FISH PASSAGE PLAN

FOR

CORPS OF ENGINEERS PROJECTS

U.S. ARMY CORPS OF ENGINEERS

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Table of Contents

Section 1 Overview and Implementation of Fish Passage Plan

Section 2 Bonneville Dam

Section 3 The Dalles Dam

Section 4 John Day Dam

Section 5 McNary Dam

Section 6 Ice Harbor Dam

Section 7 Lower Monumental Dam

Section 8 Little Goose Dam

Section 9 Lower Granite Dam

Section 10 Appendices

SECTION 1

OVERVIEW

1. Fish Passage Plan

1.1. Overview

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

The FPP is revised as necessary to incorporate changes to project operations and maintenance as a result of new facilities or changes in operational procedures. Revisions will incorporate changes adopted through coordination with the National Marine Fisheries Service (NMFS) as part of the ESA Section 7 consultation, Recovery Plan, or Section 10 permit processes, and through consideration of other regional input and plans. The current revisions reflect provisions contained in the NMFS Biological Opinion issued March 2, 1995 (Reinitiation of Consultation on 1994 - 1998 Operation of the Federal Columbia River Power System and Juvenile Transportation Program in 1995 and Future Years), in the Corps' Record of Decision signed March 10, 1995 (U.S. Army Corps of Engineers North Pacific Division Record of Decision, Reservoir Regulation and Project Operations, 1995 and Future Years), in the 1998 and 2000 Supplemental Biological Opinions, and in the Corps' Record of Consultation and Summary of Decision, signed June 24, 1998. The Corps and other action agencies are now consulting with NMFS and the U.S. Fish and Wildlife Service on hydrosystem operation during upcoming years to protect and enhance multiple ESA-listed species. Applicable project operation measures resulting from this coordination will be considered for inclusion in the final FPP. When revising the FPP, the Corps considers the amended Northwest Power Planning Council (NPPC) Columbia River Basin Fish and Wildlife Program to the fullest extent practicable.

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

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

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

1.3 Technical Management Team. In-season decisions on river operations to achieve fish passage efficiency (FPE) or survival goals for spring and summer outmigrants will be made in coordination with the Technical Management Team (TMT). Coordination of special operations identified in the FPP will occur through the TMT and will be identified in the Water Management Plan. These may include maintenance or research activities requiring unit outages that affect other river operations, operation of turbines outside of the 1% efficiency range, zero nighttime flow, and implementation of the Juvenile Fish Transportation Program.

1.4 Spill at Corps Mainstem Projects. Corps mainstem projects will provide spill for juvenile fish passage according to the NMFS Biological Opinions (specifications in Appendix E) to protect ESA-listed salmon species. Target spill levels are developed through consultation with NMFS and may be adjusted during the fish migration season as recommended by the TMT. Continuous spill is provided at Bonneville, The Dalles, and Ice Harbor Dams for spring and summer outmigrants to meet Biological Opinion requirements. Nightly spill is also provided at John Day, McNary, Lower Monumental, Little Goose, and Lower Granite Dams. Spill may also be provided under special circumstances for non-listed fish species if recommended by the fish agencies and tribes and if the recommendations are consistent with regional operational agreements (i.e., Spring Creek National Fish Hatchery release in March).

1.5 Total Dissolved Gas Monitoring. Total dissolved gas (TDG) saturation levels are monitored at the forebay and tailrace of each mainstem project during the fish passage season. The water quality standard and criterion developed by the states and EPA is 110% of saturation at ambient temperature and pressure. The Corps policy (Appendix F) is to operate each mainstem project to meet state standards insofar as physically possible unless other overriding reasons cause temporary deviations. The NMFS Biological Opinions call for fish spill to be provided at levels that create higher TDG levels (Appendix E). Also, implementation of fish spill requests from fish agencies and tribes have in the past resulted in TDG levels of 120% or greater. Therefore, fish spill implementation will be subject to further coordination with appropriate entities if excessive TDG levels occur or if evidence of gas bubble disease is observed in fish. Any spill requests that will cause exceedance of the state TDG standard must include prior coordination with state water quality agencies, including waivers of state water quality standards obtained in advance by the requester. TDG levels are provided to the TMT and summarized for the year in the Corps' annual Total Dissolved Gas Monitoring report.

1.6 System Load Shaping. Guidelines coordinated by BPA on system load shaping to consider fish impacts are included in Appendix C. The guidelines describe procedures BPA follows to make hydropower load requests that enable the Corps to operate units in consideration of the 1% turbine operating range.

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

1.8. Project Fish Passage Facilities Inspection and Reporting Criteria.

1.8.1 General. Sections 2 through 9 contain the detailed criteria for inspection and reporting for fish passage facilities at the Corps projects on the lower Snake and lower Columbia rivers. The Corps provides weekly written inspection reports to the NMFS Hydropower Program office describing out-of-criteria situations, adjustments made to resolve problems, and a detailed account of how out-of-criteria situations affected project fish passage and survival. The weekly inspection reports also include summaries of equipment calibrations, adult fish collection channel velocity monitoring, and water temperature monitoring. Equipment which does not require calibrating will not routinely be included in the weekly report. The Corps also provides an annual report to NMFS which summarizes project operations and maintenance and fish passage facility inspections and monitoring.

1.8.2 Criteria for Reporting Excursions Outside the 1% Turbine Operating Efficiency Range. Excursions outside the 1% turbine operating range will be reported by BPA annually. These reports will describe instances where lower Columbia and lower Snake river turbines were operated outside the 1% efficiency ranges for significant periods, as defined under the guidelines in Appendix C. BPA will prepare the reports by consolidating data provided by Corps project operators and the reports will be sent to NMFS by BPA. The intent of excursion reporting is to provide a means for quality assurance for project operations.

1.9. Implementation of the Fish Passage Plan.

Implementation of the FPP requires information from and coordination with NMFS, BPA, other federal and state fish agencies, and tribes. RCC coordinates operation of Corps projects that affect system water management, spill, unit availability, or other project uses through the TMT. District biologists may coordinate directly with the fish agencies and tribes on other project-specific operations that do not have system impacts.

Daily RCC briefings are held at 1300 hours, Monday through Friday, during the flood control and fish passage seasons, in the U.S. Custom House, Portland, Oregon. RCC also participates in weekly meetings of the TMT during the fish passage season which recommends river operations to implement the Biological Opinion and other recommendations from fish interests. Corps representatives are available at these meetings to discuss the latest weather and runoff forecasts, as well as fish, hydrologic, water quality, and power information to assist in the planning of operations for fish passage for the following days. Fish operation recommendations are evaluated by the Corps to determine impact on overall system operations. The Corps also coordinates with NMFS and U.S. Fish and Wildlife Service (FWS) to meet ESA requirements for endangered species.

1.9.1 Agency Responsibilities.

1.9.1.1. U.S. Army Corps of Engineers.

a. Coordinate with NMFS and FWS on operational actions that might impact threatened, endangered, or candidate species.

b. Prepare a Water Management Plan for in-season management, in coordination with TMT members, which implements the Corps Record of Decision.

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

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

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

f. Conduct the Dissolved Gas Monitoring Program as described in Appendix D.

1.9.1.2. Fish Agencies and Indian Tribes.

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

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

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

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

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

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

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

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

1.9.1.3. Bonneville Power Administration.

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

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

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

d. Adjust system generation to provide adequate water to meet fish operations requirements in accordance with the NMFS Biological Opinion on hydrosystem operations.

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

f. Provide information on unit operation within the 1% operating range, as indicated in Appendix C.

1.9.1.4. Mid-Columbia Public Utility Districts.

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

1.9.2. Coordination Procedures.

1.9.2.1. Coordination of the FPP.

The FPP is effective year-round and revisions are coordinated with FPOM, which includes NMFS, other Federal and state fish agencies, tribes, and other interested parties. Different parts of the FPP may be revised at different times. Suggested revisions should be submitted to FPOM for consideration by the Corps. Draft FPP revisions will be provided for a two-week regional review. FPP revisions will be published two weeks after the close of the regional review period. FPP revisions are provided to TMT for use as part of the overall river operation plan. Sections dealing with special operational requirements will be included in the Water Management Plan.

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

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

b. Fish Spill Management. The Corps will implement fish spill provisions described in Appendix E, consistent with state water quality standards including applicable TDG waivers in effect at the time. The TDG and gas bubble trauma signs in fish will be monitored and evaluated during the spill season by the Corps, NMFS, other fish agencies, tribes, and water quality agencies. Project spill levels will be adjusted as needed, based on daily physical and biological monitoring results, and coordinated with the TMT and tribes.

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

d. Other Operational Requests. As with Corps O&M requests, all other operational recommendations will be evaluated for impacts on fish migration and effects on other project O&M requirements. Coordination of special operations with NMFS, other fish agencies, and tribes will occur through the TMT. Except as necessary for emergency actions, adequate time will be allowed for evaluation of all project and fish impacts prior to implementation. Coordination of emergencies, as identified in the Emergency Operations Protocol adopted by the TMT, will be followed.

1.9.2.3. Activities by Non-Corps Personnel. All non-Corps personnel intending to conduct any activity, such as fish handling or minor facility modifications, at a Corps facility must have prior written approval. This approval must be requested in writing to the Chief, Operations Division, at the district office responsible for a particular project. If the activity could affect fish listed for ESA protection, proof of consultation with NMFS or FWS (Section 10 permit) must also be provided.

SECTION 2

BONNEVILLE DAM

Bonneville Dam

1. Fish Passage Information. The locations of fish passage facilities are shown on the following general site plans for Bonneville Lock and Dam (Figures BON-1 through BON-3). Dates for project operations for fish purposes and special operations are listed in Table BON-1.

1.1. Juvenile Fish Passage.

1.1.1. Facilities Description, First Powerhouse. Juvenile fish passage facilities at the Bonneville first powerhouse consist of STSs, VBSs, 12" gatewell orifices, fish bypass channel, excess water elimination facility, fish sampler, and a 24" fish transport pipe to the tailrace. All 10 main turbine units have STSs. A small unit (unit O) is located at the south end of the powerhouse and is not equipped with screens.

There are also small channels associated with the auxiliary water intakes for adult fishways at the south end of the powerhouse and at both ends of the spillway. These older juvenile fish passage channels discharge into the adult fishways at the ends of the spillway and into the ice and trash sluiceway at the south end of the powerhouse. These facilities are no longer operated on a regular basis.

1.1.2. Facilities Description, Second Powerhouse. Juvenile fish passage facilities at the Bonneville second powerhouse are comprised of turbine intake extensions (TIEs), streamlined trash racks, STSs, VBSs, two 13” orifices per gatewell in units 11-14 and fish unit 2, and one 13” 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 new outfall location. A juvenile fish sampling facility is included in the bypass. All eight main turbine units have STSs, TIEs, and streamlined trashracks. Two smaller turbines that supply adult fishway auxiliary water do not have STSs, TIEs, or streamlined trashracks however, have a fine trashrack with a 0.75 inch clear opening.

1.1.3. Juvenile Migration Timing. The juvenile fish migration season occurs from March 1 through November 30. Table BON-2 shows the primary passage periods for each species. Maintenance of juvenile fish facilities is scheduled for the period December 16 through February to reduce the impact on downstream migrants. These activities will be coordinated to minimize potential impacts on juvenile migrants that may be present at that time.

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Reserved for Figure BON-4

Reserved for Figure BON-5

Table BON-1. Dates of project operations for fish purposes at Bonneville Dam, 2000.

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Table BON-2. Juvenile fish migration timing at Bonneville Dam, 1993-1999.

% Past Project[a]	Year/Date						
	1993	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**
Yearling Chinook							
10%	4/22	4/19	4/18	4/19	4/20	4/23	4/21
90%	5/28	5/31	5/26	5/27	5/26	5/23	5/30
Subyearling Chinook[b]							
10%	N/A	6/9	6/5	6/9	6/7	6/3[d]	6/1[d]
90%	N/A	7/26	7/15	7/18	7/29	7/20[d]	7/25[d]
Steelhead							
10%	5/10[c]	5/3[c]	5/4[c]	4/27[c]	4/29[c]	5/2[c]	4/27[c]
90%	5/26[c]	6/4[c]	5/29[c]	5/29[c]	5/28[c]	6/1[c]	6/5[c]
Coho							
10%	5/5	5/9	4/28	4/23	4/29	5/3	4/28
90%	5/25	6/5	5/29	5/28	6/4	6/4	6/7
Sockeye							
10%	5/17	5/13	5/10	5/4	5/6	5/10	5/10
90%	5/27	6/2	5/27	6/2	6/22	5/29	6/1

[a] Measured at the first powerhouse bypass trap.
[b] Large spring releases of tule stock subyearling chinook in Bonneville pool overshadow the summer upriver stock migration. To avoid this, these dates are for the middle 80% of the subyearling chinook run which occurs after June 1.
[c] Dates are for hatchery steelhead. Wild steelhead averaged a few days earlier for the 10% and 90% passage.
[d] "Brights" only.

1.2. Adult Fish Passage.

1.2.1. Facilities Description. Adult fish passage facilities at Bonneville Dam consist of two main fishway segments. The first powerhouse collection system with A-branch ladder and the south spillway collection system with B-branch ladder join together at the Bradford Island ladder to form the Bradford Island fishway segment. The Cascades Island ladder at the north side of the spillway is connected to the Washington shore ladder by the upstream migrant transportation (UMT) channel. The second powerhouse collection system/ladder join together at the Washington shore to form the Washington shore fishway segment. Both the Bradford Island and the Washington shore fishways have counting stations. The second powerhouse ladder has an adult fish sampling facility. All four collection systems have auxiliary water supplies for fish attraction.

1.2.2. Adult Migration Timing. Upstream migrants are present at the project throughout the year and adult passage facilities are operated year round. Because passage through the winter months is relatively light, fish counting is by video taping (no visual counting), primarily to monitor winter steelhead passage. The adult fish counting schedule is shown in Table BON-3. Annual winter maintenance of adult fish facilities is scheduled from December 1 through February (in-water work period) to minimize the impact on upstream migrants and to minimize adult fall chinook and steelhead fallback.

Table BON-3. Adult fish counting schedule.

