may require a deviation from unit priority in **Table LMN-5**. Scheduling the unit first in line for maintenance should allow for ample water to accommodate a 48-hour run time to finalize pre-maintenance checks. More water (kcfs) will be required if unit 4, 5 or 6 is selected. This will require a deviation from Minimum Generation section in the Fish Operations Plan (FOP), included in the FPP as **Appendix E**.

4.3.5.1.c. Post-Outage Run Time: Following a 6-year overhaul, the unit must be run continuous for 48 hours to ensure unit is ready for service. Following 48 hours of continuous run time, a second period of 48 hours of intermittent testing may be required to fix minor items detected in the continuous run time. This post-outage run will require a deviation from the unit priority table in LMN-5. The post-outage run will require a deviation from paragraph 4.3.1 to allow the unit to run with the headgate cylinder in place and the headgate in the lower position. If the unit selected for 6-year overhaul is unit 4, 5 or 6, a deviation from minimum generation as defined in the FOP will be necessary as units 4-6 require an additional 2-3 kcfs at lower ranges of operation. The constraint of running the unit within the 1% efficiency guideline will remain in place.

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. Debris Spill Coordination.

All special spills (other than normal patterns for ongoing spill operations) and project operations for passing debris will be coordinated prior to operations taking place. Each project shall contact CENWW-OD-T at least two workdays prior to the day of the requested special project debris spill operation. Project personnel shall provide CENWW-OD-T the reason for the debris spill request including an explanation of project facilities impacted by debris, the date and time of the requested spill, and any special powerhouse or other operations required to move the debris to the spillway. Using information provided by the project, CENWW-OD-T shall coordinate the special operations with RCC, NOAA Fisheries and FPOM. When a debris spill is coordinated and approved, RCC shall issue a teletype detailing the specifics of the special operations.

5.2. Emergency Spills.

Emergency spills may be implemented if necessary to pass woody debris accumulating in front of the spillbay weir and compromising the safe unobstructed fish passage. The project will immediately spill the woody debris obstructing fish passage and will notify CENWW-OD-T of the emergency spill as soon as possible to notify RCC, NOAA Fisheries, and FPOM.

Table LMN-9. [pg *1 of 3*] Lower Monumental Dam Bulk Spill Patterns with RSW. [a]

Total Spill (kcfs)	LMN Bulk Spill Patterns w/RSW [a] # Gate Stops per Spillbay								Total Stops (#)
	Bay 1	Bay 2	Bay 3	Bay 4	Bay 5	Bay 6	Bay 7	Bay 8 (RSW) [b]	
8.6		1						4.5	**5.5**
10.1		2						4.5	**6.5**
11.9		2				1		4.5	**7.5**
13.4		2				2		4.5	**8.5**
14.9		2				3		4.5	**9.5**
16.3		2				4		4.5	**10.5**
17.8		3				4		4.5	**11.5**
19.6		3			1	4		4.5	**12.5**
21.3		3			1	5		4.5	**13.5**
23.1	1	3			1	5		4.5	**14.5**
25.4	1	1	1	1	1	6		4.5	**15.5**
26.9	1	1	1	1	2	6		4.5	**16.5**
28.4	1	1	1	2	2	6		4.5	**17.5**
29.6	1	1	1	2	4	5		4.5	**18.5**
31.3	1	1	1	2	5	5		4.5	**19.5**
32.8	2	1	1	2	5	5		4.5	**20.5**
34.3	2	1	2	2	5	5		4.5	**21.5**
35.8	2	2	2	2	5	5		4.5	**22.5**
37.3	3	2	2	2	5	5		4.5	**23.5**
38.8	3	3	2	2	5	5		4.5	**24.5**
40.6	3	3	2	2	5	5	1	4.5	**25.5**
42.1	3	3	2	2	5	5	2	4.5	**26.5**
43.6	3	3	2	3	5	5	2	4.5	**27.5**
45.1	3	3	3	3	5	5	2	4.5	**28.5**
46.8	3	3	3	3	5	6	2	4.5	**29.5**
48.5	3	3	3	3	6	6	2	4.5	**30.5**
50.0	3	3	3	3	6	6	3	4.5	**31.5**
51.4	3	3	3	3	6	6	4	4.5	**32.5**
53.1	3	3	3	3	6	6	5	4.5	**33.5**
54.8	3	3	3	3	6	6	6	4.5	**34.5**
56.2	3	3	3	4	6	6	6	4.5	**35.5**
57.6	3	3	4	4	6	6	6	4.5	**36.5**
59.0	3	4	4	4	6	6	6	4.5	**37.5**
60.4	4	4	4	4	6	6	6	4.5	**38.5**
62.1	4	4	4	5	6	6	6	4.5	**39.5**
63.8	4	4	5	5	6	6	6	4.5	**40.5**
65.5	4	5	5	5	6	6	6	4.5	**41.5**
67.2	5	5	5	5	6	6	6	4.5	**42.5**
68.9	5	5	5	6	6	6	6	4.5	**43.5**

Total Spill (kcfs)	LMN Bulk Spill Patterns w/RSW [a] # Gate Stops per Spillbay								Total Stops (#)
	Bay 1	Bay 2	Bay 3	Bay 4	Bay 5	Bay 6	Bay 7	Bay 8 (RSW) [b]	
70.6	5	5	6	6	6	6	6	4.5	**44.5**
72.3	5	6	6	6	6	6	6	4.5	**45.5**
74.0	6	6	6	6	6	6	6	4.5	**46.5**
75.6	6	6	6	6	6	7	6	4.5	**47.5**
77.2	6	7	6	6	6	7	6	4.5	**48.5**
78.8	6	7	6	6	7	7	6	4.5	**49.5**
80.4	6	7	7	6	7	7	6	4.5	**50.5**
82.0	6	7	7	7	7	7	6	4.5	**51.5**
83.6	7	7	7	7	7	7	6	4.5	**52.5**
85.2	7	7	7	7	7	7	7	4.5	**53.5**
87.0	7	7	7	7	7	8	7	4.5	**54.5**
88.8	7	8	7	7	7	8	7	4.5	**55.5**
90.6	7	8	7	7	8	8	7	4.5	**56.5**
92.4	7	8	8	7	8	8	7	4.5	**57.5**
94.2	7	8	8	8	8	8	7	4.5	**58.5**
96.0	8	8	8	8	8	8	7	4.5	**59.5**
97.8	8	8	8	8	8	8	8	4.5	**60.5**
99.4	8	8	8	8	8	9	8	4.5	**61.5**
101.0	8	9	8	8	8	9	8	4.5	**62.5**
102.6	8	9	8	8	9	9	8	4.5	**63.5**
104.2	8	9	9	8	9	9	8	4.5	**64.5**
105.8	8	9	9	9	9	9	8	4.5	**65.5**
107.4	9	9	9	9	9	9	8	4.5	**66.5**
109.0	9	9	9	9	9	9	9	4.5	**67.5**
110.8	9	9	9	9	9	10	9	4.5	**68.5**
112.6	9	10	9	9	9	10	9	4.5	**69.5**
114.4	9	10	9	9	10	10	9	4.5	**70.5**
116.2	9	10	10	9	10	10	9	4.5	**71.5**
118.0	9	10	10	10	10	10	9	4.5	**72.5**
119.8	10	10	10	10	10	10	9	4.5	**73.5**
121.6	10	10	10	10	10	10	10	4.5	**74.5**
123.3	10	10	10	10	10	11	10	4.5	**75.5**
125.0	10	11	10	10	10	11	10	4.5	**76.5**
126.7	10	11	10	10	11	11	10	4.5	**77.5**
128.4	10	11	11	10	11	11	10	4.5	**78.5**
130.1	10	11	11	11	11	11	10	4.5	**79.5**
131.8	11	11	11	11	11	11	10	4.5	**80.5**
133.5	11	11	11	11	11	11	11	4.5	**81.5**
135.2	11	11	11	11	11	12	11	4.5	**82.5**
136.9	11	12	11	11	11	12	11	4.5	**83.5**

Total Spill (kcfs)	LMN Bulk Spill Patterns w/RSW [a] # Gate Stops per Spillbay								Total Stops (#)
	Bay 1	Bay 2	Bay 3	Bay 4	Bay 5	Bay 6	Bay 7	Bay 8 (RSW) [b]	
138.6	11	12	11	11	12	12	11	4.5	**84.5**
140.3	11	12	12	11	12	12	11	4.5	**85.5**
142.0	11	12	12	12	12	12	11	4.5	**86.5**
143.7	12	12	12	12	12	12	11	4.5	**87.5**
145.4	12	12	12	12	12	12	12	4.5	**88.5**
147.1	12	12	12	12	12	13	12	4.5	**89.5**
148.8	12	13	12	12	12	13	12	4.5	**90.5**
150.5	12	13	12	12	13	13	12	4.5	**91.5**
152.2	12	13	13	12	13	13	12	4.5	**92.5**
153.9	12	13	13	13	13	13	12	4.5	**93.5**
155.6	13	13	13	13	13	13	12	4.5	**94.5**
157.3	13	13	13	13	13	13	13	4.5	**95.5**
159.0	13	13	13	13	13	14	13	4.5	**96.5**
160.7	13	14	13	13	13	14	13	4.5	**97.5**
162.4	13	14	13	13	14	14	13	4.5	**98.5**
164.1	13	14	14	13	14	14	13	4.5	**99.5**
165.8	13	14	14	14	14	14	13	4.5	**100.5**
167.5	14	14	14	14	14	14	13	4.5	**101.5**
169.2	14	14	14	14	14	14	14	4.5	**102.5**
171.0	14	14	14	14	14	15	14	4.5	**103.5**
172.8	14	15	14	14	14	15	14	4.5	**104.5**
174.6	14	15	14	14	15	15	14	4.5	**105.5**
176.4	14	15	15	14	15	15	14	4.5	**106.5**
178.2	14	15	15	15	15	15	14	4.5	**107.5**
180.0	15	15	15	15	15	15	14	4.5	**108.5**
181.8	15	15	15	15	15	15	15	4.5	**109.5**

a. "Total Spill" calculated at forebay elevation 537.0 ft based on interim spillway rating table dated 2 Apr 2009. Patterns expanded February 2014 for lower spill <8.6 kcfs when the RSW cannot be operated.

b. Bay 8 with RSW equivalent to ~4.5 stops at forebay elevation 537.0 ft. Raise Bay 8 tainter gate above stop 9 for RSW to ensure free surface and debris passage.

Table LMN-10. [*pg 1 of 3*] Lower Monumental Dam Uniform Spill Patterns with RSW. [a]

Total Spill (kcfs)	LMN Uniform Spill Patterns w/RSW [a] # Gate Stops per Spillbay								Total Stops (#)
	Bay 1	Bay 2	Bay 3	Bay 4	Bay 5	Bay 6	Bay 7	Bay 8 (RSW) [b]	
8.6						1		4.5	**5.5**
10.4		1				1		4.5	**6.5**
12.2		1			1	1		4.5	**7.5**
14		1	1		1	1		4.5	**8.5**
15.8		1	1	1	1	1		4.5	**9.5**
17.6	1	1	1	1	1	1		4.5	**10.5**
19.4	1	1	1	1	1	1	1	4.5	**11.5**
20.9	1	1	1	1	1	2	1	4.5	**12.5**
22.4	1	2	1	1	1	2	1	4.5	**13.5**
23.9	1	2	1	1	2	2	1	4.5	**14.5**
25.4	1	2	2	1	2	2	1	4.5	**15.5**
26.9	1	2	2	2	2	2	1	4.5	**16.5**
28.4	2	2	2	2	2	2	1	4.5	**17.5**
29.9	2	2	2	2	2	2	2	4.5	**18.5**
31.4	2	2	2	2	2	3	2	4.5	**19.5**
32.9	2	3	2	2	2	3	2	4.5	**20.5**
34.4	2	3	2	2	3	3	2	4.5	**21.5**
35.9	2	3	3	2	3	3	2	4.5	**22.5**
37.4	2	3	3	3	3	3	2	4.5	**23.5**
38.9	3	3	3	3	3	3	2	4.5	**24.5**
40.4	3	3	3	3	3	3	3	4.5	**25.5**
41.8	3	3	3	3	3	4	3	4.5	**26.5**
43.2	3	4	3	3	3	4	3	4.5	**27.5**
44.6	3	4	3	3	4	4	3	4.5	**28.5**
46	3	4	4	3	4	4	3	4.5	**29.5**
47.4	3	4	4	4	4	4	3	4.5	**30.5**
48.8	4	4	4	4	4	4	3	4.5	**31.5**
50.2	4	4	4	4	4	4	4	4.5	**32.5**
51.9	4	4	4	4	4	5	4	4.5	**33.5**
53.6	4	5	4	4	4	5	4	4.5	**34.5**
55.3	4	5	4	4	5	5	4	4.5	**35.5**
57	4	5	5	4	5	5	4	4.5	**36.5**
58.7	4	5	5	5	5	5	4	4.5	**37.5**
60.4	5	5	5	5	5	5	4	4.5	**38.5**
62.1	5	5	5	5	5	5	5	4.5	**39.5**
63.8	5	5	5	5	5	6	5	4.5	**40.5**
65.5	5	6	5	5	5	6	5	4.5	**41.5**
67.2	5	6	5	5	6	6	5	4.5	**42.5**
68.9	5	6	6	5	6	6	5	4.5	**43.5**
70.6	5	6	6	6	6	6	5	4.5	**44.5**
72.3	6	6	6	6	6	6	5	4.5	**45.5**
74	6	6	6	6	6	6	6	4.5	**46.5**

Total Spill (kcfs)	LMN Uniform Spill Patterns w/RSW [a] # Gate Stops per Spillbay								Total Stops (#)
	Bay 1	Bay 2	Bay 3	Bay 4	Bay 5	Bay 6	Bay 7	Bay 8 (RSW) [b]	
75.6	6	6	6	6	6	7	6	4.5	**47.5**
77.2	6	7	6	6	6	7	6	4.5	**48.5**
78.8	6	7	6	6	7	7	6	4.5	**49.5**
80.4	6	7	7	6	7	7	6	4.5	**50.5**
82	6	7	7	7	7	7	6	4.5	**51.5**
83.6	7	7	7	7	7	7	6	4.5	**52.5**
85.2	7	7	7	7	7	7	7	4.5	**53.5**
87	7	7	7	7	7	8	7	4.5	**54.5**
88.8	7	8	7	7	7	8	7	4.5	**55.5**
90.6	7	8	7	7	8	8	7	4.5	**56.5**
92.4	7	8	8	7	8	8	7	4.5	**57.5**
94.2	7	8	8	8	8	8	7	4.5	**58.5**
96	8	8	8	8	8	8	7	4.5	**59.5**
97.8	8	8	8	8	8	8	8	4.5	**60.5**
99.4	8	8	8	8	8	9	8	4.5	**61.5**
101	8	9	8	8	8	9	8	4.5	**62.5**
102.6	8	9	8	8	9	9	8	4.5	**63.5**
104.2	8	9	9	8	9	9	8	4.5	**64.5**
105.8	8	9	9	9	9	9	8	4.5	**65.5**
107.4	9	9	9	9	9	9	8	4.5	**66.5**
109	9	9	9	9	9	9	9	4.5	**67.5**
110.8	9	9	9	9	9	10	9	4.5	**68.5**
112.6	9	10	9	9	9	10	9	4.5	**69.5**
114.4	9	10	9	9	10	10	9	4.5	**70.5**
116.2	9	10	10	9	10	10	9	4.5	**71.5**
118	9	10	10	10	10	10	9	4.5	**72.5**
119.8	10	10	10	10	10	10	9	4.5	**73.5**
121.6	10	10	10	10	10	10	10	4.5	**74.5**
123.3	10	10	10	10	10	11	10	4.5	**75.5**
125	10	11	10	10	10	11	10	4.5	**76.5**
126.7	10	11	10	10	11	11	10	4.5	**77.5**
128.4	10	11	11	10	11	11	10	4.5	**78.5**
130.1	10	11	11	11	11	11	10	4.5	**79.5**
131.8	11	11	11	11	11	11	10	4.5	**80.5**
133.5	11	11	11	11	11	11	11	4.5	**81.5**
135.2	11	11	11	11	11	12	11	4.5	**82.5**
136.9	11	12	11	11	11	12	11	4.5	**83.5**
138.6	11	12	11	11	12	12	11	4.5	**84.5**
140.3	11	12	12	11	12	12	11	4.5	**85.5**
142	11	12	12	12	12	12	11	4.5	**86.5**
143.7	12	12	12	12	12	12	11	4.5	**87.5**
145.4	12	12	12	12	12	12	12	4.5	**88.5**
147.1	12	12	12	12	12	13	12	4.5	**89.5**

Total Spill (kcfs)	LMN Uniform Spill Patterns w/RSW [a] # Gate Stops per Spillbay								Total Stops (#)
	Bay 1	Bay 2	Bay 3	Bay 4	Bay 5	Bay 6	Bay 7	Bay 8 (RSW) [b]	
148.8	12	13	12	12	12	13	12	4.5	**90.5**
150.5	12	13	12	12	13	13	12	4.5	**91.5**
152.2	12	13	13	12	13	13	12	4.5	**92.5**
153.9	12	13	13	13	13	13	12	4.5	**93.5**
155.6	13	13	13	13	13	13	12	4.5	**94.5**
157.3	13	13	13	13	13	13	13	4.5	**95.5**
159	13	13	13	13	13	14	13	4.5	**96.5**
160.7	13	14	13	13	13	14	13	4.5	**97.5**
162.4	13	14	13	13	14	14	13	4.5	**98.5**
164.1	13	14	14	13	14	14	13	4.5	**99.5**
165.8	13	14	14	14	14	14	13	4.5	**100.5**
167.5	14	14	14	14	14	14	13	4.5	**101.5**
169.2	14	14	14	14	14	14	14	4.5	**102.5**
171	14	14	14	14	14	15	14	4.5	**103.5**
172.8	14	15	14	14	14	15	14	4.5	**104.5**
174.6	14	15	14	14	15	15	14	4.5	**105.5**
176.4	14	15	15	14	15	15	14	4.5	**106.5**
178.2	14	15	15	15	15	15	14	4.5	**107.5**
180	15	15	15	15	15	15	14	4.5	**108.5**
181.8	15	15	15	15	15	15	15	4.5	**109.5**

a. "Total Spill" calculated at forebay elevation 537.0 ft based on interim spillway rating table dated 2 Apr 2009.

b. Bay 8 with RSW equivalent to ~4.5 stops at forebay elevation 537.0 ft. Raise Bay 8 tainter gate above stop 9 for RSW to ensure free surface and debris passage.

2014 Fish Passage Plan

Section 8 – Little Goose Dam

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Section 8 - Little Goose Dam

Project Acronym*	LGS
River Mile (RM)	Snake River - RM 70.3
Reservoir	Lake Bryan
Minimum Instantaneous Flow (kcfs)	Dec–Feb: 0 kcfs \ Mar–Nov: 11.5 kcfs
Forebay Normal Operating Range (ft)	633’ – 638’
Tailrace Rate of Change Limit (ft)	1.5’/hr
Powerhouse Length (ft)	656’
Powerhouse Hydraulic Capacity (kcfs)	130 kcfs
Turbine Units (#)	6 (Units 1-3 BLH Kaplan; Units 4-6 Allis Chalmers Kaplan)
Turbine Generating Capacity (MW)	Rated: 810 MW (Units 1-6 @ 135 MW) \ Maximum: 930 MW (Units 1-6 @ 155 MW)
Gatewell Orifice Diameter (in)	35 gatewells w/ 12” orifice; 1 gatewell w/ 14” orifice
Spillway Length (ft)	512’
Spillway Hydraulic Capacity (kcfs)	850 kcfs
Spillbays (#)	8
Spillway Weirs (#)	1 (Bay 1)
Navigation Lock Length x Width (ft)	650’ x 84’ (Usable Space)
Navigation Lock Max. Lift (ft)	101’
FISH STRUCTURE/OPERATION START DATE	
Juvenile Bypass System (JBS)	1970 (1st Generation) \ 1989 (2nd Generation) \ 2010 Outfall Flume Relocation
Submersible Traveling Screens (STS)	1971 (Prototype Mesh) \ 1994 (Complete)
Extended-Length Submersible Bar Screens (ESBS)	1997
Transportation Research Program - NMFS	1971-1975
Juvenile Fish Transportation Program - Corps	1981 \ 1991 (3rd Generation)
Temporary Spillway Weir (TSW)	2009
Adult Fish Counts – South Shore	1970-1981; 1991-present

*Project acronym designated by US Army Corps of Engineers, Northwestern Division, Columbia Basin Water Management Division. Due to the large number of projects managed by NWD, this acronym may differ from other acronyms used in the region. For example, a common acronym for Little Goose is LGO. However, that acronym is assigned to another NWD project, thus the official Corps NWD acronym is LGS.

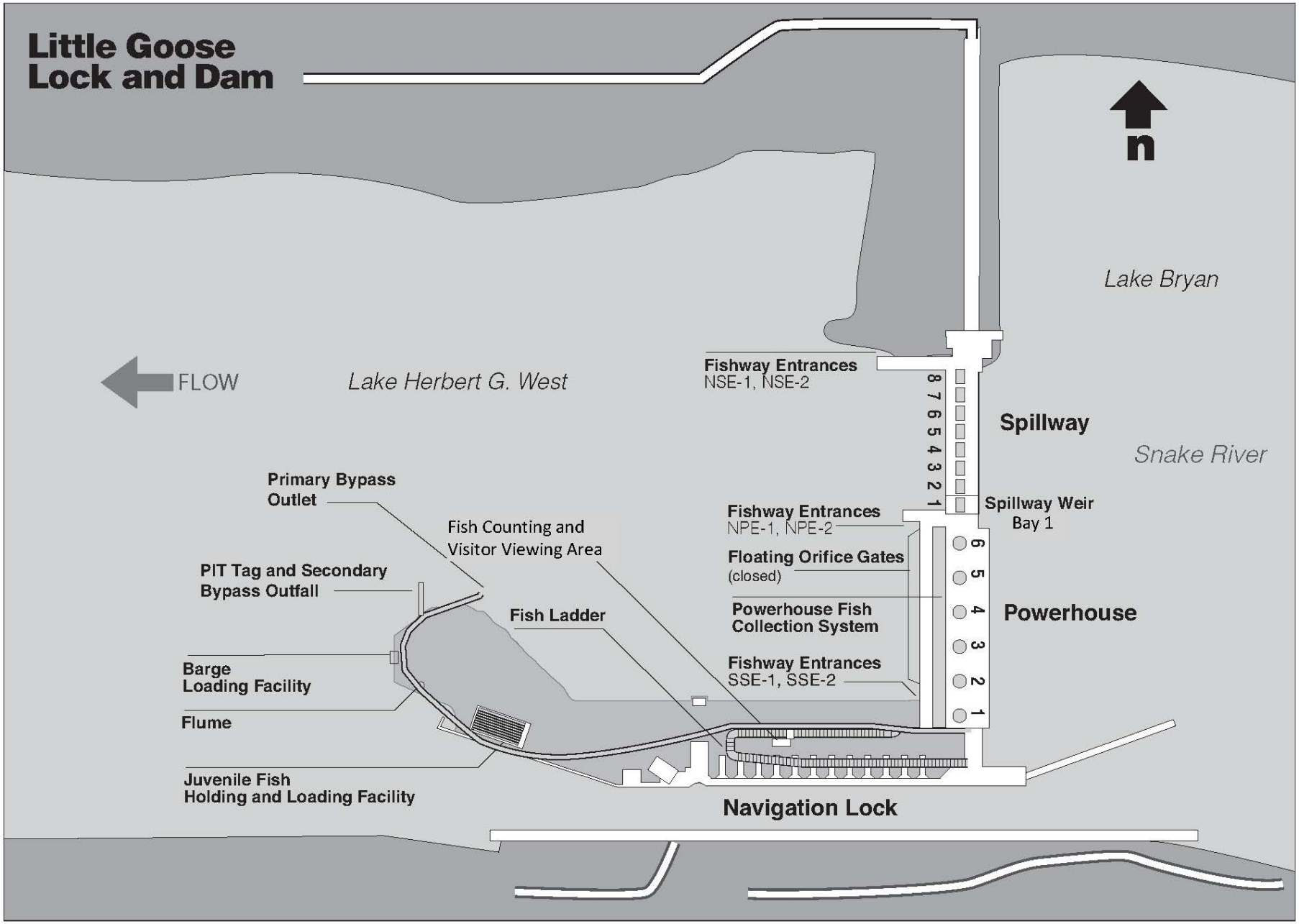
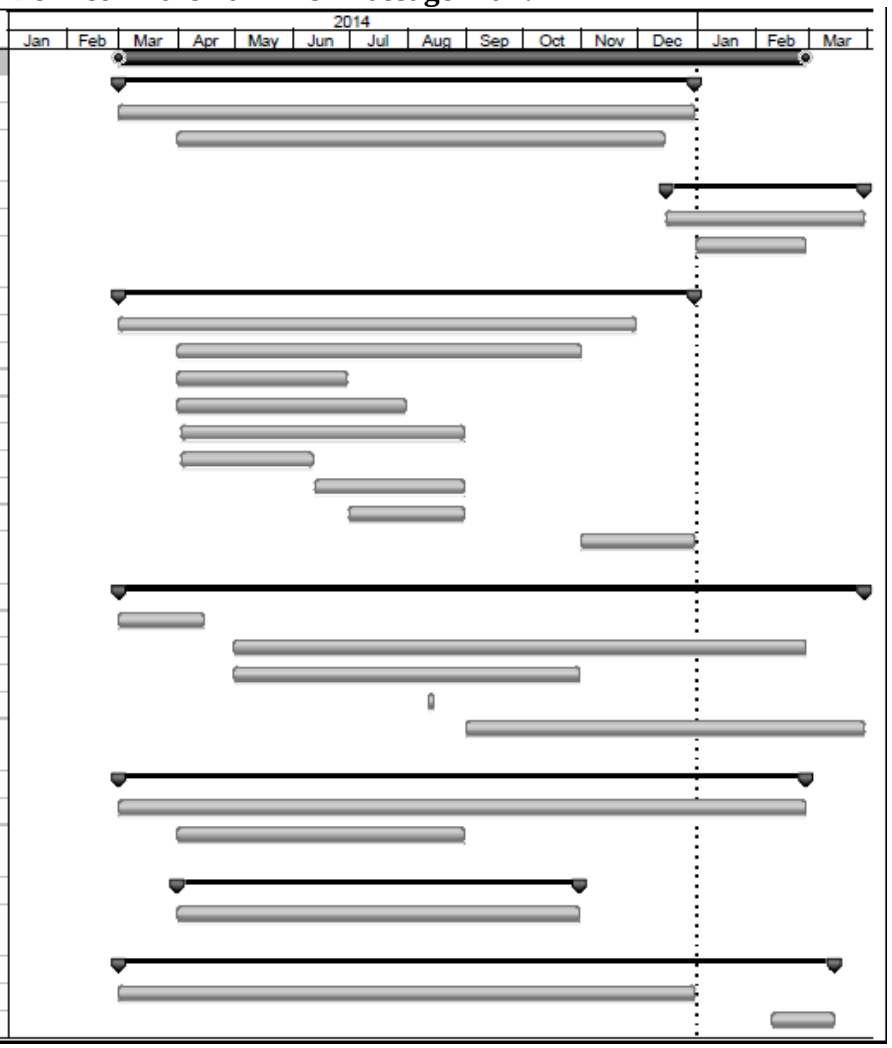


Figure LGS-1. Little Goose Lock & Dam General Site Plan.

Table LGS-1. Little Goose Dam Schedule of Operations and Actions Defined in the 2014 Fish Passage Plan.

Task Name	Start Date	End Date	FPP Reference
2014 FPP Operations & Actions - Little Goose	3/1/14	2/28/15	LGS
Fish Passage Facilities Operation	3/1/14	12/31/14	2.3.
Adult Fish Facilities	3/1/14	12/31/14	2.3.2.2
Juvenile Fish Facilities	4/1/14	12/15/14	2.3.1
Fish Passage Facilities Maintenance	12/16/14	3/31/15	2.3
Juvenile Fish Facilities Winter Maintenance	12/16/14	3/31/15	2.3.1.1
Adult Fish Facilities Winter Maintenance	1/1/15	2/28/15	2.3.2.1
Project Operations for Fish Passage	3/1/14	12/31/14	
Turbine operating priority order	3/1/14	11/30/14	4.1.1.
1% operating range - hard constraint	4/1/14	10/31/14	4.1.2.
Measure VBS head weekly (minimum)	4/1/14	6/30/14	2.3.1.2.b.11
Backflush orifices once per 8-hrs (minimum)	4/1/14	7/31/14	2.3.1.2.c.6.
Spillway Weir in service (close 8/1-8/31)	4/3/14	8/31/14	2.3.1.2.g.3.
Spring Spill Operations (end date approx)	4/3/14	6/12/14	FOP
Summer Spill Operations (dates approx)	6/13/14	8/31/14	FOP
Measure VBS head bi-weekly (minimum)	7/1/14	8/31/14	2.3.1.2.b.11
Priority turbine unit maintenance	11/1/14	12/31/14	4.2.3.
Special Operations & Studies (dates approximate)	3/1/14	3/31/15	Appendix A
Units 1, 2 Exciter Re-Commissioning	3/1/14	4/15/14	8.1.2.
Adult Salmon Studies	5/1/14	2/28/15	8.2.1
Adult Lamprey Passage Studies	5/1/14	10/31/14	8.2.2-3.
Coupling Capacitor Testing	8/12/14	8/15/14	8.1.4.
Steady State Model Validation Testing	9/1/14	3/31/15	8.1.5.
TDG Monitoring	3/1/14	2/28/15	2.2.
TDG Monitoring - Tailrace (year-round)	3/1/14	2/28/15	station LGSW
TDG Monitoring - Forebay	4/1/14	8/31/14	station LGSA
Adult Fish Counting	4/1/14	10/31/14	Table LGS-3
Daytime Visual 0400-2000 PST	4/1/14	10/31/14	
Reports	3/1/14	3/15/15	2.3.3.
Weekly Reports	3/1/14	12/31/14	
Annual Report	2/10/15	3/15/15	



1. FISH PASSAGE INFORMATION

Fish passage facilities and dam structures at Little Goose Dam are illustrated in **Figure LGS-1**. Dates of project operations for fish, research and other special operations are defined in **Table LGS-1**.

1.1. Juvenile Fish Passage.

1.1.1. Facilities Description. The Little Goose Dam juvenile fish facilities (**Figure LGS-1**) consist of a bypass system and juvenile transportation facilities. The bypass system consists of extended length submersible bar screens (ESBSs) with flow vanes, vertical barrier screens (VBSs), one 14” and thirty-five 12" 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 one corrugated metal flume to transport fish to either transportation facilities or the river. The transportation facilities include a separator structure, raceways for holding fish, a distribution system for distributing fish among raceways, 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 Little Goose Dam (**Table LGS-2**) is based on juvenile fish collection numbers for the most recent 10-year period and do not reflect fish guidance efficiency (FGE) or passage via the RSW or spillway. From 2006–2009, fish collection began later in the season and may have skewed the passage dates shown. Salmon, steelhead, bull trout, lamprey, and other species are counted when they are observed in the juvenile monitoring facility. Maintenance of fish passage facilities that may impact juvenile passage or facility operation should be conducted during the winter maintenance season.

Table LGS-2. Juvenile Salmonid Passage Timing at Little Goose Dam for Most Recent 10-Years (2004-2013) Based on Daily & Yearly Collection Data.

Year	10%	50%	90%	# Days	10%	50%	90%	# Days
	Yearling Chinook				Subyearling Chinook			
2004	24-Apr	5-May	18-May	24	9-Jun	21-Jun	17-Jul	38
2005	3-May	11-May	19-May	16	12-May	6-Jun	20-Jun	39
2006	23-Apr	6-May	20-May	27	24-May	9-Jun	4-Jul	41
2007	8-May	14-May	22-May	14	7-Jun	15-Jun	6-Jul	29
2008	5-May	15-May	28-May	23	4-Jun	20-Jun	23-Jul	49
2009	24-Apr	7-May	23-May	29	29-May	7-Jun	30-Jun	32
2010	2-May	15-May	29-May	27	6-Jun	12-Jun	8-Jul	32
2011	5-May	12-May	19-May	14	4-Jun	17-Jun	20-Jul	46
2012	30-Apr	7-May	21-May	21	4-Jun	16-Jun	12-Jul	38
2013	5-May	10-May	16-May	11	2-Jun	13-Jun	29-Jul	57
MEDIAN	**2-May**	**10-May**	**20-May**	**22**	**4-Jun**	**14-Jun**	**10-Jul**	**39**
MIN	**23-Apr**	**5-May**	**16-May**	**11**	**12-May**	**6-Jun**	**20-Jun**	**29**
MAX	**8-May**	**15-May**	**29-May**	**29**	**9-Jun**	**21-Jun**	**24-Jul**	**50**
	Unclipped Steelhead				Clipped Steelhead			
2004	25-Apr	11-May	2-Jun	38	27-Apr	10-May	1-Jun	35
2005	6-May	12-May	24-May	18	6-May	12-May	22-May	16
2006	20-Apr	5-May	23-May	33	21-Apr	4-May	20-May	29
2007	11-May	15-May	30-May	19	10-May	15-May	27-May	17
2008	8-May	18-May	1-Jun	24	1-May	12-May	23-May	22
2009	24-Apr	4-May	29-May	35	23-Apr	30-Apr	25-May	32
2010	3-May	22-May	8-Jun	36	2-May	20-May	7-Jun	36
2011	7-May	16-May	6-Jun	30	4-Apr	12-May	20-May	46
2012	30-Apr	17-May	2-Jun	33	25-Apr	9-May	26-May	31
2013	6-May	13-May	21-May	15	4-May	12-May	18-May	14
MEDIAN	**4-May**	**20-May**	**31-May**	**32**	**29-Apr**	**12-May**	**24-May**	**30**
MIN	**20-Apr**	**4-May**	**21-May**	**15**	**4-Apr**	**30-Apr**	**18-May**	**14**
MAX	**11-May**	**22-May**	**8-Jun**	**38**	**10-May**	**20-May**	**7-Jun**	**46**
	Coho				Sockeye (Wild & Hatchery)			
2004	19-May	30-May	19-Jun	31	3-May	25-May	11-Jun	39
2005	11-May	15-May	24-May	13	12-May	24-May	5-Jun	24
2006	5-May	22-May	1-Jun	27	22-Apr	20-May	27-May	35
2007	14-May	17-May	5-Jun	22	13-May	19-May	30-May	17
2008	12-May	22-May	30-May	18	20-May	26-May	6-Jun	17
2009	16-May	24-May	21-Jun	36	28-Apr	22-May	30-May	32
2010	15-May	22-May	7-Jun	23	20-May	28-May	8-Jun	19
2011	7-May	16-May	22-May	15	14-Apr	13-May	15-Jun	62
2012	5-May	20-May	31-May	26	13-May	23-May	3-Jun	21
2013	10-May	15-May	22-May	12	17-May	19-May	22-May	5
MEDIAN	**11-May**	**21-May**	**31-May**	**23**	**12-May**	**22-May**	**4-Jun**	**23**
MIN	**5-May**	**15-May**	**22-May**	**12**	**14-Apr**	**13-May**	**22-May**	**5**
MAX	**19-May**	**30-May**	**21-Jun**	**36**	**20-May**	**28-May**	**15-Jun**	**62**

1.2. Adult Fish Passage.

1.2.1. Facilities Description. Adult fish passage facilities at Little Goose Dam 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 the project throughout the year and adult passage facilities are operated year-round. Maintenance of adult fish facilities is scheduled for January–February to minimize impacts on upstream migrants. Adult salmon, steelhead, shad and lamprey are counted (**Table LGS-3**) and daily data are posted online at: http://www.nwp.usace.army.mil/Missions/Environment/Fishdata.aspx. Yearly fish counts are used to determine peak adult migration timing (**Table LGS-4**). Sturgeon and bull trout are relatively infrequent and counts are posted online periodically during the passage season in *Miscellaneous Fish Counts* and summarized in the *Annual Fish Passage Report*.