Period	Counting Method
January 1 – March 31	Video count 24 hours/day
April 1 – October 31	Visual count 16 hours/day (0400-2000 PST)
April 1 – October 31	Video Count 8 hours/day (2000-0400 PST)
November 1 December 31	Video count 24 hours/day

Adult migration count data for Bonneville Dam have been collected since 1938. Table BON-4 summarizes adult fish passage timing through 1998. The primary passage period and the earliest and latest peaks of migration recorded are listed for each species (from fish counts compiled by the Corps).

Table BON-4. Adult migration timing from fish counts, 1938-1999.

Species	Count Period	Earliest Peak	Latest Peak
Spring chinook	3/14 – 5/31	4/15	5/27
Summer Chinook	6/1 – 7/31	6/5	7/31
Fall Chinook	8/1 – 11/15	8/31	9/17
Steelhead	3/15 – 11/15	7/16	9/22
Coho	7/15 – 11/15	8/29	9/22
Sockeye	6/1 – 8/15	6/22	7/13

2. Project Operation.

2.1. General. Yearling chinook and most other juvenile salmonids migrate downstream in the spring, whereas during the summer, after mid-June, sub-yearling chinook dominate. Studies specific to Bonneville Project indicate that fish survival rates for passage through various routes differ between spring and summer. For this reason, distribution of flow between powerhouses and spill volume will change as described in sections 2.1.1. and 2.2.

2.1.1. Powerhouse Flow Distribution. Bonneville turbine operating priority is established as outlined in Table BON-5. Follow the listed priority during the appropriate calendar periods. If a turbine is out of service, use the next turbine in the priority list. Improvements in 115 kilovolt line capacity are expected to be completed this year so that the second powerhouse can operate to meet local as well as system power needs independently of the first powerhouse. Until such time as these improvements are completed, the unit operating priorities shown for the June 21 through August 31 period will be used during the March 1 through November 30 fish passage season.

Table BON-5. Turbine unit operating priorities, Bonneville first and second powerhouses.

PERIOD	PRIORITY
0001 March 1 through **2400 June 20**	**18,11,17,12-16, 10,9,1,2,6,4,5,7,8,3**
0001 June 21 through **2400 August 31**	**10,9,1,2,6,4,5,7,8,3, 18,11,17,12-16**
0001 September 1 through **2400 November 30**	**18,11,17,12-16, 10,9,1,2,6,4,5,7,8,3**
0001 December 1 through **2400 February 28**	
Washington Shore Adult Fish Ladder Out of Service	10,9,1,2,6,4,5,7,8,3,18,11,17,12-16
First Powerhouse Adult Fish Ladder Out of Service	18,11,17,12-16,10,9,1,2,6,4,5,7,8,3
First Powerhouse and Washington Shore Adult Fish Ladders In Service	18,11,17,12-16,10,9,1,2,6,4,5,7,8,3

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, unless concurred with by regional fish managers through ESA and other fish passage forums. Currently approved special operations are described in Appendix A. Alternate actions will be considered by district and project biologists in coordination with the fish managers 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 in advance with the project.

2.2. Spill Management.

2.2.1. General. Regardless of time of day, only one spill schedule will be used at Bonneville Dam (Table BON-14, end of section 2). Nighttime spill is limited as necessary to control total dissolved gas (TDG) supersaturation. Adjustments of the nighttime spill level may be granted on a case-by-case basis by the Reservoir Control Center (RCC), dependent upon TDG monitoring at stations downstream of the dam, biological monitoring, and fish movement. The hours of nighttime spill are the daily complements of the periods of daytime spill (Table BON-6). The transition from daytime spill cap to nighttime spill cap and vice versa will normally take 15 to 20 minutes due to the time required to start, synchronize, and load multiple generators. Frequently, a total river discharge change will occur concurrently with these spill transitions. The transition to the daytime cap should begin early enough in the day to minimize chances of violating the defined daytime spill maximum. The transition to the nighttime spill period should not start until after the daytime cap period is over.

2.2.2. Juvenile Fish. Spill for juvenile fish passage will begin April 20 and end August 31 (1998 Supplemental Biological Opinion). The daytime spill amount is 75 kcfs in order to reduce adult fallback (see section 2.2.3). At night, the spill amount will be up to the 120% gas cap. The second powerhouse ice and trash chute will be operated for ice and trash removal and for emergency auxiliary adult transportation channel water supply only as outlined in section 3.3.2.1.c. (second paragraph).

2.2.3. Adult Fish. During the primary adult fish passage period, March 1 through November, daytime spill will be limited to 75 kcfs whenever possible. Normally, this restriction will be from one hour before sunrise to one half hour before sunset (see Table BON-6. However, during the sockeye passage season, which begins when at least 10 fish pass the project per day (in combined ladder counts), but no later than June 1 through August 15, the cap will apply until one hour after sunset.

Table BON-6. Daytime spill schedule for Bonneville Project.

Date	Daytime Spill

	Begin	End
Mar 1 – 17	0530	1745
Mar 18 - Apr 1	0500	1800
Apr 2 – 21[1]	0530	1930
Apr 22 - May 10	0500	1945
May 11 – 31	0430	2015
Jun 1 – Jul 22[2]	0430	2200
Jul 23 – 31	0500	2200
Aug 1 – 15	0500	2130
Aug 16 – 31	0500	1930

[1] Times after April 2 are in Daylight Savings Time.
[2] Start date for sockeye passage varies.

2.3. Total Dissolved Gas (TDG) Management and Control. Implementation of spill requests will take into account TDG monitoring data and the observed condition of migrant juveniles and adults, along with juvenile migration monitoring data. The Corps will monitor TDG from a station in the Bonneville forebay and from several stations located below Bonneville Dam. The TDG data will be reported every four hours starting prior to an early Spring Creek National Fish Hatchery (NFH) fish release, but not later than March 10 for all stations at Bonneville. Spill volume and total project flow will be reported at the same time. The TDG data collection will continue year round at Bonneville forebay and Warrendale stations. The TDG monitoring plan is described in detail in Appendix D.

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 RCC, nighttime or daytime spill limits, and shaping of spill discharge.

2.4. Juvenile Fish Passage Facilities.

2.4.1. Operating Criteria, First Powerhouse.

2.4.1.1. Prior to the Juvenile Fish Passage Season (December 1 through end of February).

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

b. Inspect VBSs for damage, holes, debris accumulations, and protrusions (video inspection acceptable). Clean and repair, as necessary, such that all VBSs in operable units are functional.

c. Inspect each STS and operate on a trial run (dogged off at deck level). Install STSs in each intake of operational turbine units by the end of February. However, see section 2.4.1.2. Juvenile Fish Passage Season about accommodations for an early fish release from Spring Creek NFH.

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

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

f. Inspect and correct any deficiencies of DSM channel and outfall conduit walls and floor.

g. Avian Predation Lines. Reinstall or repair avian predator control lines in present locations 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 measures as necessary in areas where avian lines are not practical. 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.

h. Inspections. The results of all inspections and the readiness of the facilities for operation will be reported to the Fish Passage Operations and Maintenance (FPOM) Coordination Team at the meeting immediately prior to the juvenile fish passage season.

2.4.1.2. Juvenile Fish Passage Season (March 1 through end of November). Juvenile fish protection devices (STSs, etc.) will be in place for an early fish release from Spring Creek NFH, if scheduled to occur before March 1. The release is typically scheduled for mid-March. Screens will remain in operation through December 15 to protect adult fallbacks.

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, or as indicated by fish condition (e.g., higher than expected descaling), or as determined by the project biologist and smolt monitoring personnel who sample the fish. The STSs in units being raked will be run in continuous mode during raking operations. Gatewell orifices of the unit being raked must be closed during the procedure.

b. Operate STSs at an angle of 55 degrees from vertical.

c. 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) (video is acceptable). Frequency of monthly inspections may be based on individual turbine unit run time. No STS inspections will be scheduled when they will cause excessive TDG due to increased forced spill. Summaries of STS and VBS inspections will be included in weekly operation monitoring reports. VBS inspections will occur immediately prior to peaks in juvenile fish migrations, which begin about May 1, mid-July, and September 1. Inspections will be concentrated on the priority units and others with longer operating times. 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. Prior to pulling VBSs for inspections, shut off units and dip gatewells. It is not necessary to dip gatewells of units which have been off for 48 hours or longer.

If STS or VBS damage or plugging is detected, follow procedures in Section 3. Fish Facilities Maintenance. Records of inspections or summary of such records will be made available to the Fish Passage Center (FPC) by January 31.

d. Operate all gatewell orifice systems. Inspect each orifice twice daily to assure that the orifice valves and lights are operating correctly. Orifices are set to automatically flush every 8 hours at 0200, 1000, and 1800 hours. More frequent back-flushing is recommended during the high debris period of April through June. Replace all burned out orifice lights within 24 hours.

e. DSM downwell area operation (during smolt sampling):

1. Maintain between 0.3' and 1' of depth over the end of the DSM inclined dewatering screen.

2. Maintain the differential between forebay and DSM channel water surface between 5' and 6'.

3. Maintain the drop from dewatering screen to water surface in the downwell between 4.5' and 6'.

4. Operate the dewatering screen trash sweep one revolution at 60-minute intervals. This interval between operations may be increased to one revolution every 20 minutes when monitoring personnel are not present depending on the amount of debris passing.

5. Electrical modifications were made in 1995 to allow central, automatic lighting control in the first powerhouse DSM. The DSM is now darkened on a schedule as determined through coordination with the FPOM in 1994. Investigation has shown that darkening the channel results in faster fish evacuation.

f. DSM downwell area operation (non-sampling standards).

1. Maintain a depth between 0.9' and 1.3' over the end of the DSM inclined dewatering screen.

2. Maintain the differential between forebay and DSM channel water surface between 5' and 6'.

3. Maintain the drop from dewatering screen to water surface in the downwell between 3' and 4.5'.

g. Observe each STS watt and/or amp gauge reading at least once each day and record readings once per day. If an STS failure occurs, then follow procedures in Section 3. Fish Facilities Maintenance.

h. Inspect all STS gatewells daily. The project will clean gatewells before the water surface becomes one-half covered with debris. If, due to the volume of debris, it is not possible to keep the gatewell surfaces half 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 first powerhouse gatewell orifices will be closed during cleaning operations. After cleaning a gatewell, back-flush the orifice in that gatewell then check gatewell drawdown.

i. A slight oily sheen is commonly found in many gatewells. This may come from sources such as lubricated lifting beams, etc. But, when unusual accumulations of oil (e.g., oil slick) occur in gate slots, they will be removed within 24 hours. When this is not possible, the JBS 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 FPC and NMFS. Regardless of unit operating status, oil accumulations will be dealt with promptly.

j. Coordinate gatewell cleaning with personnel operating downstream migrant sampling facilities.

k. Reinstall or repair avian predator control lines in present locations as soon as possible following significant damage or removal. Install and maintain new avian predator control lines in locations determined to be significantly impacted by avian predators.

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

m. Open ice and trash sluiceway chain gate 7A to elevation 72' msl, and set gate 10C to full open. However, if the forebay is expected to stay below 72.5' for more than 48 hours (as during a specially-coordinated low forebay period), then gate 7A should be set at 70' above msl with gate 10C still full open. (Calculated from hydraulic equations to achieve approximately 475 cfs (3.7' of head) (Evaluation of Ice and Trash Sluiceway at Bonneville Dam as a Bypass System for Juvenile Salmonids, 1981). The ice and trash sluiceway may be operated without restriction October 1 through November if it is determined, through FPOM coordination, that migrating juvenile salmonid numbers are low enough that operations will not adversely affect fish migration or fish condition. This authorization may be terminated at any time if problems arise that negatively impact fish migration or condition.

n. Inspect juvenile fish passage facilities twice per day. Project fish biologist and fish biological staff will conduct at least three inspections per week.

2.4.1.3. Winter Maintenance Season (December 16 through February). The end of the season may be shortened for an early fish release from Spring Creek NFH. This will not be the case in 2000 since the Spring Creek NFH release is scheduled for March 9.

a. Remove all STSs.

b. When STSs are removed at the end of the fish passage season, they are normally stored in a position extending up through the forebay deck. An alternate storage position is below the deck, but this places the screens close in front of the gatewell orifice. When it is necessary to make room on the forebay deck for priority activities at this time of year by storing the screens beneath the deck, the blocked orifices should be closed. The DSM channel should be drained if proper operating criteria cannot be maintained as the result of a large number of closed orifice valves.

2.4.2. Operating Criteria, Second Powerhouse.

2.4.2.1. Prior to the Juvenile Fish Passage Season (December 1 through February).

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

b. Inspect VBSs for damage, holes, debris accumulations, and protrusions (video inspection acceptable). Clean and repair, as necessary, such that all VBSs in operable units are functional.

c. Inspect each STS and operate on trial run (dogged off at deck level). Install STS in each intake of operational units by the end of February. However, see section 2.4.2.2. about accommodations when there is an early fish release from Spring Creek NFH.

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

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

f. Inspect and correct any deficiencies of DSM channel and conduit outfall walls and floor.

g. 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.

h. Juvenile Monitoring Facility (all equipment). Preseason inspections will focus on post-construction assessment of facility performance relative to contract requirements and potential for successful operation for fish passage. Additional operational criteria may be developed throughout the early part of the fish migration season.

i. Avian Predation Lines. Reinstall or repair avian predator control lines in present locations as soon as possible following significant damage or removal. Install and maintain new avian predator control lines in locations determined to be significantly impacted by avian predators. Implement other avian abatement measures as necessary in areas where avian lines are not practical. 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 possible after that date.

j. Inspections. 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 juvenile fish passage season.

2.4.2.2. Juvenile Fish Passage Season (March 1 through November). Juvenile fish protection devices (STSs, TIEs, etc.) will be in place for an early fish release from Spring Creek NFH, if scheduled to occur before March 1. Screens will remain in operation through December 15 to protect adult fallbacks.

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

b. 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 work day or by turning the unit off at night and letting the debris float off the racks. However, if the head exceeds 3' or if the adult fishway head is reduced, the unit’s racks will be raked immediately, even if it is early in the day. When debris accumulation is persistent, unit 18 may be operated while the fish unit is off at night to help draw loosened debris away. An FPOM task group will develop operational guidelines on an as-needed basis.

c. Operate STSs at angle of 60^{o} from vertical.

d. 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) (video is acceptable). Frequency of monthly inspections may be based on individual turbine unit run time. No STS inspections will be scheduled when they will cause excessive TDG due to increased forced spill. Summaries of STS and VBS inspections will be included in weekly operation monitoring reports. VBS inspections will occur immediately prior to peaks in juvenile fish migrations, which begin about May 1, mid-July, and September 1. Inspections will be concentrated on the priority units and others with the longer operating time. 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. Prior to pulling VBSs for inspections, shut off units and dip gatewells. It is not necessary to dip gatewells of units which have been off for 48 hours or longer.