Table LGS-3. Adult Fish Counting Schedule at Little Goose Dam (3/1/14-2/28/15).

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

*All count hours are shown in Pacific Standard Time (PST). Note that during Daylight Saving Time (DST) from Mar 9–Nov 2, 2014, count hours will be one hour later (DST = PST+1).

Table LGS-4. Adult Fish Count Period and Peak Passage Timing at Little Goose Dam (based on yearly counts since 1970).

Species	Count Period	Earliest Peak	Latest Peak
Spring Chinook	Apr 1 – Jun 15	Apr 20	Jun 1
Summer Chinook	Jun 16 – Aug 15	Jun 16	Jul 12
Fall Chinook	Aug 16 – Oct 31	Sep 3	Sep 30
Steelhead	Apr 1 – Oct 31	Sep 6	Oct 14
Sockeye	Jun 15 – Oct 31	Jun 24	Jul 25
Lamprey	Apr 1 – Oct 31	Jul 6	Aug 20

1.2.2.1. Time-of-day (diel) distributions of adult salmonid activity at Little Goose Dam fishway entrances and exits are summarized in **Figure LGS-2** (see *Keefer & Caudill 2008* at: http://www.nwd-wc.usace.army.mil/tmt/documents/FPOM/2010/2013_FPOM_MEET/2013_JUN/).

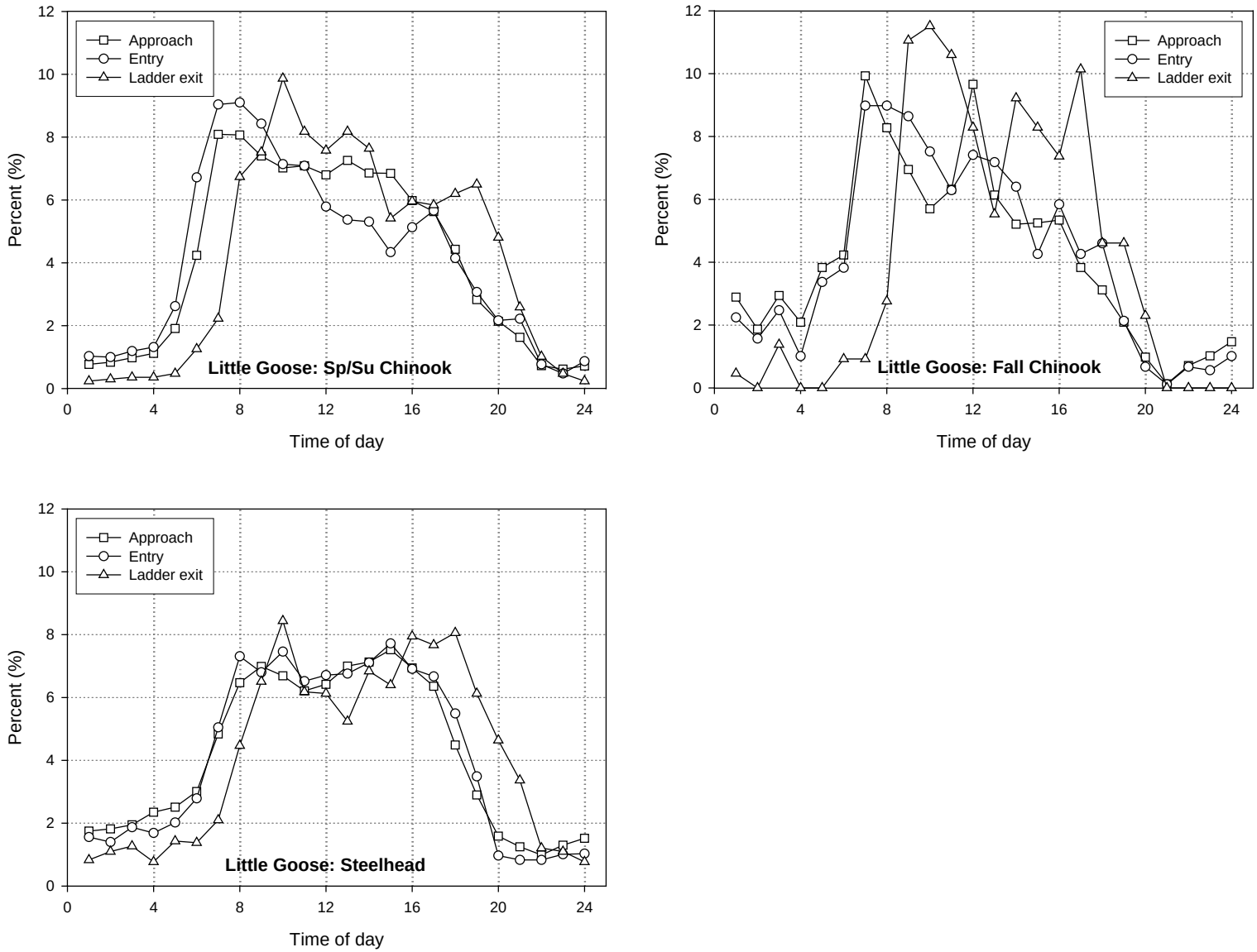


Figure LGS- 2. Diel Distribution of Adult Salmonids at Little Goose Dam Fishway Entrances and Exits (*Keefer & Caudill 2008*).

2. PROJECT OPERATIONS

2.1. Spill Management.

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

2.1.1. 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-8 through LGS-11**. Special spills for juvenile fish passage will be provided as detailed in **Appendices A** and **E**.

2.1.2. Spill for Fish Passage. During years when fish passage spill is provided at Little Goose, and project biologists or researchers at Little Goose notice an extraordinary congregation of juvenile fish delaying in the forebay, they will notify NOAA Fisheries and CENWW to request a fish flush spill (FFS) that evening. The FFS request will be for up to three hours, 8 pm to 11 pm, and be up to 50% of river flow during those hours, using a uniform spill pattern to lessen dissolved gas entrainment.

2.2. Total Dissolved Gas (TDG) Management.

TDG levels at all projects are monitored in accordance with the *TDG Monitoring Plan*, included in the *Water Management Plan* as Appendix 4, and available online at: http://www.nwd-wc.usace.army.mil/tmt/documents/wmp/.

2.3. Operating Criteria.

2.3.1. Juvenile Fish Passage Facilities. From April 1–October 31, operate for juvenile fish bypass, collection and transport and from November 1–December 15 to bypass adult fallbacks. Operate according to criteria listed below and in the *Juvenile Fish Transportation Program* (**Appendix B**) for bypass, collection, and transport. The transportation program may be revised in accordance with ESA Section 10 permit and the NOAA Fisheries Biological Opinion.

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

2.3.1.1.a. Forebay Area and Intakes.

a.1. Remove debris from forebay and gatewell slots.

a.2. Rake trashracks just prior to the operating season.

a.3. Measure drawdown in gatewell slots after cleaning trashracks with ESBSs in.

a.4. Inspect and repair gatewell dip net as needed.

2.3.1.1.b. ESBSs, Flow Vanes and VBSs.

b.1. After ESBSs are removed at the end of the season, inspect them for the presence of juvenile salmonid mortalities and all other incidental fish mortalities. Inspect ESBSs within a week after removal, or as soon as practical. All mortalities are to be counted, or otherwise estimated, for each ESBS and reported to CENWW-OD-T.

b.2. Maintenance completed on all screens.

b.3. Inspect ESBSs prior to installation and operate debris cleaner (dogged off on deck) to ensure proper operation.

b.4. Log results of trial run.

b.5. Inspect VBSs with an underwater video camera at least 1x/year; repair as needed.

b.6. Inspect flow vanes to make sure they are in good condition and all surfaces smooth. Repair as needed.

2.3.1.1.c. Collection Channel.

c.1. Water-up valve capable of operating when needed.

c.2. Orifice lights are operational.

c.3. Orifices clean and valves operating correctly.

c.4. Orifice cycling and air backflush system works correctly.

2.3.1.1.d. Dewatering Structure and Flume.

d.1. Inclined screen clean and in good condition with no gaps between screen panels or damaged panels.

d.2. Cleaning brush and air burst systems maintained and operating correctly.

d.3. Overflow weirs should be maintained, tested and operating correctly.

d.4. All valves should be operating correctly.

d.5. Baffle boards under inclined screen in good condition.

d.6. Flume interior should be smooth with no rough edges.

2.3.1.1.e. Transportation Facilities.

e.1. Flume switch gate maintained and in good operating condition.

e.2. Flume interior smooth with no rough edges.

e.3. Perforated plate smooth with no rough edges.

e.4. Wet separator and fish distribution system maintained and ready for operation as designed.

e.5. Brushes and screens on crowders in good condition with no holes in screens or rough edges.

e.6. Crowders maintained, tested, and operating correctly.

e.7. All valves, slide gates, and switch gates maintained and in good operating condition.

e.8. Retainer screens in place with no holes in screens or sharp wires protruding.

e.9. Barge and truck loading pipes free of debris, cracks, or blockages and barge loading boom maintained and tested.

e.10. All sampling equipment should be maintained and in good operating condition prior to watering up the facilities.

e.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.

e.12. Mini- and midi-tanks maintained and in good operating condition.

2.3.1.1.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.

2.3.1.1.g. Maintenance Records. Record all maintenance and inspections.

2.3.1.2. Juvenile Fish Passage Period (April 1–December 15).

2.3.1.2.a. Forebay Area and Intakes.

a.1. Remove debris from forebay. All floating debris will be removed whenever 2 acres of debris accumulates in the spring and 1 acre in the summer and fall.

a.2. Log drawdown differentials in bulkhead slots at least once a week.

a.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.

a.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 flow 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.

a.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.

a.6. Coordinate cleaning efforts with personnel operating juvenile collection facilities.

a.7. Dip bulkhead gatewell slots to remove fish prior to installing bulkhead for dewatering a bulkhead slot.

2.3.1.2.b. ESBSs, VBSs and Operating Gates.

b.1. Operate ESBSs with flow vanes attached to screen.

b.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.

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

b.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.

b.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.

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

b.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.

b.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.

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

b.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.

b.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.

b.12. Inspect at least 2 VBSs in 2 different turbine units between spring and summer migration periods. Both units should have been operated frequently during spring. If debris accumulation is noted, inspect other VBSs and clean debris as necessary.

b.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.

b.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 at: http://www.weather.gov.

2.3.1.2.c. Collection Channel.

c.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.

c.2. Orifice lights operational and operating on open orifices. Orifice lights and area lights may be turned off the evening before channel is dewatered at end of 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.

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

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

c.5. Orifice valves are either fully open or closed.

c.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.

c.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 back-flushing to maintain clear orifices.

c.8. Water-up valve capable of operating when needed.

2.3.1.2.d. Dewatering Structure.

d.1. Trash sweep and air burst systems operating correctly. The frequency of screen cleaning should be set as necessary to maintain a clean screen.

d.2. Hand clean trapezoidal section as often as required to maintain in clean condition, with a minimum of once per day.

d.3. Check overflow weirs to make sure they are operating correctly, perform maintenance as required.

d.4. There should be no gaps between screen panels or damaged panels in the inclined screen. Screen panels in place and tightly secured.

d.5. Lights at the dewatering structure should be turned off at night, unless needed for personnel access, to encourage fish to move downstream volitionally.

2.3.1.2.e. Transportation Facilities.

e.1. Operate wet separator and fish distribution system as designed.

e.2. Crowder screen brushes should be maintained in good operating condition with no holes or sharp edges on crowder screens.

e.3. Inspect raceway and tank retainer screens to make sure they are clean with no holes or protruding wires.

e.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.

e.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).

2.3.1.2.f. Avian Predation Areas (Forebay and Tailrace).

f.1. Bird wires and other avian deterrent devices should be monitored to ensure they are in good condition, and any broken wires or devices replaced as soon as possible.

f.2. Harassment program in place to deter avian predation in areas actively used by birds and not covered by bird wires or other devices.

f.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.

2.3.1.2.g. Temporary Spillway Weir (TSW).[1]

g.1. SW-Hi: Spring spill for fish passage will start with the TSW deployed in Bay 1 in the high crest elevation 622 msl (SW-Hi; approximate discharge 7 kcfs) and spill will be distributed in the "SW-Hi" pattern in **Table LGS-9**. SW-Hi will be maintained the entire spill season unless conditions described in paragraph **g.2** below are met.

g.2. SW-Lo: When flow increases above 85 kcfs (i.e., during the spring freshet), the TSW will be changed to low crest elevation 618 msl (SW-Lo; approximate discharge 11 kcfs) and spill will be distributed in the "SW-Lo" pattern in **Table LGS-8**. The crest change will occur 3 normal work days prior to the date on which the most recent STP forecasts daily average flow above 85 kcfs for at least 7 consecutive days, or if actual flow indicates that flow will exceed 85 kcfs before the next STP forecast is issued, as determined by NWW Water Management staff. The crest change will be further based on the following:

[1] Spillway weirs provide surface passage routes via spillbay(s). Temporary, or Top, Spillway Weirs (*TSW*s) at Little Goose, McNary and John Day dams can be installed, uninstalled and moved between bays using the gantry crane. Removable Spillway Weirs (*RSW*s) at Lower Granite, Lower Monumental and Ice Harbor dams are "removed" by controlled descent to the bottom of the forebay.

i. Review of juvenile fish passage at Lower Granite and Little Goose dams to prevent crest change during a peak in outmigration;

ii. Coordination with regional fish managers.

The crest change will occur within 3 normal work days after RCC issues the teletype. During the work to change the crest elevation, spill will be distributed in the "Alternate Uniform" pattern (**Table LGS-11**) and bay 2 will be closed to ensure worker safety in the adjacent bay.

When flow drops below 85 kcfs and forecasts indicate flow below 85 kcfs for at least 7 consecutive days, the TSW will be changed back to SW-Hi (**Table LGS-9**). The crest change will be further based on the criteria defined in paragraphs **i** and **ii** above, and will occur within 3 normal work days after RCC issues the teletype. During the work to change the crest elevation, spill will be distributed in the "Alternate Uniform" pattern (**Table LGS-11**) and bay 2 will be closed to ensure worker safety in the adjacent bay. *The TSW will not be changed back to SW-Lo for the rest of the season even if river flow subsequently increases above 85 kcfs.*

g.3. Close TSW: On or after August 1, when daily average discharge drops below 35 kcfs and forecasts indicate flow below 35 kcfs for at least 3 days, the TSW will be closed for the remainder of the spill season and spill will be distributed in the "Uniform" pattern with no spillway weir (**Table LGS-10**). The TSW will be closed within 3 normal work days after RCC issues the teletype and coordinated through CENWW-OD-T. During the work to close the TSW, spill will be distributed in the "Alternate Uniform" pattern (**Table LGS-11**) and bay 2 will be closed to ensure worker safety in the adjacent bay.

i. The TSW will be closed no earlier than August 1 to enhance subyearling migration even if low flow criteria (daily average discharge below 35 kcfs) is achieved prior to August 1, unless an adult passage delay is observed or if necessary due to turbine unit operational constraints at low flow. Closing the TSW prior to August 1 will be coordinated through FPOM by CENWW-OD-T.

2.3.1.2.h. Inspection and Record Keeping.

h.1. Inspect fish facilities at least once every 8 hours. Inspect all facilities according to fish facilities monitoring program.

h.2. Record all maintenance and inspections.

2.3.2. Adult Fish Passage Facilities.

2.3.2.1. Winter Maintenance Period (January 1–February 28).

2.3.2.1.a. Inspect all staff gages and water level indicators; repair and/or clean as necessary.

2.3.2.1.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.

2.3.2.1.c. Inspect for and clean debris from the fish ladder exit. The trashrack and picketed leads must be clean and installed correctly.

2.3.2.1.d. Calibrate all water level measuring devices as necessary for proper facility operations.

2.3.2.1.e. Inspect all spill gates and ensure that they are operable.

2.3.2.1.f. Fish pumps maintained and ready for operation.

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

2.3.2.2. Adult Fish Passage Period (March 1–December 31).

***Note*:** Lower Monumental pool may be operated at minimum operating pool (MOP) elevation range 537'–538' msl as part of the Corps' efforts to improve migration conditions for juvenile salmonids. This may result in some of the Little Goose adult fishway entrances 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 pumped.

2.3.2.2.a. Fishway Ladder. Water depth over weirs: 1' to 1.3'.

2.3.2.2.b. Counting Window. The Little Goose counting window slot is fixed at a width of no less than 18”. All equipment should be maintained and in good condition. The counting window and backboard should be cleaned as needed to maintain good visibility.

2.3.2.2.c. Fishway Entrance Head. Head range: 1' – 2' at all entrances.

2.3.2.2.d. North Shore Entrances (NSE 1&2). Top of gate elev. on sill = 529'.

d.1. Operate both downstream gates.

d.2. Weir depth: 6' or greater below tailwater.

2.3.2.2.e. North Powerhouse Entrances (NPE 1&2). Top of gate elev. on sill = 532'.

e.1. Operate both downstream gates.

e.2. Weir Depth: 7' or greater below tailwater (tailwater permitting). At tailwater below elevation 539', entrance weirs should be on sill.

2.3.2.2.f. Floating Orifice Gates (FOGs). No FOGs will be operated. Inspect fish fallout fence for debris buildup, holes, etc.

2.3.2.2.g. South Shore Entrances (SSE 1&2). Top of gate elev. on sill = 529'.

g.1. Operate both gates.

g.2. Weir depth: 8' or greater below tailwater.

2.3.2.2.h. Channel Velocity. 1.5' – 4' per second.

h.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 through the fishway. Velocity readings will be included in required fishway inspections and reported in the weekly and annual reports.

h.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.

h.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.

2.3.2.2.i. Tunnel Lights. Lights in the tunnel section under the spillway shall be on during fish passage period.

2.3.2.2.j. Head on Trashracks.

j.1. Ladder exit maximum head of 0.5'.

j.2. Picketed leads maximum head of 0.3'.

j.3. Trashrack and picketed leads installed correctly.

2.3.2.2.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.

2.3.2.2.l. Facility Inspections.

l.1. Powerhouse operators shall inspect facilities once per day shift and check computer monitor information at least once during each back shift.

l.2. Project biologists shall inspect facilities three times per week. Inspect all facilities according to fish facilities monitoring program.

l.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).

l.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.

l.5. Inspect fishways daily for foreign substances (particularly oil). If substances are found, corrective actions should be undertaken immediately.

l.6. Record all inspections.

2.3.3. Juvenile & Adult Fish Facility Monitoring and Reporting.

2.3.3.1. Project biologists shall inspect fish passage facilities at frequencies listed in the juvenile and adult fish facilities operating criteria sections.

2.3.3.2. Weekly Reports. March 1–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:

i. Any out-of-criteria situations observed and corrective actions taken;

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

ii. Adult fishway control calibrations;

iii. ESBS and VBS inspections;

iv. Any unusual activities at the project that may have affected fish passage.

2.3.3.3. 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.

2.3.3.4. Project 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°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 the *Guidelines for Dewatering and Fish Handling Plans* (**Appendix F**).

3.1. Juvenile Fish Passage Facilities Maintenance.

3.1.1. Scheduled Maintenance. Scheduled maintenance of 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–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:

i. Description of the problem;

ii. Type of outage required;

iii. Impact on facility operation;

iv. Length of time for repairs;

v. Expected impacts on fish passage and proposed measures to mitigate them.

3.1.2.1. Extended-length Submersible Bar Screens (ESBSs). 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 flow is at the level where taking a unit out of service will result in spill above TDG limits, 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 flow is 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. Transportation facilities can be operated either to collect and hold juveniles for the transportation program or to bypass fish back to the river. If part of the facility malfunctions or is damaged, efforts will first be made to bypass fish around the damaged area. If this is not possible, fish will be bypassed around the transportation facility.

3.2. Adult Fish Passage Facilities Maintenance.

3.2.1. Scheduled Maintenance. Scheduled maintenance that requires a facility to be dewatered or maintenance that may have a significant effect on fish passage will be done during the winter maintenance period (January–February). 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. 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 (AWS). Three turbine-driven pumps on the south shore supply auxiliary water for the fish ladder and the powerhouse collection system. All three pumps are required for normal operation. Approximately 150–180 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 providing 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 ensure 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 otherwise coordinated.

4. TURBINE UNIT OPERATION & MAINTENANCE

4.1. Turbine Unit Operation.

4.1.1. From March 1–November 30, turbine units will be operated to enhance adult and juvenile fish passage in the priority order defined in **Table LGS-5**. Unit operating priority may be coordinated differently to allow for fish research, construction, or project maintenance activities. If more than one turbine unit is operating, discharge will be maximized (i.e., operated at the 1% upper limit) through the southernmost turbine units starting with Unit 1 to the extent possible without exceeding 1% limits. If a turbine unit is taken out of service for maintenance or repair, the next unit in the priority order shall be operated.

Table LGS-5. Turbine Unit Operating Priority for Little Goose Dam. *

Season	Time of Day	Unit Priority
Fish Passage Season March 1 – November 30	24 hours/ day	1*, 2, 3, 4, 5, 6 *Maximize discharge through lowest numbered turbine units*
Winter Maintenance Period December 1 – February 28	24 hours/ day	Any Order

***See section 4.1.2.2. below.** At river flow >38 kcfs, Unit 1 is manually restricted to operate in the upper 25% of the 1% range at 115–125 MW (~16.0-17.5 kcfs). Assume other units will operate approximately uniformly within their full 1% ranges. When other units are operating at <16.0 kcfs, assume Unit 1 is at the lower end of the 1% upper range (~16.0 kcfs). When average unit discharge is >16.0 kcfs, assume all units operating uniformly. At low river flow <38 kcfs with only Unit 1 operating, Unit 1 may operate within the full 1% range.

4.1.2. Turbine Unit Operating Ranges. From April 1–October 31, turbine units will be operated within ±1% of peak turbine efficiency (1% range), as specified in *BPA's Load Shaping Guidelines* (**Appendix C**). Turbine unit output and discharge at the lower and upper 1% limits (with and without ESBSs) for various heads are defined in **Tables LGS-6** (Units 1-3) and **LGS-7** (Units 4-6). If operation outside the 1% range is necessary, Project personnel shall record the information and provide to BPA on a weekly basis according to the load shaping guidelines. Operation outside of the 1% range may be necessary to:

i. Meet BPA load requirements. Load requests will be made in accordance with BPA's policy, statutory requirements and load shaping guidelines (**Appendix C**);

ii. If the turbine unit draft tube is to be dewatered, the unit will be operated at full load (>1%) for a minimum of 15 minutes prior to installing tail logs. If not possible to load, the unit will be run at speed-no-load (<1%) for minimum of 15 minutes. This is to reduce the number of fish in the scrollcase prior to installing stop logs;

iii. Operate a turbine unit solely to provide station service; or

iv. Comply with other coordinated fish measures;

v. From November 1–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.

4.1.2.2. Unit 1 Special Operation. During fish passage season when the spillway weir (TSW) is operating in spillbay 1, Turbine Unit 1will operate in the upper 25% of the 1% range. Historic operation within the GDACS program tended to balance flow out of any units in operation. This operation will, at times, result in an unbalanced operation where more flow is passing through Unit 1 than other operating units. Physical modeling has indicated that a higher flow out of Unit 1 is 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 SW is operating in spillbay 1. When the TSW is removed from service during summer spill and low flow criteria are achieved (<38 kcfs), the tailrace eddy is mostly non-existent and all turbine units may be operated within the full 1% range.

4.1.3. Minimum Generation. All of the lower Snake River powerhouses may be required to keep one generating turbine unit online at all times to maintain power system reliability. During low flow, 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, 2 and 3 and 13.5–14.5 kcfs for turbine units 4, 5 and 6. Actual attainable minimum generation levels may vary depending on project conditions.

4.1.4. Turbine Unit Outages during High River Flow. During high spring flow, 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 flow is 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. Turbine Unit Maintenance.

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 drafted back to the MOP operating range. When inspection or repair work can be scheduled ahead of time, the following process will be followed:

i. Project personnel shall schedule unit outages through the approved outage scheduling procedure by noon of the Tuesday of the week prior to the outage.

ii. Project personnel shall also contact CENWW-OD-T and RCC by the same time period and inform them of the intended work.

iii. RCC will coordinate the work activities through TMT.

iv. After coordination with the TMT, RCC shall issue a teletype through the CBTT issuing instructions to project and BPA personnel for the scheduled work.

v. 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.

vi. 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 work started). At this point, screen inspections shall stop. (At Snake River projects, this should allow about one normal workday for the scheduled work.)

vii. 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.

viii. If work is not finished (e.g., screen inspections), project personnel shall schedule another 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 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 inflow.

Table LGS-6. Little Goose Dam Turbine Units 1, 2 and 3 Output (MW) & Discharge (cfs) Per Unit at Upper and Lower Limits of the 1% Peak Efficiency Operating Range with and without ESBSs. [1]

Project Head (feet)	TURBINE UNITS 1, 2, 3							
	With ESBS				No ESBS			
	1% Lower Limit		1% Upper Limit		1% Lower Limit		1% 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**

1. Table based on the 2003 index test of U3 and the 1962 turbine model test.

Table LGS-7. Little Goose Dam Turbine Units 4, 5 and 6 Output (MW) & Discharge (cfs) Per Unit at Upper and Lower Limits of the 1% Peak Efficiency Operating Range with and without ESBSs. [1]

Project Head (feet)	TURBINE UNITS 4, 5, 6							
	With ESBS				No ESBS			
	1% Lower Limit		1% Upper Limit		1% Lower Limit		1% 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**

1. Table based on the 2003 index test of U4 and the 1975 turbine model test.

4.2.3. Maintenance Schedule. 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 peak 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.

4.2.4. Turbine units are to be operated with raised operating gates to improve fish passage conditions when ESBSs are installed, except as provided below. [2] 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. <u>The project biologist will be notified when the operating gates are set in the standard operating position. The gatewells will be monitored 2 times per day to observe fish condition while the operating gates are in the standard operating position.</u> If turbine maintenance or the raising of the operating gates to the raised operating position is delayed after the time periods stated above, the turbine unit shall be immediately taken out of service until the work can be accomplished. Operation of turbine units with operating gates in the standard operating position shall be restricted to the 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.

[2] Operating gates may also be referred to as “head” gates at some projects. The terms are interchangeable.

4.2.5. 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.

4.2.6. 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. 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 fish impingement, injuries and/or descaling. Removing debris from 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 physical removal (e.g., using boats to encircle the debris with log booms and tow it to shore where it can be removed with a crane, or using a crane and scoop from the top of the dam to remove forebay debris) or by passing the debris through the spillway with special spill and/or powerhouse operations. The preferred option is to physically remove debris when possible to avoid passing debris to the next downstream project. However, this is not always possible as some projects do not have forebay debris removal capability. In this case, the only viable alternative is to pass the debris via the spillway.

5.1. Debris Spill Coordination.

5.1.1. 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. Project personnel shall provide CENWW-OD-T the reason for the debris spill request including an explanation of project facilities impacted by debris, the date and time of the requested spill, and any special powerhouse or other operations required to move the debris to the spillway. Using information provided by the project, CENWW-OD-T shall coordinate the special operations with RCC, NOAA Fisheries and FPOM.

When a debris spill is coordinated and approved, RCC shall issue a teletype detailing the specifics of the special operations.

5.2. Emergency Debris Spill.

5.2.1. 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-8. [*pg 1 of 3*] Little Goose Dam Spill Patterns with Spillway Weir in Low Crest (SW-Lo) Elevation 618 ft. *See notes at end of table.*

Outflow [a]				Turbine Unit Outflow [b] (kcfs)						SW-Lo Gate Stops per Spillbay									Comments (see footnotes)
Project (kcfs)	PH (kcfs)	Spill (kcfs)	Spill [c] (%)	Unit 1 [d]	Unit 2	Unit 3	Unit 4	Unit 5	Unit 6	Bay 1 [e]	Bay 2	Bay 3	Bay 4	Bay 5	Bay 6	Bay 7	Bay 8	Total Stops	
37.3	26.1	11.2	30.0%	14.8	11.3					SW-Lo								0	Min. Q at SW-Lo
38.5	27.3	11.2	29.1%	16.0	11.3					SW-Lo								0	Min. Q w/ U1 in upper 1% [d]
43.2	30.2	13.0	30.1%	16.0	14.2					SW-Lo							1	1	
49.0	34.3	14.7	30.0%	17.2	17.1					SW-Lo	1						1	2	
49.7	35.0	14.7	29.6%	17.5	17.5					SW-Lo	1						1	2	Max. Q w/ 2 units + 2 stops = ~30% Spill
53.3	38.6	14.7	27.6%	16.0	11.3	11.3				SW-Lo	1						1	2	Min. Q w/ 3 units + 2 stops = ~28% Spill
55.4	38.8	16.6	30.0%	16.0	11.4	11.4				SW-Lo	1						2	3	
61.3	42.9	18.4	30.0%	16.0	13.5	13.4				SW-Lo	1		1				2	4	
67.1	47.0	20.1	30.0%	16.0	15.5	15.5				SW-Lo	1		1		1		2	5	
73.0	51.1	21.9	30.0%	17.1	17.0	17.0				SW-Lo	1	1	1		1		2	6	
74.4	52.5	21.9	29.4%	17.5	17.5	17.5				SW-Lo	1	1	1		1		2	6	Max. Q w/ 3 units + 6 stops = ~29% Spill
74.4	52.5	21.9	29.4%	16.0	11.3	11.3	13.9			SW-Lo	1	1	1		1		2	6	Min. Q w/ 4 units + 6 stops = ~29% Spill
78.9	55.2	23.7	30.0%	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%	16.0	14.5	14.4	14.4			SW-Lo	1	1	1	1	1	1	2	8	Spring flow trigger for SW crest change [e]
91.0	63.7	27.3	30.0%	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%	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%	17.5	17.5	17.5	18.9			SW-Lo	2	1	2	1	1	1	2	10	Max. Q w/ 4 units+10 stops = ~29% Spill
100.6	71.4	29.2	29.0%	16.0	13.9	13.8	13.8	13.9		SW-Lo	2	1	2	1	1	1	2	10	5 units + 10 stops = ~29% Spill
103.7	72.6	31.1	30.0%	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%	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%	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%	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%	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%	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%	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%	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%	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 for 30% Spill [c]
158.0	109.2	48.8	30.9%	17.5	17.5	17.5	18.9	18.9	18.9	SW-Lo	3	3	3	3	3	3	2	20	

Outflow [a]				Turbine Unit Outflow [b] (kcfs)						SW-Lo Gate Stops per Spillbay									Comments (see footnotes)
Project (kcfs)	PH (kcfs)	Spill (kcfs)	Spill [c] (%)	Unit 1 [d]	Unit 2	Unit 3	Unit 4	Unit 5	Unit 6	Bay 1 [e]	Bay 2	Bay 3	Bay 4	Bay 5	Bay 6	Bay 7	Bay 8	Total Stops	
160.0	109.2	50.8	31.8%	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%	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%	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%	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	35.0%	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%	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%	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%	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	37.8%	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%	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%	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%	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%	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%	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%	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%	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%	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%	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%	17.5	17.5	17.5	18.9	18.9	18.9	SW-Lo	6	6	6	6	5	5	5	39	
197.3	109.2	88.1	44.7%	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%	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	45.8%	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%	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%	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%	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%	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%	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%	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%	17.5	17.5	17.5	18.9	18.9	18.9	SW-Lo	7	7	7	7	7	7	7	49	

Outflow [a]				Turbine Unit Outflow [b] (kcfs)						SW-Lo Gate Stops per Spillbay									Comments (see footnotes)
Project (kcfs)	PH (kcfs)	Spill (kcfs)	Spill [c] (%)	Unit 1 [d]	Unit 2	Unit 3	Unit 4	Unit 5	Unit 6	Bay 1 [e]	Bay 2	Bay 3	Bay 4	Bay 5	Bay 6	Bay 7	Bay 8	Total Stops	
216.8	109.2	107.6	49.6%	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%	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%	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%	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%	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%	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%	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%	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%	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%	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%	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%	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%	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%	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%	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%	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%	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	56.4%	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%	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%	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%	17.5	17.5	17.5	18.9	18.9	18.9	SW-Lo	10	10	10	10	10	10	10	70	

a. Spill and PH flows calculated based on average forebay elevation 633.5 ft (within MOP range 633.0–634.0 ft).

b. Units operated in priority order 1→6 (**Table LGS-5**) within 1% (**Tables LGS-6, -7**). *Unit outflows are estimates of how Unit 1 special operation will work, not precise requirement.*

c. Total Outflow >156 kcfs = Total Spill >30% due to PH at maximum capacity (~109 kcfs).

d. Unit 1 manually restricted to upper 1% range (115–125 MW; ~16.0–17.5 kcfs) to disrupt tailrace eddy that forms during spill through SW in Bay 1. Assume Unit 1 is at lower end of the upper 1% range if other units operating uniformly at <16.0 kcfs. Assume all units operating uniformly if average unit discharge is >16.0 kcfs. During low flows (<~38 kcfs) with only one unit operating, Unit 1 may be operated within full 1% range as necessary (~11.3–17.5 kcfs).

e. SW operating criteria are defined in section 2.3.1.2.g. Flow >85 kcfs = SW-Lo / Flow 35-85 kcfs = SW-Hi / Flow <35 kcfs = SW close.