If STS or VBS damage or plugging is detected, follow procedures in section 3. Fish Facilities Maintenance. Records of inspections or a summary of such records will be made available to the FPC by January 31, upon request.

e. Operate all gatewell orifice systems. Inspect each orifice twice daily to assure that the orifice valves and lights are operating correctly. Orifices are set to automatically flush 3 times per day, one orifice every 10 minutes. Orifices with less than a clear flow jet will be flushed. Replace all burned out orifice lights within 24 hours. Electrical modifications were made in 1996 which allow central, automatic lighting control in the second powerhouse DSM. The DSM is now darkened on a schedule as determined through coordination with the FPOM in 1994. The DSM lights should be left off, per this guidance, except when people are in the gallery. Investigation has shown that darkening the channel results in faster fish evacuation.

f. Observe each STS watt and/or amp gauge at least once each day and record reading once per day. If an STS failure occurs, then follow procedures in Section 3. Fish Facilities Maintenance.

g. Inspect all STS gatewells daily. The project will clean gatewells before the water surface becomes one-half covered with debris. If, due to the volume of debris, it is not possible to keep the gatewell surfaces half 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 second powerhouse 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.

h. A slight oily sheen is commonly found in many gatewells. This may come from sources such as lubricated lifting beams, etc. But, when unusual accumulations of oil (e.g., oil slick) occur in gate slots, they will be removed within 24 hours. When this is not possible, the JBS 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 FPC and NMFS. Regardless of unit operating status, oil accumulations will be dealt with promptly.

i. Coordinate gatewell cleaning with personnel operating downstream migrant sampling facilities.

j. Reinstall or repair avian predator control lines in present locations as soon as possible following significant damage or removal. Install and maintain new avian predator control lines in locations determined to be significantly impacted by avian predators.

k. Turbine units without a full compliment of STSs will not operate except to be in compliance with other coordinated fish measures.

l. Inspect facilities twice per day. Project fish biologist and fish biological staff will conduct at least three inspections per week.

m. All TIEs will be removed following the spring juvenile yearling chinook outmigration period, usually in early July. The TIEs will be re-installed just prior to the start of the juvenile fish passage season, including, when practicable, prior to early fish releases from Spring Creek NFH.

2.4.2.3. DSM2 Channel Operation.

a. Background. The DSM channel is controlled by a Program Logic Controller (PLC) which receives analog signals representing the add-in water supply position, orifice positions, channel elevation, and dewatering screen cleaner operation. The new DSM channel consists of an add-in water supply system at the south end of the channel, 28 non-regulating (existing) orifices, 14 regulating (new) orifices, 19 dewatering weirs, 3 dewatering screen cleaners, and one airburst system. The add-in water supply system is designed to operated continuously to increase velocities at the south end of the channel. However, due to juvenile impingement on the perf plate during the 1999 season, operation was terminated. Consequently, the supply system will not be operated in 2000 unless modifications are made to eliminate juvenile impingement on the perf plate. Operation of the orifices is determined by the PLC measuring head differential between the channel and second powerhouse forebay. The 28 non-regulating orifices were part of the original system and are designed to remain open with the exception of F2A-N and F2B-N orifices. These orifices are designated as the “north” orifices in the new system. The 14 regulating orifices are the new orifices installed during system modifications. These orifices are designated as the “south” orifices. There is one new regulating orifice in each gatewell slot in units 11-14 including two at fish unit 2. These orifices are designed to operate according to channel and forebay differential. They are operated to regulate channel elevation by opening beginning at the south end of the channel northward with the exception of the fish units. See Table BON-7 for regulating orifice criteria. Fish unit orifices F2B-S and F2A-S are designed to remain open in automatic control. As forebay decreases or head differential between the channel and forebay elevation decreases, the more regulating orifices there will be open. The dewatering weirs are manually set to maintain approximately 31 cfs entering the transportation flume. The three screen cleaners are designed to operate in automatic control, cycling every 3 hours or as determined by debris presence. The airburst system on the floor and wall screens upstream of the transportation flume entrance are designed to operate every 15 minutes.

Table BON-7. DSM2 regulating orifice control (FB is forebay and “X” is open).

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

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

2.4.2.4. Fish Transport Pipe and Flume.

a. Background. A 48″ fish transport pipe connects the DSM channel to the tailrace outfalls. The transport pipe leaves the DSM underground before opening-up to an open flume just upstream of the Juvenile Monitoring Facility (JMF). At this location, there is a switchgate (referred to as the upper switchgate) to divert the flume to sampling or bypass mode. Below the JMF, there is another switchgate (referred to as the lower switchgate) to divert fish to the high or low tailrace outfall. The high and low outfalls consist of 48″ and 42″ fish transport pipes, respectively.

b. Operation.

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

2. JMF personnel or project biologists will operate the lower switchgate as necessary depending on tailwater elevation.

3. On seasonal ascending tailwater elevations, the transition from low to high outfall should be between tailwater elevations at the upper end of 17′ to 13.5′ range.

4. On seasonal descending tailwater elevations, the transition from high to low outfall should be between tailwater elevations at the lower end of 17′ to 13.5′ range.

5. Operate the outfall avian cannons from March 1 through July 31 or as coordinated through FPOM. Only operate the respective avian cannons depending on the release point (high or low outfall). The cannons will be operated from sunrise to sunset unless otherwise coordinated through FPOM.

2.4.2.5. Juvenile Monitoring Facility.

a. Background. The JMF is comprised of a transport flume, Primary Dewatering Structure (PDS), adult transport flume, juvenile hopper, Secondary Dewatering Structure (SDS), 3-way diverter gate, 2-way diverter gate, sampling facility, and juvenile release transport flume.

b. Operation.

1. JMF personnel will operate the sampling facility as necessary to meet their sampling requirements. Operational criteria will be further refined during the 2000 fish migration season. The FPOM coordination team will be kept informed of progress and changes throughout the season.

2. The JMF will be monitored 24 hours per day, 7 days per week by PSMFC personnel to insure its proper functioning and provide quick response to an emergency while the JMF is in operation.

3. A person on duty will perform a walk-through inspection of the entire facility every two hours to ensure safe fish passage conditions.

4. Particular attention will be paid to the following: dewatering facilities including the PDS, SDS, PDS screen cleaner system, adult transport flume, juvenile hopper, all valves and auxiliary water systems, flushing water systems and their perforated plates, all gates including switch and diverter gates, PIT tag detectors, and all monitoring building systems including holding tanks, valves, and conduits to prevent injury and/or mortality to passing fish.

5. Ensure that outfall avian cannons are operating.

2.4.2.6. System Failures.

a. Any system failure will be reported to a project biologist as soon as possible. If a project biologist is unavailable, the control room will be contacted. The following actions should be taken in specific situations:

1. If a high water situation occurs in the PDS area, contact the control room immediately. If water level is uncontrollable, immediately switch the upper switchgate to bypass mode until the problem is corrected.

2. If a monitoring facility failure occurs, immediately switch the upper switchgate to bypass mode until repairs are made.

3. If a lower switchgate failure occurs that results in releasing to the wrong high or low outfall and repairs can not be made within 24 hours, the special operation will be coordinated through FPOM.

2.4.2.7. Winter Maintenance Season (December 16 through February). The end of the season may be shortened for an early fish release from Spring Creek NFH. To reduce adult fallback mortality, the juvenile bypass system, or DSM channel will operate from November 30 through December 15. STSs in priority units will be left in place during this period. Screens from non-priority units may be removed between December 1 and 15, but only if scheduled for maintenance. In all units, screens that are not being serviced shall be left in place during this period. Unscreened units will be operated on a last-on, first-off basis. Beginning December 16, all remaining STSs may be removed. DSM may be dewatered (see section 5. Dewatering Plans) only when required for maintenance. The maintenance period will be minimized to the extent practicable. Facilities, when operating, are to be inspected at least once per day to assure criteria are being met. These inspections are to be performed at least three times per week by the project fish biologist and fish biological staff.

2.4.3. Spillway Operating Criteria.

2.4.3.1. Prior to Juvenile Fish Passage Season (December 1 through February).

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

b. 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 juvenile fish passage season.

2.4.3.2. Juvenile Fish Passage Season (March 1 through November). Bonneville Dam uses a single spill schedule for both day and night. Spill will be provided according to the guidance in section 2.2.

2.4.3.3. Winter Maintenance Season (December 16 through February). Refer to Appendix E for spill guidance during non-passage periods at Bonneville Project.

2.5. Adult Fish Passage Facilities.

2.5.1. Operating Criteria.

2.5.1.1. Prior to Primary Adult Passage Period (December 1 through end of February).

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

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

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

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

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

2.5.1.2. Primary Adult Fish Passage Period (March 1 through end of November).

a. All Adult Facilities.

1. Maintain the water depth over fish ladder weirs at 1' +/- 0.1' during the non-shad passage season (August 16 through May 14) and 1.3' +/- 0.1' during the shad passage season (May 15 through August 15). These 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 in the Cascades Island just downstream of the entrance to the UMT. For FV3-9 calibration purposes to achieve the target depth in the A and B branches, the depth in the main ladder below the count station is 1.1' during shad passage and 0.9' during the non-shad season.

2. Water temperature will be measured in an adult fishway at each powerhouse. When water temperature reaches 70^{o} F, all fish handling activities will be coordinated through FPOM prior to any action to verify protocols that will be followed. Fish handling activities in the Adult Fish Collection and Monitoring Facility (AFC&MF) will implement protocols in Appendix H.

3. Head on all entrances should be: 1' to 2' (1.5' preferred). Head at the NUE is calculated differently because the collection channel staff gauge 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 gauges closest to NUE. Refer to section 3.3., Adult Fish Passage Facilities, when unable to achieve head criterion.

4. A water velocity of 1.5 to 4 fps (2 fps preferred) shall be maintained for the full length of the powerhouse collection channel, and the lower ends of the fish ladders which 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. Water velocities in the UMT shall be maintained within criteria, but the channel will not contain a permanent velocity meter.

5. A maximum of 0.5' head will be allowed on the first powerhouse 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.

6. Staff gauges and water level indicators will be readable at all water levels encountered during the fish passage period. These include the PH1 south collection channel, PH1 north collection channel, PH1 north tailwater, PH1 south forebay, BI A and B branch ladders, BI first weir, B branch entrance, CI entrance, CI ladder below the UMT entrance, NUE/NDE/SUE/SDE collection channel, NUE/SUE tailwater, and PH2 north forebay. Stillwells used in lieu of staff gauges will be checked for calibration once per week and summaries of these stillwell calibrations will be included in weekly operation monitoring reports.

7. The current fish counting program is conducted 24 hours per day, year around. Count station crowders shall remain in the operating position while visual counting and/or video taping is being conducted. The crowder shall be closed to allow the count slot width to be no less than 18". This will usually occur during high turbidity conditions to allow count accuracy criteria to be achieved. If passage is impaired by this condition, the count slot may be widened until proper passage conditions are achieved, even though count accuracy may be compromised to some degree. Project biologists, FFU, and the WDFW fish count supervisor shall coordinate to achieve optimum count slot passage and/or count accuracy conditions. If counting is temporarily discontinued due to unscheduled events, the crowder shall be fully opened. The crowder may remain in operating position during the counters' hourly ten-minute break period. Leave the fish passage slot lighted overnight.

8. Inspect facilities twice per day. Project fish biologist and fish biological staff will conduct at least three inspections per week.

9. 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.

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

b. Spillway Ladders.

1. Spillway gates 1 and 18 shall be open 4" for adult attraction. This operation provides adult fish attraction flow adjacent to ladder entrances.

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

c. First Powerhouse.

1. General. The Program Logic Controller (PLC) receives analog signals representing the 4 weir gate positions, the 5 orifice gate positions, the north, central, and south tailwater and collection channel water elevations, and the water pressure at the south end of the auxiliary water conduit. It also receives inputs from the bulkhead upper/lower limit switches. From this information, the PLC control program determines when to activate outputs which serve to raise or lower the weir gates, bulkheads, orifice gates, sluice gates, A branch diffusion gates, and fish valves FV1-1 and FV3-7.

2. Weir Gates. The first powerhouse weir gates will be operated as shown in Table BON-8.

3. 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 (enabled) for tailwater elevations greater than 23' msl., while gates 2 and 64 will operate together as the active pair (enabled) 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'.

Table BON-8. Bonneville Dam first powerhouse weir gate requirements.

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

* When tailwater is <13.5’, the 8’ submergence requirement can not be satisfied. From tailwater of 13.5’ to 10.0’ (when gate is on sill), the pressure differential between the auxiliary water supply conduit and the collection channel exceeds the safety limit of 10 psi.

4. Gate Pair Enabling/Disabling. If the tailwater elevation is 26' or greater, gates 2 and 64 will be closed off (raised to their maximum position and their bulkheads lowered) and their control disabled. Gates 1 and 65 will be enabled and will therefore operate as described above. Gates 1 and 65 will then continue to be enabled (and gates 2 and 64 closed off and their control disabled) until the tailwater elevation drops below 23'. Once this occurs, the bulkheads for gates 2 and 64 will be raised, the control for gates 2 and 64 will be enabled and these gates will be moved to their appropriate post-transition positions, and gates 1 and 65 will be raised to their maximum closed positions. The control for gates 1 and 65 will then be disabled. Gates 2 and 64 will then be the active pair.

If the tailwater elevation is less than 23', gates 1 and 65 will be closed off (raised to their maximum positions) and their control disabled. Gates 2 and 64 will be enabled and will then operate as described above. Gates 2 and 64 will then continue to be enabled (and gates 1 and 65 closed off and their control disabled) until the tailwater elevation rises to 26'. Once this occurs, the control for gates 1 and 65 will be enabled and these gates will be moved to their appropriate post-transition positions, gates 2 and 64 will be raised to their maximum positions, and the bulkheads for gates 2 and 64 will be lowered. The control for gates 2 and 64 will then be disabled. Gates 1 and 65 will then be the active pair.