Table LGS-9. [*pg 1 of 3*] Little Goose Dam Spill Patterns with Spillway Weir in High Crest (SW-Hi) Elevation 622 ft. [a]

Outflow [a]				Turbine Unit Outflow [b] (kcfs)						SW-Hi Gate Stops per Spillbay									Comments (see footnotes)
Project (kcfs)	PH (kcfs)	Spill (kcfs)	Spill [c] (%)	Unit 1 [d]	Unit 2	Unit 3	Unit 4	Unit 5	Unit 6	Bay 1 [e]	Bay 2	Bay 3	Bay 4	Bay 5	Bay 6	Bay 7	Bay 8	Total Stops	
23.9	16.7	7.2	30.1%	16.7						SW-Hi								0	Min. Q w/ SW-Hi
26.4	17.5	8.9	33.7%	17.5						SW-Hi							1	1	1 unit + 1 stop = ~34% Spill
31.5	22.6	8.9	28.3%	11.3	11.3					SW-Hi							1	1	2 units at min. 1% + 1 stop = ~28% Spill
35.0	24.3	10.7	30.6%	13.0	11.3					SW-Hi	1						1	2	Min. Q w/ SW-Hi per FPP [e]
35.6	24.9	10.7	30.1%	13.6	11.3					SW-Hi	1						1	2	
38.0	27.3	10.7	28.2%	16.0	11.3					SW-Hi	1						1	2	Min. Q w/ U1 in upper 1% [d]
41.9	29.3	12.6	30.1%	16.0	13.3					SW-Hi	1						2	3	
47.7	33.4	14.3	30.0%	17.5	15.9					SW-Hi	1		1				2	4	
51.1	35.0	16.1	31.5%	17.5	17.5					SW-Hi	1		1		1		2	5	2 units + 5 stops = ~31% Spill
54.7	38.6	16.1	29.4%	16.0	11.3	11.3				SW-Hi	1		1		1		2	5	3 units + 5 stops = ~29% Spill
59.6	41.7	17.9	30.0%	16.0	12.9	12.8				SW-Hi	1	1	1		1		2	6	
65.4	45.8	19.6	30.0%	16.0	14.9	14.9				SW-Hi	1	1	1		1	1	2	7	
71.3	49.9	21.4	30.0%	16.6	16.7	16.6				SW-Hi	1	1	1	1	1	1	2	8	
73.9	52.5	21.4	29.0%	17.5	17.5	17.5				SW-Hi	1	1	1	1	1	1	2	8	Max. Q w/ 3 units = ~29% Spill
73.9	52.5	21.4	29.0%	16.0	11.3	11.3	13.9			SW-Hi	1	1	1	1	1	1	2	8	Min. Q w/ 4 units = ~29% Spill
77.6	54.3	23.3	30.0%	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%	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%	16.0	14.6	14.6	14.6			SW-Hi	2	1	2	1	1	1	2	10	Spring flow trigger for SW crest change [e]
90.3	63.2	27.1	30.0%	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%	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%	17.5	17.5	17.5	18.9			SW-Hi	2	2	2	1	2	1	2	12	Max. Q w/ 4 units+12 stops = ~29% Spill
100.4	71.4	29.0	28.9%	16.0	13.9	13.8	13.8	13.9		SW-Hi	2	2	2	1	2	1	2	12	5 units + 12 stops = ~29% Spill
102.9	72.0	30.9	30.0%	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%	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%	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%	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%	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%	16.0	15.9	15.8	15.8	15.8	15.8	SW-Hi	3	3	3	3	2	2	2	18	

Outflow [a]				Turbine Unit Outflow [b] (kcfs)						SW-Hi Gate Stops per Spillbay									Comments (see footnotes)
Project (kcfs)	PH (kcfs)	Spill (kcfs)	Spill [c] (%)	Unit 1 [d]	Unit 2	Unit 3	Unit 4	Unit 5	Unit 6	Bay 1 [e]	Bay 2	Bay 3	Bay 4	Bay 5	Bay 6	Bay 7	Bay 8	Total Stops	
142.4	99.7	42.7	30.0%	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%	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%	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 for 30% Spill. [c]
157.9	109.2	48.7	30.8%	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%	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%	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%	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%	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%	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%	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%	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%	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%	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%	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%	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%	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%	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%	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%	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%	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%	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%	17.5	17.5	17.5	18.9	18.9	18.9	SW-Hi	6	6	6	6	6	5	5	40	
195.2	109.2	86.0	44.1%	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%	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%	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%	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%	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%	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%	17.5	17.5	17.5	18.9	18.9	18.9	SW-Hi	7	7	7	7	7	6	6	47	

Outflow [a]				Turbine Unit Outflow [b] (kcfs)						SW-Hi Gate Stops per Spillbay									Comments (see footnotes)
Project (kcfs)	PH (kcfs)	Spill (kcfs)	Spill [c] (%)	Unit 1 [d]	Unit 2	Unit 3	Unit 4	Unit 5	Unit 6	Bay 1 [e]	Bay 2	Bay 3	Bay 4	Bay 5	Bay 6	Bay 7	Bay 8	Total Stops	
208.9	109.2	99.7	47.7%	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%	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%	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%	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%	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%	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%	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%	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%	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%	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%	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%	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%	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%	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%	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%	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%	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%	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%	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%	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%	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%	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%	17.5	17.5	17.5	18.9	18.9	18.9	SW-Hi	10	10	10	10	10	10	10	70	

a. Spill and PH flows calculated based on average forebay elevation 633.5 ft (within MOP range 633.0–634.0 ft).

b. Units operated in priority order 1→6 (**Table LGS-5**) within 1% (**Tables LGS-6, -7**). *Unit outflows are estimates of how Unit 1 special operation will work, not precise requirement.*

c. Total Outflow >156 kcfs = Total Spill >30% due to PH at maximum capacity (~109 kcfs).

d. Unit 1 manually restricted to upper 1% range (115–125 MW; ~16.0–17.5 kcfs) to disrupt tailrace eddy that forms during spill through SW in Bay 1. Assume Unit 1 is at lower end of the upper 1% range if other units operating uniformly at <16.0 kcfs. Assume all units operating uniformly if average unit discharge is >16.0 kcfs. During low flows (<~38 kcfs) with only one unit operating, Unit 1 may be operated within full 1% range as necessary (~11.3–17.5 kcfs).

e. SW operating criteria are defined in section **2.3.1.2.g**. Flow >85 kcfs = SW-Lo / Flow 35-85 kcfs = SW-Hi / Flow <35 kcfs = SW close.

Table LGS-10. [*pg 1 of 3*] Little Goose Dam Uniform Spill Patterns with No Spillway Weir (Bay 1 Closed). [a]

Outflow [a]				Turbine Unit Outflow [b] (kcfs)						No SW Gate Stops per Spillbay									Comments (see footnotes)
Project (kcfs)	PH (kcfs)	Spill (kcfs)	Spill [c] (%)	Unit 1 [d]	Unit 2	Unit 3	Unit 4	Unit 5	Unit 6	Bay 1 [e]	Bay 2	Bay 3	Bay 4	Bay 5	Bay 6	Bay 7	Bay 8	Total Stops	
11.3	11.3	0.0	0.0%	11.3						Closed								0	Min. Q w/ Closed and no spill.
13.1	11.3	1.8	13.5%	11.3						Closed							1	1	
14.8	11.3	3.5	23.8%	11.3						Closed	1						1	2	
18.0	12.6	5.4	30.0%	12.6						Closed	1						2	3	Min. Q w/ Closed and 30% spill.
24.0	16.8	7.2	29.9%	16.8						Closed	1		1				2	4	
26.4	17.5	8.9	33.8%	17.5						Closed	1		1		1		2	5	1 unit + 5 stops = ~34% spill
31.5	22.6	8.9	28.3%	11.3	11.3					Closed	1		1		1		2	5	2 units + 5 stops = ~28% spill
35.7	25.0	10.7	30.0%	13.7	11.3					Closed	1	1	1		1		2	6	
38.0	27.3	10.7	28.2%	16.0	11.3					Closed	1	1	1		1		2	6	Min. Q w/ U1 in upper 1% [d]
41.6	29.1	12.5	30.0%	16.0	13.1					Closed	1	1	1		1	1	2	7	
47.4	33.2	14.2	30.0%	16.6	16.6					Closed	1	1	1	1	1	1	2	8	
51.1	35.0	16.1	31.5%	17.5	17.5					Closed	2	1	1	1	1	1	2	9	2 units + 9 stops = ~31% spill
54.7	38.6	16.1	29.5%	16.0	11.3	11.3				Closed	2	1	1	1	1	1	2	9	3 units + 9 stops = ~29% spill
60.0	42.0	18.0	30.0%	16.0	13.0	13.0				Closed	2	1	2	1	1	1	2	10	
66.4	46.5	19.9	30.0%	16.0	15.3	15.2				Closed	2	1	2	1	2	1	2	11	
72.7	50.9	21.8	30.0%	17.0	17.0	16.9				Closed	2	2	2	1	2	1	2	12	
74.3	52.5	21.8	29.4%	17.5	17.5	17.5				Closed	2	2	2	1	2	1	2	12	Max. Q w/ 3 units = ~29% spill
76.2	52.5	23.7	31.1%	16.0	11.3	11.3	13.9			Closed	2	2	2	2	2	1	2	13	Min. Q w/ 4 units = ~31% spill
79.0	55.3	23.7	30.0%	16.0	12.7	12.7	13.9			Closed	2	2	2	2	2	1	2	13	
85.4	59.8	25.6	30.0%	16.0	14.6	14.6	14.6			Closed	2	2	2	2	2	2	2	14	
92.0	64.4	27.6	30.0%	16.1	16.1	16.1	16.1			Closed	3	2	2	2	2	2	2	15	
98.7	69.1	29.6	30.0%	17.3	17.3	17.3	17.2			Closed	3	3	2	2	2	2	2	16	
105.3	73.7	31.6	30.0%	16.0	14.5	14.4	14.4	14.4		Closed	3	3	3	2	2	2	2	17	
112.0	78.4	33.6	30.0%	16.0	15.6	15.6	15.6	15.6		Closed	3	3	3	3	2	2	2	18	
118.7	83.1	35.6	30.0%	16.7	16.6	16.6	16.6	16.6		Closed	3	3	3	3	3	2	2	19	
125.1	87.5	37.6	30.1%	17.5	17.5	17.5	17.5	17.5		Closed	3	3	3	3	3	3	2	20	
132.0	92.4	39.6	30.0%	16.0	15.3	15.3	15.3	15.3	15.2	Closed	3	3	3	3	3	3	3	21	
138.6	97.0	41.6	30.0%	16.2	16.2	16.2	16.2	16.1	16.1	Closed	4	3	3	3	3	3	3	22	

Outflow [a]				Turbine Unit Outflow [b] (kcfs)						No SW Gate Stops per Spillbay									Comments (see footnotes)
Project (kcfs)	PH (kcfs)	Spill (kcfs)	Spill [c] (%)	Unit 1 [d]	Unit 2	Unit 3	Unit 4	Unit 5	Unit 6	Bay 1 [e]	Bay 2	Bay 3	Bay 4	Bay 5	Bay 6	Bay 7	Bay 8	Total Stops	
145.1	101.6	43.5	30.0%	17.0	17.0	16.9	16.9	16.9	16.9	Closed	4	4	3	3	3	3	3	23	
151.7	106.2	45.5	30.0%	17.5	17.5	17.5	17.9	17.9	17.9	Closed	4	4	4	3	3	3	3	24	
156.7	109.2	47.5	30.3%	17.5	17.5	17.5	18.9	18.9	18.9	Closed	4	4	4	4	3	3	3	25	Max. PH capacity for 30% Spill. [c]
158.6	109.2	49.4	31.2%	17.5	17.5	17.5	18.9	18.9	18.9	Closed	4	4	4	4	4	3	3	26	
160.6	109.2	51.4	32.0%	17.5	17.5	17.5	18.9	18.9	18.9	Closed	4	4	4	4	4	4	3	27	
162.6	109.2	53.4	32.8%	17.5	17.5	17.5	18.9	18.9	18.9	Closed	4	4	4	4	4	4	4	28	
164.5	109.2	55.3	33.6%	17.5	17.5	17.5	18.9	18.9	18.9	Closed	5	4	4	4	4	4	4	29	
166.5	109.2	57.3	34.4%	17.5	17.5	17.5	18.9	18.9	18.9	Closed	5	5	4	4	4	4	4	30	
168.5	109.2	59.3	35.2%	17.5	17.5	17.5	18.9	18.9	18.9	Closed	5	5	5	4	4	4	4	31	
170.4	109.2	61.2	35.9%	17.5	17.5	17.5	18.9	18.9	18.9	Closed	5	5	5	5	4	4	4	32	
172.4	109.2	63.2	36.7%	17.5	17.5	17.5	18.9	18.9	18.9	Closed	5	5	5	5	5	4	4	33	
174.4	109.2	65.2	37.4%	17.5	17.5	17.5	18.9	18.9	18.9	Closed	5	5	5	5	5	5	4	34	
176.3	109.2	67.1	38.1%	17.5	17.5	17.5	18.9	18.9	18.9	Closed	5	5	5	5	5	5	5	35	
178.3	109.2	69.1	38.8%	17.5	17.5	17.5	18.9	18.9	18.9	Closed	6	5	5	5	5	5	5	36	
180.3	109.2	71.1	39.4%	17.5	17.5	17.5	18.9	18.9	18.9	Closed	6	6	5	5	5	5	5	37	
182.2	109.2	73.0	40.1%	17.5	17.5	17.5	18.9	18.9	18.9	Closed	6	6	6	5	5	5	5	38	
184.2	109.2	75.0	40.7%	17.5	17.5	17.5	18.9	18.9	18.9	Closed	6	6	6	6	5	5	5	39	
186.1	109.2	76.9	41.3%	17.5	17.5	17.5	18.9	18.9	18.9	Closed	6	6	6	6	6	5	5	40	
188.1	109.2	78.9	41.9%	17.5	17.5	17.5	18.9	18.9	18.9	Closed	6	6	6	6	6	6	5	41	
190.1	109.2	80.9	42.5%	17.5	17.5	17.5	18.9	18.9	18.9	Closed	6	6	6	6	6	6	6	42	
192.0	109.2	82.8	43.1%	17.5	17.5	17.5	18.9	18.9	18.9	Closed	7	6	6	6	6	6	6	43	
193.9	109.2	84.7	43.7%	17.5	17.5	17.5	18.9	18.9	18.9	Closed	7	7	6	6	6	6	6	44	
195.9	109.2	86.7	44.3%	17.5	17.5	17.5	18.9	18.9	18.9	Closed	7	7	7	6	6	6	6	45	
197.8	109.2	88.6	44.8%	17.5	17.5	17.5	18.9	18.9	18.9	Closed	7	7	7	7	6	6	6	46	
199.8	109.2	90.6	45.3%	17.5	17.5	17.5	18.9	18.9	18.9	Closed	7	7	7	7	7	6	6	47	
201.7	109.2	92.5	45.9%	17.5	17.5	17.5	18.9	18.9	18.9	Closed	7	7	7	7	7	7	6	48	
203.7	109.2	94.5	46.4%	17.5	17.5	17.5	18.9	18.9	18.9	Closed	7	7	7	7	7	7	7	49	
205.6	109.2	96.4	46.9%	17.5	17.5	17.5	18.9	18.9	18.9	Closed	8	7	7	7	7	7	7	50	
207.6	109.2	98.4	47.4%	17.5	17.5	17.5	18.9	18.9	18.9	Closed	8	8	7	7	7	7	7	51	

Outflow [a]				Turbine Unit Outflow [b] (kcfs)						No SW Gate Stops per Spillbay									Comments (see footnotes)
Project (kcfs)	PH (kcfs)	Spill (kcfs)	Spill [c] (%)	Unit 1 [d]	Unit 2	Unit 3	Unit 4	Unit 5	Unit 6	Bay 1 [e]	Bay 2	Bay 3	Bay 4	Bay 5	Bay 6	Bay 7	Bay 8	Total Stops	
209.6	109.2	100.4	47.9%	17.5	17.5	17.5	18.9	18.9	18.9	Closed	8	8	8	7	7	7	7	52	
211.5	109.2	102.3	48.4%	17.5	17.5	17.5	18.9	18.9	18.9	Closed	8	8	8	8	7	7	7	53	
213.5	109.2	104.3	48.9%	17.5	17.5	17.5	18.9	18.9	18.9	Closed	8	8	8	8	8	7	7	54	
215.5	109.2	106.3	49.3%	17.5	17.5	17.5	18.9	18.9	18.9	Closed	8	8	8	8	8	8	7	55	
217.4	109.2	108.2	49.8%	17.5	17.5	17.5	18.9	18.9	18.9	Closed	8	8	8	8	8	8	8	56	
219.4	109.2	110.2	50.2%	17.5	17.5	17.5	18.9	18.9	18.9	Closed	9	8	8	8	8	8	8	57	
221.3	109.2	112.1	50.7%	17.5	17.5	17.5	18.9	18.9	18.9	Closed	9	9	8	8	8	8	8	58	
223.2	109.2	114.0	51.1%	17.5	17.5	17.5	18.9	18.9	18.9	Closed	9	9	9	8	8	8	8	59	
225.1	109.2	115.9	51.5%	17.5	17.5	17.5	18.9	18.9	18.9	Closed	9	9	9	9	8	8	8	60	
227.1	109.2	117.9	51.9%	17.5	17.5	17.5	18.9	18.9	18.9	Closed	9	9	9	9	9	8	8	61	
229.0	109.2	119.8	52.3%	17.5	17.5	17.5	18.9	18.9	18.9	Closed	9	9	9	9	9	9	8	62	
230.9	109.2	121.7	52.7%	17.5	17.5	17.5	18.9	18.9	18.9	Closed	9	9	9	9	9	9	9	63	
232.9	109.2	123.7	53.1%	17.5	17.5	17.5	18.9	18.9	18.9	Closed	10	9	9	9	9	9	9	64	
235.0	109.2	125.8	53.5%	17.5	17.5	17.5	18.9	18.9	18.9	Closed	10	10	9	9	9	9	9	65	
237.0	109.2	127.8	53.9%	17.5	17.5	17.5	18.9	18.9	18.9	Closed	10	10	10	9	9	9	9	66	
239.0	109.2	129.8	54.3%	17.5	17.5	17.5	18.9	18.9	18.9	Closed	10	10	10	10	9	9	9	67	
241.0	109.2	131.8	54.7%	17.5	17.5	17.5	18.9	18.9	18.9	Closed	10	10	10	10	10	9	9	68	
243.0	109.2	133.8	55.1%	17.5	17.5	17.5	18.9	18.9	18.9	Closed	10	10	10	10	10	10	9	69	
245.0	109.2	135.8	55.4%	17.5	17.5	17.5	18.9	18.9	18.9	Closed	10	10	10	10	10	10	10	70	

a. Spill and PH flows calculated based on average forebay elevation 633.5 ft (within MOP range 633.0–634.0 ft).

b. Units operated in priority order 1→6 (**Table LGS-5**) within 1% (**Tables LGS-6, -7**). *Unit outflows are estimates of how Unit 1 special operation will work, not precise requirement.*

c. Total Outflow >156 kcfs = Total Spill >30% due to PH at maximum capacity (~109 kcfs).

d. Unit 1 manually restricted to upper 1% range (115–125 MW; ~16.0–17.5 kcfs) to disrupt tailrace eddy that forms during spill through SW in Bay 1. Assume Unit 1 is at lower end of the upper 1% range if other units operating uniformly at <16.0 kcfs. Assume all units operating uniformly if average unit discharge is >16.0 kcfs. During low flows (<~38 kcfs) with only one unit operating, Unit 1 may be operated within full 1% range as necessary (~11.3–17.5 kcfs).

e. SW operating criteria are defined in section **2.3.1.2.g**. Flow >85 kcfs = SW-Lo / Flow 35-85 kcfs = SW-Hi / Flow <35 kcfs = SW close.

Table LGS-11. [*pg 1 of 3*] Little Goose Dam ALTERNATE UNIFORM Spill Patterns for use during Spillway Weir Crest Change. [a, f]

Outflow [a]				Turbine Unit Outflow [b] (kcfs)						SW Crest Change (Bays 1 & 2 closed) [f] Gate Stops per Spillbay									Comments (see footnotes)
Project (kcfs)	PH (kcfs)	Spill (kcfs)	Spill [c] (%)	Unit 1 [d]	Unit 2	Unit 3	Unit 4	Unit 5	Unit 6	Bay 1 [e]	Bay 2 [f]	Bay 3	Bay 4	Bay 5	Bay 6	Bay 7	Bay 8	Total Stops	
11.3	11.3	0.0	0.0%	11.3						Closed	Closed							0	Min. Q w/ no SW and no spill.
13.1	11.3	1.8	13.5%	11.3						Closed	Closed						1	1	
14.8	11.3	3.5	23.8%	11.3						Closed	Closed	1					1	2	
18.0	12.6	5.4	30.0%	12.6						Closed	Closed	1					2	3	Min. Q w/ no SW and 30% spill.
24.0	16.8	7.2	29.9%	16.8						Closed	Closed	1		1			2	4	
26.4	17.5	8.9	33.8%	17.5						Closed	Closed	1		1		1	2	5	1 unit + 5 stops = ~34% spill
31.5	22.6	8.9	28.3%	11.3	11.3					Closed	Closed	1		1		1	2	5	2 units + 5 stops = ~28% spill
35.7	25.0	10.7	30.0%	13.7	11.3					Closed	Closed	1	1	1		1	2	6	
38.0	27.3	10.7	28.2%	16.0	11.3					Closed	Closed	1	1	1		1	2	6	Min. Q w/ U1 in upper 1% [c]
41.6	29.1	12.5	30.0%	16.0	13.1					Closed	Closed	1	1	1	1	1	2	7	
47.6	33.2	14.4	30.2%	16.6	16.6					Closed	Closed	2	1	1	1	1	2	8	
51.3	35.0	16.3	31.7%	17.5	17.5					Closed	Closed	2	1	2	1	1	2	9	2 units + 9 stops = ~31% spill
54.9	38.6	16.3	29.6%	16.0	11.3	11.3				Closed	Closed	2	1	2	1	1	2	9	3 units + 9 stops = ~29% spill
60.2	42.0	18.2	30.2%	16.0	13.0	13.0				Closed	Closed	2	1	2	1	2	2	10	
66.6	46.5	20.1	30.1%	16.0	15.3	15.2				Closed	Closed	2	2	2	1	2	2	11	
72.9	50.9	22.0	30.1%	17.0	17.0	16.9				Closed	Closed	2	2	2	2	2	2	12	
74.5	52.5	22.0	29.5%	17.5	17.5	17.5				Closed	Closed	2	2	2	2	2	2	12	Max. Q w/ 3 units = ~29% spill
76.5	52.5	24.0	31.3%	16.0	11.3	11.3	13.9			Closed	Closed	3	2	2	2	2	2	13	Min. Q w/ 4 units = ~31% spill
79.3	55.3	24.0	30.2%	16.0	12.7	12.7	13.9			Closed	Closed	3	2	2	2	2	2	13	
85.8	59.8	26.0	30.3%	16.0	14.6	14.6	14.6			Closed	Closed	3	3	2	2	2	2	14	
92.3	64.4	27.9	30.3%	16.1	16.1	16.1	16.1			Closed	Closed	3	3	3	2	2	2	15	
99.0	69.1	29.9	30.2%	17.3	17.3	17.3	17.2			Closed	Closed	3	3	3	3	2	2	16	
105.6	73.7	31.9	30.2%	16.0	14.5	14.4	14.4	14.4		Closed	Closed	3	3	3	3	3	2	17	
112.3	78.4	33.9	30.2%	16.0	15.6	15.6	15.6	15.6		Closed	Closed	3	3	3	3	3	3	18	
119.0	83.1	35.9	30.2%	16.7	16.6	16.6	16.6	16.6		Closed	Closed	4	3	3	3	3	3	19	
125.4	87.5	37.9	30.2%	17.5	17.5	17.5	17.5	17.5		Closed	Closed	4	4	3	3	3	3	20	
132.2	92.4	39.8	30.1%	16.0	15.3	15.3	15.3	15.3	15.2	Closed	Closed	4	4	4	3	3	3	21	
138.8	97.0	41.8	30.1%	16.2	16.2	16.2	16.2	16.1	16.1	Closed	Closed	4	4	4	4	3	3	22	

Outflow [a]				Turbine Unit Outflow [b] (kcfs)						SW Crest Change (Bays 1 & 2 closed) [f] Gate Stops per Spillbay									Comments (see footnotes)
Project (kcfs)	PH (kcfs)	Spill (kcfs)	Spill [c] (%)	Unit 1 [d]	Unit 2	Unit 3	Unit 4	Unit 5	Unit 6	Bay 1 [e]	Bay 2 [f]	Bay 3	Bay 4	Bay 5	Bay 6	Bay 7	Bay 8	Total Stops	
145.4	101.6	43.8	30.1%	17.0	17.0	16.9	16.9	16.9	16.9	Closed	Closed	4	4	4	4	4	3	23	
152.0	106.2	45.8	30.1%	17.5	17.5	17.5	17.9	17.9	17.9	Closed	Closed	4	4	4	4	4	4	24	
156.9	109.2	47.7	30.4%	17.5	17.5	17.5	18.9	18.9	18.9	Closed	Closed	5	4	4	4	4	4	25	Max. PH capacity for 30% Spill. [c]
158.9	109.2	49.7	31.3%	17.5	17.5	17.5	18.9	18.9	18.9	Closed	Closed	5	5	4	4	4	4	26	
160.8	109.2	51.6	32.1%	17.5	17.5	17.5	18.9	18.9	18.9	Closed	Closed	5	5	5	4	4	4	27	
162.8	109.2	53.6	32.9%	17.5	17.5	17.5	18.9	18.9	18.9	Closed	Closed	5	5	5	5	4	4	28	
164.8	109.2	55.6	33.7%	17.5	17.5	17.5	18.9	18.9	18.9	Closed	Closed	5	5	5	5	5	4	29	
166.7	109.2	57.5	34.5%	17.5	17.5	17.5	18.9	18.9	18.9	Closed	Closed	5	5	5	5	5	5	30	
168.7	109.2	59.5	35.3%	17.5	17.5	17.5	18.9	18.9	18.9	Closed	Closed	6	5	5	5	5	5	31	
170.7	109.2	61.5	36.0%	17.5	17.5	17.5	18.9	18.9	18.9	Closed	Closed	6	6	5	5	5	5	32	
172.6	109.2	63.4	36.7%	17.5	17.5	17.5	18.9	18.9	18.9	Closed	Closed	6	6	6	5	5	5	33	
174.6	109.2	65.4	37.4%	17.5	17.5	17.5	18.9	18.9	18.9	Closed	Closed	6	6	6	6	5	5	34	
176.5	109.2	67.3	38.1%	17.5	17.5	17.5	18.9	18.9	18.9	Closed	Closed	6	6	6	6	6	5	35	
178.5	109.2	69.3	38.8%	17.5	17.5	17.5	18.9	18.9	18.9	Closed	Closed	6	6	6	6	6	6	36	
180.4	109.2	71.2	39.5%	17.5	17.5	17.5	18.9	18.9	18.9	Closed	Closed	7	6	6	6	6	6	37	
182.4	109.2	73.2	40.1%	17.5	17.5	17.5	18.9	18.9	18.9	Closed	Closed	7	7	6	6	6	6	38	
184.3	109.2	75.1	40.8%	17.5	17.5	17.5	18.9	18.9	18.9	Closed	Closed	7	7	7	6	6	6	39	
186.3	109.2	77.1	41.4%	17.5	17.5	17.5	18.9	18.9	18.9	Closed	Closed	7	7	7	7	6	6	40	
188.2	109.2	79.0	42.0%	17.5	17.5	17.5	18.9	18.9	18.9	Closed	Closed	7	7	7	7	7	6	41	
190.2	109.2	81.0	42.6%	17.5	17.5	17.5	18.9	18.9	18.9	Closed	Closed	7	7	7	7	7	7	42	
192.1	109.2	82.9	43.2%	17.5	17.5	17.5	18.9	18.9	18.9	Closed	Closed	8	7	7	7	7	7	43	
194.1	109.2	84.9	43.7%	17.5	17.5	17.5	18.9	18.9	18.9	Closed	Closed	8	8	7	7	7	7	44	
196.1	109.2	86.9	44.3%	17.5	17.5	17.5	18.9	18.9	18.9	Closed	Closed	8	8	8	7	7	7	45	
198.0	109.2	88.8	44.9%	17.5	17.5	17.5	18.9	18.9	18.9	Closed	Closed	8	8	8	8	7	7	46	
200.0	109.2	90.8	45.4%	17.5	17.5	17.5	18.9	18.9	18.9	Closed	Closed	8	8	8	8	8	7	47	
202.0	109.2	92.8	45.9%	17.5	17.5	17.5	18.9	18.9	18.9	Closed	Closed	8	8	8	8	8	8	48	
203.9	109.2	94.7	46.4%	17.5	17.5	17.5	18.9	18.9	18.9	Closed	Closed	9	8	8	8	8	8	49	
205.8	109.2	96.6	46.9%	17.5	17.5	17.5	18.9	18.9	18.9	Closed	Closed	9	9	8	8	8	8	50	
207.8	109.2	98.6	47.4%	17.5	17.5	17.5	18.9	18.9	18.9	Closed	Closed	9	9	9	8	8	8	51	

Outflow [a]				Turbine Unit Outflow [b] (kcfs)						SW Crest Change (Bays 1 & 2 closed) [f] Gate Stops per Spillbay									Comments (see footnotes)
Project (kcfs)	PH (kcfs)	Spill (kcfs)	Spill [c] (%)	Unit 1 [d]	Unit 2	Unit 3	Unit 4	Unit 5	Unit 6	Bay 1 [e]	Bay 2 [f]	Bay 3	Bay 4	Bay 5	Bay 6	Bay 7	Bay 8	Total Stops	
209.7	109.2	100.5	47.9%	17.5	17.5	17.5	18.9	18.9	18.9	Closed	Closed	9	9	9	9	8	8	52	
211.6	109.2	102.4	48.4%	17.5	17.5	17.5	18.9	18.9	18.9	Closed	Closed	9	9	9	9	9	8	53	
213.5	109.2	104.3	48.9%	17.5	17.5	17.5	18.9	18.9	18.9	Closed	Closed	9	9	9	9	9	9	54	
215.6	109.2	106.4	49.3%	17.5	17.5	17.5	18.9	18.9	18.9	Closed	Closed	10	9	9	9	9	9	55	
217.6	109.2	108.4	49.8%	17.5	17.5	17.5	18.9	18.9	18.9	Closed	Closed	10	10	9	9	9	9	56	
219.6	109.2	110.4	50.3%	17.5	17.5	17.5	18.9	18.9	18.9	Closed	Closed	10	10	10	9	9	9	57	
221.6	109.2	112.4	50.7%	17.5	17.5	17.5	18.9	18.9	18.9	Closed	Closed	10	10	10	10	9	9	58	
223.6	109.2	114.4	51.2%	17.5	17.5	17.5	18.9	18.9	18.9	Closed	Closed	10	10	10	10	10	9	59	
225.6	109.2	116.4	51.6%	17.5	17.5	17.5	18.9	18.9	18.9	Closed	Closed	10	10	10	10	10	10	60	
227.6	109.2	118.4	52.0%	17.5	17.5	17.5	18.9	18.9	18.9	Closed	Closed	11	10	10	10	10	10	61	
229.6	109.2	120.4	52.4%	17.5	17.5	17.5	18.9	18.9	18.9	Closed	Closed	11	11	10	10	10	10	62	
231.7	109.2	122.5	52.9%	17.5	17.5	17.5	18.9	18.9	18.9	Closed	Closed	11	11	11	10	10	10	63	
233.7	109.2	124.5	53.3%	17.5	17.5	17.5	18.9	18.9	18.9	Closed	Closed	11	11	11	11	10	10	64	
235.7	109.2	126.5	53.7%	17.5	17.5	17.5	18.9	18.9	18.9	Closed	Closed	11	11	11	11	11	10	65	
237.7	109.2	128.5	54.1%	17.5	17.5	17.5	18.9	18.9	18.9	Closed	Closed	11	11	11	11	11	11	66	
239.7	109.2	130.5	54.4%	17.5	17.5	17.5	18.9	18.9	18.9	Closed	Closed	12	11	11	11	11	11	67	
241.8	109.2	132.6	54.8%	17.5	17.5	17.5	18.9	18.9	18.9	Closed	Closed	12	12	11	11	11	11	68	
243.8	109.2	134.6	55.2%	17.5	17.5	17.5	18.9	18.9	18.9	Closed	Closed	12	12	12	11	11	11	69	
245.8	109.2	136.6	55.6%	17.5	17.5	17.5	18.9	18.9	18.9	Closed	Closed	12	12	12	12	11	11	70	

a. Spill and PH flows calculated based on average forebay elevation 633.5 ft (within MOP range 633.0–634.0 ft).

b. Units operated in priority order 1→6 (**Table LGS-5**) within 1% (**Tables LGS-6, -7**). *Unit outflows are estimates of how Unit 1 special operation will work, not precise requirement.*

c. Total Outflow >156 kcfs = Total Spill >30% due to PH at maximum capacity (~109 kcfs).

d. Unit 1 manually restricted to upper 1% range (115–125 MW; ~16.0–17.5 kcfs) to disrupt tailrace eddy that forms during spill through SW in Bay 1. Assume Unit 1 is at lower end of the upper 1% range if other units operating uniformly at <16.0 kcfs. Assume all units operating uniformly if average unit discharge is >16.0 kcfs. During low flows (<~38 kcfs) with only one unit operating, Unit 1 may be operated within full 1% range as necessary (~11.3–17.5 kcfs).

e. SW operating criteria are defined in section **2.3.1.2.g**. Flow >85 kcfs = SW-Lo / Flow 35-85 kcfs = SW-Hi / Flow <35 kcfs = SW close.

f. This "*Alternate Uniform*" pattern applies when changing the SW crest. Bay 2 is closed to ensure safety of workers at Bay 1.

2014 Fish Passage Plan

Section 9 – Lower Granite Dam

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Lower Granite Dam

Project Acronym*	LWG
River Mile (RM)	Snake River – RM 107.5
Reservoir	Lake Lower Granite
Minimum Instantaneous Flow (kcfs)	Dec–Feb: 0 kcfs \ Mar–Nov: 11.5 kcfs
Forebay Normal Operating Range (ft)	733’ – 738’
Tailrace Rate of Change Limit (ft/hr)	1.5’/hr
Powerhouse Length (ft)	656’
Powerhouse Hydraulic Capacity (kcfs)	130 kcfs
Turbine Units (#)	6 (Units 1-3 BLH Kaplan; Units 4-6 Allis Chalmers Kaplan)
Turbine Unit Generating Capacity (MW)	Rated: 810 MW (135 MW/unit) \ Maximum: 930 MW (155 MW/unit)
Gatewell Orifices	36 orifices (2 per gatewell = 6 per unit). 35 w/10” diameter; 1 w/14” diameter (5A)
Spillway Length (ft)	512’
Spillway Hydraulic Capacity (kcfs)	850 kcfs
Spillbays (#)	8
Spillway Weirs (#)	1 Removable Spillway Weir (RSW) in Bay 1
Navigation Lock Length x Width (ft)	650’ x 84’ (Usable Space)
Navigation Lock Max. Lift (ft)	105’
	FISH STRUCTURE/OPERATION START DATE
Transportation Research Program – NMFS **	1975
Submersible Traveling Screens (STS)	1978
Extended-Length Submersible Bar Screens (ESBS)	1996
Juvenile Fish Transportation Program – Corps **	1981
Removable Spillway Weir (RSW)	2003
Adult Fish Counts	1969 (North Shore); 1975 (South Shore)

*Project acronym designated by US Army Corps of Engineers, Northwestern Division, Columbia Basin Water Management Division. Due to the large number of projects managed by NWD, this acronym may differ from other acronyms used in the region. For example, a common acronym for Lower Granite is LWG. However, that acronym is assigned to another NWD project, thus the official Corps NWD acronym is LWG.

**Smolt transportation and research done by NMFS via truck until 1978 when barges purchased. Corps began implementing transportation program in 1981.

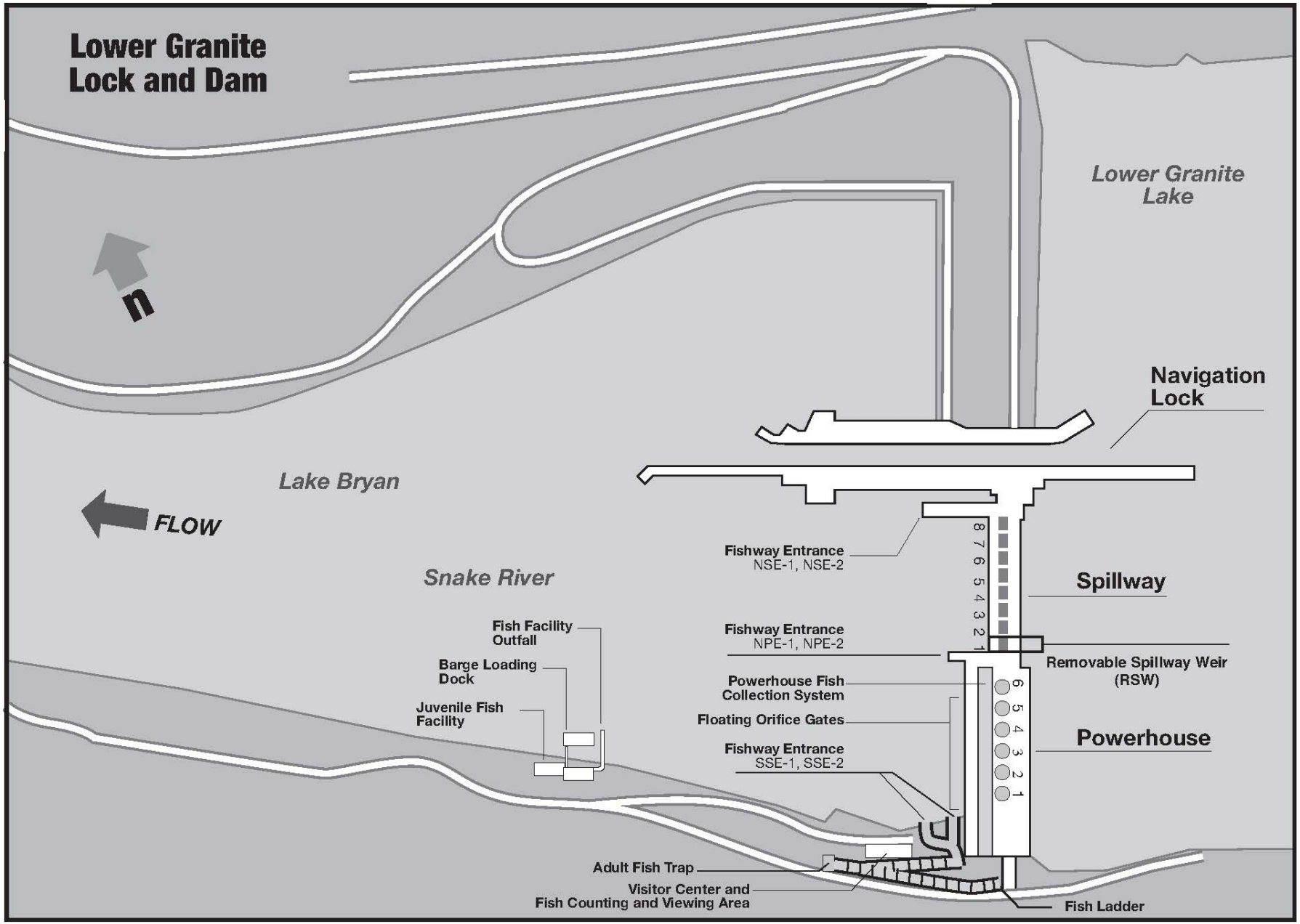
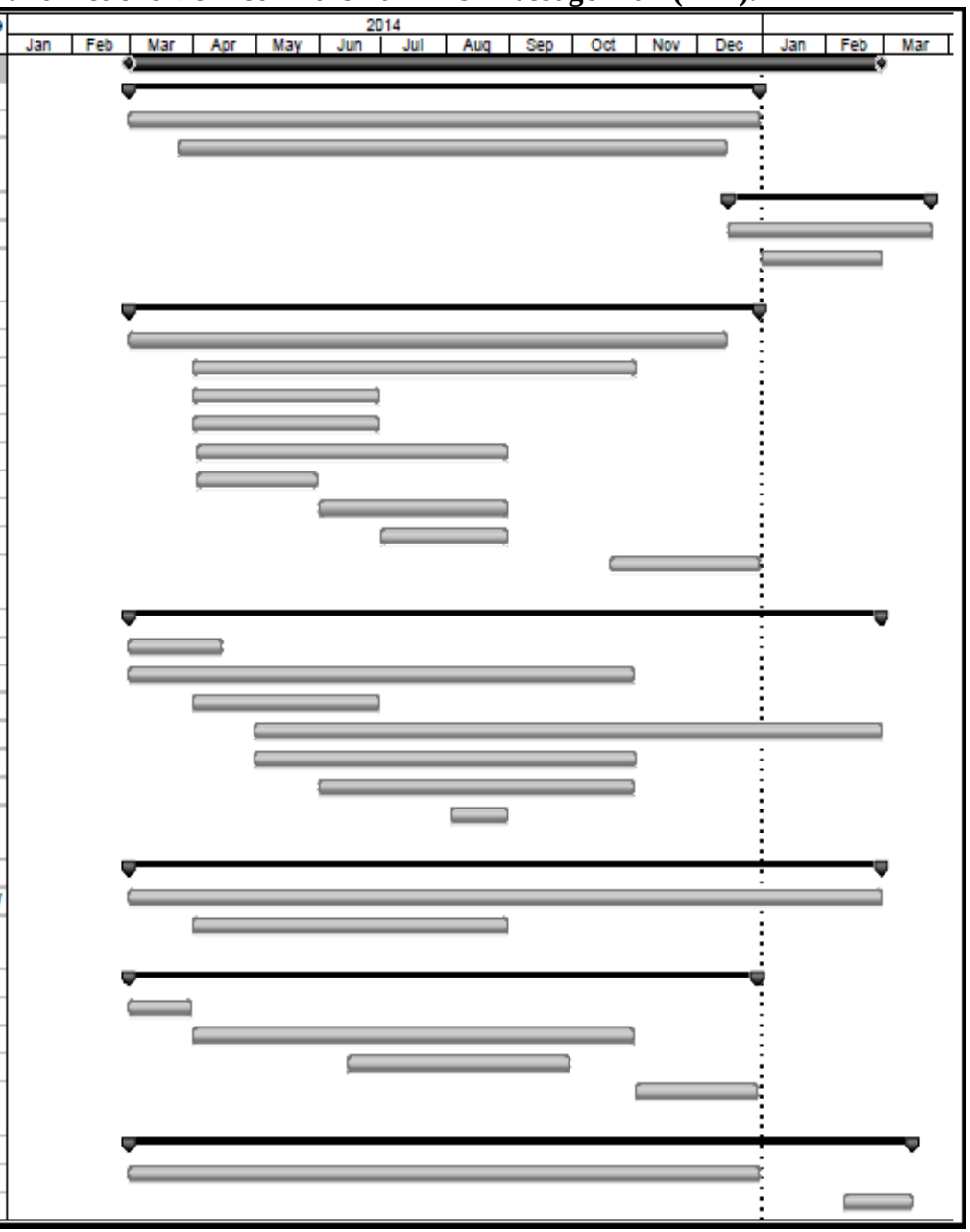


Figure LWG-1. Lower Granite Lock & Dam General Site Plan.

Table LWG-1. Lower Granite Dam Schedule of Operations and Actions Defined in the 2014 Fish Passage Plan (FPP).

Task Name	Start Date	End Date	FPP Reference
2014 FPP Operations & Actions - Lower Granite	**3/1/14**	**2/28/15**	**LWG**
Fish Passage Facilities Operation	**3/1/14**	**12/31/14**	**2.3.**
Adult Fish Facilities	3/1/14	12/31/14	2.3.2.2
Juvenile Fish Facilities	3/25/14	12/15/14	2.3.1
Fish Passage Facilities Maintenance	**12/16/14**	**3/24/15**	**2.3**
Juvenile Fish Facilities Winter Maintenance	12/16/14	3/24/15	2.3.1.1
Adult Fish Facilities Winter Maintenance	1/1/15	2/28/15	2.3.2.1
Project Operations for Fish Passage	**3/1/14**	**12/31/14**	
Turbine operating priority order	3/1/14	12/15/14	Table LWG-5
1% operating range - hard constraint	4/1/14	10/31/14	4.1.2.
ESBS monthly video inspection	4/1/14	6/30/14	2.3.1.2.b.4.
VBS measure head differential weekly	4/1/14	6/30/14	2.3.1.2.b.8
Spillway Weir in service (end date approx)	4/3/14	8/31/14	2.3.1.2.f.
Spring Spill Operations (end date approx)	4/3/14	5/31/14	App E (FOP)
Summer Spill Operations (dates approx)	6/1/14	8/31/14	App E (FOP)
VBS measure head differential bi-weekly	7/1/14	8/31/14	2.3.1.2.b.8.
Priority turbine unit maintenance	10/20/14	12/31/14	4.3.1.
Special Operations & Studies (dates approximate)	**3/1/14**	**2/28/15**	**App A**
Units 4, 5, 6 Exciter Re-Commissioning	3/1/14	4/15/14	9.1.2
BiOp Kelt Passage & Survival Monitoring	3/1/14	10/31/14	9.2.2.
Prototype Overflow Weir & 14" Orifice Study	4/1/14	6/30/14	9.2.1.
Adult Salmon Studies	5/1/14	2/28/15	9.2.3.
Unit 3 Partial Discharge Analysis (PDA)	5/1/14	11/1/14	9.1.4.
Adult Lamprey Passage Studies	6/1/14	10/31/14	9.2.4-.5.
T1 Bushing Replacement	8/4/14	8/31/14	9.1.3.
TDG Monitoring	**3/1/14**	**2/28/15**	**2.2.**
TDG Monitoring - Tailrace (year-round)	3/1/14	2/28/15	station LGNW
TDG Monitoring - Forebay	4/1/14	8/31/14	station LWG
Adult Fish Counting	**3/1/14**	**12/30/14**	**Table LWG-3**
Daytime Video 0400-2000 PST	3/1/14	3/31/14	
Daytime Visual 0400-2000 PST	4/1/14	10/31/14	
Night Video 2000-0400 PST	6/15/14	9/30/14	
Daytime Video 0400-2000 PST	11/1/14	12/30/14	
Reports	**3/1/14**	**3/15/15**	**2.3.3.**
Weekly Reports	3/1/14	12/31/14	
Annual Report	2/10/15	3/15/15	



1. FISH PASSAGE INFORMATION

The locations of fish passage facilities at Lower Granite Dam are shown on the general site plan in **Figure LWG-1**. The schedule for project operations described in the Fish Passage Plan (FPP) and appendices is included in **Table LWG-1**.

1.1. Juvenile Fish Passage.

1.1.1. Juvenile Fish Passage Facilities. The Lower Granite juvenile facilities consist of a bypass system and juvenile transportation facilities. The bypass system contains extended-length submersible bar screens (ESBS) with flow vanes, improved modified balanced flow vertical barrier screens (VBS) , gatewell orifices, a bypass channel running the length of the powerhouse, and a bypass pipe to transport fish to the transportation facilities or 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 Fish Migration Timing. Juvenile passage timing at Lower Granite Dam (**Table LWG-2**) is calculated based on juvenile fish collection data over the most recent 10-year period and do not reflect bypass (FGE) or spillway passage. Salmon, steelhead, bull trout, lamprey, and other species are routinely counted. Maintenance of juvenile fish passage facilities that may impact juvenile fish or facility operations should be conducted during winter maintenance.

Table LWG-2. Juvenile Salmonid Passage Timing at Lower Granite Dam for the Most Recent 10-Years (2004-2013) Based on Daily & Yearly Collection Data.

Year	10%	50%	90%	# Days	10%	50%	90%	# Days
	Yearling Chinook				Subyearling Chinook			
2004	24-Apr	5-May	12-May	18	8-Jun	21-Jun	14-Jul	36
2005	24-Apr	5-May	10-May	16	29-May	3-Jun	17-Jun	19
2006	20-Apr	5-May	15-May	25	26-May	5-Jun	3-Jul	38
2007	19-Apr	4-May	14-May	25	3-Jun	9-Jun	12-Jul	39
2008	26-Apr	9-May	18-May	22	31-May	20-Jun	28-Jul	58
2009	22-Apr	7-May	20-May	28	29-May	11-Jun	2-Jul	34
2010	24-Apr	4-May	21-May	27	2-Jun	9-Jun	14-Jul	42
2011	19-Apr	8-May	16-May	27	26-May	11-Jun	16-Jul	51
2012	14-Apr	27-Apr	17-May	33	29-May	13-Jun	11-Jul	43
2013	19-Apr	8-May	14-May	25	30-May	9-Jun	1-Aug	63
MEDIAN	**21-Apr**	**5-May**	**15-May**	**25**	**29-May**	**10-Jun**	**13-Jul**	**41**
MIN	**14-Apr**	**27-Apr**	**10-May**	**16**	**26-May**	**3-Jun**	**17-Jun**	**19**
MAX	**26-Apr**	**9-May**	**21-May**	**33**	**8-Jun**	**21-Jun**	**1-Aug**	**63**
	Unclipped Steelhead				Clipped Steelhead			
2004	29-Apr	9-May	24-May	25	27-Apr	9-May	24-May	27
2005	27-Apr	9-May	20-May	23	26-Apr	8-May	16-May	20
2006	19-Apr	5-May	21-May	32	21-Apr	4-May	19-May	28
2007	1-May	10-May	21-May	20	28-Apr	7-May	20-May	22
2008	20-Apr	11-May	27-May	37	28-Apr	8-May	21-May	23
2009	22-Apr	6-May	29-May	37	21-Apr	1-May	21-May	30
2010	26-Apr	19-May	5-Jun	40	25-Apr	11-May	4-Jun	40
2011	22-Apr	13-May	31-May	39	3-Apr	6-May	20-May	47
2012	18-Apr	3-May	24-May	36	16-Apr	27-Apr	19-May	33
2013	22-Apr	13-May	19-May	27	20-Apr	9-May	17-May	27
MEDIAN	**22-Apr**	**20-May**	**24-May**	**34**	**23-Apr**	**7-May**	**20-May**	**28**
MIN	**18-Apr**	**3-May**	**19-May**	**20**	**3-Apr**	**27-Apr**	**16-May**	**20**
MAX	**1-May**	**19-May**	**5-Jun**	**40**	**28-Apr**	**9-May**	**4-Jun**	**47**
	Coho				Sockeye (Wild & Hatchery)			
2004	8-May	21-May	28-May	20	12-May	22-May	19-Jun	38
2005	30-Apr	10-May	17-May	17	9-May	20-May	1-Jun	23
2006	2-May	18-May	1-Jun	30	11-Apr	12-May	28-May	47
2007	5-May	15-May	23-May	18	11-May	16-May	21-May	10
2008	6-May	10-May	22-May	16	17-May	20-May	8-Jun	22
2009	13-May	21-May	23-Jun	41	21-Apr	20-May	28-May	37
2010	6-Jun	21-May	5-Jul	29	19-May	30-May	5-Jun	17
2011	5-May	15-May	1-Jun	27	4-Apr	20-May	4-Jun	61
2012	28-Apr	18-May	26-May	28	5-May	19-May	26-May	21
2013	8-May	14-May	18-May	10	15-May	17-May	19-May	4
MEDIAN	**5-May**	**16-May**	**27-May**	**24**	**10-May**	**20-May**	**30-May**	**23**
MIN	**28-Apr**	**10-May**	**17-May**	**10**	**4-Apr**	**12-May**	**19-May**	**4**
MAX	**6-Jun**	**21-May**	**5-Jul**	**41**	**19-May**	**30-May**	**19-Jun**	**61**

1.2. Adult Fish Passage.

1.2.1. Adult Fish Passage Facilities Description. Adult fish passage facilities at Lower Granite are made up of one south shore fish ladder with two 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. 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. Auxiliary water is supplied from the tailrace by three electric pumps, as well as from the forebay through diffuser 14. Two pumps are normally used to provide required flows. Four weirs in the upper end of the ladder were outfitted with PIT-tag detectors in early 2003.

1.2.2. Adult Fish Migration Timing and Counting. Upstream migrants are present at the project throughout the year and adult passage facilities are operated year-round. Maintenance of adult facilities is scheduled for January–February to minimize impacts on upstream migrants. Adult salmon, steelhead, shad and lamprey are counted (**Table LWG-3**) and daily data are posted online at: http://www.nwp.usace.army.mil/Missions/Environment/Fishdata.aspx. Yearly fish counts are used to determine peak adult migration timing (**Table LWG-4**). Sturgeon and bull trout are relatively infrequent and counts are posted online periodically during the passage season in *Miscellaneous Fish Counts* and summarized in the *Annual Fish Passage Report*.

Table LWG-3. Adult Fish Counting Schedule at Lower Granite Dam (3/1/14-2/28/15).

Count Period	Counting Method and Hours *
March 1–31	Video 0400–2000 hours (PST)
April 1 – October 31	Visual 0400–2000 hours (PST)
June 15 – September 30	Night Video 2000–0400 hours (PST)
November 1 – December 30	Video 0400–2000 hours (PST)

* All count hours are shown in Pacific Standard Time (PST). Note that during Daylight Saving Time (DST) from Mar 9–Nov 2, 2014, count hours will be one hour later (DST = PST+1).

Table LWG-4. Adult Fish Count Period and Peak Passage Timing at Lower Granite Dam (based on yearly counts since 1975).

Species	Counting Period	Earliest Peak	Latest Peak
Spring Chinook	Mar 1 – Jun 17	Apr 26	Jun 17
Summer Chinook	Jun 18 – Aug 17	Jun 18	Jul 17
Fall Chinook	Aug 18 – Dec 30	Sep 5	Oct 6
Steelhead	Mar 1 – Dec 30	Sep 1	Oct 16
Sockeye	Mar 1 – Oct 31	Jul 1	Jul 19
Lamprey	Apr 1 – Oct 31	Jul 18	Jul 25

1.2.2.1. Time-of-day (diel) distributions of adult salmonid activity at Lower Granite Dam fishway entrances and exits are summarized in **Figure LWG-2** (see *Keefer & Caudill 2008*: http://www.nwd-wc.usace.army.mil/tmt/documents/FPOM/2010/2013_FPOM_MEET/2013_JUN/).

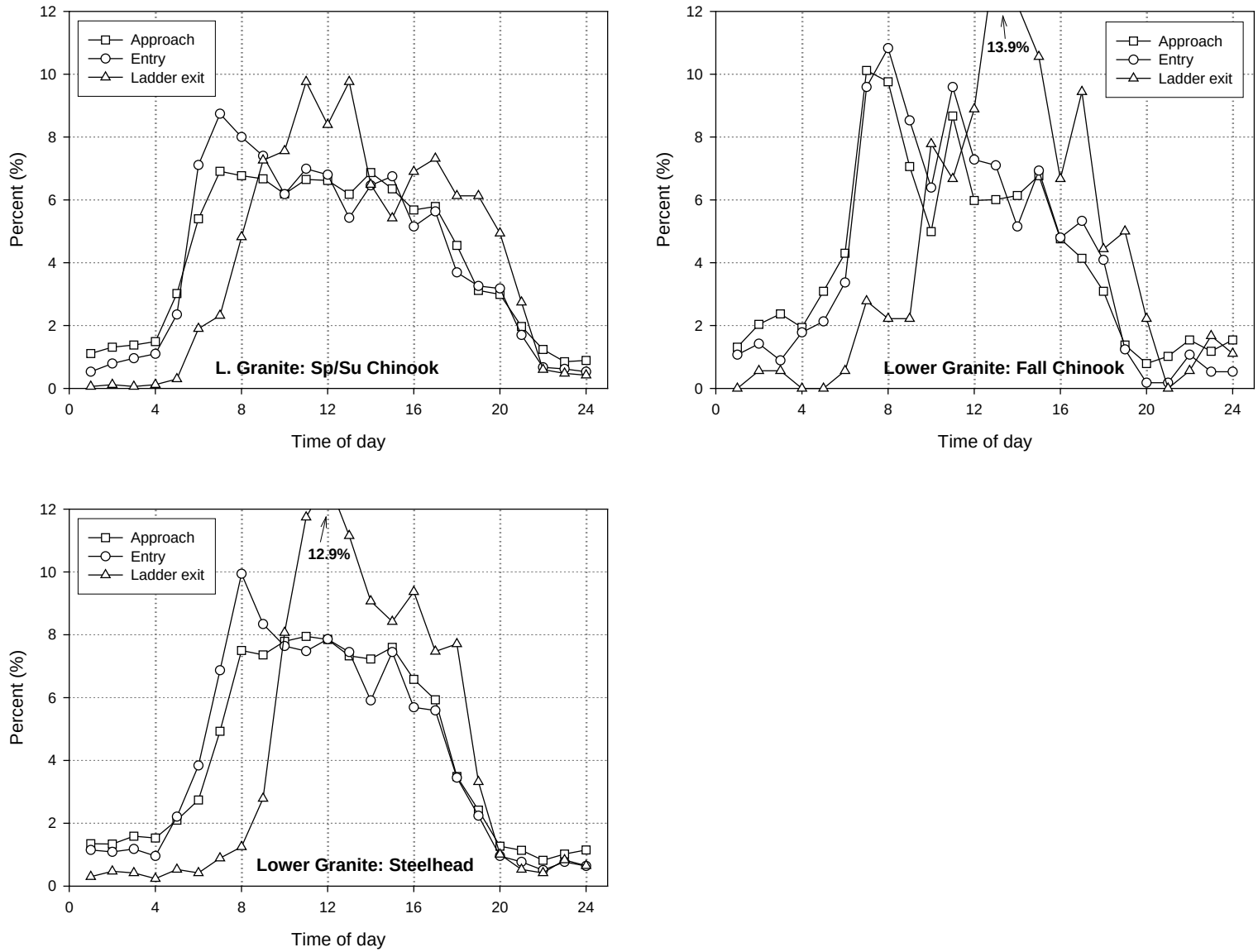


Figure LWG-2. Diel Distribution of Adult Salmonids at Lower Granite Dam Fishway Entrances and Exits (*Keefer & Caudill 2008*).

2. PROJECT OPERATIONS

2.1. Spill Management.

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

2.1.2. Involuntary Spill. Involuntary spill occurs when river flow exceeds powerhouse capacity, there is insufficient load (lack of load), forced or scheduled turbine outages, or a failure of a key component of the juvenile fish facility requires spill to provide juvenile fish passage. Spill at Lower Granite shall be distributed in accordance with the spill patterns included in **Tables LWG-8, LWG-9** and **LWG-10**. Special spills for juvenile fish passage will be provided as detailed in **Appendices A** and **E**.

2.2. Total Dissolved Gas (TDG) Management.

2.2.1. Total dissolved gas (TDG) levels at all projects are monitored in accordance with the TDG Monitoring Plan, included in the *Water Management Plan* as Appendix 4 and available online at: http://www.nwd-wc.usace.army.mil/tmt/documents/wmp/.

2.3. Operating Criteria.

2.3.1. Juvenile Fish Passage Facilities. Operate from March 25 – October 31 for juvenile fish bypass, collection, and transportation, and from November 1 – December 15 for bypassing adult fallbacks. Operate the juvenile facilities according to criteria below and in the *Corps of Engineers Juvenile Fish Transportation Plan* (**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 NOAA Fisheries biological opinion. Project personnel shall retain 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 – March 24). Check and perform maintenance as required on the items listed below.

2.3.1.1.a. Forebay Area and Intakes.

a.1. Remove debris from forebay and gatewell slots.

a.2. Rake trashracks just prior to the operating season.

a.3. Measure gatewell drawdown after cleaning trashracks and with ESBSs in.

a.4. Inspect and repair gatewell; dipnet as needed.

2.3.1.1.b. ESBSs, Flow Vanes and VBSs.

b.1. After ESBSs are removed at the end of the season, inspect them for the presence of juvenile salmonid mortalities and all other incidental fish mortalities. Inspect

ESBSs within a week after removal, or as soon as practical. All mortalities are to be counted, or otherwise estimated, for each ESBS and reported to CENWW-OD-T.

b.2. Maintenance completed on all screens.

b.3. Inspect ESBSs prior to installation and operate debris cleaner (dogged off on deck) to ensure proper operation.

b.4. Log results of trial run.

b.5. Inspect all VBSs with an underwater video camera at least 1x/year; repair as needed.

b.6. Inspect flow vanes to make sure they are in good condition and all surfaces smooth. Repair as needed.

b.7. ESBSs installed in at least 4 turbine units (all 6 if possible) by March 24. Remaining ESBSs installed prior to April 1.

2.3.1.1.c. Collection Channel.

c.1. Makeup water valves and float control equipment maintained and ready for operation.

c.2. Orifice lights are operational.

c.3. Orifices clean and valves operating correctly.

c.4. Orifice cycling and air backflush system works correctly.

2.3.1.1.d. Transportation Facilities.

d.1. 42" and 72" sluice gates maintained and operating correctly.

d.2. Inclined screen clean and in good condition with no holes in or damage to screen mesh, gaps around screen, or missing silicone.

d.3. Perforated plate smooth with no rough edges.

d.4. Wet separator and fish distribution system maintained and ready for operation.

d.5. Brushes and screens on crowders in good condition; no holes or rough edges.

d.6. Crowders maintained, tested, and operating correctly.

d.7. All valves, slide gates, and switch gates maintained and in good condition.

d.8. Retainer screens in place with no holes in screens or sharp wires protruding.

d.9. Barge and truck loading pipes should be free of debris, cracks, or blockages and barge loading boom maintained and tested.

d.10. All sampling equipment should be maintained and in good operating condition prior to watering up the facilities.

d.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.

d.12. Mini- and midi-tanks maintained and in good operating condition.

2.3.1.1.e. Barges.

e.1. All engines and pumps maintained and in good operating condition.

e.2. Fish release openings and related equipment in good operating condition.

e.3. No rough edges or support beams protruding into compartments.

e.4. No brass or galvanized fittings in circulation lines.

e.5. All loading hoses properly installed so fish will not hit sides of compartments or support beams when loading.

e.6. Loading hoses in good shape with rubber gaskets in cam lock fittings.

e.7. Inside edges of cam lock joints should be beveled to avoid sharp edges.

e.8. Warning systems tested and operational.

e.9. Provide net and/or deck covers.

e.10. Net pens maintained and installed in barge holds for transport of steelhead kelts or juveniles as required.

e.11. Deck wash systems fully operational.

e.12. Oxygen monitoring probes installed and tested; monitoring system operational.

2.3.1.1.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.

2.3.1.1.g. Maintenance Records. Record all maintenance and inspections.

2.3.1.2. Juvenile Fish Passage Facilities (March 25 – December 15).

2.3.1.2.a. Forebay Area and Intakes.

a.1. Remove debris from forebay.

a.2. Inspect gatewell slots daily for debris, fish buildup, and contaminating substances (particularly oil). Clean gatewells before they become 50% covered with debris. If, due to the volume of the debris it is not possible to keep the gatewell at least 50% clear, they should be cleaned at least once daily. If flows through an orifice or fish conditions indicate 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.

a.3. If a visible accumulation of contaminating substances is detected in a gatewell and 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.

a.4. Log drawdown differentials in bulkhead slots at least once per week.

a.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.

a.6. Coordinate cleaning effort with personnel operating juvenile collection facilities.

a.7. Dip bulkhead gatewell slots to remove fish prior to installing bulkhead for dewatering bulkhead slot.

2.3.1.2.b. ESBSs, VBSs, and Operating Gates.

b.1. ESBSs and flow vanes installed in all operating turbine units by March 24.

b.2. Operate ESBSs with flow vanes attached to screen.

b.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.

b.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.

b.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.

b.6. One-half of the ESBSs may be pulled after October 1 for maintenance as long as unscreened turbine units are not operated.

b.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.

b.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.

b.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.

b.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).

b.11. When extreme cold weather is forecasted (defined as forecasted temperatures below 20°F for ≥24 hours) 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 FPOM of the action.

2.3.1.2.c. Collection Channel.

c.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% peak turbine efficiency range if deemed

necessary by the project biologist. Monitor fish conditions in gatewells hourly or more frequently during orifice closure periods.

c.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.

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

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

c.5. Rotate orifices in fish screens slots weekly (6 open).

c.6. Orifice valves are either fully open or closed.

c.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% peak turbine efficiency range to minimize orifice plugging problems.

c.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 back-flushing to maintain clear orifices.

c.9. Makeup water valves and associated float controls operational and maintaining stable channel flow.

2.3.1.2.d. Transportation Facilities.

d.1. 42" and 72" sluice gates operational; 42-inch separator remote controller switch fully operational.

d.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.

d.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.

d.4. All valves, slide gates, and switch gates in and around separator and raceways operational.

d.5. Inspect raceway and tank retainer screens to make sure they are clean with no holes or protruding wire.

d.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.

d.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).

2.3.1.2.e. Avian Predation Areas (Forebay and Tailrace).

e.1. Bird wires and other avian deterrent devices should be monitored to ensure they are in good condition. Any broken wires or devices should be replaced as soon as possible.

e.2. Harassment program in place to deter avian predation in areas actively used by birds and not covered by bird wires or other devices.

e.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.

2.3.1.2.f. Removable Spillway Weir (RSW).[1]

f.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).

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

f.3. Complete RSW stow (complete rotation to the landing pad) when inflows exceed 260 kcfs, upstream river gage flows are increasing, and the NWS forecasts Lower Granite inflow to exceed 300 kcfs.

[1] Spillway weirs provide surface passage routes via spillbay(s). Temporary, or Top, Spillway Weirs (*TSW*s) at Little Goose, McNary and John Day dams can be installed, uninstalled and moved between bays using the gantry crane. Removable Spillway Weirs (*RSW*s) at Lower Granite, Lower Monumental and Ice Harbor dams are "removed" by controlled descent to the bottom of the forebay.

f.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)).

2.3.1.2.g. Inspection and Record Keeping.

g.1. Inspect fish facilities at least once every 8 hours. Inspect facilities according to fish facilities monitoring program.

g.2. Record all maintenance and inspections.

2.3.2. Adult Fish Passage Facilities. Operate adult fish passage facilities according to the following criteria.

2.3.2.1. Winter Maintenance Period (January 1 – February 28).

2.3.2.1.a. Inspect all staff gages and water level indicators; repair and/or clean as necessary.

2.3.2.1.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.

2.3.2.1.c. Inspect for and clean debris from the fish ladder exit. The trashrack and picketed leads must be clean and installed correctly.

2.3.2.1.d. Calibrate all water level measuring devices, as necessary, for proper facility operations.

2.3.2.1.e. Inspect all spill gates and ensure that they are operable.

2.3.2.1.f. Fish pumps maintained and ready for operation.

2.3.2.1.g. Maintain adult PIT-tag system as required. Coordinate with PSMFC.

2.3.2.1.h. Maintain the adult fish trap as required.

2.3.2.1.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. Adult Fish Passage Period (March 1 – December 31).

Note: Little Goose pool may be operated at minimum operating pool (MOP) elevation range 633'–634' msl, as part of the Corps' efforts to improve migration conditions for juvenile salmonids. This may result in some of the Lower Granite adult fishway entrances 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 pumped. Fish pump #1 may be run at "slow speed" to avoid frequent tripping from an overload condition while operating within MOP.

2.3.2.2.a. Fishway Ladder. Water depth over weirs: 1' to 1.3'.

a.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.

2.3.2.2.b. Counting Window. The crowder shall be opened to full count slot width when not counting. The crowder shall be open as far as possible to allow accurate counting and shall not be closed to less than 18" while counting. This will usually occur during high turbidity conditions to allow count accuracy criteria to be achieved. The counting slot has a width range of 12-30". All equipment should be maintained in good condition. Counting window and backboard should be cleaned as needed to maintain good visibility.

2.3.2.2.c. Head on all Fishway Entrances. Head range: 1' to 2'.

2.3.2.2.d. North Shore Entrances (NSE 1&2). Elevation at top of gates on sill = 625'.

d.1. Operate both downstream gates.

d.2. Weir depth: 7' or greater below tailwater.

2.3.2.2.e. North Powerhouse Entrances (NPE 1&2). Elev. at top of gates on sill= 628'.

e.1. Operate both downstream gates.

e.2. Weir depth: 8' or greater below tailwater. At tailwater below elevation 636', weirs should be on sill.

2.3.2.2.f. Floating Orifice Gates (FOGs). Operate four FOGs (1, 4, 7 and 10). Inspect fish fallout fence for debris buildup, holes, etc.

2.3.2.2.g. South Shore Entrances (SSE 1 & 2). Elevation at top of gates on sill = 625'.

g.1. Operate both gates.

g.2. Weir depth: 8' or greater below tailwater.

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

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

h.1. To take an actual reading, turn the monitor on and allow a few seconds to warm up. 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 note the maximum and minimum velocity from the inspections. This information is included in the weekly adult fishway report.

2.3.2.2.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.

2.3.2.2.j. Head on Trashracks.

j.1. Maximum head of 0.5' on ladder exit.

j.2. Maximum head on picketed leads shall be 0.3'.

j.3. Trashrack and picketed leads installed correctly.

2.3.2.2.k. Staff Gages and Water Level Indicators. All staff gages should be readable at all water levels encountered during the fish passage period. Repair/clean as necessary.

k.1. 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).

2.3.2.2.l. Facility Inspections.

l.1. Powerhouse operators shall inspect adult facilities once per day shift and check computer monitor information at least once during each back shift.

l.2. Project biologists shall inspect adult facilities at least three times per week. Inspect all facilities according to fish facilities monitoring program.

l.3. Picketed leads shall be checked during all inspections to ensure they are clean and in the correct position (all the way down).

l.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.

l.5. Inspect fishways daily for foreign substances (particularly oil). If substances are found, corrective actions should be undertaken immediately.

l.6. Record all inspections.

2.3.2.2.m. 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.

m.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.

m.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.

m.3. After September 1, 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 LWG fish ladder to meet its depth over ladder weir criteria.

m.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.

m.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 facilities at the frequencies defined in the juvenile and adult fish facilities operating criteria sections.

2.3.3.1. March 1–December 31, Project biologists shall prepare weekly reports summarizing project operations for the Friday through Thursday time period and submit to CENWW-OD-T by noon the following Monday via electronic mail. Reports shall provide an overview of

how the project and fish passage facilities operated during the week and evaluate resulting fish passage conditions. The reports shall include:

i. Any out-of-criteria situations observed and subsequent corrective actions taken;

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

iii. Adult fishway control calibrations;

iv. ESBS and VBS inspections;

v. Any unusual activities that occurred that may have affected fish passage.

2.3.3.2. 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 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.

2.3.3.3. 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 spill adjustments may be required for navigation safety, including: spill discharge reduction, spill pattern adjustment, and/or spill stoppages that result in forebay exceedances of the Minimum Operating Pool (MOP) range. 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 spill adjustments in real-time as appropriate to provide safe navigation conditions. Additional information regarding spill-specific operations for navigation is available in the FOP (**Appendix E**).

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 Maintenance.

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:

i. Description of the problem;

ii. Type of outage required;

iii. Impact on facility operation;

iv. Length of time for repairs;

v. Expected impacts on fish passage and proposed measures to mitigate them.

3.1.2.1. ESBSs. 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 spring runoff when river flows are at a level where taking a unit out of service will spill in excess of TDG 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, 18 bulkhead slot orifices (one per gatewell slot) and fish screen slot orifice at 5B South shall be operated. Additional bulkhead slot orifices may be operated to hasten fish departure and/or allow debris to exit gatewells as the hydraulic capacity of the gallery will allow. If very high flow conditions in the collection gallery prevent the operation of all 19 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), fish screen slot orifice 5B South 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 closed, the turbine unit will be taken out of service until repairs can be made. If repairs will take longer than 48 hours, juvenile fish will be dipped from the gatewell with a 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 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 Maintenance.