5. Transition Positioning. During a transition, the former active pair is closed and the new active pair is positioned according to tailwater. If gates 1 and 65 are the active pair and the tailwater falls below 23', there is a transition in which gates 2 and 64 will be enabled and moved to their appropriate post-transition positions. Gates 1 and 65 will then be raised to their maximum closed position (26'). If gates 2 and 64 are the active pair and the tailwater rises to more than 26', there is a transition in which gates 1 and 65 then become the active pair. Gates 1 and 65 will be enabled and moved to their appropriate post-transition positions. Gates 2 and 64 will be raised to their maximum closed position (gate 2: 11', gate 64: 18'). In either case, there is a 1.5' "dead band" as described above.

6. Control of Orifice Gates 9, 21, 34, 58 and 62. Orifice gates open from tailwater elevation 16.2' to 36' on a rising tailwater and elevation 36' to 15.8' on a falling tailwater.

7. Control of Sluice Gates 9, 21, 34, 58 and 62. Sluice gates open from tailwater elevation 15.8' and less on a falling tailwater and close from tailwater elevation 16.2' and more on a rising tailwater.

8. Control of Fish Valve FV1-1.

(a) Emergency Closure. If the collection channel/tailwater differential is greater than 2.5' or if the pressure differential between the auxiliary water supply conduit and the collection channel exceeds 10 psi.

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

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

10. Control of A-Branch Diffusion Gates FG3-3, 4, 5, 6, 7, 8, and 9. First powerhouse A-branch diffusers are open according to the pattern in Table BON-9.

11. First Powerhouse Collection Channel Diffusers. Diffuser valves are operated according to the pattern in Table BON-10.

Table BON-9. Bonneville Dam A-branch diffuser operating ranges.

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

Table BON-10. Bonneville Dam first powerhouse adult fish collection channel diffuser valve settings.

Valve	Setting	Valve	Setting
FG2-1	Closed	FG2-13	Closed
FG2-2	Closed	FG2-14	Closed
FG2-3	Closed	FG2-15	Closed
FG2-4	Open	FG2-16	Closed
FG2-5	Closed	FG2-17	Closed
FG2-6	Closed	FG2-18	Closed
FG2-7	Closed	FG2-19	Open
FG2-8	Open	FG2-20	Open
FG2-9	Closed	FG2-21	Open
FG2-10	Closed	FG2-22A	Open
FG2-11	Closed	FG2-22B	Open
FG2-12	Open		

d. Second Powerhouse.

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

2. Operate all 12 powerhouse floating gate fishway entrances.

e. Spillway Operations. Bonneville Dam uses a single spill schedule (Table BON-11) for both day and night. See section 2.2. Spill Management for guidance.

2.5.2. Winter Operating Period, or In-water Work Period (December 1 through February).

2.5.2.1. Adult Fish Facilities. Operate the adult fish passage facilities according to the fish passage period standards above, except systems may be dewatered or operated out of criteria for repair and maintenance.

a. Only one of the ladders servicing the two powerhouses and the associated powerhouse collection system (including the auxiliary water supply system) may be out of service or operating out of standard operating criteria at any one time unless specifically coordinated. Turbines will be operated in the priority outlined in section 2.1.1. during the winter maintenance period. One of the two ladders servicing the spillway channel will be in full operation at all times unless specially coordinated. Outage periods will be minimized to the extent practicable.

b. Adult facilities will be inspected once per day to assure operation as per criteria above. Project fish biologist and fish biological staff will conduct at least three inspections per week.

c. Spill bays 1 and 18 may be on seal throughout the winter operating period.

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

2.6. Facility Monitoring and Reporting.

2.6.1. Inspections. The project will inspect fish passage facilities at least twice per day to assure operation according to established criteria. More frequent inspections of some facility components will occur as noted throughout the text. The project fish biologist and fish biological staff will conduct at least three inspections per week. Additional fishway inspections may be performed by FFU and fish agencies.

2.6.2. 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.

2.6.3. Reporting. 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: any out-of-criteria situations observed and subsequent corrective actions taken; any equipment malfunctions, breakdowns, or damage along with a summary of resulting repair activities; adult fishway control calibrations; STS and VBS inspections; AWS closures (i.e. cleaning times); times picket leads were lowered and raised in the Washington shore ladder when adult trapping is occurring in the adult fish collection and monitoring facility (AFC&MF); and any unusual activities which occurred at the project which may affect fish passage. The weekly reports shall cover a Sunday through Saturday time period and the Operations Manager shall send them to CENWP-OP and other interested parties as soon as possible the following week, with a copy to RCC, Attention: Fish Team. The reports may be delivered electronically. The project biologist shall prepare an annual report by January 31, summarizing the operation of the project fish passage facilities for the previous year. The report will cover from the beginning of one adult fish facility winter maintenance period to the beginning of the next. The annual report will be provided to CENWP-OP in time for distribution to FPOM members at the February meeting.

3. Fish Facilities Maintenance.

3.1. General.

3.1.1. Scheduled Maintenance.

3.1.1.1. Staff gauges will be installed, cleaned, and/or repaired as required.

3.1.1.2. 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. Maintenance activities that occur during the fish passage period and that may affect fish passage will be reported in the weekly reports (section 2.6.3.).

3.2. Juvenile Fish Passage Facilities.

3.2.1. Scheduled Maintenance.

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

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

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

3.2.1.3. 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 (see section 5. Dewatering Plans). The maintenance schedules for these turbines and spillways will be coordinated with fish agencies through the FPOM. Certain turbine and spillway discharges at the projects are secondarily used to attract adult fish to fishway entrances, to keep predator fish from accumulating near juvenile release sites, and to move juveniles downstream away from the project. 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. Units which should not be scheduled for maintenance during the fish passage season are F1, F2, 1, 2, 9, 10, 11, 17, and 18.

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.

3.2.2. Unscheduled Maintenance. Maintenance of facilities such as fish screens, which sometimes break down during the fish passage season, will be carried out as described below. Unscheduled maintenance that will have a significant impact on juvenile fish passage shall be coordinated with FPOM and NMFS on a case-by-case basis by project and CENWP-OP biologists. The CENWP-OP 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-OP when delay of the work will result in an unsafe situation for people, property, or fish. Information required by CENWP-OP includes:

a. Description of the problem.

b. Type of outage required.

c. Impact on facility operation.

d. Length of time for repairs.

e. Expected impacts on fish passage.

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

3.2.2.2. Juvenile Bypass System. Juvenile bypass systems are controlled automatically (PLC). When an automatic system fails, it can usually be operated manually. This allows either facility to operate according to criteria while repair of the automatic system is completed. 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. If the automatic systems fail and the system is operated manually, facility inspections should be increased to a frequency that assures these systems continue to operate within criteria.

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

a. First Powerhouse. If any part of the dewatering screen, downwell, or juvenile release conduit fails, making this portion of the system unsafe for juvenile fish, the juveniles will be diverted to the ice and trash sluiceway. This operating mode will require the gate at the south end of the DSM channel to be removed and a stop-log installed at the north end so migrants will flow down into the ice and trash sluiceway channel. Assure that sluiceway gate 7A is opened to 72' msl, gate 10C is opened fully, and the ice and trash sluiceway end gate is open to provide safe transportation flows for juveniles. Forebay elevation will be kept above 74' msl to the extent practicable. The bypass will then continue operating while repairs are completed. In either operating mode, the orifices will be cleaned with the air pressure system at least once per day, when plugged orifices are indicated, or after trash rack raking and gatewell debris removal.

b. Second Powerhouse. 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 second powerhouse. Repairs will receive high priority.

c. During fishway inspections the VBSs may be found plugged or damaged. 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.

3.2.2.3. 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.

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 the fish passage way and physically inspecting the diffuser gratings, or by 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. Daily inspections of fish ladders and collection systems should include looking for any flow changes which 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, creating openings into the diffuser chambers, a method of repair shall be developed and coordinated with the fish agencies and tribes through the established coordination procedure. Repairs shall be made as quickly as possible unless coordinated differently.

3.3. Adult Fish Passage Facilities.

3.3.1. Scheduled Maintenance. Maintenance activities that occur during the fish passage period and that may affect fish passage will be reported in the weekly reports (section 2.6.3).

3.3.1.1. 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.

3.3.1.2. 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 (see section 5. Dewatering Plans.). A diver or underwater video system may be used for the underwater inspections. This scheduled inspection and any associated maintenance will occur during the winter maintenance period (in-water work period) unless specially coordinated. Any non-routine maintenance and fishway modifications will be handled on a case by case basis.

A project biologist or alternate Corps fish personnel will attend all dewatering activities potentially involving fish, as well as inspections, to provide fish-related input (see section 5. Dewatering Plans).

3.3.1.3. Adult Fish Ladders and Counting Stations. The adult fish ladders will be dewatered once each year during the winter maintenance period. During this time, the ladders will be inspected for blocked orifices, projections into the fishway that may injure fish, stability of the weirs, damaged picket leads, exit gate problems, loose diffusion gratings, unreadable or damaged staff gauges, defective diffusion valves, and malfunctioning operating equipment at the counting stations, as well as other potential problems. Problems identified throughout the passage year that do not affect fish passage, as well as those identified during the dewatered period, may then be repaired. Trash racks at the ladder exits will be raked when criteria is approached or exceeded. When practicable, rake trash racks during the time of day when fish passage is least affected. 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.

3.3.2. Unscheduled Maintenance. Maintenance activities that occur during the fish passage period and that may affect fish passage will be reported in the weekly reports (section 2.6.3.). Unscheduled maintenance that will significantly affect the operation of a facility, such as repair of displaced diffuser gratings, will be coordinated with the CBFWA (through the FPC) and NMFS. Coordination procedures for unscheduled maintenance of adult facilities are the same as for juvenile facilities (section 3.2.2).

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

a. First Powerhouse. If any of the valves or any other part of the system fails, then the project is to attempt to maintain criteria by adjusting those valves which continue to function. Conduit pressure must be monitored and not allowed to exceed the established limits. If this maneuver fails to keep the facility operating according to the adult fishway criteria and repairs cannot be made within 24 hours, then close powerhouse entrances 9, 21, 34, 58, and 62, one at a time, starting with gate 9 and proceeding north.

If closing the orifice gate fails to achieve a minimum fishway head of 1' when tailwater is greater than 17' msl, then operation of gate 1 and gate 65 weirs becomes necessary. Operational guidelines of these gates appear in section 2.5.1.2.c.

When tailwater elevation is less than 17' and the gate 65 weir crest is at least 6' below tailwater, then operation of gates 1, 2, 64, and 65 becomes necessary. Operational guidelines of these gates appear in section 2.5.1.2.c.

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, stoplogs are to be added to the entrance slots until the desired head or a weir depth of not less than 6' below the tailwater surface is reached. At this point maintain the gate positions until the auxiliary water system is repaired.

c. Second Powerhouse.

1. If either or both of the fishway auxiliary water turbines are unable to provide water sufficient to meet full criteria between April 1 and August 31, the adult facilities will be operated as follows or until a fishway head of 1′ is achieved.

(a) Raise the NUE in 1′ increments until weir crest is 8′ below tailwater or a fishway head of at least 1′ is achieved.

(b) Raise the SUE in 1′ increments until weir crest is 8′ below tailwater or a fishway head of at least 1′ is achieved.

(c) Raise the SDE in 1′ increments until weir crest is 8’ below tailwater or a fishway head of at least 1’ is achieved.

(d) Raise the NDE in 1’ increments until weir crest is 8’ below tailwater or a fishway head of at least 1’ is achieved.

(e) Raise the NUE in 1’ increments until weir crest is 6’ below tailwater or a fishway head of at least 1’ is achieved.

(f) Raise the SUE in 1’ increments until weir crest is 6’ below tailwater or a fishway head of at least 1’ is achieved.

(g) Raise the SDE in 1’ increments until weir crest is 6’ below tailwater or a fishway head of at least 1’ is achieved.

(h) Raise the NDE in 1’ increments until weir crest is 6’ below tailwater or a fishway head of at least 1’ is achieved.

(i) Close the NUE.

(j) Close the SUE.

2. If one of the fishway water supply turbine units fails between September 1 and March 31, during a time when tailwater is high enough that normal operation can’t be maintained using the remaining fish unit, and repairs can’t be made within 24 hours, then the ice and trash sluiceway will be used to supplement discharge to allow operation of the fishway according to the above standards. Between September 1 and 15, and between March 1 and 31, the juvenile and adult runs will be evaluated to decide if the sluice chute should be operated when one fish unit is out of service. Care will be taken to keep the trash chute screen free of debris. When the ice and trash chute is operated as supplemental discharge, a barrier rack will be used at the entrance to the ice and trash chute to exclude adult salmonids. Under this operation, the ice and trash chute downstream end gate will be raised briefly at least once weekly to flush trapped juvenile salmonids, smaller resident fish, and debris out of the chute. If the rack is not used, the chute will be flushed twice weekly, on Monday and Thursday, or more frequently if needed. Frequency of use during peak adult passage season (September to early October) will be coordinated with FPOM.

3. If both of the fishway auxiliary water turbines fail between September 1 and March 31, and repairs can not be made within 8 hours, then the ice and trash chute will be started. The adult facilities will be operated as follows or until a fishway head of 1′ is achieved.

(a) Close the NUE and SUE.

(b) Operate the SDE and NDE weir crest at 8′ below tailwater or until a fishway head of at least 1′ is achieved.

(c) Operate the SDE and NDE weir crest at 6′ below tailwater or until a fishway head of at least 1′ is achieved.

(d) Close the SDE.

(e) If the back-up auxiliary water system must be used for a period exceeding 30 days, then block off as many of the floating orifice gates as possible beginning in the center and proceeding north and then south and open the SDE and NDE to a weir depth of 8′ below tailwater. While under this configuration, power generation at the second powerhouse will be minimized to reduce fish attraction into this area.

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

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

3.3.2.2. 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.

3.3.2.3. Adult Fish Ladders and Counting Stations. The first powerhouse ladder was completed in 1937 and the second powerhouse ladder in 1981. Modification of the first powerhouse ladder was completed during the winter of 1981-82. The components of the ladders include picket leads, counting stations, fishway exits, and overflow weirs with orifices. Picket leads can cause problems. 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 FPOM.

3.3.2.4. 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 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. Daily inspections of fish ladders and collection systems should include looking for any flow changes which 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, creating openings into the diffuser chambers, a method of repair shall be developed and coordinated with the fish agencies and tribes through the established coordination procedure. Repairs shall be made as quickly as possible unless coordinated differently.

4. Turbine Unit Operation and Maintenance.

4.1. Unit operating priority throughout the year is shown in section 2.1.1, Powerhouse Flow Distribution. Operating the end units provides attraction flow for adult fish at both powerhouses and helps move juvenile fish out of the first powerhouse tailrace.

4.2. Turbine units will operate within 1% of best efficiency and within cavitation limits at various head ranges as shown in Tables BON-11 through BON-13 for both powerhouses. Operating ranges for the first powerhouse (Tables BON-11 and BON-12) do not include the influence of the prototype surface collector or ESBSs which have been installed to conduct fish passage studies. Also, first powerhouse units 4 and 6 have different MW output requirements because they are minimum gap runner units and have a different MW versus discharge relationship.

4.3. To the extent technically feasible, turbines will be operated within +/-1% of best turbine efficiency, unless operation outside of that range is necessary to meet load requests from the BPA administrator, consistent with BPA’s System Load Shaping Guidelines (Appendix C), to avoid excess daytime spill (during the time of year when the 75 kcfs spill cap applies), or to comply with other coordinated fish measures. The guidelines apply between March 15 and October 31. However, during the rest of the year, the project will continue to operate units within the 1% turbine efficiency range, except as specifically requested by BPA to do otherwise as provided in Appendix C.

4.4. If it is necessary to operate outside the +/- 1% efficiency range, then units which pass the least fish should be selected first. Assuming a preference to pass fish through the juvenile bypass system, units which pass the least fish will be selected first. Therefore, when units must be selected to operate outside the 1% efficiency range, they will be chosen according to the following prioritized list, when not constrained by specific project limitations: (5-8), 3, 9, 10, 2, 1, 15, 14, 13, 16, 12, 17, 11, 18.

Table BON-11. Turbine operating ranges within the 1% turbine efficiency range for Bonneville first powerhouse, units 1-3, 5, and 7-10.

	First Powerhouse (units 1-3, 5, 7-10)							
	With STS				Without STS			
Head (feet)	Lower Limit (MW)	Lower Limit (cfs)	Upper Limit (MW)	Upper Limit (cfs)	Lower Limit (MW)	Lower Limit (cfs)	Upper Limit (MW)	Upper Limit (cfs)
35	12.7	5,285	29.2	12,107	13.2	5,385	31.0	12,620
36	13.3	5,345	30.3	12,212	13.7	5,409	32.3	12,716
37	13.8	5,401	31.5	12,310	14.2	5,431	33.5	12,803
38	14.4	5,453	32.7	12,401	14.7	5,450	34.8	12,882
39	14.9	5,501	33.8	12,486	15.2	5,466	36.0	12,954
40	15.1	5,377	35.1	12,485	15.7	5,481	37.3	13,020
41	15.6	5,422	36.2	12,557	16.3	5,5282	38.5	13,095
42	16.2	5,464	37.4	12,623	16.8	5,571	39.8	13,165
43	16.7	5,504	38.6	12,685	17.4	5,612	41.0	13,230
44	17.3	5,541	39.7	12,743	18.0	5,650	42.3	13,291
45	17.8	5,576	40.9	12,796	18.5	5,685	43.5	13,347
46	18.4	5,633	41.8	12,769	19.2	5,743	44.4	13,319
47	19.1	5,687	42.7	12,742	19.8	5,798	45.4	13,292
48	19.7	5,738	43.6	12,716	20.4	5,851	46.3	13,265
49	20.3	5,786	44.5	12,690	21.1	5,900	47.3	13,238
50	20.9	5,832	45.4	12,664	21.7	5,947	48.2	13,211
51	21.7	5,923	46.1	12,587	22.5	6,041	49.0	13,131
52	22.5	6,011	46.8	12,512	23.3	6,130	49.8	13,075
53	23.2	6,095	47.4	12,440	24.2	6,216	50.6	13,020
54	24.0	6,174	48.1	12,370	25.0	6,297	51.4	12,966
55	24.8	6,251	48.8	12,302	25.8	6,376	51.9	12,836
56	25.3	6,2626	50.1	12,400	26.3	6,387	53.3	12,938
57	25.8	6,273	51.3	12,495	26.8	6,398	54.6	13,036
58	26.3	6,284	52.6	12,587	27.3	6,409	55.9	13,132
59	26.7	6,294	53.8	12,676	27.8	6,420	57.2	13,225
60	27.2	6,305	55.1	12,762	28.3	6,430	58.6	13,315
61	27.6	6,298	56.2	12,810	28.7	6,423	59.7	13,365
62	28.0	6,292	57.2	12,857	29.1	6,417	60.9	13,413
63	28.4	6,286	58.3	12,903	29.5	6,411	62.0	13,461
64	28.4	6,281	59.4	12,947	29.9	6,405	63.1	13,507
65	29.2	6,275	60.5	12,991	30.4	6,399	64.3	13,553
66	29.9	6,328	61.3	12,986	31.0	6,453	65.1	13,547
67	30.5	6,379	62.1	12,981	31.7	6,505	66.0	13,541
68	31.2	6,429	62.9	12,977	32.4	6,556	66.9	13,537
69	31.8	6,478	63.7	12,947	33.1	6,606	67.8	13,533
70	32.5	6,526	64.5	13,968	33.8	6,654	68.6	13,529

Table BON-12. Turbine operating ranges within the 1% turbine efficiency range for Bonneville first powerhouse, units 4 and 6.

	First Powerhouse (units 4 and 6)							
	STS				Without STS			
Head (feet)	Lower Limit (MW)	Lower Limit (cfs)	Upper Limit (MW)	Upper Limit (cfs)	Lower Limit (MW)	Lower Limit (cfs)	Upper Limit (MW)	Upper Limit (cfs)
35	17.5	6,761	24.3	9,386	18.9	7,246	24.4	9,365
36	18.1	6,776	25.1	9,406	19.5	7,250	25.2	9,368
37	18.7	6,790	25.9	9,424	20.1	7,252	26.0	9,370
38	19.2	6,803	26.7	9,440	20.7	7,253	26.8	9,369
39	19.8	6,814	27.5	9,455	21.4	7,253	27.6	9,368
40	20.4	6,764	28.2	9,384	22.0	7,251	28.4	9,364
41	20.9	6,770	29.4	9,519	22.6	7,257	29.5	9,499
42	21.5	6,775	30.6	9,646	23.2	7,263	30.7	9,626
43	22.0	6,779	31.7	9,766	23.8	7,267	31.9	9,746
44	22.6	6,783	32.9	9,880	24.4	7,271	33.0	9,860
45	23.1	6,786	34.0	9,988	25.0	7,274	34.2	9,967
46	23.7	6,789	35.0	10,031	25.6	7,278	35.1	10,010
47	24.2	6,793	35.9	10,071	26.2	7,282	36.1	10,050
48	24.8	6,795	36.9	10,109	26.8	7,285	37.1	10,088
49	25.4	6,798	37.8	10,145	27.4	7,287	38.0	10,124
50	25.9	6,799	38.8	10,178	28.0	7,289	39.0	10,157
51	26.5	6,802	39.8	10,221	28.6	7,293	40.0	10,201
52	27.0	6,805	40.8	10,262	29.2	7,296	40.5	10,145
53	27.6	6,808	41.7	10,301	29.8	7,298	41.1	10,092
54	28.1	6,810	42.7	10,339	30.4	7,301	41.7	10,040
55	28.7	6,811	43.7	10,374	31.0	7,302	43.9	10,353
56	29.2	6,816	44.7	10,433	31.5	7,308	44.9	10,412
57	29.8	6,821	45.8	10,489	32.1	7,312	46.0	10,468
58	30.3	6,825	46.9	10,544	32.7	7,317	47.1	10,523
59	30.9	6,829	47.9	10,596	33.3	7,322	48.1	10,575
60	31.4	6,833	49.0	10,647	33.9	7,326	49.2	10,626
61	32.0	6,843	49.6	10,609	34.5	7,337	49.8	10,587
62	32.6	6,853	50.3	10,572	35.2	7,347	50.5	10,551
63	33.2	6,863	50.9	10,536	35.8	7,358	51.2	10,515
64	33.8	6,872	51.6	10,501	36.4	7,367	51.8	10,480
65	34.4	6,881	52.3	10,467	37.1	7,377	52.5	10,446
66	34.8	6,872	53.2	10,502	37.6	7,368	53.4	10,481
67	35.3	6,864	54.1	10,535	38.1	7,360	54.4	10,514
68	35.7	6,857	55.1	10,569	38.6	7,351	55.3	10,547
69	36.2	6,850	56.0	10,601	39.1	7,344	56.3	10,580
70	36.7	6,643	57.0	11,451	39.6	7,336	57.2	10,611

Table BON-13. Turbine operating ranges within the 1% turbine efficiency range for Bonneville second powerhouse, with or without STSs in place.

Head (feet)	Second Powerhouse (units 11-18)			
	Lower Limit (MW)	Lower Limit (cfs)	Upper Limit (MW)	Upper Limit (cfs)
34	29	12,047	39	16,478
35	29	12,055	40	16,578
36	30	12,063	41	16,578
37	31	12,070	43	16,627
38	32	12,078	44	16,677
39	33	12,086	45	16,727
40	34	12,044	47	16,777
41	35	12,022	49	16,826
42	36	11,960	51	16,876
43	37	11,918	53	16,926
44	38	11,881	55	17,008
45	39	11,844	56	17,090
46	39	11,807	58	17,173
47	40	11,770	59	17,255
48	41	11,733	61	17,337
49	42	11,747	63	17,338
50	43	11,760	65	17,338
51	44	11,774	66	17,339
52	45	11,787	68	17,339
53	46	11,801	70	17,340
54	47	11,842	72	17,340
55	48	11,884	73	17,341
56	49	11,925	75	17,342
57	51	11,967	76	17,342
58	52	12,008	77	17,343
59	53	12,050	77	17,343
60	54	12,091	77	17,344
61	55	12,103	77	16,967
62	56	12,115	77	16,590
63	57	12,128	77	16,214
64	58	12,140	77	15,837
65	59	12,152	77	15,460
66	60	12,164	77	15,083
67	61	12,176	77	14,706
68	62	12,189	77	14,330
69	63	12,201	77	13,953
70	64	12,213	77	13,576

4.5. 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 non-fish passage periods, or when there are low numbers of fish passing the project. See section 3.2.1.3.

4.5.1. Unit 10 provides important attraction flow for adult fish and helps move juvenile fish out of an area of high predation in the tailrace. Therefore, long-term outages will be avoided after the beginning of the juvenile fish passage season, particularly the first Spring Creek NFH fish release, until after the adult fall chinook and coho runs at the end of October.

4.5.2. Unit 1 provides important attraction flow for adult fish, and, when the juvenile bypass system flow is reversed, it also helps move juvenile fish downstream. Therefore, long-term outages will be avoided after the beginning of the juvenile fish passage season, particularly the first Spring Creek NFH fish release, until after the adult fall chinook and coho runs at the end of October.

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

4.6. Until problems with the second powerhouse hydraulic head gate operating system are corrected, the gates at units 11 through 18 will be set onto the latches. 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. Dewatering Plans.

5.1. Guidelines for Dewatering and Fish Handling Plans (Appendix G) 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. Although it isn’t a complete dewatering, the procedure for reversing flow in the first powerhouse DSM is also included in Appendix G.

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

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

5.4. Juvenile bypass systems. Key elements of the Guidelines for Dewatering and Fish Handling Plans (Appendix G) for JBS flow reversal are shown in sections 5.4.1. through 5.4.5., below.

5.4.1. A project biologist will attend all activities which involve dropping the JBS water surface below the end of the dewatering screen. Refer to the project Fish Salvage Plan for descriptions of JBS dewaterings. (The plan is available from project biologists).

5.4.2. Personnel involved in use of the sampling facilities will be advised before facilities are drained.

5.4.3. Automatic controls for the trash sweeps will be turned off.

5.4.4. Flow through the dewatering screen will be reduced before the water level drops below the upper end of the screen. Refer to the Fish Salvage Plan.

5.4.5. The area beneath the dewatering screen will be filled before allowing water in the channel to rise to the elevation of the dewatering screen.

5.5. Adult Fish Ladder.

5.5.1. Scheduled Maintenance.

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

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

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

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

5.5.1.5. A 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. Rescue personnel will walk the inside of the ladder from the head gates down to tailwater, salvaging all fish either by moving fish to tailwater within the ladder flow, or capturing and placing the fish in a large water-filled tank, which is then transported to the forebay or tailrace for release. Adult fish will be released into the forebay and juvenile fish will be released into the tailrace. If a ladder is dewatered in the spring or summer, steelhead kelts will be released into the tailrace.

5.5.1.6. 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 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.

5.5.2. Unscheduled Maintenance.

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

5.5.2.2. Follow guidance in sections 5.5.1.3. through 5.5.1.5. above.

5.6. Powerhouse Fish Collection System.

5.6.1. Scheduled Maintenance.

5.6.1.1. During the pumping or draining operation to dewater a portion or all of the collection channel, the water level will not be allowed to drop to a level which strands fish. Adequate inspections will be conducted to ensure that stranding does not occur.

5.6.1.2. A project biologist will assure that rescue equipment and adequate personnel are available if needed.

5.6.1.3. A project biologist will provide technical guidance to assure fish safety and will assist directly as needed in rescue operations.

5.7. Turbines.

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

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

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

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

5.7.5. Fish rescue personnel will inspect dewatered turbine draft tubes, scroll cases, and intakes as soon as the water levels reach a depth permitting visual inspection and the hatch cover is opened. A project biologist and/or alternate Corps fish personnel will provide technical guidance for fish safety and will directly participate in fish salvage.

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

5.7.7. 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. Forebay Debris Removal. Debris can impact fish passage conditions in several ways. It can plug or block trash racks, VBSs, gatewell orifices, dewatering screens, and facility piping, resulting in impingement, injuries, and descaling of fish. Debris is removed by operating the ice and trash sluiceway at the first powerhouse, the ice and trash chute at the second powerhouse, or passing it through the spillway with special spill gate operation.