3.2.1. Scheduled Maintenance. Scheduled maintenance of a facility that must be dewatered to work on or whose maintenance will have a <u>significant effect</u> on fish passage will be done during the January and February winter maintenance period. Maintenance of facilities that will have <u>no effect</u> on fish passage may be conducted at any time. When facilities are not being maintained during the winter maintenance period, they will be operated according to normal criteria unless otherwise coordinated with NOAA Fisheries and other FPOM participants.

3.2.2. Unscheduled Maintenance. Unscheduled maintenance that will significantly affect the operation of a facility will be coordinated with NOAA Fisheries and other FPOM participants. Coordination procedures for unscheduled maintenance of adult facilities are the same as for

juvenile facilities (see section 3.1.2.). If part of a facility malfunctions or is damaged during the fish passage season and the facility can still be operated within criteria without any detrimental effects on fish passage, repairs may not be conducted until the winter maintenance period or until fewer numbers of fish are passing the project. If part of a facility is damaged or malfunctions that may significantly impact fish passage, it will be repaired as soon as possible.

3.2.2.1. Fish Ladder and Counting Station. The fish ladder contains fixed weirs, a counting station with picket leads, an adult fish trap, and a fish exit with trashrack. If any part of the ladder fails or is blocked with debris during the fish passage season, efforts will first be made to correct the problem without dewatering the ladder. Trashracks, picket leads, and counting stations can sometimes be repaired or maintained without dewatering the ladder. If the fish trap malfunctions or is damaged, fish may be passed around it until repairs are made. The decision to dewater the ladder and make repairs during the fish passage season or wait until the winter maintenance period will be made after coordination with the fish agencies and tribes.

3.2.2.2. Auxiliary Water Supply (AWS). Three electric pumps supply the auxiliary water for the fish ladder and powerhouse collection system. During normal operations and most flow conditions, two pumps are capable of providing 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 ensure they are in place. These inspections are done by either dewatering to physically inspect 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 problems should begin immediately through the established 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 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 & MAINTENANCE

4.1. Turbine Unit Operation.

4.1.1. 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 peak 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. Lower Granite Dam Turbine Unit Operating Priority Order.

Season	Duration	Unit Priority
March 1 – December 15 Fish Passage Season	Start Units	2, 3, then 4-6 any order, then 1 [a]
	Stop Units [b]	4-6 any order, then 3, 2, 1 [b]
December 16 – February 28 Winter Maintenance Season	Stop/Start Units	Any Order

a. Unit 1 has fixed Kaplan blades (non-adjustable) and can only operate in the upper 1% range. The priority order minimizes Unit 1 starts/stops and allows for the longest runtime once Unit 1 is started.

b. Stop units in reverse Start order, except run Unit 1 as long as BPA load request and required spill rate can be met.

4.1.2. April 1–October 31, turbine units will be operated within ±1% of peak turbine efficiency (1% range), as specified in *BPA's Load Shaping Guidelines* (**Appendix C**). Turbine unit output and discharge at the lower and upper 1% limits (with and without ESBSs) for various heads are defined in **Tables LWG-6 (units 1-3)** and **LWG-7 (units 4-6).** Unit 1 has fixed Kaplan blades and can only run in the upper 1% range. If operation outside the 1% range is necessary, Project personnel shall record the information and provide to BPA on a weekly basis according to the load shaping guidelines. Operation outside of 1% range may be necessary to:

i. Meet BPA load requirements. Load requests will be made in accordance with BPA's policy, statutory requirements and load shaping guidelines (**Appendix C**);

ii. If the draft tube is to be dewatered, the unit will be operated at full load (>1%) for a minimum of 15 minutes prior to installing tail logs. If not possible to load, the unit will be run at speed-no-load (<1%) for a minimum of 15 minutes. This is to reduce the number of fish in the unit prior to installing stop logs;

iii. operate a turbine unit solely to provide station service; or

iv. comply with other coordinated fish measures;

4.1.3. November 1–March 31, turbine units will continue to be operated within the 1% range except when BPA load requests require units to be operated outside the 1% range. Unit 1 has fixed Kaplan blades and can only run in the upper 1% range.

4.1.4. Minimum Generation. All of the lower Snake River powerhouses may be required to keep one generating turbine unit online 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 11.3–13.1 kcfs for turbine units 2 and 3, and 13.5–14.5 kcfs for turbine units 4, 5 and 6. Unit 1 has fixed (welded) blades and cannot be adjusted to run at the lower end of the 1% range; therefore operating Unit 1 during minimum generation results in approximately 17-19 kcfs turbine discharge.

Table LWG-6. Lower Granite Dam Turbine Units 1, 2 and 3 Output (MW) and Discharge (cfs) Per Unit at Upper and Lower Limits of the 1% Peak Efficiency Operating Range With and Without Extended-Length Submersible Bar Screens (ESBSs).[a, b]

Project Head (feet)	Turbine Units 1[b], 2, 3							
	With ESBSs				No ESBSs			
	1% Lower Limit		1% Upper Limit		1% Lower Limit		1% Upper Limit	
	(MW)	(cfs)	(MW)	(cfs)	(MW)	(cfs)	(MW)	(cfs)
85	**69.9**	**11,938**	**116.2**	**19,863**	**65.7**	**10,897**	**120.6**	**20,010**
86	70.6	11,922	118.5	20,007	66.4	10,882	123.0	20,155
87	71.4	11,906	120.8	20,146	67.2	10,868	125.4	20,296
88	72.2	11,890	123.1	20,282	67.9	10,853	127.8	20,434
89	73.0	11,875	125.4	20,415	68.6	10,839	130.2	20,568
90	**73.7**	**11,859**	**127.7**	**20,544**	**69.3**	**10,826**	**132.6**	**20,698**
91	74.6	11,849	128.1	20,346	70.2	10,817	133.0	20,500
92	75.5	11,839	128.5	20,152	71.0	10,808	133.3	20,305
93	76.3	11,829	128.8	19,963	71.8	10,799	133.7	20,115
94	77.2	11,818	129.2	19,777	72.6	10,790	134.1	19,929
95	**78.1**	**11,808**	**129.5**	**19,596**	**73.4**	**10,781**	**134.4**	**19,747**
96	79.1	11,825	129.7	19,385	74.4	10,797	134.6	19,536
97	80.2	11,841	129.8	19,179	75.4	10,813	134.7	19,329
98	81.2	11,857	130.0	18,978	76.4	10,827	134.9	19,126
99	82.3	11,872	130.1	18,780	77.4	10,842	135.0	18,928
100	**83.3**	**11,887**	**130.3**	**18,586**	**78.3**	**10,855**	**135.2**	**18,734**
101	84.2	11,890	132.0	18,637	79.2	10,858	137.0	18,785
102	85.1	11,892	133.7	18,687	80.0	10,860	138.8	18,836
103	86.0	11,895	135.4	18,736	80.9	10,863	140.6	18,885
104	86.9	11,897	137.2	18,784	81.7	10,865	142.4	18,934
105	**87.8**	**11,899**	**138.9**	**18,830**	**82.5**	**10,867**	**144.2**	**18,981**

a. Tables revised to reflect new information using the 2004 Unit 3 NS index test and the 1962 model test regarding extended-length submersible bar screens.

b. Unit 1 can only operate in the upper 1% range (approximately 17-19 kcfs) due to non-adjustable runner blades that were welded at a fixed angle in 2012 to address cracks in the link pins from shear fatigue. This restriction of Unit 1 operation will continue until the unit is restored to an adjustable blade Kaplan.

Table LWG-7. Lower Granite Dam Turbine Units 4, 5 and 6 Output (MW) and Discharge (cfs) Per Unit at Upper and Lower Limits of the 1% Peak Efficiency Operating Range With and Without Extended-Length Submersible Bar Screens (ESBSs).[a]

Project Head (feet)	Turbine Units 4, 5, 6							
	With ESBSs				No ESBSs			
	1% Lower Limit		1% Upper Limit		1% Lower Limit		1% Upper Limit	
	(MW)	(cfs)	(MW)	(cfs)	(MW)	(cfs)	(MW)	(cfs)
85	**83.9**	**13,761**	**107.2**	**17,586**	**85.1**	**13,602**	**116.0**	**18,546**
86	85.0	13,769	108.9	17,652	86.1	13,600	117.9	18,616
87	86.1	13,777	110.7	17,717	87.2	13,597	119.8	18,685
88	87.1	13,784	112.4	17,780	88.2	13,595	121.7	18,751
89	88.2	13,791	114.2	17,841	89.2	13,592	123.5	18,816
90	**89.3**	**13,798**	**115.9**	**17,900**	**90.3**	**13,589**	**125.4**	**18,879**
91	90.3	13,778	117.1	17,878	91.4	13,598	126.8	18,856
92	91.2	13,759	118.4	17,857	92.5	13,607	128.1	18,834
93	92.1	13,740	119.6	17,836	93.7	13,615	129.4	18,812
94	93.1	13,722	120.8	17,815	94.8	13,623	130.8	18,791
95	**94.0**	**13,703**	**122.0**	**17,795**	**95.9**	**13,630**	**132.1**	**18,769**
96	95.1	13,707	122.6	17,676	96.9	13.620	132.7	18,645
97	96.1	13,711	123.1	17,560	97.9	13,609	133.3	18,523
98	97.2	13,714	123.7	17,446	98.9	13,599	133.9	18,403
99	98.3	13,717	124.2	17,335	99.9	13,589	134.5	18,285
100	**99.4**	**13,720**	**124.8**	**17,225**	**100.9**	**13,579**	**135.0**	**18,170**
101	100.4	13,724	126.0	17,227	101.9	13,579	136.4	18,172
102	101.4	13,728	127.3	17,229	102.9	13,580	137.8	18,174
103	102.5	13,731	128.6	17,230	104.0	13,580	139.1	18,175
104	103.5	13,735	129.8	17,232	105.0	13,581	140.5	18,177
105	**104.5**	**13,739**	**131.1**	**17,233**	**106.0**	**13,581**	**141.9**	**18,179**

a. Tables revised to reflect new information using the 2004 Unit 3 NS index test and the 1975 model test regarding extended-length submersible bar screens.

4.2. Turbine Unit Outages during High River Flows.

4.2.1. During high spring flows, turbine unit outages for inspecting fish screens, repairing research equipment (e.g., hydroacoustic or radio-telemetry equipment), and other fish items may cause increased spill 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 TMT whenever possible.

4.2.2. 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:

i. Project personnel shall schedule turbine unit outages through the approved outage scheduling procedure by 1200 on Tuesday of the week prior to the outage.

ii. Project personnel shall also contact CENWW-OD-T and RCC by the same time period and inform them of the intended work.

iii. RCC will coordinate work activities through TMT.

iv. After coordination with the TMT, RCC shall issue a teletype through the CBT issuing instructions to project and BPA personnel for the scheduled work.

v. 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.

vi. When 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.)

vii. 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.

viii. If work (e.g., screen inspections) is not finished, project personnel shall schedule another turbine unit outage for a date where it can be implemented.

4.2.3. If the work 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 vs. a failed fish screen), and cannot wait for the above process to be implemented, project personnel shall notify CENWW-OD-T and RCC for approval. If approved, 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.

4.3.1. The 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 low numbers of fish are 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 through late November time frame. The maintenance of priority units for adult passage is normally conducted during late- October through December, when fewer adults are migrating, to minimize impacts on migrating adults. Turbine units may occasionally require overhauls to repair major problems with the turbine or generator. Overhauls may take over one year to accomplish. Turbine units, governors, exciters, and control systems require periodic maintenance, calibration, and testing which may take them outside of the 1% 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 3–5 workdays. To conduct the testing, the transmission lines have to be disconnected from the transformers and normal generation stopped. One turbine unit will operate at speed-no-load 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 August–early September to minimize impacts on adult and juvenile fish passage.

4.3.2. Turbine units are to be operated with raised operating gates to improve fish passage conditions when ESBSs are installed, except as provided below.[2] To facilitate annual maintenance, operating gates are used to dewater turbine units. To minimize turbine outage periods to the actual time required for maintenance (from July 1–December 15), 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 maintenance. With the operating gates in standard operating position, the turbine unit may be operated until 0900 hours the next regular workday (normally Monday). On completion of maintenance, the turbine unit can be operated with one operating gate in the standard operating position until 0900 hours of the first regular workday after the maintenance is completed. <u>The project biologist will be notified when the operating gates are set in standard operating position. The gatewells will be monitored 2 times per day to observe fish condition while the operating gates are in the standard operating position.</u> If turbine maintenance or the raising of the operating gates to the raised operating position is delayed after the time periods stated above, the turbine unit shall be immediately taken out of service until the work can be accomplished. Operation of turbine units with operating gates in the standard operating position shall be restricted to July 1–December 15, and shall not occur unless at least 4 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.

[2] Operating gates may also be referred to as “head” gates at some projects. The terms are interchangeable.

4.3.3. 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 beforehand.

4.3.4. 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 fish impingement, injuries and/or descaling. Removing debris from 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 physical removal (e.g., using boats to encircle the debris with log booms and tow it to shore where it can be removed with a crane, or using a crane and scoop from the top of the dam to remove forebay debris) or by passing the debris through the spillway with special spill and/or powerhouse operations. The preferred option is to physically remove debris when possible to avoid passing debris to the next downstream project. However, this is not always possible as some projects do not have forebay debris removal capability. In this case, the only viable alternative is to pass the debris via spill.

5.1. Debris Spill Coordination.

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. Project personnel shall provide CENWW-OD-T the reason for the debris spill request including an explanation of project facilities impacted by debris, the date and time of the requested spill, and any special powerhouse or other operations required to move the debris to the spillway. Using information provided by the project, CENWW-OD-T shall coordinate the special operations with RCC, NOAA Fisheries and FPOM. When a debris spill is coordinated and approved, RCC shall issue a teletype detailing the specifics of the special operations.

5.2. Emergency Debris Spills.

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 FPOM.

Table LWG-8. Lower Granite Dam Spring Spill Patterns for Fish Passage with RSW. [1]

Total Spill (kcfs)	LWG Spring Spill with RSW [1] # Gate Stops per Spillbay								Total Stops [2] (#)
	1 (RSW) [2]	2	3	4	5	6	7	8	
15.2	3.5		1		1	1	1	1	**8.5**
16.9	3.5		1	1	1	1	1	1	**9.5**
18.6	3.5	1	1	1	1	1	1	1	**10.5**
20.4	3.5	1	1	2	1	1	1	1	**11.5**
22.2	3.5	1	1	2	1	1	1	2	**12.5**
24	3.5	1	1	2	2	1	1	2	**13.5**
25.8	3.5	1	1	2	2	2	1	2	**14.5**
27.7	3.5	1	2	2	2	2	1	2	**15.5**
29.5	3.5	2	2	2	2	2	1	2	**16.5**
31.3	3.5	2	2	2	2	2	2	2	**17.5**
36.6	3.5	2	2	3	2	2	2	2	**18.5**
35	3.5	2	2	3	3	2	2	2	**19.5**
36.9	3.5	2	2	3	3	3	2	2	**20.5**
38.7	3.5	2	3	3	3	3	2	2	**21.5**
40.6	3.5	3	3	3	3	3	2	2	**22.5**
42.4	3.5	3	3	4	3	3	2	2	**23.5**
44.3	3.5	3	3	4	4	3	2	2	**24.5**
46.2	3.5	3	3	4	4	4	2	2	**25.5**
48	3.5	3	4	4	4	4	2	2	**26.5**
49.9	3.5	4	4	4	4	4	2	2	**27.5**
51.7	3.5	4	4	4	4	4	2	3	**28.5**
53.6	3.5	4	4	4	4	4	3	3	**29.5**
55.5	3.5	4	4	5	4	4	3	3	**30.5**
57.3	3.5	4	4	5	5	4	3	3	**31.5**
59.2	3.5	4	4	5	5	5	3	3	**32.5**
61	3.5	4	5	5	5	5	3	3	**33.5**
62.9	3.5	5	5	5	5	5	3	3	**34.5**
64.8	3.5	5	5	5	5	5	3	4	**35.5**
66.6	3.5	5	5	5	5	5	4	4	**36.5**
68.5	3.5	5	5	6	5	5	4	4	**37.5**
70.3	3.5	5	5	6	6	5	4	4	**38.5**
72.2	3.5	5	5	6	6	6	4	4	**39.5**
74.1	3.5	5	6	6	6	6	4	4	**40.5**
75.9	3.5	6	6	6	6	6	4	4	**41.5**

1. "Total Spill" calculated based on forebay elevation 734.0 ft (approx. 1.7–1.8 kcfs spill per gate stop).

2. RSW in Bay 1= approx. 6.8 kcfs spill (equivalent to 3.5 gate stops) at forebay elevation 734.0 ft. Tainter gate does not regulate flow and should be raised ≥ 9 stops to not interfere with RSW flow.

Table LWG-9. Lower Granite Dam Spill Patterns for Fish Passage with No RSW. [1]

Total Spill (kcfs)	LWG Spill w/ No RSW [1] # Gate Stops per Spillbay								Total Stops (#)
	1 (RSW)	2	3	4	5	6	7	8	
10.3	CLOSED	1	1			1	1	2	**6**
12.1	CLOSED	1	1			1	2	2	**7**
13.9	CLOSED	2	1			1	2	2	**8**
15.7	CLOSED	2	2			1	2	2	**9**
17.4	CLOSED	2	2	1		1	2	2	**10**
19.1	CLOSED	2	2	1	1	1	2	2	**11**
20.9	CLOSED	2	2	2	1	1	2	2	**12**
22.7	CLOSED	2	2	2	1	2	2	2	**13**
24.5	CLOSED	2	2	2	2	2	2	2	**14**
26.4	CLOSED	2	2	2	2	2	2	3	**15**
28.3	CLOSED	2	2	2	2	2	3	3	**16**
30.2	CLOSED	3	2	2	2	2	3	3	**17**
32.1	CLOSED	3	3	2	2	2	3	3	**18**
34.0	CLOSED	3	3	3	2	2	3	3	**19**
35.9	CLOSED	3	3	3	2	3	3	3	**20**
37.8	CLOSED	3	3	3	3	3	3	3	**21**
39.6	CLOSED	3	3	3	3	3	3	4	**22**
41.4	**CLOSED**	**3**	**3**	**3**	**3**	**3**	**4**	**4**	**23**
43.2	CLOSED	4	3	3	3	3	4	4	**24**
45.0	CLOSED	4	4	3	3	3	4	4	**25**
46.8	**CLOSED**	**4**	**4**	**4**	**3**	**3**	**4**	**4**	**26**
48.6	CLOSED	4	4	4	3	4	4	4	**27**
50.4	**CLOSED**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**28**
52.3	CLOSED	4	4	4	4	4	4	5	**29**
54.2	**CLOSED**	**5**	**4**	**4**	**4**	**4**	**4**	**5**	**30**
56.1	CLOSED	5	4	4	4	4	5	5	**31**
58.0	CLOSED	5	5	4	4	4	5	5	**32**
59.9	**CLOSED**	**5**	**5**	**5**	**4**	**4**	**5**	**5**	**33**
61.8	CLOSED	5	5	5	4	5	5	5	**34**
63.7	CLOSED	5	5	5	5	5	5	5	**35**
65.6	CLOSED	5	5	5	5	5	5	6	**36**
67.5	CLOSED	5	5	5	5	5	6	6	**37**

1. "Total Spill" calculated based on forebay elevation 734.0 ft (approx. 1.7-1.8 kcfs spill per gate stop). **Bold patterns** evaluated with Corps' Lower Granite 1:80 physical general model.

Table LWG-10. [*pg 1 of 2*] Lower Granite Dam Summer Spill Patterns for Fish Passage with RSW. [1]

Total Spill	LWG Summer Spill w/ RSW [1] # Gate Stops per Spillbay								Total Stops [2]
(kcfs)	1 RSW [2]	Bay 2	Bay 3	Bay 4	Bay 5	Bay 6	Bay 7	Bay 8	(#)
6.8	3.5								**3.5**
7.9	3.5		1						**4.5**
9.6	3.5		2						**5.5**
11.4	3.5		3						**6.5**
13.1	3.5		4						**7.5**
14.9	3.5		4				1		**8.5**
16.6	3.5		4			1	1		**9.5**
18.4	3.5		4			1	1	1	**10.5**
20.1	3.5		4		1	1	1	1	**11.5**
21.9	3.5	1	4		1	1	1	1	**12.5**
23.6	3.5	1	4	1	1	1	1	1	**13.5**
25.4	3.5	1	5	1	1	1	1	1	**14.5**
27.1	3.5	1	5	1	2	1	1	1	**15.5**
28.9	3.5	1	5	1	3	1	1	1	**16.5**
30.6	3.5	1	5	1	4	1	1	1	**17.5**
32.4	3.5	1	5	1	5	1	1	1	**18.5**
34.1	3.5	1	5	1	5	1	2	1	**19.5**
35.9	3.5	1	5	1	5	1	3	1	**20.5**
37.6	3.5	1	5	1	5	1	4	1	**21.5**
39.4	3.5	1	5	1	5	1	5	1	**22.5**
41.1	3.5	1	5	2	5	1	5	1	**23.5**
42.9	3.5	1	5	3	5	1	5	1	**24.5**
44.6	3.5	1	5	4	5	1	5	1	**25.5**
46.4	3.5	1	5	5	5	1	5	1	**26.5**
48.1	3.5	1	5	5	5	2	5	1	**27.5**
49.9	3.5	1	5	5	5	3	5	1	**28.5**
51.6	3.5	1	5	5	5	4	5	1	**29.5**
53.4	3.5	1	5	5	5	5	5	1	**30.5**
55.1	3.5	1	5	5	5	5	5	2	**31.5**
56.9	3.5	1	5	5	5	5	5	3	**32.5**
58.6	3.5	1	5	5	5	5	5	4	**33.5**
60.4	3.5	1	5	5	5	5	5	5	**34.5**
62.1	3.5	2	5	5	5	5	5	5	**35.5**
63.9	3.5	3	5	5	5	5	5	5	**36.5**
65.6	3.5	4	5	5	5	5	5	5	**37.5**
67.4	3.5	5	5	5	5	5	5	5	**38.5**
69.1	3.5	5	5	6	5	5	5	5	**39.5**
70.9	3.5	5	5	6	6	5	5	5	**40.5**
72.6	3.5	5	6	6	6	5	5	5	**41.5**
74.4	3.5	5	6	6	6	6	5	5	**42.5**

Total Spill (kcfs)	LWG Summer Spill w/ RSW [1] # Gate Stops per Spillbay								Total Stops [2] (#)
	1 RSW [2]	Bay 2	Bay 3	Bay 4	Bay 5	Bay 6	Bay 7	Bay 8	
76.1	3.5	5	6	6	6	6	6	5	**43.5**
77.9	3.5	5	6	6	6	6	6	6	**44.5**
79.6	3.5	6	6	6	6	6	6	6	**45.5**
81.4	3.5	6	6	7	6	6	6	6	**46.5**
83.1	3.5	6	6	7	7	6	6	6	**47.5**
84.9	3.5	6	7	7	7	6	6	6	**48.5**
86.6	3.5	6	7	7	7	7	6	6	**49.5**
88.4	3.5	6	7	7	7	7	7	6	**50.5**
90.1	3.5	6	7	7	7	7	7	7	**51.5**
91.9	3.5	7	7	7	7	7	7	7	**52.5**
93.6	3.5	7	7	8	7	7	7	7	**53.5**

1. "Total Spill" calculated based on forebay elevation 734.0 ft (approx. 1.7-1.8 kcfs spill per gate stop).

2. RSW in Bay 1= approx. 6.8 kcfs spill (equivalent to 3.5 gate stops) at forebay elevation 734.0 ft. Tainter gate does not regulate flow and should be raised ≥ 9 stops to not interfere with RSW flow.

Appendix A

Special Project Operations & Studies

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1. INTRODUCTION

This Appendix describes special project operations and studies planned to occur during the current year that may affect fish passage at the eight Lower Snake and Lower Columbia River projects. All special operations and studies will be coordinated with the project and appropriate regional agencies. The Corps RCC will issue a teletype to authorize all necessary operational changes and provide guidance to project operators.

1.1. Schedules: All dates shown for studies and special operations are approximate and could begin earlier or later depending on multiple factors, including river flow, contractor schedules, equipment failures, or other real-time conditions. Some studies may not proceed. Therefore, a final description of studies and outages/operations being conducted will be regionally coordinated prior to April 1 as part of the Corps' Anadromous Fish Evaluation Program (AFEP) via the Fish Facilities Design Review Workgroup (FFDRWG) and/or the Studies Review Workgroup (SRWG). The Action Agencies will coordinate all significant special operations requests or schedule changes with fisheries agencies and tribes through the appropriate regional forum to inform the final decision.

1.2. Spill: During the spring and summer juvenile salmonid outmigration seasons, spill operations for fish passage will be implemented as defined in the *Fish Operations Plan* (FOP), included in the Fish Passage Plan as **Appendix E,** and as coordinated through TMT. Spill for juvenile fish passage will begin on April 3 at Lower Snake River projects and on April 10 at Lower Columbia River projects, and continue through August 31. Alternative spill patterns to manage total dissolved gas (TDG) and/or fish passage conditions will be coordinated through the Fish Passage Operations & Maintenance (FPOM) regional workgroup.

During periods of high river flow, spill rates and forebay elevation may need to be adjusted at Lower Monumental and Lower Granite dams on a daily or every-other-day basis if necessary to provide safe conditions for the fish barge at the juvenile fish facility downstream of the dam.

1.3. Navigation: Annual lock outages are scheduled for routine maintenance and inspections, as well as some non-routine work such as gate machinery replacement and gudgeon crack welding. The 2014 schedule for navigation lock outages is as follows:

(a) March 1–15 (2 weeks): BON, TDA, JDA, MCN, LWG;

(b) March 1-22 (3 weeks): IHR, LMN, LGS.

2. BONNEVILLE DAM

2.1. Bonneville Dam Special Operations.

2.1.1. See **Introduction** sections **1.2** and **1.3** above for special operations at Bonneville Dam regarding spill operations for juvenile fish passage and navigation lock outages for maintenance.

2.2. Bonneville Dam Studies.

2.2.1. March 2014–March 2015: Adult Salmon and Steelhead Migration and Passage Behavior in the Lower Columbia River. This is the second year of a study to address two primary objectives: 1) assess passage behavior of adult salmonids in relation to modifications at BON, TDA, and JDA; and 2) estimate passage success (i.e., conversion rates) from BON to MCN. The study will include evaluation of late-run (October) summer steelhead passage and overwintering behavior at BON, TDA, JDA and MCN. At BON, the primary focus of this study will be on adult passage behavior at the modified Washington Shore Fish Ladder north downstream entrance and Cascades Island entrance.

Installation of new antennas and repairs to existing antennas will be made during the 2013/14 winter maintenance period and completed prior to commencement of tagging in spring of 2014. From late March through October, access will be needed to the BON Adult Fish Facility (AFF) and USACE tagging trailers to collect spring-summer Chinook salmon (up to 600 adult/400 jack), sockeye salmon (400 adult), and steelhead (up to 800 adults), tag with radio and PIT-tags, and release ~8 km below BON. Lower Columbia River projects will monitor for adult salmonids from March through October, then for late-run (overwintering) steelhead from October through March. Access to antennas and receivers for downloading and maintenance will be needed from March 2014 through the 2014/15 winter maintenance period.

2.2.2. May–June 2014: FGE Program PH2 Gatewell Velocity Testing. The USACE Portland District is planning to collect water velocity data at PH2 in late May and early June 2014. A test frame will be in the A-slot of Unit 14 for each test. Unit 14 would be held to a specific range of the 1% for each test day. All testing is scheduled to occur during daylight hours only, 0600-1700. A test frame will be in the A-slot for Unit 15 testing. Unit 15 would be held to a specific range of the 1% for each test day. All testing will occur daylight hours only, 0600-1700. A schedule will be provided to Bonneville Dam Operations. See Memorandum of Coordination (MOC) **14BON02** for further information.

3. THE DALLES DAM

3.1. The Dalles Dam Special Operations.

3.1.1. See **Introduction** sections **1.2** and **1.3** above for special operations at The Dalles Dam regarding spill operations for juvenile fish passage and navigation lock outages for maintenance.

3.2. The Dalles Dam Studies.

3.2.1. March 2014–March 2015: Adult Salmon and Steelhead Migration and Passage Behavior in the Lower Columbia River. This is the second year of a study to address two primary objectives: 1) assess passage behavior of adult salmonids in relation to modifications at BON, TDA, and JDA; and 2) estimate passage success (i.e., conversion rates) from BON to MCN. The study will include evaluation of late-run (October) summer steelhead passage and overwintering behavior at BON, TDA, JDA and MCN. At TDA, the primary focus will be on impacts of the 8/9 extended spill wall and associated spill pattern on passage behavior of adult salmonids.

Installation of new antennas and repairs to existing antennas will be made during the 2013/14 winter maintenance period and completed prior to commencement of tagging in spring of 2014. From late March through October, adult salmon and steelhead will be collected and tagged at the Bonneville Dam Adult Fish Facility and released below BON (see BON section **2.2.1.** above). Lower Columbia River projects will monitor for adult salmonids from March through October, then for late-run (overwintering) steelhead from October through March. Access to antennas and receivers for downloading and maintenance will be needed from March 2014 through the 2014/15 winter maintenance period.

4. JOHN DAY DAM

4.1. John Day Dam Special Operations.

4.1.1. See **Introduction** sections **1.2** and **1.3** above for special operations at John Day Dam regarding spill operations for juvenile fish passage and navigation lock outages for maintenance.

4.2. John Day Dam Studies.

4.2.1. March 2014–March 2015: Adult Salmon and Steelhead Migration and Passage Behavior in the Lower Columbia River. This is the second year of a study to address two primary objectives: 1) assess passage behavior of adult salmonids in relation to modifications at BON, TDA, and JDA; and 2) estimate passage success (i.e., conversion rates) from BON to MCN. The study will include evaluation of late-run (October) summer steelhead passage and overwintering behavior at BON, TDA, JDA and MCN. At JDA, the primary focus will be on the efficacy of improvements to the North Fish Ladder entrance and transition pool area.

Installation of new antennas and repairs to existing antennas will be made during the 2013/14 winter maintenance period and completed prior to commencement of tagging in spring of 2014. From late March through October, adult salmon and steelhead will be collected and tagged at the Bonneville Dam Adult Fish Facility and released below BON (see BON section **2.2.1.** above). Lower Columbia River projects will monitor for adult salmonids from March through October, then for late-run (overwintering) steelhead from October through March. Access to antennas and receivers for downloading and maintenance will be needed from March 2014 through the 2014/15 winter maintenance period.

4.2.2. June–July 2014: BiOp Performance Standard Compliance Test at John Day Dam during Summer Spill Operations. In 2014, 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 subyearling Chinook salmon. 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 forebay of the spillway and powerhouse and autonomous receivers will be deployed in both the forebay and tailrace each approximately two kilometers from the dam.

5. McNARY DAM

5.1. McNary Dam Special Operations.

5.1.1. See **Introduction** sections **1.2** and **1.3** above for special operations at McNary Dam regarding spill operations for juvenile fish passage and navigation lock outages for maintenance.

5.1.2. Early April 2014: Units 4 and 11 RTS Testing (post-rewind). Units 4 and 11 are scheduled to be returned to service in Feb 2014. There is a chance that restoration procedures and testing may extend beyond April 1st and will fall within the 1% efficiency operating requirement. If the rewind Units are to be tested correctly, they will be required to operate beyond the efficiency rate of 1% for short periods of time.

5.1.3. April–May 2014: Precise Level Surveys. Dam safety has scheduled the performance of Precise Level surveys at McNary Lock and Dam, in the April/May 2014 time frame. This requires contracted surveyors to have a direct line of sight across the top of the embankment and roadway deck of the powerhouse, spillway, non-overflow sections and Navigation lock, and that the brass cap survey markers do not have anything set over the top of them.

5.1.4. Late April–Early July: Waterfowl Nesting. From the end of April through the beginning of July, the McNary pool may be restricted to an operating range of 337.0–340.0 feet elevation in support of waterfowl nesting on Lake Wallula. Pool elevations are also operated in the range of 338.5–339.5 feet at least once every 4 days during daylight hours for a period of 4–6 hours. A yearly teletype has been issued to regulate the McNary pool in this manner since 1982.

5.1.5. June 2014 and September–October 2014: Periodic Inspection & Hydrographic Survey. There will be a formal Periodic Inspection of the McNary Levees planned for June 2014. Most of the inspection is land based, but there will be an inspection by boat along the shore of the levees to evaluate riverside levee slope protection (riprap). These inspections are accomplished once every five years. A hydrographic survey of the McNary stilling basin is tentative for September/October 2014 (subject to available funding).

5.1.6. June 2014–February 2015: Units 9 and 12 Rewind. Units 9 and 12 will be taken out of service from June 2014 through February 1, 2015, for winding and replacement of various other electrical and mechanical components, from the old excitation system down to the wicket gate servomotors. If the rewind Units are to be tested correctly, they will be required to operate beyond the efficiency rate of 1% for short periods of time.

5.1.7. July 2014: Doble Tests. From July 7 – July 10, 2014, Doble testing of transformer bank T1, and July 14–17, 2014 for Transformer Bank T2, will require their respective turbine units to be out of service (OOS) and unavailable for up to 4 days each transformer bank, 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.

5.1.8. Long-Term (Bi-Monthly): 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.

5.1.1. Bridge Inspections. The next round of Bridge inspections is scheduled for 2014. Bridges as appurtenance structures to the dam are inspected every two years based on the Federal DOT Bridge Inspection Program. Those Bridges include the Navigation lock upstream split Bascule Bridge, and the Fish Ladder Section 5 and Section 22 Bridge. Inspections require using a boat to inspect under the bridge in the Navigation forebay or the use of a snooper truck from the road way deck. No underwater inspection of piers will be accomplished.

5.2. McNary Dam Studies.

5.2.1. March 2014: Direct Injury and Survival of Adult Steelhead Passing Turbines and Temporary Spillway Weirs (TSW). Turbine unit 12 intake A will be used for the study and turbine operations have been identified as peak turbine efficiency and best geometry (approximately 14 kcfs if sample size allows). Turbines operate within ±1% of peak turbine efficiency (1% range) as a soft constraint from November 1 through March 31; however, operation at the best geometry point (approximately14 kcfs) will be coordinated through FPOM. Turbine testing is expected to require approximately 7 days for completion. A scintillation frame with fish release pipe will be lowered into the unit 12A head gate slot and will require McNary Project assistance. Turbine outages may be required to install direct release pipes in unit 12A. Appropriate coordination with McNary Project personnel will occur for the installation and removal of the unit 12A head gate, and mobilization and install of the fish release pipe structure. This will require the use of the gantry crane.

A TSW will be installed in spillbay 19 or 20 (at the discretion of McNary Project) to conduct the study. The TSW will operate at 10 kcfs assuming a forebay elevation of approximately 339-340 feet mean sea level. The 10 kcfs spill requirement for this study is expected for approximately 4-7 days, 10 hours per day. This operation has previously been accepted by BPA and the Region for the FY14 study. The installation of the TSW will be coordinated through FPOM and will include a request to leave the TSW installed (not spilling) through the fish passage season. The Contractor will be self-sufficient for installation of the fish release pipes at the TSW.