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-OP at least two work days prior to the day the special operation is required. Using information provided by the project, CENWP-OP will coordinate with RCC, NMFS, and other FPOM members as necessary. Once the coordination is complete, RCC will issue a teletype detailing the specifics of the special operations.

7. Response to Hazardous Materials Spills. Bonneville Project’s guidance for responding to hazardous substance spills is contained in its Emergency Spill Response Plan. This guidance will be followed in case of a spill. The project biologist will be contacted as soon as possible after a hazardous material release. The project biologist will in turn contact the CENWP-OP biologist, NMFS, and FPC.

Table BON-14. Spill patterns for Bonneville Dam.

Bay Number																		Total Dogs	kcfs
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18		
4"	1																4"	1	3.1
4"	1															1	4"	2	6.2
4"	1	1														1	4"	3	9.3
4"	1	1													1	1	4"	4	12.4
4"	1	1	1												1	1	4"	5	15.5
4"	1	1	1											1	1	1	4"	6	18.6
4"	1	1	1	1										1	1	1	4"	7	21.7
4"	1	1	1	1									1	1	1	1	4"	8	24.8
4"	1	2	1	1									1	1	1	1	4"	9	28.5
4"	3	2									2				1	2	4"	10	33.6
4"	3	2									2				2	2	4"	11	37.2
4"	3	2			1						2				2	2	4"	12	40.3
4"	3	2			2						2				2	2	4"	13	43.9
4"	3	2	1		2						2				2	2	4"	14	47.0
4"	3	2	1		2						2			1	2	2	4"	15	50.1
4"	3	2	1		2				1		2			1	2	2	4"	16	53.2
4"	3	2	1		2				2		2			1	2	2	4"	17	56.9
4"	3	2	2		2				2		2			1	2	2	4"	18	60.5
4"	3	2	2		2		1		2		2			1	2	2	4"	19	63.6
4"	3	2	2		2		2		2		2			1	2	2	4"	20	67.2
4"	3	2	2		2		2		2		2		1	1	2	2	4"	21	70.3
4"	3	2	2		2		2		2		2		2	1	2	2	4"	22	74.0
4"	3	2	2		2		2		2		2		2	1	2	3	4"	23	77.5
4"	3	2	2		2		2		2		2		2	2	2	3	4"	24	81.1
4"	3	3	2		2		2		2		2		2	2	2	3	4"	25	84.6
4"	3	3	2		2		2	1	2		2		2	2	2	3	4"	26	87.7
4"	3	3	2		2		2	2	2		2		2	2	2	3	4"	27	91.4
4"	4	3	2		2		2	2	2		2		2	2	2	3	4"	28	94.9
4"	4	3	2		2		2	2	2		2		2	2	3	3	4"	29	98.4
4"	4	3	2		2		2	2	2		2		2	2	3	4	4"	30	102
4"	4	3	3		2		2	2	2		2		2	2	3	4	4"	31	105
4"	4	3	3	1	2		2	2	2		2		2	2	3	4	4"	32	109
4"	4	3	3	2	2		2	2	2		2		2	2	3	4	4"	33	112
4"	4	3	3	2	2		2	2	2		2	1	2	2	3	4	4"	34	115
4"	4	3	3	2	2		2	2	2		2	2	2	2	3	4	4"	35	119
4"	4	3	3	2	2	1	2	2	2		2	2	2	2	3	4	4"	36	122
4"	4	3	3	2	2	2	2	2	2		2	2	2	2	3	4	4"	37	126
4"	4	3	3	2	2	2	2	2	2	1	2	2	2	2	3	4	4"	38	129
4"	4	3	3	2	2	2	2	2	2	2	2	2	2	2	3	4	4"	39	132
4"	4	4	3	2	2	2	2	2	2	2	2	2	2	2	3	4	4"	40	136
4"	4	4	3	2	2	2	2	2	2	2	2	2	2	3	3	4	4"	41	139
4"	4	4	3	2	2	2	2	2	2	2	2	2	2	3	4	4	4"	42	143
4"	4	4	3	3	2	2	2	2	2	2	2	2	2	3	4	4	4"	43	146
4"	4	4	3	3	2	2	2	2	2	2	3	2	2	3	4	4	4"	44	150
4"	4	4	3	3	2	2	2	2	2	2	3	2	3	3	4	4	4"	45	153

Table BON-14 (cont). Spill patterns for Bonneville Dam.

Bay Number																		Total Dogs	kcfs
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18		
4"	4	4	3	3	2	3	2	2	2	2	3	2	3	3	4	4	4"	46	157
4"	4	4	3	3	2	3	2	2	3	2	3	2	3	3	4	4	4"	47	160
4"	4	4	3	3	2	3	2	3	3	2	3	2	3	3	4	4	4"	48	164
4"	5	4	3	3	2	3	2	3	3	2	3	2	3	3	4	4	4"	49	167
4"	5	4	3	3	2	3	2	3	3	2	3	2	3	3	4	5	4"	50	171
4"	5	4	4	3	2	3	2	3	3	2	3	2	3	3	4	5	4"	51	174
4"	5	5	4	3	2	3	2	3	3	2	3	2	3	3	4	5	4"	52	178
4"	5	5	4	3	2	3	2	3	3	2	3	2	3	3	5	5	4"	53	181
4"	5	5	4	3	2	3	2	3	3	3	3	2	3	3	5	5	4"	54	185
4"	5	5	4	3	2	3	3	3	3	3	3	2	3	3	5	5	4"	55	188
4"	5	5	4	3	2	3	3	3	3	3	3	2	3	4	5	5	4"	56	192
4"	5	5	4	4	2	3	3	3	3	3	3	2	3	4	5	5	4"	57	195
4"	5	5	4	4	2	3	3	3	3	3	3	2	3	4	5	5	4"	57	195
4"	5	5	5	4	3	3	3	3	3	3	3	2	3	4	5	5	4"	59	202
4"	5	5	5	4	3	3	3	3	3	3	3	3	3	4	5	5	4"	60	206
4"	5	5	5	4	3	4	3	3	3	3	3	3	3	4	5	5	4"	61	209
4"	5	5	5	4	3	4	3	3	3	3	4	3	3	4	5	5	4"	62	213
4"	5	5	5	4	4	4	3	3	3	3	4	3	3	4	5	5	4"	63	216
4"	5	5	5	4	4	4	3	4	3	3	4	3	3	4	5	5	4"	64	220
4"	5	5	5	4	4	4	3	4	3	3	4	3	4	4	5	5	4"	65	223
4"	5	5	5	4	4	4	3	4	4	3	4	3	4	4	5	5	4"	66	227
4"	5	5	5	4	4	4	3	4	4	3	4	3	4	5	5	5	4"	67	230
4"	5	5	5	4	4	4	3	4	4	4	4	3	4	5	5	5	4"	68	234
4"	5	5	5	4	4	4	3	4	4	4	4	4	4	5	5	5	4"	69	237
4"	5	5	5	5	4	4	3	4	4	4	4	4	4	5	5	5	4"	70	241
4"	5	5	6	5	4	4	3	4	4	4	4	4	4	5	5	5	4"	71	244
4"	5	5	6	5	4	4	4	4	4	4	4	4	4	5	5	5	4"	72	248
4"	5	5	6	5	4	4	4	4	4	4	4	4	4	6	5	5	4"	73	251
4"	5	5	6	5	4	5	4	4	4	4	4	4	4	6	5	5	4"	74	255
4"	5	5	6	5	4	5	4	4	4	4	4	4	5	6	5	5	4"	75	258
4"	5	5	6	5	4	5	4	4	4	4	5	4	5	6	5	5	4"	76	262
4"	5	5	6	5	5	5	4	4	4	4	5	4	5	6	5	5	4"	77	265
4"	5	5	6	6	5	5	4	4	4	4	5	4	5	6	5	5	4"	78	268
4"	5	5	6	6	5	5	4	5	4	4	5	4	5	6	5	5	4"	79	272
4"	5	5	6	6	5	5	4	5	4	5	5	4	5	6	5	5	4"	80	275
4"	5	5	6	6	5	5	4	5	5	5	5	4	5	6	5	5	4"	81	279
4"	5	5	6	6	5	5	4	5	5	5	5	5	5	6	5	5	4"	82	282
4"	5	5	6	6	5	5	5	5	5	5	5	5	5	6	5	5	4"	83	286
4"	5	5	6	6	5	6	5	5	5	5	5	5	5	6	5	5	4"	84	289
4"	5	5	6	6	5	6	5	5	5	5	5	5	6	6	5	5	4"	85	292
4"	5	5	6	6	5	6	5	5	5	5	6	5	6	6	5	5	4"	86	296
4"	5	5	6	6	6	6	5	5	5	5	6	5	6	6	5	5	4"	87	299
4"	5	5	6	6	6	6	5	6	5	5	6	5	6	6	5	5	4"	88	302
4"	5	5	6	6	6	6	5	6	6	5	6	5	6	6	5	5	4"	89	306
4"	5	5	6	6	6	6	5	6	6	6	6	5	6	6	5	5	4"	90	309

Table BON-14 (cont). Spill patterns for Bonneville Dam.

Bay Number																		Total Dogs	kcfs
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18		
4"	5	5	6	6	6	6	5	6	6	6	6	6	6	6	5	5	4"	91	312
4"	5	5	6	6	6	6	6	6	6	6	6	6	6	6	5	5	4"	92	316
4"	5	5	6	6	6	7	6	6	6	6	6	6	6	6	5	5	4"	93	319
4"	5	5	6	6	6	7	6	6	6	6	6	6	7	6	5	5	4"	94	323
4"	5	5	6	6	6	7	6	6	6	6	7	6	7	6	5	5	4"	95	326
4"	5	5	6	6	7	7	6	6	6	6	7	6	7	6	5	5	4"	96	330
4"	5	5	6	6	7	7	6	7	6	6	7	6	7	6	5	5	4"	97	333
4"	5	5	6	6	7	7	6	7	7	6	7	6	7	6	5	5	4"	98	336
4"	5	5	6	6	7	7	6	7	7	7	7	6	7	6	5	5	4"	99	340
4"	5	5	6	6	7	7	7	7	7	7	7	6	7	6	5	5	4"	100	343
4"	5	5	6	6	7	7	7	7	7	7	7	7	7	6	5	5	4"	101	347
4"	5	5	6	7	7	7	7	7	7	7	7	7	7	6	5	5	4"	102	350
4"	5	5	6	7	7	7	7	8	7	7	7	7	7	6	5	5	4"	103	353
4"	5	5	6	7	7	7	7	8	8	7	7	7	7	6	5	5	4"	104	357
4"	5	5	6	7	7	7	8	8	8	7	7	7	7	6	5	5	4"	105	360
4"	5	5	6	7	7	7	8	8	8	8	7	7	7	6	5	5	4"	106	363
4"	5	5	6	7	7	8	8	8	8	8	7	7	7	6	5	5	4"	107	367
4"	5	5	6	7	7	8	8	8	8	8	8	7	7	6	5	5	4"	108	370
4"	5	5	6	7	8	8	8	8	8	8	8	7	7	6	5	5	4"	109	373
4"	5	5	6	7	8	8	8	8	8	8	8	8	7	6	5	5	4"	110	376
4"	5	5	6	7	8	8	8	9	8	8	8	8	7	6	5	5	4"	111	380
4"	5	5	6	7	8	8	8	9	9	8	8	8	7	6	5	5	4"	112	383
4"	5	5	6	7	8	8	9	9	9	8	8	8	7	6	5	5	4"	113	386
4"	5	5	6	7	8	8	9	9	9	9	8	8	7	6	5	5	4"	114	390
4"	5	5	6	7	8	9	9	9	9	9	8	8	7	6	5	5	4"	115	393
4"	5	5	6	7	8	9	9	9	9	9	9	8	7	6	5	5	4"	116	396
4"	5	5	6	7	9	9	9	9	9	9	9	8	7	6	5	5	4"	117	400
4"	5	5	6	7	9	9	9	9	9	9	9	9	7	6	5	5	4"	118	403
4"	5	5	6	7	9	9	9	10	9	9	9	9	7	6	5	5	4"	119	406
4"	5	5	6	7	9	9	9	10	10	9	9	9	7	6	5	5	4"	120	409
4"	5	5	6	7	9	9	10	10	10	9	9	9	7	6	5	5	4"	121	413
4"	5	5	6	7	9	9	10	10	10	10	9	9	7	6	5	5	4"	122	416
4"	5	5	6	7	9	10	10	10	10	10	9	9	7	6	5	5	4"	123	419
4"	5	5	6	7	9	10	10	10	10	10	10	9	7	6	5	5	4"	124	422

SECTION 3

THE DALLES DAM

The Dalles Dam

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

1.1. Juvenile Fish Passage.

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

1.1.2. Juvenile Migration Timing. The primary juvenile fish passage period at The Dalles Dam is April through November. Currently juvenile migration timing is monitored by NMFS at John Day Dam. Table JDA-2 in section 4 of the FPP reports data from 1990 to 1998. Since no juvenile monitoring is done at The Dalles Dam, refer to this table, and add approximately 2 days to the dates reported for each species to estimate juvenile fish arrival at The Dalles.

Dates of Snake River steelhead peak passage at The Dalles Dam have ranged from May 11 in 1978 to June 21 in 1977. Peak passage for Snake River spring chinook has ranged from May 8 in 1976 to June 17 in 1977. Travel time from the upper Snake River to The Dalles Dam ranges from 12 to 39 days for yearling chinook and 10 to 40 days for steelhead (Migrations of Juvenile Chinook Salmon and Steelhead Trout in the Snake River from 1973 to 1979. Sims and Ossiander, NMFS, CZES, June 1981. 31 pp.).

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

Reserved for Figure TDA-1

Reserved for Figure TDA-2

Reserved for Figure TDA-3

Table TDA-1. Dates of project operations for fish purposes at The Dalles Dam, 2000.

1.2. Adult Fish Passage.

1.2.1. Facilities Description. Adult fish passage facilities at The Dalles Dam are composed of a north shore fish ladder, which passes fish collected at the north end of the spillway, and an east fish ladder which passes those fish collected at the south end of the spillway and across the downstream face of the powerhouse. A fish lock exists at the east end of the powerhouse but is not operated.