Previous attempts to conduct this study have been unsuccessful due to low adult steelhead returns in 2013. If the full sample size cannot be obtained in 2014, we will only test the turbine operated at peak efficiency and the TSW. Final study dates, turbine outages and operations, and TSW spill will be coordinated appropriately through FPOM. Spill requirements for the study will require further coordination and cooperation with BPA. Equipment removal will occur prior to the beginning of the fish passage season and is expected to occur prior to the last week of March.

Depending upon sample size for the March 2014 study it may be necessary to repeat the study as described above between October 2014 and February 2015. Regional discussion of the 2014 study results will determine the need for a second year of study. Coordination for a follow-on study will occur immediately upon a Regional decision to conduct such a study.

5.2.2. March 2014–March 2015: Adult Salmon and Steelhead Migration and Passage Behavior in the Lower Columbia River. This is the second year of a study to address two primary objectives: 1) assess passage behavior of adult salmonids in relation to modifications at BON, TDA, and JDA; and 2) estimate passage success (i.e., conversion rates) from BON to MCN. The study will include evaluation of late-run (October) summer steelhead passage and overwintering behavior at BON, TDA, JDA and MCN. At MCN, the primary focus will be on the effects of a prototype lamprey entrance installed in the winter of 2013/14 at the south fishway entrance on passage behavior and success of adult salmonids.

Installation of new antennas and repairs to existing antennas will be made during the 2013/14 winter maintenance period and completed prior to commencement of tagging in spring of 2014. From late March through October, adult salmon and steelhead will be collected and tagged at the Bonneville Dam Adult Fish Facility and released below BON (see BON section **2.2.1.** above). Lower Columbia River projects will monitor for adult salmonids from March through October, then for late-run (overwintering) steelhead from October through March. Access to antennas and receivers for downloading and maintenance will be needed from March 2014 through the 2014/15 winter maintenance period.

5.2.3. April–July 2014: BiOp Performance Standard Compliance Test at McNary Dam during Spring and Summer Spill Operations. In 2014, 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 juvenile steelhead, and yearling and subyearling Chinook salmon. 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.

5.2.4. June–October 2014: Adult Pacific Lamprey Passage Success. This study will use half-duplex (HD) PIT-tag systems to evaluate passage success of adult Pacific lamprey at McNary Dam, the four Lower Snake River projects and associated river segments. This study will require Project support to provide power for electronics and access to download data from the PIT-tag detection equipment. Maintenance of equipment will occur during the winter maintenance period when adult fishways are dewatered.

5.2.5. June–October 2014: Underwater Video Monitoring of Adult Fish Ladder Modifications to Improve Pacific Lamprey Passage. 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 lamprey in the fish ladders at McNary Dam. The primary goal of this work is to estimate the number 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. This study will require Project support to provide power for electronics equipment in the fishways, access for the installation, repair, and testing of electronic equipment and access to download data from video camera equipment.

5.2.6. June–October 2014: Adult Lamprey Study. Installation of a prototype adult lamprey passage structure at the McNary Dam South (Oregon) Fish Ladder (SFE2) is expected

to be completed in February 2014. This passage structure will provide a lower velocity passage route into the adult fish ladder. Optical video and DIDSON acoustic cameras will be used to evaluate fine-scale passage behavior of Pacific lamprey at the entrance and exit of the passage structure. 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). Additionally, two half-duplex PIT-tag detectors (4 loops) will be installed into the passage structure to determine the preferred passage route through the varied-velocity baffle box section. The passage structure includes a knife gate which will be opened in early June and closed at the end of October as the adult lamprey migration winds down.

5.2.7. September 2014–March 2015: Adult Steelhead Temporary Spillway Weir (TSW) Passage Efficiency. Hydroacoustic transducers will be installed from outside of the trashrack in a single turbine unit intake on up to 10 turbine units. Turbine unit intakes will be randomly selected and rolling unit outages of 3 units at a time is expected for installation of the transducers. A dive will be required to install and remove transducers and the installation dive is expected to require 5-7 days. Scheduled turbine unit outages will dictate which and how many turbine units will be used for the study and will be coordinated with the McNary Project. No specific turbine unit operation will be tested. Hydroacoustic transducers will also be installed on a TSW in either spillbay 19 or 20 and will be coordinated with the McNary Project. This study is to be conducted in conjunction with the adult steelhead direct injury and survival study (section **5.2.1.** above) and will require 10 kcfs spill over the TSW 24 hours per day in a block design (to be determined) of X number of days “on” and X number of days “off” for the duration of the study to equate to spilling during 50% of the study period. Final study dates, turbine unit outages, installation and removal of equipment and TSW, and spill through the TSW will be appropriately coordinated through FPOM, RCC, BPA and the McNary Project.

6. ICE HARBOR DAM

6.1. Ice Harbor Dam Special Operations.

6.1.1. See **Introduction** sections **1.2** and **1.3** above for special operations at Ice Harbor Dam regarding spill operations for juvenile fish passage and navigation lock outages for maintenance.

6.1.2. March–May 2014: Periodic Inspection. The Periodic Inspection at Ice Harbor Lock and Dam is tentatively scheduled for May 2014. Most of the inspection is land based, but in March an inspection by boat of the upstream and downstream face of the concrete dam, shore line, and embankment slope protection (riprap) is planned. These inspections are accomplished once every five years and are very important for monitoring of the overall condition of the dam features and structure. Prior to this inspection date the Ice Harbor spillway emergency generator will also be tested (tentative for March 2014). During the test we will raise as many of the spillway gates as possible with emergency power to maximize power usage and then close them.

6.1.3. March 2014 and October 2014–March 2015: Main Unit Digital Governor Upgrades. From June 2013 to December 2015, the Main Unit Digital Governors at Ice Harbor will be replaced starting on unit 4 and proceeding up to unit 6. Each unit will take about 5 weeks for the governors to be replaced. Unit 4, 5 and 6 will be complete in March 2014. Unit 1, 2 and 3 will be replaced between October 2014 and March 2015. This will also involve model validation testing that will require the unit be operated outside of the 1% range and out of unit priority order in the Fish Passage Plan. Unit 4, 5, and 6 Model Validation will occur 25 to 31 March 2014, and Unit 1, 2 and 3 testing will occur in March 2015.

6.1.4. April–May 2014: Precise Level Surveys. Dam safety has scheduled the performance of Precise Level surveys at Ice Harbor Lock and Dam, in the April/May 2014 time frame. This requires the contracted surveyors to have a direct line of sight across the top of the embankment and roadway deck of the powerhouse, spillway, non-overflow sections, and Navigation lock and that the brass cap survey markers do not have anything set over the top of them.

6.1.5. July–October 2014: Transformer Oil Replacement. In FY14, Ice Harbor project will be replacing transformer oil on TW-4, TW-5, TJ-0 and TW-0 based on the condition of the oil and the PCB levels within these transformers. Currently the outages are scheduled in 2014 as follows: TJ0 July 21–30; TW0 and TW4 August 4–28, and TW5 September 10–October 1.

6.1.6. August–September 2014: Doble Testing. In 2014, Doble testing will take the following out of service: 3 transformers, TW3, TW4, and TJO and turbine units 3 and 4**.** The outage is tentatively scheduled for August–September, 2014. Since Ice Harbor Dam has multiple transformer banks, transmission lines, and redundant switching capability, the remaining turbine units will be available for operation during these tests. Turbine units will operate within the 1% of peak efficiency operating range, in accordance with the turbine priority order defined in the Fish Passage Plan.

6.1.7. September 2014 –March 2015: Steady State Model Validation Testing. Western Electricity Coordinating Council (WECC) 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. Tests will involve running the unit out of fish priority sequence and outside the 1% range. Testing can occur at any time from September 1–March 31, and will not occur during fish passage season (April 1–August 31). 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.

6.1.8. Bridge Inspections. The next round of Bridge inspections is scheduled for 2014. Bridges as appurtenance structures to the dam are inspected every two years based on the Federal DOT Bridge Inspection Program. Those Bridges include the spillway road way deck bridge, and the Navigation lock downstream bridge. Bridge inspections require using a boat to inspect under the bridge in the spillway forebay or the use of a snooper truck from the road way deck. No underwater inspection of piers will be accomplished. Inspection of the spillway bridges will be attempted to be accomplished before the spill season.

6.2. Ice Harbor Dam Studies.

6.2.1. February–August 2014: Ice Harbor Turbine Characterization Study. In support of the Ice Harbor turbine replacement program, baseline Sensor Fish data will be collected in one or two of turbine units 1-3. Specific study units may vary depending on scheduled outages and will be coordinated with the Ice Harbor Project. It is expected that 3 or 4 specific turbine operations will be required for testing with 2 release elevations. This study will implement the new generation of Sensor Fish as well as a new release mechanism; therefore, data collection may occur in multiple timeframes as equipment optimization may be intermittently required. Ice Harbor Project support beyond adjusting turbine operations is not expected for this study. Study dates and specific turbine units and operations will be appropriately coordinated with the Ice Harbor Project and/or FPOM once finalized.

6.2.2. March 2014–March 2015: Adult Salmon Study. A study of adult salmon passage in the Lower Columbia River is planned for the 2014 adult passage season using salmon tagged at the Bonneville Dam Adult Fish Facility (AFF) and includes passage and fate through the Lower Snake River. Salmon and steelhead will be collected, tagged with radio-telemetry transmitters and/or PIT-tags, and released below Bonneville Dam (see BON section **2.2.1.** above). Installation and maintenance of any new radio-telemetry antennas or receivers will be completed in March–April 2014 for detecting adult fish tagged at the Bonneville AFF and adult lamprey tagged for the Lower Snake River radio-tracking study. There is no Lower Snake River adult spring Chinook salmon study from Ice Harbor Dam planned for 2014.

6.2.3. May–October 2014: Adult Lamprey Study. A study of Snake River adult lamprey passage is planned for the 2014 adult passage season. The primary goals of the research are to determine fish ladder entrance preferences, migration timing through the ladders, turn-around points in the ladders, fallback rates, and conversion rates between the Lower Snake River dams. Lamprey will be captured and tagged with radio tags and half-duplex PIT-tags at John Day Dam, transported for release below Ice Harbor Dam, and monitored at the four Lower Snake River projects. Radio-telemetry equipment is in place from the adult salmon passage studies and some

additional arrays will be installed in the adult fish ladders in the vicinity of transition or turn pools. Installation and maintenance of radio-telemetry equipment will be completed in May–June prior to the adult lamprey migration season. Access to antennas and receivers for downloading and maintenance will be needed from May through October.

6.2.4. June–October 2014: Underwater Video Monitoring of Adult Fish Ladder Modifications to Improve Pacific Lamprey Passage. 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 goal of this work is to estimate the number 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. 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.

6.2.5. June–October 2014: Adult Pacific Lamprey Passage Success. 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 (HD) PIT-tag systems. This study will require Project support 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.

7. LOWER MONUMENTAL DAM

7.1. Lower Monumental Dam Special Operations.

7.1.1. See **Introduction** sections **1.2** and **1.3** above for special operations at Lower Monumental Dam regarding spill operations for juvenile fish passage and navigation lock outages for maintenance.

7.1.2. January–February 2014: Transient Model Validation (Exciter Step Response). Western Electricity Coordinating Council requires model validation testing on a minimum 5-year cycle to ensure generating equipment responds as planned to system requirements and disturbances. Testing of the Units was last performed in 2009. Unit tests will be accomplished on Lower Monumental Units 1 through 3. As testing will involve running the test unit out of fish priority sequence and outside the 1% criteria, testing is scheduled to occur during the in-water work period between January 2, 2014 and February 28, 2014. Testing will take require operation of each unit for approximately 1 hour with 30 minutes outside the 1% criteria.

7.1.3. February–March 2014: Lower Snake Exciter Replacement: Lower Snake exciter replacement took place at Lower Monumental in FY12. . During the commissioning process at Little Goose, deficiencies were found that affected units previously installed at Lower Monumental and Lower Granite. The PDT has determined that these deficiencies require correction to ensure compliance with contract documents. Units 4-6 at Lower Monumental will undergo re-commissioning to verify designed capabilities are restored to pre-construction levels. This work will also require performance testing and model validation testing. This work is presently scheduled to occur between February 11 and March 3, 2014. The dates for this work are subject to change, but the outages will be scheduled to minimize impacts to fish passage. During this time, it will be necessary to run units out of priority order and outside the 1% operating range. See model validation testing paragraph number 7.1.1 & 7.1.2. This contract work is subject to normal contracting and construction delays.

7.1.4. February–April 2014: Precise Level Surveys. Dam safety has scheduled the performance of Precise Level surveys at Lower Monumental Lock and Dam, in the February/March/April 2014 time frame. This requires the contracted surveyors to have a direct line of sight across the top of the embankment and roadway deck of the powerhouse, spillway, non-overflow sections, and Navigation lock and that the brass cap survey markers do not have anything set over the top of them.

7.1.5. August 2014: Transformer Maintenance. Transformer bank T2 and turbine units 5, and 6 will be taken out of service for maintenance work in 2014 subject to available water flows. The outage is tentatively scheduled for August 11 to August 15, 2014. 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 2, 3, 4, and 1. Turbine unit 1% efficiency operations and turbine priorities will continue to follow fish passage plan requirements during this maintenance work. Another total plant outage will be required on the last day of testing to remove clearance tags and restore T2 bank. The following week, August 18 to August 21, 2014, similar work is tentatively scheduled to be performed on Transformer bank T1 and turbine units 1, 2, 3, and 4 will be taken

out of service for scheduled maintenance work. 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 5 and 6. 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 T1 bank.

7.1.6. September 2014 –March 2015: Steady State Model Validation Testing. Western Electricity Coordinating Council (WECC) 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. Tests will involve running the unit out of fish priority sequence and outside the 1% range. Testing can occur at any time from September 1–March 31, and will not occur during fish passage season (April 1–August 31). 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.

7.1.7. Long-Term (through 2018): Lower Monumental Head Gate Rehab: Under the BPA Large Cap Program, parts and materials have been acquired to rehabilitate the headgates at Lower Monumental Dam. To facilitate the process, units will be scheduled out of service to remove or replace headgates. The headgates will be serviced in the repair pit and then placed back into service. Deviation from unit priority will be necessary to swap headgates from the unit to the pit. The duration of the outages is expected to be one day. The work is expected to start in December of 2012 and continue in to 2018.

7.1.8. Bridge Inspections. The next round of Bridge inspections is scheduled for 2014. Bridges as appurtenance structures to the dam are inspected every two years based on the Federal DOT Bridge Inspection Program. Those Bridges include the spillway road way deck bridges and the Navigation lock downstream Bridge. Inspections require using a boat to inspection under the bridge in the spillway forebay or the use of a snooper truck from the road way deck. No underwater inspection of piers will be accomplished. Inspection of the spillway bridges will be attempted to be accomplished before the spill season.

7.2. Lower Monumental Dam Studies.

7.2.1. May–October 2014: Adult Lamprey Study. A study of Snake River adult lamprey passage is planned for the 2014 adult passage season. The primary goals of the research are to determine fish ladder entrance preferences, migration timing through the ladders, turn-around points in the ladders, fallback rates, and conversion rates between the Lower Snake River dams. Lamprey will be captured and tagged with radio tags and half-duplex PIT-tags at John Day Dam, transported for release below Ice Harbor Dam, and monitored at the four Lower Snake River projects. Radio-telemetry equipment is in place from the adult salmon passage studies and some additional arrays will be installed in the adult fish ladders in the vicinity of transition or turn pools. Installation and maintenance of radio-telemetry equipment will be completed in May–

June prior to the adult lamprey migration season. Access to antennas and receivers for downloading and maintenance will be needed from May through October.

7.2.2. June–October 2014: Adult Pacific Lamprey Passage Success. This study will evaluate passage success of adult Pacific lamprey *Entosphenus tridentatus* at McNary Dam, the four lower Snake River dams, and associated river segments using half-duplex (HD) PIT-tag systems. This study will require Project support to provide power for electronics, and access for downloading data from the PIT-tag detection equipment. Maintenance of equipment will occur during the winter maintenance period when adult fishways are dewatered.

8. LITTLE GOOSE DAM

8.1. Little Goose Dam Special Operations.

8.1.1. See **Introduction** sections **1.2** and **1.3** above for special operations at Little Goose Dam regarding spill operations for juvenile fish passage and navigation lock outages for maintenance.

8.1.2. Through April 2014: Lower Snake Exciter Replacement. Little Goose units 1 or 2 exciter replacement is ongoing, but may extend into April for testing. This work will also require performance testing and model validation testing. This will require 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.

8.1.3. April–May 2014: Precise Level Surveys. Dam safety has scheduled the performance of Precise Level surveys at Little Goose Lock and Dam, in the April/May 2014 time frame. This requires the contracted surveyors to have a direct line of sight across the top of the embankment and roadway deck of the powerhouse, spillway, non-overflow sections, and Navigation lock and that the brass cap survey markers do not have anything set over the top of them.

8.1.4. August 2014: Coupling Capacitor testing. In 2014, two transformers, T-1 and turbine units 1 to 4 and T-2 Turbine Units 5 and 6 will be taken out of service for Coupling Capacitor testing**.** The outage is tentatively scheduled for August 12th, 2014.

8.1.5. September 2014–March 2015: Steady State Model Validation Testing. Western Electricity Coordinating Council (WECC) 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. Tests will involve running the unit out of fish priority sequence and outside the 1% range. Testing can occur at any time from September 1–March 31, and will not occur during the spill season (April 1–August 31). 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.

8.1.6. Bridge Inspections. The next round of Bridge inspections is scheduled for 2014. Bridges as appurtenance structures to the dam are inspected every two years based on the Federal DOT Bridge Inspection Program. Those Bridges include the spillway road way deck Bridges, and the Navigation lock downstream pedestrian Bridge and the upstream upper and downstream lower bascule bridges. Inspections require using a boat to inspection under the bridge in the spillway forebay or the use of a snooper truck from the road way deck. No underwater inspection of piers will be accomplished. Inspection of the spillway bridges will be attempted to be accomplished before the spill season.

8.2. Little Goose Dam Studies.

8.2.1. March 2014–March 2015: Adult Salmon Study. A study of adult salmon passage in the Lower Columbia River is planned for the 2014 adult passage season using salmon tagged at the Bonneville Dam Adult Fish Facility (AFF) and includes passage and fate through the Lower Snake River. Salmon and steelhead will be collected, tagged with radio-telemetry transmitters and/or PIT-tags, and released below Bonneville Dam (see BON section **2.2.1.** above). Installation and maintenance of any new radio-telemetry antennas or receivers will be completed in March–April 2014 for detecting adult fish tagged at the Bonneville AFF and adult lamprey tagged for the Lower Snake River radio-tracking study. There is no Lower Snake River adult spring Chinook salmon study from Ice Harbor Dam planned for 2014.

During the 2013/14 winter maintenance period, the LGS adult ladder count window slot will be modified to a minimum slot opening of 18' in preparation of temporary PIT-tag antennae in January 2014.

8.2.2. May–October 2014: Adult Lamprey Study. A study of Snake River adult lamprey passage is planned for the 2014 adult passage season. The primary goals of the research are to determine fish ladder entrance preferences, migration timing through the ladders, turn-around points in the ladders, fallback rates, and conversion rates between the Lower Snake River dams. Lamprey will be captured and tagged with radio tags and half-duplex PIT-tags at John Day Dam, transported for release below Ice Harbor Dam, and monitored at the four Lower Snake River projects. Radio-telemetry equipment is in place from the adult salmon passage studies and some additional arrays will be needed in the adult fish ladders in the vicinity of transition or turn pools. Installation and maintenance of radio-telemetry equipment will be completed in May–June prior to the adult lamprey migration season. Access to antennas and receivers for downloading and maintenance will be needed from May through October.

8.2.3. June–October 2014: Adult Pacific Lamprey Passage Success. This study will evaluate passage success for adult Pacific lamprey, *Entosphenus tridentatus*, at McNary Dam, the four Lower Snake River dams, and associated river segments using half-duplex (HD) PIT-tag systems. This study will require Project support to provide power for electronics and access for downloading data from the PIT-tag detection equipment. Maintenance of equipment will occur during the winter maintenance period when adult fishways are dewatered.

9. LOWER GRANITE DAM

9.1. Lower Granite Dam Special Operations.

9.1.1. See **Introduction** sections **1.2** and **1.3** above for special operations at Lower Granite Dam regarding spill operations for juvenile fish passage and navigation lock outages for maintenance.

9.1.2. March–April 2014: Units 4, 5, 6 Exciter Re-Commissioning. Lower Granite turbine units 4, 5 and 6 are tentatively scheduled for exciter re-commissioning from March 3-16 (Unit 6), March 17-29 (Unit 4) and March 24-April 4 (Unit 5). The re-commissioning may require units to temporarily operate out of the unit priority order defined in the Fish Passage Plan (Lower Granite Dam **Table LWG-5)** and/or outside of the 1% operating range.

9.1.3. April–May 2014: Precise Level Surveys. Dam safety has scheduled the performance of Precise Level Surveys at Lower Granite in the April/May 2014 time frame. This requires contracted surveyors to have a direct line of sight across the top of the embankment and roadway deck of the powerhouse, spillway, non-overflow sections, and Navigation lock and that the brass cap survey markers do not have anything set over the top of them.

9.1.4. August 2014: T1 Bushing Replacement. Lower Granite performed Doble testing of T1/T2 in August 2013 and testing will occur again in 2015 (every-other-year test schedule). The 2013 test results indicated that the T1 phase-C neutral bushing test lead was broken. A line outage is required to replace the bushing and is currently expected to be performed during the normal Doble test timeframe of early to mid-August 2014. The anticipated duration is 5 days for the T1 outage (Units 1-4 OOS) with T2 returning to service nightly, and 3 days for the T2 outage (Units 5-6 OOS) with T1 returning to service nightly.

9.1.5. May 2014 and November 2014: Unit 3 Partial Discharge Analysis (PDA). The PDA measures the health of the generator stator. The two most recent PDA results for Unit 3 indicate extremely poor condition; therefore the unit needs to be analyzed every 6 months. To analyze the unit, it has to be running at or near the 1% upper limit for approximately 4 hours. It takes about 15 minutes to connect the computer to the test points and gather the PDA data. All PDA data will be taken during spring runoff (May 1–31) when running all the units will be in accordance with FPP unit priority (see Lower Monumental Dam **Table LMN-5**). In November, Unit 3 needs to be tested and run, possibly out of the FPP unit priority order for about 4.5 hours.

9.1.6. Long-Term (Bi-Monthly): 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 brief unit outages throughout the year while transporting rebuilt gates from the turbine units to the repair pit and vice versa. Each swap will take 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 no special operations outside the Fish Passage Plan are expected, but it may cause an occasional outage on a priority unit.

9.1.7. Bridge Inspections. The next round of Bridge inspections is scheduled for 2014. Bridges as appurtenance structures to the dam are inspected every two years based on the Federal DOT Bridge Inspection Program. Those Bridges include the spillway road way deck bridges and the spillway gate trunnion pedestrian bridges, the Navigation lock downstream Bridge, and the south shore project access Bridges, and upstream construction facility Bridge. Inspections require using a boat to inspect under the bridge in the spillway forebay or the use of a snooper truck from the road way deck. No underwater inspection of piers will be accomplished. Inspection of the spillway bridges will be attempted to be accomplished before the spill season.

9.2. Lower Granite Dam Studies.

9.2.1. March 2014–March 2015: Adult Salmon Study. A study of adult salmon passage in the Lower Columbia River is planned for the 2014 adult passage season using salmon tagged at the Bonneville Dam Adult Fish Facility (AFF) and includes passage and fate through the Lower Snake River. Salmon and steelhead will be collected, tagged with radio-telemetry transmitters and/or PIT-tags, and released below Bonneville Dam (see BON section **2.2.1.** above). Installation and maintenance of any new radio-telemetry antennas or receivers will be completed in March–April 2014 for detecting adult fish tagged at the Bonneville AFF and adult lamprey tagged for the Lower Snake River radio-tracking study. There is no Lower Snake River adult spring Chinook salmon study from Ice Harbor Dam planned for 2014.

From July through September, adult steelhead will be collected from the Lower Granite adult trap by a contractor for radio-tagging.

9.2.2. April–June 2014: Evaluation of Prototype Overflow Weir and 14-inch Orifice for the Lower Granite Juvenile Bypass System Upgrade. The prototype overflow weir and enlarged 14” orifice that were installed into intake gatewell 5A in the winter 2012/13 will be evaluated for a variety of metrics including survival and travel time during April-June 2014. The following modifications will be made in winter 2013/14, prior to initiation of the 2014 study:

- **(a)** the broad-crested overflow weir that was installed in winter 2012/13 will be modified into a sharp-crested overflow weir;
- **(b)** the 14” orifice that was installed in winter 2012/13 will have a gatewell-side light ring installed;
- **(c)** a temporary in-channel PIT-tag detection system will be installed within the juvenile collection channel.

The 2014 biological testing period, approximately April 15 to June 20, is intended to coincide with peak fish out-migration periods, debris passage and water passage for juvenile spring and fall Chinook salmon, juvenile and adult steelhead and juvenile Pacific lamprey. Preliminary plans for a new Juvenile Fish Facility (JFF) at Lower Granite Dam include the use of the larger 14” orifices with the gatewell-side light ring for fish to pass from gatewells to the collection channel. Results of this study will be used to inform management decisions on final structural modifications and operational changes at Lower Granite Dam to optimize salmonid survival and passage, including determining whether installation of additional overflow weirs is warranted.

Final study plans during the test period will principally mimic the 2013 study plan, as coordinated with RCC and Lower Granite project staff for implementation. In order to conduct

the necessary biological testing, deviations from the standard turbine operating priority order defined in the Fish Passage Plan, Lower Granite Dam **Table LWG-5**, will be necessary in order to operate unit 5 during testing periods (see **Table LWG-5** below with testing priority order).

Unit 2 will remain the first priority unit during the test period to provide fish ladder attraction flow. If low inflow occurs, Unit 1 will be prioritized to provide fish ladder attraction flow. There will be no changes to spill or spill patterns for this study. From April 15–June 30, 2014, unit 5 will be operated at the upper end of the 1% range, or at an alternative fixed discharge if possible, during each test block to provide consistent testing conditions. Based on historical river flow, it is likely that sufficient inflow will permit operation of unit 5 for this test through June 30. Final unit operations will be dictated by final study plans (i.e., days per week) and will be coordinated with RCC and Lower Granite Dam project staff.

Table LWG-1. Lower Granite Dam Turbine Unit Operating Priority Order.

Season	Duration	Unit Priority
March 1 – December 15 Fish Passage Season	Start Units	2, 3, then 4-6 any order, then 1 [a]
	Stop Units [b]	4-6 any order, then 3, 2, 1 [b]
April 15 – June 30 Study of Unit 5 Prototype Bypass Structures [c]	Start Units	2, 5, 3, then 4 or 6 any order, then 1 [a]
	Stop Units [b]	4 or 6 any order, then 3, 5, 2, 1 [b]
December 16 – February 28 Winter Maintenance Season	Stop/Start Units	Any Order

a. Unit 1 has fixed Kaplan blades (non-adjustable) and can only operate in the upper 1% range. The priority order minimizes Unit 1 starts/stops and allows for the longest runtime once Unit 1 is started.

b. Stop units in reverse Start order, except run Unit 1 as long as BPA load request and required spill rate can be met.

c. From April 15–June 30, 2014, unit 5 will be operated at the upper end of the 1% range, or at an alternative fixed discharge if possible, during each test block to provide consistent testing conditions.

9.2.3. Kelt Reconditioning, Transport and In-River Survival. Provide assistance to Nez Perce Tribe for collection of post-spawn steelhead (kelt) off the Lower Granite separator for their reconditioning program. Depending on flow conditions, separator technicians will collect a similar number of A-run and B-run kelt for transfer to CRITFC/NPT researchers at Dworshak Dam reconditioning facilities (about 400 kelt) with remaining kelt PIT-tagged for direct release into the tailwaters (about 1,200-1,400 kelt) and limited release into gatewell 5A as part of the evaluation of prototype overflow weirs and enlarged 14" orifice (see section **9.2.2.** above).

9.2.4. May–October 2014: Adult Lamprey Study. A study of Snake River adult lamprey passage is planned for the 2014 adult passage season. The primary goals of the research are to determine fish ladder entrance preferences, migration timing through the ladders, turn-around points in the ladders, fallback rates, and conversion rates between the Lower Snake River dams. Lamprey will be captured and tagged with radio tags and half-duplex PIT-tags at John Day Dam, transported for release below Ice Harbor Dam, and monitored at the four Lower Snake River projects. Radio-telemetry equipment is in place from the adult salmon passage studies and some

additional arrays will be needed in the adult fish ladders in the vicinity of transition or turn pools. Installation and maintenance of radio-telemetry equipment will be completed in May–June prior to the adult lamprey migration season. Access to antennas and receivers for downloading and maintenance will be needed from May through October.

9.2.5. June–October 2014: Adult Pacific Lamprey Passage Success. This study will evaluate passage success for adult Pacific lamprey, *Entosphenus tridentatus*, at McNary Dam, the four Lower Snake River dams, and associated river segments using half-duplex (HD) PIT-tag systems. This study will require Project support to provide power for electronics and access for downloading data from the PIT-tag detection equipment. Maintenance of equipment will occur during the winter maintenance period when adult fishways are dewatered.

9.2.6. July 2014 – January 2015: Juvenile Fish Bypass System Upgrade Construction. Starting in July 2014, construction activities associated with the Lower Granite Dam fish bypass system upgrade will include the plugging of the fish screen slots and Wagner Horns. The construction project will occur during scheduled turbine unit outages for annual maintenance. Following placement of the plugs, the slots will be dipped to remove all fish prior to the placement of Tremie concrete. Fish removed from the slots will be transported below the dam and released. Fish salvage operations will be coordinated with Project Fisheries and SMP staff. This operation has been coordinated with the region via FPOM as described in Memorandum of Coordination (MOC) **13 LWG 22**. The fish screen slot and Wagner Horn plugs are anticipated to be completed by January 2015.

Appendix B

Corps of Engineers Juvenile Fish Transportation Plan (JFTP) [1]

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1. If any provisions herein conflict with the current Corps' Fish Operations Plan (FOP; included in the Fish Passage Plan as **Appendix E**), the latter shall prevail.

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 and Lower Monumental dams (collector dams) to release areas below Bonneville Dam. The JFTP supplements operating criteria presented in the project-specific sections of the current Fish Passage Plan (FPP), available online at: http://www.nwd-wc.usace.army.mil/tmt/documents/fpp/.

The JFTP is conducted by the Corps of Engineers' Walla Walla District (CENWW) under Endangered Species Act (ESA) Section 7 (a)(2) consultation as an integral component for Federal Columbia River Power System (FCRPS) under Reasonable and Prudent Alternatives (RPA) Actions 30 and 31; Section 3.3.3.4. From 1992 to 2013, this activity was implemented under 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 and Lower Monumental 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:

(i) Providing safe and efficient collection and barge or truck transport of juvenile salmon and steelhead from collector dams to release areas below Bonneville Dam;

(ii) Identifying and recommending programs or facility changes that would benefit fish collection and transportation or bypass operations;

(iii) Assuring that collection, transport, and release site facilities are ready for operation prior to the beginning of transport operations;

(iv) Assuring that collection, transport, and release site facilities are properly maintained throughout the transport season;

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

(vi) Coordinating changes needed to accommodate fluctuations in the outmigration with projects, NOAA Fisheries, PSMFC, FPOM, and TMT personnel;

(vii) Coordinating transport evaluation and other research with the transportation program;

(viii) Providing the training of new personnel associated with collection and transport facilities and equipment;

(ix) 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;

(x) Preparing annual reports detailing transportation activities and results for the previous year, and identifying maintenance, replacement, or modifications needed for the next transport season.

3. PROGRAM DURATION

3.1. Starting Operations.

3.1.1. Consistent with the Fish Operations Plan (FOP; included in FPP as **Appendix E**) and guidance provided by the Regional Implementation Oversight Group (RIOG), the best transport operation for fish will be determined upon review of data on fish survival, adult returns, current in-river conditions and water supply forecast each year. TMT will review transport studies annually and provide an annual recommendation to CENWW on how to operate the juvenile transport program to achieve the goal of transporting approximately 50% of juvenile steelhead.

3.1.2. Planning dates to initiate juvenile transport at Lower Granite Dam will be April 21 to April 25, unless the Corps adopts a recommendation by TMT that proposes a later start date (no later than May 1) and accompanying alternative operation in their annual recommendation to achieve the goal of transporting approximately 50% of juvenile steelhead.

3.1.3. Transport at Little Goose and Lower Monumental will begin up to 4 days and up to 7 days, respectively, after the Lower Granite start date.

3.2. Summer Transport Operations.

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 are below 500 fish per day (per PSMFC sampling guidelines) and smaller pick-up mounted transport tanks may be used. Steelhead that are determined by State biologists to be in poor condition or reverting to the parr stage may be bypassed to the river.

3.3. Ending Operations.

Transport operations are anticipated to continue through approximately September 30 at Lower Monumental and through October 31 at Lower Granite and Little Goose.

3.4. 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

4.1. 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:

4.1.1. 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.

4.1.2. 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.

4.1.3. 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.

4.2. Collection & 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.

4.2.1. Lower Granite, Little Goose, Lower Monumental: All juvenile fish collected, with the exception of those marked for in-river studies, shall be transported once transport operations begin (paragraph **3.1**.).

4.2.2. The collection of fish for transport will commence at 0700 hours on the agreed-to start dates at Lower Granite and Little Goose dams. The collection of fish at Lower Monumental Dam will begin at 1500 hours on the agreed-to start date. Barging of fish will begin the following day and collected juvenile fish will be transported by barge 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.

4.3. Collection Facility Operations.

4.3.1. Once transport operations begin, collection facilities will be staffed 24 hours per day until transport operations cease.

4.3.2. Flows and fish passage at juvenile fish separators will be monitored at least every 15 minutes throughout separator operations.

4.3.3. 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, and then notify CENWW as soon as possible. The CENWW Transportation Coordinator will coordinate changes with NOAA Fisheries and TMT.

4.3.4. Fish collection numbers at Lower Granite, Little Goose, and Lower Monumental dams may exceed facility and barge capacities for short periods of time. This is most likely to happen during low flow years when the project is not spilling. During low flow years when there is no spill, CENWW will coordinate with RCC at the beginning of the transport season for permission to spill if a facility appears to be exceeding its carrying capacity. During low flow years, <u>if it appears that holding capacity may be exceeded on a given day</u>, the project biologist shall immediately inform CENWW. The project biologist will report the hourly fish collection numbers, barge arrival time or holding capabilities, along with facility descaling and mortality information. The CENWW Transportation Coordinator shall promptly coordinate this information with RCC and NOAA Fisheries. Spill through the RSW/spillway at the affected project may be requested if it appears that holding capacity will be exceeded or fish condition information indicates that spill passage is a better passage route than bypassing through the facility. If it is determined that the best course of action is to spill, spill operations shall begin prior to the facility reaching its holding capacity (around when the eighth of 10 raceways is filled). Spill may continue until holding capacity becomes available or fish condition improves.

4.3.5. To avoid attracting predatory birds, mortalities should be returned to the river at night if deemed necessary by the project biologist.

4.3.6. At Little Goose and Lower Monumental dams, lamprey-friendly tailscreens will be installed for the entire fish collection season. Fishery staff at these projects have never observed salmon fry being impinged on these screens. At Lower Granite Dam, lamprey-friendly tailscreens will be installed as needed at the discretion of Project Biologists based on the presence of lamprey in the raceways, while considering the risk of impingement of salmon fry on the lamprey friendly tailscreens. Project biologists will switch back to salmon-criteria screens at the first sign of impingement of salmon fry on the lamprey-friendly tailscreens or when there are fry observed in the sample. The salmon-criteria screens will be left in place until salmon fry are no longer present in the sample.