A small hydropower facility, utilizing the north fishway ladder auxiliary water supply, was constructed in 1991 and is monitored by the North Wasco PUD. Possible impacts of this facility on operation of the fish passage facilities are monitored by The Dalles project personnel. A backup auxiliary water supply system, unscreened for juveniles has been upgraded to facilitate its use if required.

1.2.2. Adult Migration Timing. Upstream migrants are present at The Dalles Dam throughout the year. However, passage through the winter months is relatively light and there is no fish counting. The adult fish counting schedule is shown in Table TDA-2. Annual winter maintenance of adult fish facilities is scheduled from December 1 through February (in-water work period) to minimize impacts on upstream migrants. Table TDA-3 shows the passage period by species and the earliest and latest recorded dates of peak passage since 1957.

Table TDA-2. Adult fish counting schedule at The Dalles Dam.

Period	Counting Method
April 1 – October 31	Visual count 16 hours/day (0400-2000 PST)
November 1 – March 31	No Counting

Table TDA-3. The Dalles Dam adult migration timing, 1957-1999.

Species	Count Period	Earliest Peak	Latest Peak
Spring Chinook	4/1 - 6/3	4/17	5/13
Summer Chinook	6/4 - 8/3	6/6	8/1
Fall Chinook	8/4 – 10/31	9/2	9/16
Sockeye	4/1 – 10/31	6/20	7/10
Steelhead	4/1 – 10/31	7/9	9/22
Coho	4/1 – 10/31	9/3	10/24

2. Project Operation.

2.1. General.

2.1.1. Research, non-routine maintenance, other fish related activities, and construction activities will not be conducted within 100' of any fishway entrance or exit, or within 50' of any other part of the adult fishway, or directly in, above, or adjacent to any fishway, unless coordinated with regional fish managers through ESA and other fish passage forums. Currently approved special operations are described in Appendix A. Alternate actions will be considered by district and project biologists in conjunction with the fish managers 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 the boat restricted zone (BRZ) will be coordinated in advance with the project.

2.2. Spill Management. The spill schedule in Table TDA-6 at the end of this section will be used for juvenile fish passage from 2000 to 0500 hours (juvenile passage period). The spill schedule in Table TDA-7 at the end of this section will be used for adult fish passage from 0500 to 2000 hours (adult passage period).

2.3. Total Dissolved Gas Management and Control. Additional spill management will be based on total dissolved gas (TDG) monitoring data and the observed condition of migrant juvenile and adult fish, along with juvenile migration data. The Corps will monitor TDG at The Dalles Dam forebay and tailrace. Data from automated stations will be reported every four hours from April 1 until September 15. The TDG monitoring system is described in detail in Appendix D.

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. Prior to Juvenile Fish Passage Season (December 1 through March).

a. Remove debris from forebay, trashracks, gatewell slots, and gatewell orifices such that these areas are free of debris on April 1.

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

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

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

e. Reinstall or repair avian predator control lines in the present locations as soon as possible following damage or removal. Install and maintain new avian predator control lines where possible, in locations determined to be significantly impacted by avian predators. Implement other avian abatement measures as necessary in areas where avian lines are not practical. These are performed under contract with the U.S. Department of Agriculture, Animal Damage Control. Abatement measures include selective hazing, pyrotechnics, propane cannon scare techniques, and lethal take where necessary. 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.

g. The results of all inspections and the readiness of the facility for operation will be reported to the FPOM immediately prior to the fish passage season.

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

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

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

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

d. Operate all gate slot orifices full time.

e. Operate ice and trash sluiceway gates 1-1, 1-2, and 1-3 from 0400 to 2000 hrs, including daylight hours after September 1, with full surface flow (lower or raise sluice gates completely). During nighttime hours, operate the ice and trash sluiceway as a plunge pool for the gate slot orifices. During periods of involuntary spill, sluice gates may be operated continuously. Operate the sluiceway end gate full open from sunrise to sunset. During periods when gates do not operate, set the top of the bottom end gate at elevation 142' to create an orifice plunge pool.

f. Once each week, and more frequently if accumulations of debris are observed in the sluiceway, close gates 1-1, 1-2, and 1-3, and open gates 17-3, 18-1, and 18-2 for 30 minutes to flush debris and fish being held in the sluiceway channel east of unit 1. When units are being dewatered, set top of bottom end gate at elevation 142' to create an orifice plunge pool, and install orifice gill posts. After gill posts are installed, end gate should be returned to its original elevation of 161' msl during the juvenile passage season.

g. A slight oily sheen is commonly found in many gatewells. This may come from sources such as lubricated lifting beams, etc. But, when unusual accumulations of oil (e.g., oil slick) occur in gate slots, 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.

h. Reinstall or repair avian predator control lines in present locations as soon as possible following damage or removal. Where possible, 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, in areas where avian lines are not practical. 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 possible after that date.

i. During chain gate operation, maintain forebay level above elevation 158′ to the extent practicable. Management of this operation will maintain a tailwater elevation of 158′ or greater at John Day Dam to assure adequate adult fishway entrance and collection facility operation at John Day.

j. Maintain orifices clear of debris to the extent practicable.

k. Inspect facilities twice each day. At least three inspections per week will be performed by project fish biologist and fish biological staff.

l. Follow the schedule in Table TDA-6 for nighttime spill (2000-0500 hours). This schedule was developed for juvenile fish passage.

2.4.1.3. Winter Maintenance Season (December 1 through March).

a. Maintain orifices clear of debris.

b. Set top of bottom end gate at elevation 142' to create an orifice plunge pool.

c. Inspect operating facilities once per day by project fish staff.

2.5. Adult Fish Passage Facilities.

2.5.1. Operating Criteria.

2.5.1.1. Prior to Adult Passage Period (December 1 through February).

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

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

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

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

e. The results of all inspections and the readiness of the facilities for operation will be reported at the Fish Passage O and M Coordinating Committee (FPOM) meeting immediately prior to the passage season.

2.5.1.2. Adult Fish Passage Period (March 1 through November).

a. All Adult Facilities.

1. Water depth over fish ladder weirs: 1′ +/- 0.1'. During the shad passage season (May 15 through August 15): 1.3′ +/- 0.1′.

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

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

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

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

6. Necessary staff gauges and water level indicators will be readable at all water levels encountered during the fish passage period and calibration checked weekly. Instruments will be recalibrated ASAP if out of calibration.

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

8. Count station crowders shall remain in the operating position while visual counting and/or video taping is being conducted. The crowder shall be closed to allow the count slot width to be no less than 18". This will usually occur during high turbidity conditions to allow count accuracy criteria to be achieved. If passage is impaired by this condition, the count slot may be widened until proper passage conditions are achieved, even though count accuracy may be compromised to some degree. Project biologists, FFU, and fish counters shall coordinate to achieve optimum count slot passage and/or count accuracy conditions. The crowder shall remain fully open during hours that no fish counting is going on. Leave fish passage slot lighted overnight.

9. Inspect facilities twice each day. At least three inspections per week will be performed by project fish biologist and biological staff. Inspections of once per day can begin November 1.

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

b. East Fishway.

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

2. Telescoping weir #159 will adjust to maintain 1.2 +/- 0.1' depth over the weirs, measured below the counting station.

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

c. North Fishway Entrance. Operate one entrance weir, N1 or N2 regardless of spill. Entrance weirs shall be operated only by project fish biologists when in manual control. If the Wasco County PUD operates entrance weirs in automatic control, they shall be required to keep them within established fishway criteria.

d. Powerhouse.

1. West Powerhouse Entrance: Operate entrance weirs (W1 and W2).

2. East Powerhouse Entrance: Operate entrance weirs E2 and E3 to maintain gate crest at 8’ or greater below tailwater. Set E1 with the gate crest at 81' msl. If 2’ differential is exceeded, lower E2 and E3 in one foot increments to achieve differential criteria or lower E1 in one foot increments if E2 and E3 cannot be lowered.

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

JP2..........................8'
JP4..........................8'
JP6..........................7'

4. Operate two submerged orifices, 22b and 22c, along the powerhouse collection system.

5. South Spillway Entrance: Operate entrance weirs S1 and S2.

6. Discharge from the two operating fish units will be adjusted to maintain criteria at all associated fishway entrances.

2.5.1.3. Winter Operating Period, or In-water Work Period (December 1 through end of February).

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

b. Operate the north fishway adult fish passage facilities according to fish passage season standards listed above, except the system may be dewatered or operated out of criteria for repair and maintenance. Adjust the counting station fish crowder to full open and pull picket leads at counting station at the end of the counting season.

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

d. Inspect operating facilities once per day by project fish staff.

2.6. Facility Monitoring and Reporting. Project staff shall inspect fish passage facilities at the frequencies listed in the juvenile and adult fish facilities operating criteria sections. Additional fishway inspections may be performed by FFU and/or fish agencies. The project fish biologist and fish biological staff shall prepare weekly reports, throughout the year, summarizing project operations. The weekly reports will provide an overview of how the project and fish passage facilities operated during the week and an evaluation of resulting fish passage conditions. The reports shall include: any out of criteria situations observed and subsequent corrective actions taken; any equipment malfunctions, breakdowns, or damage along with a summary of resulting repair activities; adult fishway control calibrations; and any unusual activities which occurred at the project which may affect fish passage. The weekly reports shall cover a Sunday through Saturday time period and shall be sent to CENWP-OP and other interested parties as soon as possible the following week, with a copy to RCC, Attention: Fish Team. The project biologist shall prepare an annual report by January 31, summarizing the operation of the project fish passage facilities for the previous year. The report will cover from the beginning of one adult fish facility winter maintenance season to the beginning of the next. The annual report will be provided to CENWP-OP in time for distribution to FPOM members at the February meeting.

3. Fish Facilities Maintenance.

3.1. General.

3.1.1. Scheduled Maintenance.

3.1.1.1. Staff gauges will be installed, cleaned, and/or repaired as required.

3.1.1.2. A 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.

3.1.1.3. 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 effect fish passage will be reported in the weekly reports (paragraph 2.6).

3.2. Juvenile Fish Passage Facilities.

3.2.1. Scheduled Maintenance.

3.2.1.1. Collection and Transportation Systems. The Dalles Dam ice and trash sluiceway will receive preventive maintenance throughout the year. During the juvenile fish passage season, this will normally be above water work, such as maintenance of automatic systems, air lines, electrical systems, and monitoring equipment. During the winter maintenance period, the systems are dewatered downstream of the gatewell orifices. The system is then visually inspected in all accessible areas for damaged equipment and areas that may cause problems to the juvenile fish. Any problem areas identified are repaired and modifications to the channel and general maintenance are completed. The trash racks are raked 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.

3.2.1.2. Turbines and Spillways. Maintenance and routine repair of project turbines and spillways is a regular and recurring process which requires that units be shut down for up to two months (see section 5. Dewatering Plans). The schedule for this maintenance is reviewed by the project and district biologists and coordinated within NWP, NWR, 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 (during sluice way operation).

3.2.2. Unscheduled 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 with the CBFWA (through the FPC) and NMFS on a case-by-case basis by project and CENWP-OP biologists. The CENWP-OP 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-OP when delay of the work will result in an unsafe situation for people, property, or fish. Information required by CENWP-CO includes:

a. Description of the problem.

b. Type of outage required.

c. Impact on facility operation.

d. Length of time for repairs.

e. Expected impacts on fish passage.

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

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

b. Orifices allow fish a passage route out of the gatewells into the sluiceway. If orifices become plugged with debris they will be manually cleaned.

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

d. 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.

3.2.2.2. Turbines and Spillways- Spill Gate Failure. If a spill gate becomes inoperable, the operators will make the changes necessary to accommodate the spill and then immediately notify the 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 the FPOM through the district biologist, who will, depending on coordination, provide additional guidance to the project.

3.3. Adult Fish Passage Facilities.

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

3.3.1.1. 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.

3.3.1.2. 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 which 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 additional inspection during the fish passage season by dive or underwater video, will also be conducted. (see section 5. Dewatering Plans.). A diver or underwater video system may be used for underwater inspections. This scheduled inspection and any associated maintenance will occur during the winter maintenance period (in-water work period), unless specially coordinated. Any non-routine maintenance and fishway modification will be handled on a case by case basis.

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

3.3.1.3. 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 will be raked when criteria are exceeded. When practicable, rake trashracks during the time of day when fish passage is least affected. Fish count station windows will be cleaned when necessary, and when practicable, during the time of day when fish passage is least affected.

3.3.2. Unscheduled Maintenance. Maintenance activities that occur during the fish passage period and that may affect fish passage will be reported in the weekly reports (section 2.6). Unscheduled maintenance that will significantly affect the operation of a facility, such as repair of displaced diffuser gratings, will be coordinated with the CBFWA (through the FPC) and NMFS. Coordination procedures for unscheduled maintenance of adult facilities are the same as for juvenile facilities (paragraph 3.2.2).

3.3.2.1. 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. 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 surveillance on the adult system to ensure that criteria are being met. In the event of AWS failure, FPOM will work with the project to determine the best operating procedure.

a. Powerhouse (spring/summer). If one of the two fishway auxiliary water turbines fails or malfunctions during the spring/summer adult migration season (March 1 - July 31), use the following sequential procedure until a fishway head of 1' is achieved:

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

2. Raise the open west powerhouse entrance weirs W1 and W2 (W3 stationary at 78' msl) in 1' increments until the weirs reach 6' of depth below the tailwater surface.

3. Raise the east entrance weirs E2 and E3 (E1 closed at tailwater below 81' msl) in 1' increments to 6' of depth below the tailwater surface.

4. Close west powerhouse entrance weir W2.

5. Close one east entrance weir E2.

6. Raise the south spillway entrance weirs S1 and S2 in 1' increments to 6' of depth below the tailwater surface.

7. Close one south spillway entrance (S2).

8. For long-term outages, close floating orifices.

The duration of “long-term” will be determined through FPOM coordination.

9. If a fishway head of 1' is still not achieved, leave the fishway in this configuration until more auxiliary water becomes available. Then reverse the above procedure.

b. Powerhouse (fall/winter). If one of the fishway auxiliary water turbines fails, malfunctions, or is out of service for necessary maintenance during the fall adult migration or winter maintenance season (August 1 through February), assuming no spill during this period, use the following sequential procedure until a fishway head of 1' is achieved:

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

2. Close the south spillway entrance weirs and all diffusers associated with these entrances, including those adjacent to the entrances and those at the east and west ends of the powerhouse.