4.3.7. 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 and put in a container with water and later returned to the river.

4.4. Sampling Procedures.

4.4.1. 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.

4.4.2. Sampled fish will be counted by electronic counting tunnels, then verified and adjusted by manual counts. All estimates of fish numbers, rates and loading densities in raceways, trucks, and barges will be based on a sample of collected fish. Samples will be taken hourly 24 hours/day at sample rates set by project biologists as coordinated with SMP personnel.

4.4.3. 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.

4.4.4. Where SMP activities are conducted at collector dams, project biologists may utilize daily total information gathered by those personnel.

4.5. Loading Criteria.

4.5.1. Raceway Capacity: Maximum raceway capacity is 0.5 pounds (lbs) of fish per 1 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. Individual raceway

volume is approximately 12,000 gallons of water at Lower Granite and Little Goose, and 24,000 gallons at Lower Monumental. The 0.5 lbs/gallon criterion shall not be exceeded without CENWW review and approval through coordination with NOAA Fisheries and TMT. Project biologists will provide the following information to the CENWW Transportation Coordinator to inform the joint decision whether to exceed capacity criteria or to bypass fish to the river:

(i) species composition;

(ii) total anticipated collection during the critical holding period;

(iii) in-river fish passage conditions; and

(iv) fish condition.

4.5.2. Raceway Distribution: Collected fish will be distributed among available raceways in a manner that minimizes crowding, stress and risk of disease transmission. Additional fish will 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 separate raceways from large fish.

4.5.3. Raceway Holding Time: Maximum raceway holding time is 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.

4.5.4. Truck & Barge Capacity: Maximum loading capacity is 5 lbs of fish per 1 gpm inflow for barges, and 0.5 lbs per 1 gallon of water for trucks (**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

4.6. Summer Transport Operations.

4.6.1. During the summer, all fish collected will be routed to 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 necessary.

4.6.2. All collected fish may be routed to sample tanks when fish numbers drop to an acceptable handling level. At that time, all collected fish will be handled as part of the daily

sample per smolt monitoring program guidelines (see **Appendix J**). To minimize handling stress, facility samples may be processed every other day. When large trucks are used, fish may be loaded from either 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.

4.6.3. 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, joint fish transportation between 2 or more operating projects, or prioritize transport/bypass operations between the projects.

4.6.4. When water temperatures are above 68^0F, all personnel handling fish shall take extra care to minimize stress and other impacts on fish.

4.7. Facility and Equipment Logbooks, Records and Reports.

To document and transportation activities at Snake River collector dams, the following items will be logged t each dam by either project personnel or state biologists:

4.7.1. 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.

4.7.2. Truck & Barge Logbooks: Each truck and barge shall have a logbook to record fish loading rates, fish condition, estimated mortality, release site, 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.

4.7.3. Weekly Reports: Contracted 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 to inform consultations with NOAA Fisheries on the status of project operations. Contract biologists shall distribute the weekly reports to other regionally interested parties as directed by the CENWW Transportation Coordinator.

5. TRANSPORT OPERATIONS

5.1. Truck Operations.

5.1.1. Trucks. 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. Trucks may be redistributed to meet transport demands and when smaller transport vehicles begin operating in late summer.

5.1.2. 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.

5.1.3. 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.

5.1.4. 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.

5.2. Barge Operations.

5.2.1. Barges: Eight fish barges and four towboats will be available for use.

5.2.2. 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 RIOG. 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 Section 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.

5.2.3. Barge Loading: Whenever possible, small and large fish will be loaded in separate compartments in barges.

5.2.4. 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.

5.2.5. 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.

5.2.6. 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

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.

In the event of an emergency (e.g., 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.

A complete listing of persons to be notified in case of emergencies with business and home phone 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 phone 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 & RESPONSIBILITIES

The fishery agencies provide biological assistance at collector dams for transportation. CENWW contracts for fish biologists to work at each collector facility. Contracts specify that state agency personnel at collector dams accomplish specific tasks for the Corps, including:

(i) Reviewing or conducting handling, inspection, and recording of data from fish sampled at the collection facility;

(ii) Evaluating and recording fish condition, and recommending operational changes or inspection of facilities if fish condition indicates a problem;

(iii) 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 PSMFC Smolt Monitoring Program counts where appropriate;

(iv) Conducting quality control inspections of collection facilities and transport equipment including visits to other collection facilities when work schedules allow;

(v) 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;

(vi) Participating in gatewell dipping as required to monitor fish condition;

(vii) Preparing weekly reports summarizing fish numbers and transport activities, and;

(viii) Preparing accurate text and tabular data in correct format for project annual reports.

8. REPORTING

8.1. Daily Reports.

Project biologists or contract 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.

8.2. Weekly Reports.

Contract 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. Corps biologists shall provide the reports to interested parties within the region.

9. REQUIREMENTS FOR FISHERY AGENCY ACTIVITIES AND RESEARCH

9.1. Coordination.

9.1.1. Agencies and tribes requesting to work at Corps dams will provide early coordination including work proposals, evidence of CBFWA approval, copies of ESA permits, and project needs and requirements through written correspondence to CENWW, Operations Division Chief. Work shall not start until written approval is received. The Corps expects the PSMFC to coordinate Smolt Monitoring Program sampling guidelines with the Corps annually.

9.2. Protocol.

9.2.1. 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:

(i) Have agency picture identification and present it to project security on arrival;

(i) 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;

(ii) 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;

(iii) 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*.;

(iv) Notify the Operations Manager or his/her representative of unscheduled or non-routine work and activities, and;

(v) 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 & Peak Efficiency

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1. INTRODUCTION

Out-migrating juvenile salmonids have several potential routes of passage past hydroelectric dams on the mainstem Columbia and Snake rivers, including turbines, mechanical bypass, sluiceways and spillways. Fish passage survival varies depending on the route of passage. As a result of reported higher mortality rates for fish passage through turbines (Iwamoto and Williams 1993), regional efforts have 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, thus efforts to minimize turbine-related mortality is a priority of 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 peak efficiency at a given head during periods of peak fish passage to minimize fish mortality.

2. TURBINE EFFICIENCY

For the purposes of this document, peak turbine efficiency operation shall be based on tables of operating ranges within ±1% of peak efficiency (1% range) provided by the Corps for each project in the Fish Passage Plan (FPP). The Corps shall ensure that the 1% ranges are based on the best available information and that updates are coordinated with BPA, the Fish Passage Operation and Maintenance (FPOM) Coordination Team, 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

3.1. Objective.

To reduce mortality of out-migrating juvenile salmonids, BPA will provide the Corps hydrosystem projects with generation requests that allow turbines at the Lower Snake (LSN) and Lower Columbia (LCOL) projects to operate within ±1% of peak turbine efficiency (1% range), or as otherwise specified, during the Peak Efficiency Operating Period of April 1 through October 31, in accordance with the guidelines below.

3.2. In-Season Peak Efficiency Operating Period (April 1–October 31).

During this period, 24 hours/day, BPA will maintain generation requests at all Lower Columbia (LCOL) and Lower Snake (LSN) hydroelectric projects to allow turbines to operate within the 1% range in accordance with these guidelines. Excursion outside of the 1% range during this period will be tracked using the codes in **Table C-1**.

3.3. Off-Season (November 1–March 31).

While not required to do so during the off-season, turbines will normally run within the 1% range since it is the optimum point for maximizing energy output of a given unit of water over time. Operation outside the 1% range 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 FPP for *Turbine Unit Operation & Maintenance*. There are no reporting requirements for this period.

3.4. Unit Priorities.

The Corps should make every effort to adhere to 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 peak 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 peak 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.

3.5. Project Priorities.

If units must be operated out of the 1% peak efficiency range, BPA will make every effort to assure that generation requests to 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).

3.6. Coordination.

Coordination will occur through existing interagency 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 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 the 1% range for limitations listed in paragraphs **4.1** (*System Reliability*) and **4.2** (*Routine Starting*) are at the discretion of BPA and the Corps. BPA and the Corps will coordinate with NOAA Fisheries when operation of turbines outside of the 1% range may be appropriate under provisions in section 4 below. Additional coordination may also occur during the next scheduled TMT meeting.

Emergency situations described in **4.1** (*System Reliability*) that require an immediate change in FCRPS operation will be coordinated directly by the Action Agencies with NOAA Fisheries as soon as practicable. If coordination of an emergency change in FCRPS operation cannot be completed immediately, information will be supplied to TMT as soon as practicable. The Action Agencies shall establish points of contact with the appropriate agencies to allow such emergency coordination to occur.

3.7. 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 1% range.

4. IN-SEASON LIMITATIONS (APRIL 1 – OCTOBER 31)

Occurrence of the conditions described below may limit the ability of the Action Agencies to operate turbines continuously within the 1% peak efficiency range.

4.1. System Reliability.

BPA's ability to operate the power system in a manner that enables the Corps to maximize operation of turbines within the1% 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 BiOP operations for system reliability, BPA will provide an automated e-mail to the Corps. For longer term emergencies, see the current Water Management Plan Appendix 1 (*Emergency Protocols*).

System response criteria and margin of resource generation are defined in the following documents: *Reliability Criteria for Operations (BPA), Northwest Power Pool Operating Manual*, *Western Systems Coordinating Council Operations Committee Handbook*, and *North American Electric Reliability Council Operating Manual*. 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 the 1% range as a consequence of prudent utility operation for control of short-term system dynamics include:

(i) 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.

(ii) Deliberate dropping of generation (i.e., instantaneous interruption of output) to preserve system integrity. This dropping could cause a brief excursion.

4.2. Routine Starts and Stops.

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).

Operations in sections 4.3–4.8 will include notification to NOAA Fisheries at least 2 working days before implementation to allow sufficient time to evaluate effects of proposed actions (non-emergency situations).

4.3. Total Dissolved Gas (TDG) Supersaturation.

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. Peak 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 3.5 (*Coordination*).

4.4. Coordinated Fishery Operations.

In the event that coordinated fishery operations and approved fish research are not in accord with operating turbines in 1% ranges, operational modifications will be coordinated through processes outlined in paragraph 3.5 (*Coordination*).

4.5. Flow Augmentation Operations.

Flow augmentation requests for flows at McNary (MCN) are primarily met by water releases from GCL. The decision on whether to use GCL flexibility to provide MCN inflows 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 coordination processes outlined in paragraph 3.5 (*Coordination*). The TMT flow augmentation requests may exceed the 1% range at LCOL/LSN projects. Meeting this flow request will take precedence over 1% operations.

4.6. Transport Projects.

Resolution of the conflict between spill management and turbine operation within 1% ranges at transport projects during the transport season shall be determined through the coordination process outlined in 3.5., and in accordance with 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.

4.7. Routine Maintenance and Testing.

All units at all projects must undergo maintenance and associated testing. The testing necessitates deviation from the 1% ranges for periods of 15 minutes to 8 hours. Scheduling of maintenance testing will be coordinated through the process outlined in paragraph 3.5. to ensure that it is conducted during times of low fish passage within a day to minimize impacts on fish.

4.8. Flood Control.

The FCRPS provides multiple regional benefits and 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% ranges may be modified or suspended based on the Corps' direction. Allowing excursions outside the 1% ranges for flood control operations would facilitate transportation, reduce excessive TDG levels, and lower the risk of gas bubble disease in fish. Coordination of flood control operations will occur as outlined in paragraph 3.5 (*Coordination*). See also paragraphs 4.3 (TDG) and 3.6 (*Grand Coulee and Chief Joseph Flexibility*).

4.9. Other.

In the event that the excursion was not explainable or caused by human error.

5. QUALITY CONTROL

Significant deviations outside of the 1% range 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:

(i) exceed 15 minutes in duration; and/or

(ii) occur 5 or more times exceeding 5 minutes within 1 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 C-1**. 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% range, the date and length of time of the excursion, will be provided by the appropriate parties. For the report, the following numerical codes will be used to explain excursions outside the 1% 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 the 1% Peak Efficiency Range.

Code	Reason
1	Equipment reporting errors, including lack of data (GDAC or AGC not operating correctly and not recording readings, dead-band and precision issues, etc.)
2	Modified spill operations in support of BiOp or court order (requested flow augmentation, coordinated fish operation)
3	O&M requirements (fish screen inspection, trash raking, Doble testing, dam safety, etc.)
4	Operational tests (index testing, testing or calibrating new or repaired equipment)
5	BPA requested operation (request operation via AGC)
6	Turbine start-up or stops longer than 5 minutes
7	Emergency conditions or system failures, including transmission system emergencies, remedial action schemes (RAS), or others as described in 4.1. *System Reliability*.
8	Fish research
9	Human error
10	Unknown causes
11	Other (Please specify)
12	Flood control
13	TDG reduction

Appendix D

Operations for Non-Listed Species (Lamprey, etc.)

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1. INTRODUCTION

This Appendix describes special operations that are implemented for lamprey and other non-listed fish species that may pass a project via the juvenile or adult passage facilities. These operations are regionally coordinated with the Fish Passage Operations & Maintenance (FPOM) workgroup and supplement operations for ESA-listed salmonids described in the current Fish Passage Plan (FPP), available online at: http://www.nwd-wc.usace.army.mil/tmt/documents/fpp/.

2. BONNEVILLE DAM OPERATING PROTOCOLS FOR LAMPREY

2.1. Lamprey Passage Improvements.

Several adult lamprey passage improvements have been made to Bonneville Dam fish ladders, including:

2.1.1. Bradford Island: In 2004, a Lamprey Passage System (LPS) was installed to the FV 3-9 AWS channel and then expanded with PIT-tag detection in 2006. In 2011, counting improvements, including video verification at the exit flume and 1" picket lead spacers were added. In 2012, these spacers were upgraded and improved to insure sufficient lamprey passage while not interfering with adult salmonid passage. In 2014, NOAA Fisheries installed a picket lead sill ramp and ¾" spaced picket leads in the crowder slot. The remaining picket leads were raised with new spacers to 1.5" off the sill.

2.1.2. Cascades Island: In 2006, half-duplex PIT-tag detectors were installed along the picket leads to help track lamprey. In 2009, an LPS was installed, complete with a bollard floor guidance path and a variable-width entrance weir. In 2013, the LPS was extended to allow fully volitional passage to the forebay with PIT-tag detection and video verification at the new exit, adjacent to FV 5-9.

2.1.3. Washington Shore: In 2001, guidance plates were installed over the diffuser grates. In 2005, a lamprey ramp and trap box were installed at the North Downstream Entrance (NDE). In 2008, an LPS was added to the FV 6-9 AWS channel, similar to the LPS at the Bradford Island FV 3-9 AWS. In 2010, 1" picket lead spacers were installed to provide lamprey passage under the leads. In 2011, NOAA Fisheries installed a picket lead sill ramp as well as ¾" crowder picket leads in the crowder slot. In 2013, the picket lead spacers were modified to provide a 1.5" gap off the sill. Additionally, the NDE lamprey trap was removed and replaced with a Lamprey Flume System (LFS) for attraction and guidance from the NDE area to an LPS that terminates in a trap box on the +55 deck.

Beginning in 2010, Fish Unit output is reduced during nighttime hours from June 1 through August 31 (lamprey passage season) to operate the Washington Shore ladder entrances at 0.5 feet of project head to encourage lamprey to enter the ladder. This operation is also described in the FPP Bonneville Dam section **2.5.4**.

2.2. Adult Lamprey Passage Facilities Description.

2.2.1. Powerhouse One (PH1): At the Bradford Island ladder, the FV 3-9 AWS channel is equipped with a LPS that allows lamprey to bypass the serpentine section of the fish ladder and exit directly into the forebay adjacent to the ladder exit. The picket leads that block passage of adult salmonids into the AWS channel are raised 1" off the ladder floor, allowing lamprey to pass under the leads and into the AWS channel.

2.2.2. Spillway. The Cascades Island fish ladder entrance is equipped with a variable-width weir entrance gate. This entrance is coupled with a bollard field on the floor of the ladder, leading to a LPS located in the entrance bay. This LPS bypasses the overflow weirs and provides a direct route to the forebay. This LPS is currently being converted into a fully volitional passage route with an exit directly into the forebay, adjacent to the Cascades Island fish ladder exit**.**

2.2.3. Powerhouse Two (PH2). The Washington Shore ladder FV 6-9 AWS channel is equipped with an LPS that allows lamprey to bypass the serpentine section of the ladder and exit directly into the exit channel of the ladder. The picket leads that block passage of adult salmonids into the AWS channel are raised 1.5" off the ladder floor, allowing lamprey to pass under the leads and into the AWS channel.

2.3. Adult Lamprey Migration Timing and Counting.

2.3.1. Adult lamprey migration season at Bonneville Dam is March 1–November 30 with the majority of the run passing in June and July. LPS maintenance is scheduled for December 1 through the end of February.

2.3.2. Adult lamprey counting is conducted in conjunction with other adult fish counting. Counting hours and visual/video counting periods are shown in the FPP in **Table BON-2.** In addition to count window operations, each volitional passage LPS is equipped with a mechanical counting system and video verification in the exit sections.

2.4. Lamprey Passage System (LPS) Operation & Maintenance.

2.4.1. General. Maintain adequate water depth for lamprey passage in all LPS flumes.

2.4.2. Dewatering. When adult lamprey are recovered during dewaterings, they will be transported and released into the Bonneville forebay whenever possible. Fish recovered during dewaterings, including lamprey, will not be held for other uses.

2.4.3. Cleaning Criteria. When water levels in an LPS flume drop below the required level, the water supply pump intakes must be cleaned and debris removed.

2.4.4. Trapping. All LPSs are designed for volitional passage; however, LPSs may be temporarily set up with a trap box at the terminus while new potential locations are tested for usage by fish. These trap boxes are operated solely by research groups who are responsible for monitoring, handling, and transportation of lamprey from the boxes.

2.4.5. Water Temperature. Temperatures will be monitored in each LPS. 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. Fish handling activities in the Adult Fish Facility (AFF) will implement protocols in **Appendix G**.

2.4.6. Winter Maintenance Season. From December 1 through the end of February, LPS maintenance will be scheduled, including: remove and winterize water supply pumps; inspect all pumps and repair/replace where necessary; power spray flumes and rest boxes to remove excessive algal growth and any debris; inspect all joints and re-caulk where necessary.

3. THE DALLES DAM OPERATING PROTOCOLS FOR LAMPREY

3.1. Adult Lamprey.

Passage improvements were made in the east fish ladder by installing 4 orifice ramps to eliminate 90° edges. Several concrete 90°s were also rounded with 2” radius. Picket leads were raised 1.5” for both north and east count stations. Steel plates were installed in the lower 14 weir orifices for lamprey attachment substrate.

3.2. Juvenile Lamprey.

Data are being collected in the powerhouse turbine cooling water strainers for informational purposes. These data will not be available as the strainers are now being replaced with self-cleaning mechanisms.

3.3. Dewatering Collections.

Lamprey are collected and returned to the forebay during fishway dewaterings. Tribal restocking efforts collect lamprey from some dewaterings. These lamprey are held for no longer than 10 hours.

4. JOHN DAY DAM OPERATING PROTOCOLS FOR LAMPREY

In the winter of 2013, an adult lamprey trap was installed behind the count station picketed leads of John Day Dam’s south fish ladder. The following protocols will be implemented by agencies operating this trap. These protocols will be coordinated with fish agencies and tribes through the Fish Passage Operation and Maintenance Coordination Team (FPOM). The purpose of these protocols is to provide safe access for personnel and measures to limit handling stress to lamprey and reduce impact to salmonids migrating past the John Day South Ladder Lamprey Trap.

4.1. General Facility Protocols.

4.1.1. Users must have appropriate documentation for conducting research at the dam. This includes valid state transportation permits and federal or tribal permits that cover species targeted 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 the more restrictive directive. The U.S. Army Corps of Engineers (Corps) reserves the right to terminate trapping operations at any time.

4.1.2. 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 when operating the trap.

4.1.3. Users will be trained in the proper operation of the jib crane and hoist to insure fish and personnel safety. Jib crane and hoist training is required prior to operating this equipment. Currently the John Day Project Safety Office in conjunction with Project rigging crew have offered to provide training. Users may request training through the John Day Project Biologists.

4.1.4. Undesired fish will be released back into the fish ladder. In the unfortunate event of mortalities, see reporting requirements below.

4.1.5. Researchers shall perform no maintenance on Corps owned/installed equipment. Please contact the on shift project biologist or biotech to alert them of any problems.

4.1.6. Users must use a cotton mesh net or water retaining refuge net large enough to safely handle the largest fish passing the project during the trapping period.

4.1.7. Fish ladder water temperatures should be measured and recorded upon arrival and departure. Transport water should be within 2°F of the fish ladder water temperature and provided with aeration or oxygenation when needed.

4.1.8. Upper Thermal Limit. Currently there is no published literature to guide the determination of an appropriate upper temperature limit, above which the trap should not be operated. Trapping data for John Day Dam from 2008-2012 (Aaron Jackson, CTUIR) indicated a mean mortality rate of 0.8% within the temperature range of 14.8–22.8°C (58.6–73.0°F) and no relation between mortality and water temperature (WQM tailrace). Therefore, there is a need for trap operators to collect additional water temperature and mortality data to inform the determination of upper thermal limit.

4.2. Notification & Documentation

4.2.1. Users will sign in and out of at the project fisheries office and notify them when they set up and close down the trap.

4.2.2. Users will record the times the trap is lowered and raised and which agency they are representing on the sheet provided by the project biologists.

4.2.3. Lamprey may be held up to 48 hours in the juvenile fish facility. Researchers will notify Project Fisheries and the Control Room whenever lamprey are held.

4.2.4. Users will scan all collected lamprey for full and half-duplex PIT tags and provide code information of previously-tagged animals to appropriate USACE personnel and interested parties. Because they are of research value, tagged fish must be returned to the fishway.

4.2.5. Any and all mortalities must be immediately reported to a Project Biologist. The Project Biologist will examine the mortality and should take photos and file a memorandum for the record (MFR). The researcher shall give a detailed report including:

(a) Species;
(b) Origin;
(c) Length (cm);
(d) Weight (g);
(e) Tags: recovery of radio or acoustic tags, scanning for full and half-duplex PIT-tags;
(f) Injuries;
(g) Cause and time of death or discovery;
(h) Future preventative measures.

4.2.6. All mortalities are included in the Project Fisheries weekly report and the reports are submitted to regional Fish Passage Operation and Maintenance (FPOM) group.

4.2.7. When trapping is completed for the season, users will properly shut down the trap. For example the basket should placed in pass through mode by removing the upstream side panel or removing the entire basket from the fishway.

5. NWW PROJECTS OPERATING PROTOCOLS FOR LAMPREY

5.1. Raceway Tailscreens.

5.1.1. By 2012, lamprey-friendly raceway tailscreens were installed at all of the juvenile fish facilities that collected for transportation (Lower Granite, Little Goose, Lower Monumental and McNary dams) to allow collected lamprey to be returned to the river rather than transported. The new tailscreen wire mesh diameter is 16.0 mm (0.063”) with an open width/height of 8.6 mm (0.337”), open diagonal dimension of 12.1 mm (0.477”) and overall screen open area of 71.0%.

5.1.2. Lower Monumental tested a perforated plate tailscreen that can be cleaned with brushes without entangling lamprey. The plate is $^{1}/_{4}$” thick with 0.312”x1.0” slots that are spaced $^{1}/_{4}$” apart oriented vertically in a side-staggered pattern. With consensus of regional partners, the remaining mesh tailscreens at Lower Monumental were replaced with these perforated plate tailscreens in the 2012-13 winter maintenance season.

5.2. McNary Dam.

5.2.1. Unit trash racks are raked during the winter maintenance period prior to January 15 to minimize the potential for lamprey entanglement in built-up debris when river flow increases.

5.2.2. ESBSs are installed and operating prior to April 16 (two weeks later than other NWW projects) to allow juvenile lamprey passage directly through turbines without bypass collection.

5.2.3. During lamprey passage season from June 15–September 30, the ladder entrance weirs at SFE and NFE are lowered to sill during nighttime hours (2100-0400) to reduce velocities and encourage lamprey entrance into the ladder. This operation has been implemented since 2010. During the 2013-14 winter maintenance period, a prototype structure designed for adult lamprey

passage will be installed at SFE 2. This structure will provide a deep-slot under the entrance weir gate with lower water velocities for lamprey. Consequently, the SFE2 weir will not need to be lowered to sill at night with the prototype structure in place.

5.2.4. During the 2009-10 winter maintenance period, horizontal slots were cut at the bottom of the stem walls in the upper section of the Oregon shore ladder to allow adult lamprey attachment along a level pathway through the weir. Plating was also attached on the diffuser gratings near the ladder walls to create a continuous path for lamprey attachment.

5.3. Other Improvements for Adult Lamprey.

5.3.1. During the 2011-12 winter maintenance period at Ice Harbor and Lower Monumental dams, improvements were made to the upper fish ladder weirs for adult lamprey, including:

> **5.3.1.(a)** Horizontal slots were cut into weirs at the floor to allow adult lamprey attachment along a level pathway through the weir.
>
> **5.3.1.(b)** Ramps were installed in the upper ladder weirs from the ladder floor to the bottom of elevated salmon orifices to assist lamprey in maintaining attachment as they maneuver through these areas.
>
> **5.3.1.(c)** Plates were installed on diffuser grating adjacent to orifices in the Ice Harbor north ladder to provide attachment surfaces for lamprey in higher-velocity areas.
>
> **5.3.1.(d)** Similar lamprey orifices and plating were installed in the Little Goose and Lower Granite ladders during the 2012-13 winter maintenance period. Three of the weirs at Lower Granite, which did not have lamprey orifices cut due to time constraints, will have the orifices cut during the 2013-14 winter maintenance period.

5.3.2. At all projects in 2011, picketed leads were raised and secured 1.5” off the ladder floor at the count stations to enable adult lamprey passage through a low-velocity passage route under the picketed leads around the adult fish count slot.

5.3.3. Fallback adult lamprey collected off fish separators and other areas of the juvenile fish facilities at Lower Monumental, Little Goose and Lower Granite are released into the forebay rather than being bypassed back into the tailrace or transported downstream.

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2014 Spring Fish Operations Plan

INTRODUCTION

The 2014 spring 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 2014 spring fish migration season[1]; generally April through at least June 1 at Snake River dams or through June 15 at Columbia River dams. The 2014 spring FOP is consistent with the spring spill operations and the adaptive management provisions in the 2014 NOAA Fisheries FCRPS Supplemental Biological Opinion (2014 Supplemental BiOp)[2] and the Corps' Record of Consultation and Statement of Decision (ROCASOD) adopting the project operations contained in the 2014 Supplemental BiOp and the Columbia Basin Fish Accords (Accords).

The 2014 spring FOP incorporates planned project operational adjustments necessary to conduct essential research to evaluate fish passage features during the 2014 migration season. Other FCRPS water management actions and project operations not specifically addressed in this document shall be consistent with the 2014 Supplemental BiOp and other guiding operative documents, including the 2014 Water Management Plan (WMP), seasonal WMP updates, and the 2014 Fish Passage Plan (FPP). Operations described herein are consistent with the 2014 Supplemental BiOp, including adjustments to address in-season developments through discussion and coordination with the regional sovereigns as provided for in the 2014 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.

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[1] The Corps will prepare a summer FOP to address summer operations.
[2] The 2014 Supplemental BiOp considered the Action Agencies' 2014-2018 Implementation Plan (2014-2018 IP) and incorporates both the 2008 NOAA BiOp and the 2010 Supplemental BiOp. References to the 2014 Supplemental BiOp also include, as appropriate, references to prior BiOps.

GENERAL CONSIDERATIONS FOR FISH OPERATIONS

For planning purposes, the Corps' 2014 spring 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 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.[3] 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 Table 2 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

[3] The 2014 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, but the State of Washington did not. The Corps will continue to manage to 120% and 115% (the Washington TDG standard) in 2014.

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% tailrace/115% forebay TDG limits, consistent with the respective Oregon and Washington TDG waiver and criteria adjustments.

Within any given day, some hours of measured TDG levels may be higher or lower than the gas caps due to changing environmental conditions (wind, air temperature, etc.). The process of establishing daily spill caps entails reviewing existing hourly data at each dam (including flow, spill, temperature, and TDG levels) and taking into consideration a number of forecast conditions (including total 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. 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 Table 2 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 Table 2 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 Table 2 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.

- 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 Table 2 may not always be attained due to low flow conditions and minimum generation requirements (Table 1), TDG 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 ±1% of best efficiency turbine operation tables and actual generation records when turbines were operating within ±1% of best efficiency (Table 1[4]). 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

[4] Table 1 was updated on March 27, 2014 using the current ±1% of best efficiency turbine operation tables along with recent actual generation data to determine minimum generation ranges.

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 Granite and Lower Monumental dams, however, turbine unit 1 (the first priority unit during fish passage) cannot operate at the low end of the design range because they have 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 Corps Hydropower Projects on the Lower Snake and Lower Columbia Rivers (revised March 27, 2014 - see footnotes).

Project	**Turbine Unit(s)**	**Minimum Generation Range (kcfs)[a]**	
		Lower	**Upper**
Lower Granite	1[b]	16.7	19.1
	2, 3	11.8	12.2
	4, 5, 6	13.7	14.8
Little Goose	1, 2, 3	11.3	11.8
	5[c]	16.2	17.3
	4, 6	13.8	14.4
Lower Monumental	1[b]	16.7	18.3
	2, 3	10.8	12.3
	4, 5, 6	14.1	14.9
Ice Harbor	1, 3	8.4	9.8
	2[d]	10.9	12.3
	4, 5, 6	9.4	10.6
McNary	N/A	50	60
John Day	N/A	50	60
The Dalles	N/A	50	60
Bonneville	N/A	30	40

a. Resulting flow (kcfs) through turbines is a function of power output (MW), turbine efficiency and project head. Except for fixed units noted below, *Lower* flow limit equates to minimum 1% lower limit in the 2014 Fish Passage Plan tables. *Upper* flow limit calculated from Upper MW value at lowest project head.
b. Unit 1 at both Lower Granite and Lower Monumental restricted to upper 1% range (125-130 MW) due to runner blades that are welded at a fixed angle (non-adjustable) to address linkage cracks from shear fatigue. Operation of these units is restricted to the upper 1% range until they are rehabilitated to fully adjustable Kaplans.
c. Little Goose Unit 5 operation restricted to upper 1% range due to vibration issues at operating points <120 MW.
d. Ice Harbor Unit 2 operation restricted to lower 1% range due to welded runner blades (non-adjustable).

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 Table 2. 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 Table 2 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 2014 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 2014, 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 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. As addressed in the 2014-2018 IP, 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 the 2014-2018 IP and considered in issuing the 2014 Supplemental BiOp[5].

[5] 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).

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. To improve survival of juvenile migrants, the 2014 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 juvenile fish transportation program operations at the Snake River collector projects in 2014. These operations will continue spill levels specified in Table 2 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.

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

To achieve the 2014 Supplemental BiOp goal of transporting about 50% of juvenile steelhead, transportation will be initiated at Lower Granite Dam no earlier than April 21 and no later than April 25, unless the Corps adopts a recommendation by TMT that proposes a later start date (no later than May 1) and accompanying alternative operation in their annual recommendation. 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). During the Corps' 2014 annual navigation lock maintenance outage, monitoring of existing cracks in the south downstream miter gate hinge at Little Goose Dam showed that the cracks had worsened. The navigation lock is currently out of service and it is estimated that the outage may continue until approximately May 1. With the lock out of service, 2014 Supplemental BiOp fish transportation operations scheduled to begin sometime in late April may be delayed. Coordination of fish transportation operations and related research will be addressed through BiOp adaptive management processes.

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.

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 at least June 1 according to the spring to summer spill transition criteria for Snake River dams as stated in 2014 Supplemental BiOp[6]. 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 15. Spring spill operations are shown in Table 2.

PROJECT BY PROJECT OPERATIONS

The following sections describe 2014 spring spill operations for each project. Included in the descriptions are planned research activities identified in the 2014 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 2014. 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.

[6] The spring to summer spill transition date at Lower Granite Dam will be based on a 95 percent passage of spring migrants and would occur no earlier than June 1. The transition date at Little Goose, Lower Monumental, and Ice Harbor dams will be staggered to factor for fish travel time from Lower Granite Dam to these dams. The stagger will be based on in-season river flow conditions and a calculation of water travel time between Lower Granite and the other dams.

Table 2.— Summary of 2014 spring spill levels at lower Snake and Columbia River projects.[7]

Project	Planned 2014 Spring Spill Operations (Day/Night)
Lower Granite	20 kcfs/20 kcfs
Little Goose	30%/30%
Lower Monumental	Gas Cap/Gas Cap (approximate Gas Cap range: 20-29 kcfs)
Ice Harbor	**April 3-April 28:** 45 kcfs/Gas Cap **April 28-June 1:** 30%/30% vs. 45 kcfs/Gas Cap (approximate Gas Cap range: 75-95 kcfs)
McNary	40%/40%
John Day	**Pre-test:** 30%/30% **Testing:** 30%/30% and 40%/40%
The Dalles	40%/40%
Bonneville	100 kcfs/100 kcfs

Lower Granite

Spring Spill Operations April 3 through at least June 1: 20 kcfs 24 hours per day.

Changes in Operations for Research Purposes:

- Research operations: There are no special spill operations for research planned in 2014. Established spill patterns as described in FPP Section 9 will be used.

Operational Considerations:

- 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 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.

[7] Table 2 summarizes the planned spring spill operations. More specific detail governing project operations is included in project specific sections.

Little Goose

Spring Spill Operations April 3 through at least June 1: 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.

Changes in Operations for Research Purposes:

- Research operations: There are no special spill operations for research planned in 2014. Established spill patterns as described in FPP Section 8 will be used.

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 (<38 kcfs), the full ±1% of best efficiency range will be restored to minimize impacts on spill levels.

Lower Monumental

Spring Spill Operations April 3 through at least June 1: Spill to the 115/120% gas cap 24 hours per day using the bulk spill pattern (see Operational Considerations).

Changes in Operations for Research Purposes:

Research operations: There are no special spill operations for research planned in 2014. Established spill patterns as described in FPP Section 7 will be used.

Operational Considerations:

- Consistent with adjustments made in 2013 spring operations through regional coordination, when total river flow is likely to exceed turbine capacity and spill over the 120% 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% 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 approximately 141 kcfs the gas cap will be exceeded.
- 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 at least June 1: Spill will begin at 45 kcfs day/gas cap night on April 3 and continue until April 28. On April 28, spill will alternate between 2-day blocks of 45 kcfs day/gas cap night and 30% /30% with the spillway weir operating and continue through the spring season. Nighttime spill hours are 1800–0500.

Changes in Operations for Research Purposes:

- Research operations: There are no special spill operations for research planned in 2014. 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.
- 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 June 15: 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 FPOM. 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 using the spill pattern identified in FPP Table MCN-10. Following removal of the spillway weirs, the spill pattern contained in Table MCN-9 in FPP section 5 will be used for the remainder of the spring.

Changes in Operations for Research Purposes:

- Research operations: Performance standard testing at 40% spill will occur in 2014 at McNary Dam. Testing will begin in late April and continue through May. 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 and juvenile steelhead to determine if juvenile dam survival at 40% spill under the current project configuration meets or exceeds the juvenile dam survival performance standard for spring (96%) migrants specified in the 2014 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.
- 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 15: 30% spill 24 hours per day will begin on April 10 and continue until the alternating two-treatment operation begins on approximately April 27. During the two-treatment operation, 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 2000 hours.

Changes in Operations for Research Purposes:

- Research operations: There are no special spill operations for research planned in 2014. Established spill patterns as described in FPP Section 4 will be used.

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 15: 40% spill 24 hours per day.

Changes in Operations for Research Purposes:

- Research operations: There are no special spill operations for research planned in 2014. Established spill patterns as described in FPP Section 3 will be used.

Operational Considerations:

- If total river flow is between 92 and 160 kcfs, the spill percentage could range from 38.6 to 41.4 percent or up to ±3 kcfs when operating to a gas cap spill level below the target 40 percent of total flow operation.
- 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 9, 10, 11, 13, 16, 18, 19, and 23 are operationally restricted due to wire rope, structural and concrete erosion concerns.
- The spill pattern in the FPP is based on a nominal forebay elevation at The Dalles Dam of 158.5 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.

Changes in Operations for Research Purposes:

- Research operations: There are no special spill operations for research planned in 2014. Established spill patterns as described in FPP Section 2 will be used.

Operational Considerations:

- 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 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 7, with marking beginning on April 8. 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, 4,000-6,000 wild steelhead, and 4000-6000 hatchery steelhead weekly for approximately eight weeks. As described above, the navigation lock outage at Little Goose Dam may delay the start of this research to as late as approximately May 1.

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/2014/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 2014 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/

Appendix F

Dewatering Guidelines & Fish Salvage Plans

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1. INTRODUCTION

1.1. Each Corps mainstem project on the Columbia and Snake rivers has dewatering and fish handling/salvage plans which describe 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 new information and guidelines listed below as coordinated by the Fish Passage Operations & Maintenance (FPOM) workgroup.

2. COORDINATION

2.1. The dewatering and fish handling/salvage plan for each project shall include coordination procedures for planned and emergency fish salvage activities. The Project Biologist shall coordinate all fish salvage activities with Project and District personnel.

3. DEWATERING & FISH HANDLING PERSONNEL

3.1. The plans shall specify the number and specialty of personnel required for each type of dewatering activity, including the Project Biologist, fisheries staff, crane operators, riggers, winch operators, forklift operators and maintenance workers. Adequate personnel must be available for fish salvage activities to avoid or minimize fish stress and mortality.

3.2. The plans shall include a requirement that *all participants* involved in a dewatering activity attend a fish salvage briefing prior to dewatering in order to define responsibilities for each participant.

3.3. All emergency fish salvage operations will be coordinated and overseen by the Project Biologist or fisheries staff if possible.

4. FACILITIES

4.1. Salvage plans shall be project-specific and contain step-by-step dewatering and fish salvaging procedures for all facilities and project features which may contain fish, most commonly the adult fish ladders and collection channels, juvenile bypass systems, juvenile fish sampling facilities, turbine unit scroll cases and draft tubes, gatewell slots and navigation locks. Individual projects may have other facilities or features that contain fish.

4.2. The plans shall specify how the facility is to be dewatered, where and how fish are to be salvaged, and the location of designated release sites for the various types of fish expected to be encountered during each dewatering activity.

4.3. Fish Safety Pools. The fish salvage plans shall identify areas for “safety pools” in each facility that 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

there is potential for the safety pools to freeze or lose their water source, the fish should be evacuated as soon as possible.

5. EQUIPMENT

5.1. The plans shall specify where equipment is required for use during a dewatering, where certain equipment should be pre-positioned before work begins, and any heavy equipment needed for fish salvage activities.

5.2. Fish Handling Equipment. The plans shall specify all fish handling equipment required during each type of dewatering activity, including gloves, hand-held fish nets, seines, fish buckets, gatewell dip baskets, and fish transport tanks and vehicles. All equipment should be in good condition and pre-positioned before dewatering begins.

5.3. Support Equipment. The plans shall include a detailed list of all support equipment required for each dewatering activity, including 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.

6. FISH HANDLING PROCEDURES

6.1. 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.

6.2. Plans shall specify the details of all fish handling activities including how to crowd and handle fish within each facility, specifics on the number of fish that can be hauled or transported in containers or transport tanks at varying water temperatures, and how and where to release fish at each project.

6.3. The plans should reflect the following general fish handling guidelines:

6.3.1. Adult salmonids and other large adult fish should be salvaged first.

6.3.2. Netting of fish should be minimized whenever possible.

6.3.3. Fish should not be crowded in the holding containers.

6.3.4. Fish will be less stressed in larger containers (≥ 300 gallons preferred), in colder water, and with supplemental oxygen or aeration.

6.3.5. If fish are transported in warmer water (>65° F), reduce fish loading density and holding times.

6.3.6. All fish will be returned to the river as soon as possible at predetermined release sites.

6.3.7. Fish should not be held in holding tanks or containers for more than two hours under any circumstances.

6.3.8. Fish should be released from the holding tanks into the river as soon as the fish salvage operation stops for any reason.

6.3.9. Fish should be carefully released into the tailwater or forebay with a short vertical drop to the river. Fish release slides are desirable.

6.3.10. Water temperature in the transport tank should be monitored and maintained within 2°F of the river water at the release site.

6.3.11. Fish should be removed prior to debris removal if possible.

7. FISH SALVAGE REPORT

7.1. The fish salvage plan should include a report template for fish salvage operations that should be completed for all fish salvage activities and kept permanently on file at each project.

Appendix G

Adult Fish Facility Operating Protocols at Bonneville, Ice Harbor and Lower Granite Dams

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1. BONNEVILLE DAM ADULT FISH FACILITY

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.

1.1. General Facility Protocols.

1.1.1. 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. Users shall comply with all fish handling conditions in the permits. *If permit conditions are more restrictive than the following protocols, users must follow permit conditions.*

1.1.2. The Corps reserves the right to terminate trapping operations at any time.

1.1.3. 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.

1.1.4. Bridge crane certification is required prior to operating the overhead crane. Training will not be provided by the Corps of Engineers.

1.1.5. 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.

1.1.6. Water temperatures should be observed upon arrival and periodically during the day.

1.1.7. 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.

1.1.8. Undesired fish will be bypassed to the return pool.

1.1.9. Researchers shall perform no maintenance on Corps owned/installed equipment. Nets may be mended as necessary.

1.1.10. 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.

1.1.11. 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.

1.1.12. Users must use a sanctuary net large enough to safely handle the largest fish passing the project during the trapping period.

1.1.13. Fish greater than 100 cm forklength 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.

1.2. Notification & Documentation.

1.2.1. Users will notify the control room when they set up and close down the lab.

1.2.2. 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.

1.2.3. Lamprey may be held up to 48 hours in the AFF. Researchers will notify Project Fisheries and the Control Room whenever lamprey are held.

1.2.4. 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.

1.2.5. All mortalities are included in Project Fisheries weekly reports submitted to FPOM.

1.3. Trapping Protocols – Ladder Water Temperatures <70°F.

1.3.1. There will be no start time restriction for trapping operations.

1.3.2. There will be no more than 4 Chinook, or 4 steelhead, or 6 sockeye, or any combination of 4 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.

1.3.3. There will be no more than two adult fish in any one observation tank at any one time. The brail pool is the primary and preferred recovery area.

1.3.3.1. Observation tanks will primarily be used for fish in "*distress*", defined as fish that have sustained injury during the trapping and sampling process; fish that have a previous injury (e.g., fish in "*fair*" or "*poor*" condition upon trapping due to marine mammal injuries or similar) fish that are showing symptoms of heavy sedation (e.g., diminishing gill movement, reduced gasp response when out of water).

1.3.3.2. Fish will be released from the observation tanks when they are in the state of "*Partial Equilibrium*," defined as: gilling normally, making weak tailing movements, cannot swim upright and swims off course without avoiding obstacles; fish will not strongly try to break free of handlers.

1.3.3.3. All fish in an observation tank must be continuously observed by a dedicated observer to ensure adult fish do not recover beyond partial equilibrium prior to return to the brail pool. No lid or restraining device shall be installed on top of the observation tanks.

1.3.3.4. Observation tanks may be used for study objectives such as monitoring recovery time from anesthetic, if approved by FPOM and USACE.

1.3.4. Anesthetic tank water 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. *If anesthetic tank water temperature exceeds 70°F, criteria in section 4 will go into effect.*

1.3.5. Water in the observation tanks will be running continuously to allow a constant exchange of water through the tank.

1.3.6. 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.

1.3.7. 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.

1.3.8. When trapping is completed for the day, users will properly shut down the lab.

1.3.9. Four picket leads will be allowed during trap operations for up to four 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 of adult salmonids as enumerated the previous day at the Washington Shore count station, and assumes 4 shad = 1 salmonid (e.g., 6,000 salmonids + 4,000 shad = 7,000 total*).

- **(a) 0–6,000:** 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 1 picket lead for ½ hour, and then continue sampling for an additional 1 hour.
- **(c) 12,000 -18,000:** All 4 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) >18,000:** All 4 picket leads down for 1 hour. At the end of the 1st 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 operation with 4 picket leads down has been achieved.

1.3.10. Researchers will also be required to monitor the ladder every hour to ensure there is no crowding. If evidence of crowding is occurring at least two picket leads will be raised.

1.3.11. Project Fisheries will notify FPOM as soon as Weir 37 violates FPP criteria.

1.3.12. Project biologists retain the authority to raise additional picket leads depending on fish densities and ladder conditions.

1.4. Trapping Protocols – Ladder Water Temperatures ≥70°F.

1.4.1. 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. Nighttime is defined as official sunset to sunrise.

1.4.1.1. Project Biologists will use the Corps temperature probe reading as the official temperature.

1.4.1.2. Temperatures are both instantaneous readings and 0000–2400 daily averages. Researchers can review daily average, minimum and maximum temperatures from http://www.nwd-wc.usace.army.mil/tmt/documents/ops/temp/daily_by_basin.html to determine if the trap is within temperature criteria prior to traveling to BON. Instantaneous temperatures will be used to determine if trapping operations will continue for the day.

1.4.1.3. 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.

1.4.2. At water temperatures of 70–72°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.

1.4.3. Researchers may continue to work through fish in the holding pool for one hour after picket leads have been raised.

1.4.4. Project Fisheries will notify FPOM as soon as Weir 37 violates FPP criteria.

1.4.5. The density criteria for picket lead operations will be reduced by half and the operations will be as follows. The density criteria and adult ladder monitoring outlined in **1.3.9** above also apply. *******All counts are of adult salmonids as enumerated the previous day at the Washington Shore count station, and assumes 4 shad = 1 salmonid (e.g., 6,000 salmonids + 4,000 shad = 7,000 total*).

(a) 0–3,000: All 4 picket leads can be lowered for 4 continuous hours.

(b) 3,000-6,000: All 4 picket leads down for 3 hours; at the 3rd hour raise at least 1 picket lead for ½ hour and then continue sampling for an additional 1 hour.

(c) 6,000-9,000: All 4 picket leads down for 2 hours; at the 2rd hour raise at least 1 picket lead for ½ hour and then continue sampling for an additional 2 hours.

(d) > 9,000: All 4 picket leads down for 1 hour; at the end of the 1st 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 4 picket leads operation has been achieved and all picket leads need to be raised by 10:30 am.

1.4.6. There will be no more than 3 adult Chinook or steelhead or 4 sockeye in the anesthetic tank at a time. A combination of salmonids is allowed, with the maximum of either 2 Chinook or steelhead and 1 sockeye, or 1 Chinook or steelhead and 2 sockeye. This assumes users can effectively track the length of time fish stay in the anesthetic tank.

1.4.7. The brail pool is the primary and preferred recovery pool.

1.4.8. The observation tanks will be used for fish in distress under guidelines established in 3.3.1 through 3.3.4.

1.4.9. If used, water in the observation tanks will be running continuously allowing a constant exchange of water through the tank.

1.4.10. 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.

1.4.11. 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 and should be added in individual sealed containers. Do not exceed a 2°F difference between the anesthetic or recovery tank water and fish ladder water.

1.4.12. 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.

1.4.13. Personnel shall ensure fish are fully recovered from anesthetization prior to release. Fish may volitionally leave the brail pool when they are ready.

1.4.14. Project biologists retain the authority to raise additional picket leads depending on fish densities and ladder conditions.

1.5. Winter Trapping Protocols (December 1 – 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.

1.5.1. 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.

1.5.2. 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.

1.5.3. 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.

1.5.4. There will be no more than two adult salmonids in the recovery tank at a time.

1.5.5. Water in the recovery tank will be running continuously, allowing a constant exchange of water through the tank.

1.5.6. 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.

1.5.7. Personnel shall ensure fish are fully recovered from anesthesia prior to release.

1.5.8. 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.

2. ICE HARBOR DAM ADULT FISH FACILITY

2.1. 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 (FPOM).

2.2. Administrative Requirements. All researchers and managers working at the facility will adhere to the following requirements:

2.2.1. 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.

2.2.2. Users must have the proper federal authorization (e.g., ESA Section 10 permit) from the U.S. Fish & 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 & 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.*

2.2.3. Hard hats will be worn if so required by the Corps' Operations Manager at Ice Harbor (509-543-3256).

2.2.4. Long pants are to be worn at all times.

2.2.5. Steel-toed shoes or steel-toed rubber boots are to be worn at all times.

2.2.6. <u>Notification Required For Work during Regular Business Hours (Monday–Thursday, 0630–1700 hours)</u>. Users will notify the project biologist when they arrive on site and when they depart (509-543-3208). The Project Biologist will determine daily availability of the transport tank trailer. Project Biologist needs for fish rescue or emergencies will be priority over the trap user needs for the project transport trailer. If users supply the project biologist with a season schedule, it may not be necessary to notify project biologist upon arrival and departure.

2.2.7. <u>Notification Required For Work during All Other Hours (Monday–Thursday, 1700–0630 hours, or anytime Friday–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 *in advance*. Users *may* be required to contact the control room (509-543-3231) upon arrival and departure.

2.2.8. Users must present a safety plan to the project biologist, who can provide guidance for developing the plan.

2.3. Trapping Protocols (Mar 1-Dec 15) – Ladder Water Temperatures <70°F.

Since the trap is operated manually, personnel conducting research are required to be present at the facility to divert desired fish.

2.3.1. 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 either dogging it off above the water or completely removing it from the fish ladder for subsequent days of trap use. On days when users will not be trapping, the trap will be completely removed and stored on the ladder deck.

2.3.2. Trapping operations can take place between 0600 and 1400 hours, operating in the water not to exceed 4 hours per day or until the designated number of desired fish are obtained, whichever occurs first. Trapping operations shall limit the number of fish lifted from the trap to the powerhouse deck to two per lifting cycle.

2.3.3. 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.

2.3.4. Non-target fish will be released to the ladder.

2.3.5. Oxygen levels in fish handling tanks will be maintained at saturation by replacing the water and providing aeration as necessary.

2.3.6. Water temperatures in all fish handling tanks will be maintained within 2°F of the fish ladder water temperature but less than 70°F. Frozen river water or chillers may be used to regulate water temperature in the anesthetic, recovery, and transportation tanks as long as the temperatures do not deviate more than 2°F from the ladder temperature and the tank temperature remains less than 70°F. Note: If anesthetic tank water temperature exceeds 70°F, criteria in section 4 will go into effect.

2.3.7. 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. If practical, river water shall be cycled through anesthetic, recovery and/or transportation tanks while holding fish at the dam until transported to the river for release or returned to the ladder. If flow-through water cannot be provided in the transportation tank, water will be recirculated within the tank and oxygen added to maintain the tank at oxygen saturation level.

2.4. Trapping Protocols (Mar 1-Dec 15) – Ladder Water Temperatures 70°F–72°F.

2.4.1. The trap may be operated when water temperatures are within the range of 70–72°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. Water temperature in each tank and the ladder will be logged when each fish is handled or tagged. Due to the narrow temperature range involved, researchers must use reliable digital thermometers.

2.4.2. 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.

2.4.3. 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 either dogging it off above the water or completely removing it from the fish ladder. On days when users will not be trapping, the trap will be completely removed and stored on the ladder deck.

2.4.4. Trapping operations can take place between 0600 and 1200 hours, operating in the water not to exceed 4 hours per day or until the designated number of desired fish are obtained, whichever occurs first. The period from 0600 to 1000 hours is preferred. Trapping operations shall limit the number of fish lifted from the trap to the powerhouse deck to two per lifting cycle.

2.4.5. Between 70°F and 72°F, sampling will be permitted as defined here in Section 4 for up to four days per week until the 1200 hour when the trap will be removed from the water. This 70-72°F operation will remain in effect until daily average water temperatures drop to ≤ 69.9°F when the <70°F criteria in Section 3 apply. All sampling will cease when ladder water temperatures reach 72°F. No sampling may resume until daily average ladder water temperatures drop to ≤ 71.9°F.

2.4.6. 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.

2.4.7. Non-target fish will be released to ladder.

2.4.8. Oxygen levels in fish handling tanks will be maintained at saturation by replacing the water and providing aeration as necessary.

2.4.9. Water temperature in the anesthetic tank will be maintained within 1-2°F of the ladder water temperature (not to exceed 72°F). Frozen river water or chillers may be used to regulate water temperature in the anesthetic, recovery, and transportation tanks as long as the temperatures do not deviate more than 1-2°F from the ladder temperature. If practical, flow-through water should be running continuously through these tanks. If flow-through water cannot be provided in the transportation tank, water will be recirculated within the tank and oxygen added to maintain the tank at oxygen saturation level. Water in all tanks shall not exceed 72°F at any time. Water temperature in each tank and the ladder will be logged when each fish is handled or tagged.

2.4.10. 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.

2.4.11. Fish must be adequately recovered from anesthetization prior to the next step in the handling process, whether placed in the ladder or transported.

3. LOWER GRANITE DAM ADULT FISH FACILITY

3.1. 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 (FPOM).

3.2. 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.

3.2.1. 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.

3.2.2. Users must have the proper federal authorization (e.g., ESA Section 10 permit) from the U.S. Fish & 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 & 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.*

3.2.3. Hard hats will be worn if so required by the Corps' Operations Manager at Lower Granite (509-843-1493 x258).

3.2.4. Long pants are to be worn at all times.

3.2.5. Steel-toed shoes or steel-toed rubber boots are to be worn at all times.

3.2.6. <u>Notification Required For Work during Regular Business Hours (Monday–Thursday, 0630–1700 hours)</u>. Users will notify the project biologist when they arrive on site and when they depart (509-843-1493 x263 or x264). If users supply the project biologist with a season schedule, it will not be necessary to notify project biologist upon arrival and departure.

3.2.7. <u>Notification Required For Work during All Other Hours (Monday–Thursday, 1700–0630 hours, or anytime Friday–Sunday)</u>. If users are on site during times other than regular business hours, specific notification procedures must be worked out with the Operations Manager at Lower Granite *in advance*. Users *may* be required to contact the control room (509-843-1493 x231) upon arrival and departure.

3.2.8. Users must present a safety plan to the project biologist, who can provide guidance for developing the plan.

3.3. Trapping Protocols (Mar 1-Dec 15) – Ladder Water Temperatures <70°F.

3.3.1. During years prior to 2003, the trap was operated automatically 24 hours/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 the current Lower Granite Dam section of the Fish Passage Plan for further information on the operation of the adult fish trap (available online at: http://www.nwd-wc.usace.army.mil/tmt/documents/fpp/).

3.3.2. 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.

3.3.3. There will be no time-of-day restrictions for trapping operations.

3.3.4. 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.

3.3.5. Non-target fish will be released to the return pool.

3.3.6. 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.

3.3.7. There will be no more than 12 adult salmonids allowed in the recovery tank at any one time.

3.3.8. Oxygen levels in fish handling tanks will be maintained at saturation by replacing the water and providing aeration as necessary.

3.3.9. Water temperatures in fish handling tanks will be maintained within 2°F of the fish ladder water temperature but less than 70°F.

3.3.10. 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.

3.3.11. 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.

3.3.12. Fish must be released or transported from the trap within four days.

3.3.13. 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.

3.4. Trapping Protocols (Mar 1-Dec 15) – Ladder Water Temperatures 70°F–72°F.

The trap may be operated when water temperatures are within the range of 70–72°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.

3.4.1. 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.

3.4.2. 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.

3.4.3. 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.

3.4.4. Trapping operations may take place up to 4 days per week.

3.4.5. 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.

3.4.6. Non-target fish will be released to the return pool.

3.4.7. 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.

3.4.8. There will be no more than 3 adult salmonids allowed in the recovery tank at any one time.

3.4.9. Oxygen levels in fish handling tanks will be maintained at saturation by replacing the water and providing aeration as necessary.

3.4.10. 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.

3.4.11. 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.

3.4.12. 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.

3.4.13. 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.

3.4.14. 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

Dworshak Dam 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°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°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

LWG Fisheries Biologist in Charge: Other Personnel:	Activity	Date	Time
	Emergency Gate in Place		
	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

Smolt Monitoring Facility Operating Protocols at Bonneville, John Day and McNary Dams

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1. BONNEVILLE DAM JUVENILE MONITORING FACILITY (JMF)

This Appendix describes operating protocols that will be implemented by agencies conducting research in the Bonneville Dam (BON) Juvenile Monitoring Facility (JMF) to avoid or minimize delayed fish mortality resulting from stress during handling. These protocols were coordinated with fish agencies and tribes in the Fish Passage Operations & Maintenance (FPOM) workgroup.

1.1. General Facility Protocols.

1.1.1. Sample rates should not exceed 25% unless collecting research fish when water temperatures <70°F.

1.1.2. Personnel conducting research or monitoring must be present at the facility to monitor the separator bars for debris and stranded fish.

1.1.3. The Corps reserves the right to terminate trapping operations at any time.

1.1.4. 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 24-hour averages (0000-2400 hours).

1.2. BON JMF Requirements for Users.

All personnel conducting research or monitoring in the JMF will implement the following:

1.2.1. Users must have appropriate documentation for conducting research at the dam (see *Guide for Researchers at Bonneville Dam*).

1.2.2. Users must have valid State and Federal permits that cover all ESA-listed species that may occur at the project during the collection period. Users shall comply with all permit conditions, even if more restrictive than protocols herein.

1.2.3. 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.

1.2.4. Hard hats worn outside at all times.

1.2.5. Long pants or raingear worn at all times. Shorts not permitted in the lab.

1.2.6. Steel-toed shoes or rubber boots worn at all times. Tennis shoes or sandals not permitted.

1.2.7. If JMF users supply the Project Biologists with a season schedule, it will not be necessary to notify Project Biologists upon arrival and departure.

1.2.8. Users may coordinate sample rates with Smolt Monitoring Program (SMP) personnel.

1.2.9. Users are permitted to routinely operate flushing valves, fish lifts, and release pipes/valves within the monitoring building.

1.2.10. Any modifications to the building or equipment will first be approved by Bonneville Project through Project Fisheries.

1.2.11. All anesthetic water will be emptied into the sewage lift station after running through the activated charcoal filters.

1.2.12. 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.

1.2.13. The lower switchgate is in automatic control. Users will monitor and report to Project biologists any problems with the lower switchgate.

1.2.14. 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.

1.2.15. 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.

1.2.16. Avian cannons will be operated 24 hours per day from March 1 through November 1.

1.2.17. Project operators and mechanics are responsible for starting/stopping avian cannons.

1.3. BON JMF Sample Mode Operations (typically Fish Passage Season Mar 1-Nov 30).

1.3.1. In August, SMP avian personnel will operate the sampling facility as part of the SMP and to collect fish for regionally-approved research.

1.3.2. Research updates and equipment or sampling trouble reports will go through Project Biologists to FPOM.

1.3.3. JMF personnel will monitor the JMF continuously while in sample mode to ensure proper functioning and to provide quick response to an emergency while JMF is in sample operation.

1.3.4. 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.

1.3.5. During August, avian cannons may be shut off if Project Biologists observe no predatory birds at the outfall and coordinate through FPOM.

1.3.6. To prevent injury and/or mortality to passing fish, 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.

1.3.7. JMF personnel will observe video monitors at least every $^{1}/_{2}$ hour or continuously, and manually inspect every 2 hours or more frequently according to trash sweep operation or other debris potential.

1.3.8. JMF personnel shall monitor kelt passage over the separator.

1.4. BON JMF Sampling at Water Temperatures >70°F.

1.4.1. 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.

1.4.2. Daily index sampling will be reduced to every other day index/condition monitoring.

1.4.3. The upper switchgate is used to select between sample and bypass mode.

1.4.4. Sample sizes will be reduced to approximately 100 fish per day.

1.4.5. Monitoring for gas bubble trauma (GBT) symptoms will continue.

1.4.6. 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.

1.4.7. An instantaneous temperature of ≥70°F taken from 0630–0700 hours will trigger a change in sampling mode after Project Fisheries notify SMP Biologists.

1.4.8. Normal index sampling may resume when daily average temperature decrease to ≤69.5°F.

1.4.9. If there is a research need to sample at temperatures >70°F, coordination with FPOM will be initiated by the researcher through the Corps District POC.

1.4.10. 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.

1.5. BON JMF Bypass Mode Operation (or when no PDS Monitors).

1.5.1. The upper switchgate will be in bypass mode.

1.5.2. The Emergency fish release valve will be open.

1.5.3. All rotating gates will be set to bypass.

1.5.4. The bypass flume gate will be raised.

1.5.5. Project Biologists will inspect the facility daily.

1.6. BON JMF System Failure Protocols.

1.6.1. 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.

1.6.2. If a high or low water situation occurs in the PDS area, operate as follows:

- **(a)** Contact the control room immediately;
- **(b)** Switch the upper switchgate to bypass mode until the problem is corrected;
- **(c)** Immediately open the emergency fish release valve;
- **(d)** Raise bypass flume gate. *DO NOT ADJUST ANY WEIRS***.**

1.6.3. If a monitoring facility failure occurs, operate as follows:

- **(a)** Open the emergency fish release valve;
- **(b)** Switch the upper switchgate to bypass mode until the problem is corrected;
- **(c)** Raise the bypass flume gate;
- **(d)** Begin fish salvage operations.

1.6.4. If a lower switchgate failure occurs and releases are sent to the wrong high or low outfall, and repairs cannot be made within 24 hours, a special operation will be coordinated via FPOM.

1.6.5. In the event of a problem with either the 2-way or 3-way rotating gates (e.g., stuck open or partially open), the response protocol is as follows:

- **(a)** Switch the upper switchgate to bypass;
- **(b)** Open the emergency fish release valve;
- **(c)** Turn off air to rotating gate and manually rotate half-round pipe section to bypass position;
- **(d)** 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.*
- **(e)** 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.

1.6.6. Once all fish safety issues have been addressed and repairs requested, document the problem in an e-mail to Project Biologists prior to sending to other interested parties.

2. JOHN DAY DAM SMOLT MONITORING FACILITY (SMF)

The following protocols will be implemented by agencies conducting research in the John Day Dam (JDA) Smolt Monitoring Facility (SMF) as precautionary measures to avoid or minimize delayed fish mortality resulting from stress during handling. These protocols were coordinated with fish agencies and tribes in the Fish Passage Operations & Maintenance (FPOM) workgroup.

2.1. General Facility Protocols.

2.1.1. Sample rates should not exceed 25% unless collecting research fish at water temperatures <70°F.

2.1.1. The Corps reserves the right to terminate trapping operations at any time.

2.2. JDA SMF Requirements for Users.

All personnel conducting research or monitoring in the JDA SMF will implement the following:

2.2.1. Users must have appropriate documentation for conducting research at the dam (see *Guide for Researchers at John Day Dam*).

2.2.2. Users must have valid State and Federal permits that cover all ESA-listed species that may occur at the project during the collection period. Users shall comply with all permit conditions, even if more restrictive than protocols herein.

2.2.3. Hard hats are to be worn outside at all times.

2.2.4. Long pants or raingear worn at all times. No shorts or sweats permitted.

2.2.5. Steel-toed shoes or rubber boots worn at all times. No tennis shoes, sandals permitted.

2.2.6. If users provide Project Biologists with a schedule, it will not be necessary to notify Project Biologists upon arrival and departure.

2.2.7. Users may coordinate sample rates with Smolt Monitoring Program (SMP) personnel.

2.2.8. Users are permitted to routinely operate SMF flushing valves and release pipes/valves.

2.2.9. Any modifications to the building or equipment will first be approved by The Dalles/John Day/Willow Creek Project through Project Fisheries.

2.2.10. All anesthetic water will be emptied into the activated charcoal filters tanks.

2.3. JDA SMF Sample Mode Operations (typically Fish Passage Season Mar 1-Nov 30).

2.3.1. SMP personnel will operate the facility as part of the SMP and to collect fish for regionally-approved research.

2.3.2. Research updates and trouble reports will go through the Project Biologists to FPOM.

2.4. JDA SMF Sampling at Water Temperatures >70°F.

2.4.1. 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.

2.4.2. Daily 24-hour index sampling will be reduced to 2x/wk every-other-day index/condition monitoring from 0700–1300 hours. Mondays and Thursdays are preferred.

2.4.3. The switchgate is used to select between sample and bypass mode.

2.4.4. Sample sizes will be reduced to approximately 100 fish per day.

2.4.5. Project Fisheries will use Project thermometer in the sample holding tank for official reporting requirements, instantaneous temperatures or when online data are unavailable.

2.4.6. 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.

2.4.7. Normal index sampling may resume when daily average temperatures are ≤69.5°F.

2.4.8. If there is a research need to sample at temperatures >70°F, coordination with FPOM will be initiated by the researcher through the Corps District POC.

2.4.9. 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.

2.5. JDA SMF Bypass Mode Operation.

2.5.1. All rotating gates will be set to bypass.

2.5.2. Project Biologists will inspect the facility every two hours.

2.5.3. If the full-flow PIT-tag detector is effective, the switch gate will be moved to bypass.

2.6. JDA SMF System Failure Protocols.

2.6.1. 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.

2.6.2. In the event of a problem with either the 2-way or 3-way rotating gates (e.g., stuck open or partially open), the response protocol is as follows:

- **(a)** Contact the Project Biologist, or if unavailable, the control room. Project personnel (SMF Biologist) will request maintenance crews. Repairs should commence within 4 hours of discovering the problem;
- **(b)** Once all fish safety issues have been addressed and repairs requested, document the problem in an e-mail to Project Biologists prior to sending to other parties.

3. McNARY DAM JUVENILE FISH FACILITY (JFF)

Agencies conducting research in the McNary Dam (MCN) Juvenile Fish Facility (JFF) will implement the following protocols as precautionary measures to avoid or minimize delayed fish mortality resulting from stress during handling. The Fish Passage Operations & Maintenance (FPOM) workgroup coordinated these protocols with fish agencies and tribes.

3.1. General Facility Protocols.

3.1.1. Sample rates should not exceed 25% unless collecting research fish at water temperatures <70°F.

3.1.2. The Corps reserves the right to terminate trapping operations at any time.

3.2. MCN JFF Requirements for Users.

All personnel conducting research or monitoring in the MCN JFF shall:

3.2.1. Have appropriate documentation for conducting research at the dam;

3.2.2. Have valid State and Federal permits that cover all ESA-listed species that may occur at the project during the collection period;

3.2.3. Comply with all permit conditions, even if more restrictive than protocols herein;

3.2.4. Wear hard hats at all times when outside, in or under the JFF, or in, on and around the dam;

3.2.5. Wear long pants or raingear at all times. No shorts or sweats permitted; and

3.2.6. Wear steel-toed shoes (or rubber boots when likely to enter water) at all times. No tennis shoes or sandals permitted.

3.2.7. If users provide the project biologists with a schedule, it will not be necessary to notify them upon arrival and departure.

3.2.8. Users shall coordinate sample rates with Smolt Monitoring Program (SMP) or MCN project biologists.

3.2.9. Users are not permitted to routinely operate JFF flushing valves and release pipes/valves without the permission of project biologists.

3.2.10. The Project Biologist must approve any proposed modifications to the building or equipment.

3.3. MCN JFF Sample Mode Operations (typically occurs April 6 – September 30).

3.3.1. Sampling Procedures:

3.3.1.a. Personnel will normally conduct sampling in accordance with smolt monitoring program guidelines recommended by the PSMFC. Project and SMP personnel may occasionally alter sampling guidelines if fish research activities require it. Normal alterations of sampling guidelines are to adjust the number of fish sampled to meet approved research needs or to minimize the handling of fish during warm water temperature periods.

3.3.1.b. Electronic counting tunnels count sampled fish and staff verify and adjust the counts by hand counts. Staff will base all fish number estimates and rates on the size of the sample of fish collected. Staff will take samples hourly for 24 hours every-other-day. Project biologists will coordinate with SMP personnel to set sample rates.

3.3.1.c. SMP and project personnel will take and use species composition and weight samples to determine loading densities for raceways (if fish are being collected for research needs). Project personnel will keep a running total of hourly estimates of fish numbers and raceway totals. Daily samples for monitoring descaling will include a minimum of 100 fish of the dominant group(s) for which descaling information is recorded. SMP and project personnel will monitor descaling every-other-day for facility operations. SMP and project personnel may conduct full sample descaling instead of 100 fish subsamples as long as it does not adversely affect other facility operations.

3.3.1.d. Where SMP activities are conducted at collector dams, project biologists may utilize daily total information gathered by those personnel.

3.3.1.e. Research updates and trouble reports will go through project biologists to FPOM.

3.4. MCN JFF Sampling at Water Temperatures >70°F.

3.4.1. Personnel will obtain daily average river temperatures from the Corps website at: http://www.nwd-wc.usace.army.mil/tmt/documents/ops/temp/string_by_project.html.

3.4.2. Staff will conduct daily 24-hour index sampling every-other-day, 0700 to 0700. If juvenile salmonid populations experience high mortality after personnel implement the above procedures, the project will cease fish collection for regular sampling, but SMP and project staff shall continue to collect for fish condition sampling for up to 8 hours per day.

3.4.3. The switchgate selects between sample and bypass mode.

3.4.4. If populations experience high mortality, staff will reduce sample sizes to “approximately” 100 fish per day, within sampling limitations.

3.4.5. Project or SMP personnel will use a thermometer in the sample holding tank for official reporting requirements, instantaneous temperatures or when online data are unavailable.

3.4.6. An instantaneous temperature of 70°F or greater taken between 0630 and 0700 hours will trigger a change in sampling mode after a project biologist notifies SMP biologists.

3.4.7. Normal index sampling may resume when daily average temperatures are ≤ 69.5°F.

3.4.8. If there is a research need to sample at temperatures >70°F, the Corps District POC will initiate coordination with FPOM.

3.4.9. If the SMP and project fisheries biologists suspect a bypass system problem during a high temperature sampling period, additional sample collection may occur. Project or District biologists will notify FPOM as soon as possible and provide updates as they attempt to resolve the problem.

3.4.10. See Fish Passage Plan - McNary Dam Section 4.1.2 for additional measures to take when sampling at water temperatures > 68.0°F.

3.5. MCN JFF Bypass Mode Operation.

3.5.1. Project personnel will set the switchgate to the appropriate bypass mode.

3.5.2. Project personnel will inspect the facility as necessary.

3.6. MCN JFF System Failure Protocols.

3.6.1. Personnel shall report any system failure or abnormality to a project biologist immediately. If a project biologist is unavailable, they will contact the control room at ext. 231.

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 & Wildlife Service
VBS	Vertical Barrier Screen
W	West
WDFW	Washington Department of Fish & Wildlife
WECC	Western Electricity Coordinating Council