3. Close entrance E2 (leaving E3 open at 8' depth).

4. Close west entrance weir W2, leaving W1 open to 8' below tailwater surface elevation.

5. Raise entrance weir W1 to 6' below tailwater surface elevation.

6. Raise entrance weir E3 to 7' below tailwater. If 1' of head is still not achieved, then raise it an additional 1' to a 6' minimum below tailwater surface.

7. For long-term outages, close floating orifices. The duration of ‘long-term’ will be determined through FPOM coordination.

8. If a fishway head of 1' is still not achieved, then leave in this configuration until more auxiliary water becomes available.

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

1. Close entrance weir S2 and raise S1 to 6’ below tailwater.

2. Close junction pool weirs JP2 and JP4.

3. Close entrance weir E1 and E2 and raise E3 to 6' below tailwater.

d. 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.

3.3.2.2. 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.

3.3.2.3. 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.

3.3.2.4. 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 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. Daily inspections of fish ladders and collection systems should include looking for any flow changes which 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 diffuser gratings are found to be missing or displaced, creating openings into the diffuser chambers, a method of repair shall be developed and coordinated with the fish agencies and tribes through the established coordination procedure. Repairs shall be made as quickly as possible unless coordinated differently.

4. Turbine Unit Operation and Maintenance.

4.1. Through the juvenile fish passage season, either turbine unit 1 or unit 2 or both units will operate during daylight hours unless specially coordinated with FPOM.

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

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

4.4. To the extent technically feasible, turbines will be operated within +/- 1% of best turbine efficiency, (Appendix C), unless operation outside of that range is necessary to meet load requests from BPA, consistent with their System Load Shaping Guidelines (Appendix C), or to comply with other coordinated fish measures. The BPA System Load Shaping Guidelines apply between March 15 and October 31. 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.

4.5. When it is necessary to operate turbines outside of the 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, 3, 1, 8, etc.

5. Dewatering Plans.

5.1. Guidelines for Dewatering and Fish Handling Plans (Appendix G) 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.

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

5.3. The fish agencies and tribes are encouraged to participate at all ladder dewaterings.

5.4. Adult Fish Ladder.

5.4.1. Scheduled maintenance.

5.4.1.1. When possible, operate the ladder to be dewatered at a reduced flow for at least 24 hours, but not more than 96 hours prior to dewatering. Reduced flow is defined as less than criterion operation, but more than orifice flow.

5.4.1.2. Discontinue all fishway auxiliary water supply at least 24 hours, but no more than 96 hours prior to dewatering.

5.4.1.3. 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.

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

5.4.1.5. The project biologist or alternate Corps fish personnel will oversee fish rescue when the ladders are dewatered. Rescue personnel will walk the inside of the ladder from the head gates down to tailwater salvaging all fish either by moving fish to tailwater within the ladder flow or capturing and placing the fish in a large water filled tank. 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, steelhead kelts should be released into the tailrace.

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

Head (ft)	Units 1 - 14				Units 15 – 22			
	Lower Limit MW	Lower Limit Cfs	Upper Limit Mw	Upper Limit cfs	Lower Limit MW	Lower Limit cfs	Upper Limit Mw	Upper Limit Cfs
61	38	8,919	63	14,822	39	9,025	65	14,909
62	39	8,933	65	14,875	40	9,082	66	14,920
63	40	8,947	66	14,927	42	9,139	68	14,920
64	40	8,961	68	14,980	42	9,122	70	14,998
65	41	8,975	69	15,032	43	9,079	71	15,076
66	42	8,989	71	15,085	43	9,036	73	15,154
67	43	9,003	72	15,137	44	8,993	74	15,232
68	43	9,011	74	15,192	44	8,966	76	15,378
69	44	9,019	75	15,246	45	8,939	78	15,524
70	45	9,027	77	15,301	45	8,913	80	15,669
71	46	9,035	78	15,355	46	8,886	82	15,815
72	46	9,026	79	15,343	46	8,873	84	15,947
73	47	9,018	80	15,330	47	8,860	86	16,080
74	48	9,009	81	15,318	48	8,847	87	16,212
75	48	9,001	83	15,305	48	8,834	89	16,344
76	49	8,992	84	15,293	49	8,821	91	16,476
77	50	9,022	85	15,219	50	8,813	93	16,603
78	50	9,052	85	15,145	50	8,805	95	16,730
79	50	9,082	86	15,071	51	8,797	97	16,857
80	50	9,111	87	14,997	52	8,788	97	16,983
81	54	9,141	88	14,923	52	8,780	99	16,381
82	54	9,109	89	14,915	53	8,770	99	16,181
83	54	9,076	90	14,907	53	8,765	99	15,986
84	55	9,044	90	14,714	54	8,757	99	15,760
85	55	9,011	90	14,541	54	8,749	99	15,610
86	56	8,979	90	14,372	55	8,742	99	15,429
87	56	8,946	90	14,207	56	8,734	99	15,251

NOTE: The turbine efficiency tables are being revised to reflect new information. This table contains the best information currently available.

5.4.1.6. Orifice blocking devices, with attachment ropes tied to handrails, will be placed in the lower-most weirs to prevent fish from re-ascending the dewatered portion of the adult fishway. These will have clearances placed on them by project operations. Clearances shall be removed just before the fishway is returned to service. This will prevent the orifice blocks from being accidentally left in place after fishway water-up.

The fishway return to service checklist is as follows:

a. Remove orifice blocking devices.

b. Activate automation for weir crest depth.

c. Assure all count station lighting is operational.

d. Close count station crowder to desired width (minimum 18").

e. Close picket leads.

f. Remove all tools, equipment, and debris from inside ladder.

g. Assure all entrance weir automation is operational and activated.

h. Remove all safety clearances by the designated clearance holder.

5.4.2. Unscheduled Maintenance.

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

5.4.2.2. Follow steps 5.4.1.3. through 5.4.1.5. above.

5.5. Powerhouse Collection System.

5.5.1. Scheduled Maintenance.

5.5.1.1. During the pumping or draining operation to dewater a portion or all of the collection channel, the water level will not be allowed to drop so low it strands fish. Adequate inspections will be conducted to ensure stranding does not occur.

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

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

5.6. Turbines.

5.6.1. Gatewells need not be dipped as is required at other projects due to the lack of VBSs. Instead, the following procedure may be used. The unit will be shut down for at least 24 hours before it is drained. Then, immediately before draining it will be operated at speed/no load briefly to flush fish out of the draft tube.

5.6.2. When possible, place head gates and tail logs immediately after the turbine unit is shut down if the draft tube is to be dewatered. 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.

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

5.6.4. 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 two weeks to accommodate fish trapped in the draft tube. Adequate inspections will need to be conducted to ensure 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 which stresses fish. The appropriate level will be determined by the project biologist.

5.6.5. 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. Forebay Debris Removal. 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. Removing debris at its source in the forebay is sometimes necessary to maintain safe and efficient fish passage conditions, navigation, and other project activities. Debris can be removed from the forebay by: physically encircling the debris with log booms and pulling it to shore with boats where it can be removed with a crane, removing the debris from the top of the dam using a crane and scoop, or passing the debris through the spillway with special powerhouse operations and spill. The preferred option is to remove debris at each project when possible to avoid passing a debris problem on to the next project downstream. This is not always possible at each project as some projects do not have forebay debris removal capability. In this case, the only viable alternative is to spill to pass the debris.

All special spills (other than normal spill patterns for ongoing spill operations) and project operations for passing debris will be coordinated prior to the operations taking place. Each project shall contact CENWP-OP at least two work days prior to the day they want the special project operations for spilling to pass debris. CENWP-OP shall coordinate the special operations with RCC and NMFS. Project personnel shall provide CENWP-OP the reason for the debris spill request, including an explanation of project facilities being impacted by the debris, the date and time of the requested spill, and any special powerhouse or other operations required to move the debris to the spillway. When a debris spill is coordinated and approved, RCC shall issue a teletype detailing the specifics of the special operations.

Table TDA-6. Spill patterns for juvenile fish passage at The Dalles Dam.

Gate # (Opening in feet)																							Total Feet	Kcfs
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23		
1																							1	1.5
2																							2	3
2	1																						3	4.5
2	2																						4	6
2	2	1																					5	7.5
2	2	2																					6	9
2	2	2	1																				7	10.5
2	2	2	2																				8	12
2	2	2	2	1																			9	13.5
2	2	2	2	2																			10	15
2	2	2	2	2	1																		11	16.5
2	2	2	2	2	2																		12	18
2	2	2	2	2	2	1																	13	19.5
2	2	2	2	2	2	2																	14	21
2	2	2	2	2	2	2	1																15	22.5
2	2	2	2	2	2	2	2																16	24
2	2	2	2	2	2	2	2	1															17	25.5
2	2	2	2	2	2	2	2	2															18	27
2	2	2	2	2	2	2	2	2	1														19	28.5
2	2	2	2	2	2	2	2	2	1	1													20	30
2	2	2	2	2	2	2	2	2	2	1													21	31.5
2	2	2	2	2	2	2	2	2	2	2													22	33
2	2	2	3	2	2	2	2	2	2	2													23	34.5
2	2	2	3	3	2	2	2	2	2	2													24	36
2	2	3	3	3	2	2	2	2	2	2													25	37.5
2	2	3	3	3	3	2	2	2	2	2													26	39
2	2	3	3	3	3	2	2	2	2	2	1												27	40.5
2	2	3	3	3	3	2	2	2	2	2	2												28	42
2	2	3	3	3	3	3	2	2	2	2	2												29	43.5
2	2	3	3	3	3	3	3	2	2	2	2												30	45
2	2	3	3	3	3	3	3	3	2	2	2												31	46.5
2	2	3	3	3	3	3	3	3	3	2	2												32	48
2	2	3	3	3	3	3	3	3	3	2	2	1											33	49.5
2	2	3	3	3	3	3	3	3	3	2	2	2											34	51
2	2	3	4	3	3	3	3	3	3	2	2	2											35	52.5

Table TDA-6 (cont). Spill patterns for juvenile fish passage at The Dalles Dam.

Gate # (Opening in feet)																							Total Feet	Kcfs
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23		
2	3	3	4	3	3	3	3	3	3	2	2	2											36	54
2	3	3	4	4	3	3	3	3	3	2	2	2											37	55.5
2	3	4	4	4	3	3	3	3	3	2	2	2											38	57
3	3	4	4	4	3	3	3	3	3	2	2	2											39	58.5
3	3	4	4	4	3	3	3	3	3	3	2	2											40	60
3	3	4	4	4	3	3	3	3	3	3	3	2											41	61.5
3	3	4	4	4	3	3	3	3	3	3	3	2	1										42	63
3	3	4	4	4	3	3	3	3	3	3	3	2	2										43	64.5
3	3	4	4	4	4	3	3	3	3	3	3	2	2										44	66
3	3	4	5	4	4	3	3	3	3	3	3	2	2										45	67.5
3	3	4	5	4	4	4	3	3	3	3	3	2	2										46	69
3	3	4	5	5	4	4	3	3	3	3	3	2	2										47	70.5
3	4	4	5	5	4	4	3	3	3	3	3	2	2										48	72
3	4	4	5	5	4	4	4	3	3	3	3	2	2										49	73.5
3	4	4	5	5	4	4	4	4	3	3	3	2	2										50	75
4	4	4	5	5	4	4	4	4	3	3	3	2	2										51	76.5
4	4	4	5	5	4	4	4	4	4	3	3	2	2										52	78
4	4	5	5	5	4	4	4	4	4	3	3	2	2										53	79.5
4	4	5	5	5	5	4	4	4	4	3	3	2	2										54	81
4	4	5	5	5	5	5	4	4	4	3	3	2	2										55	82.5
4	4	5	5	5	5	5	4	4	4	4	3	2	2										56	84
4	4	5	6	5	5	5	4	4	4	4	3	2	2										57	85.5
4	4	5	6	5	5	5	4	4	4	4	3	2	2	1									58	87
4	4	5	6	5	5	5	4	4	4	4	3	2	2	2									59	88.5
4	4	5	6	6	5	5	4	4	4	4	3	2	2	2									60	90
4	4	5	6	6	5	5	5	4	4	4	3	2	2	2									61	91.5
4	4	5	6	6	5	5	5	4	4	4	3	3	2	2									62	93
4	5	5	6	6	5	5	5	4	4	4	3	3	2	2									63	94.5
4	5	5	6	6	5	5	5	4	4	4	4	3	2	2									64	96
4	5	5	6	6	5	5	5	5	4	4	4	3	2	2									65	97.5
4	5	5	6	6	6	5	5	5	4	4	4	3	2	2									66	99
5	5	5	6	6	6	5	5	5	4	4	4	3	2	2									67	100.5
5	5	6	6	6	6	5	5	5	4	4	4	3	2	2									68	102
5	5	6	7	6	6	5	5	5	4	4	4	3	2	2									69	103.5
5	6	6	7	6	6	5	5	5	4	4	4	3	2	2									70	105

Table TDA-6 (cont). Spill patterns for juvenile fish passage at The Dalles Dam.

Gate # (Opening in feet)																							Total Feet	Kcfs
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23		
5	6	6	7	6	6	5	5	5	4	4	4	3	3	2									71	106.5
5	6	6	7	7	6	5	5	5	4	4	4	3	3	2									72	108
5	6	6	7	7	6	6	5	5	4	4	4	3	3	2									73	109.5
5	6	6	7	7	6	6	5	5	5	4	4	3	3	2									74	111
5	6	7	7	7	6	6	5	5	5	4	4	3	3	2									75	112.5
5	6	7	7	7	6	6	5	5	5	4	4	4	3	2									76	114
5	6	7	7	7	6	6	6	5	5	4	4	4	3	2									77	115.5
5	6	7	7	7	6	6	6	5	5	5	4	4	3	2									78	117
6	6	7	7	7	6	6	6	5	5	5	4	4	3	2									79	118.5
6	6	7	7	7	6	6	6	6	5	5	4	4	3	2									80	120
6	6	7	7	7	7	6	6	6	5	5	4	4	3	2									81	121.5
6	6	7	7	7	7	6	6	6	5	5	5	4	3	2									82	123
6	6	7	7	7	7	6	6	6	6	5	5	4	3	2									83	124.5
6	6	7	8	7	7	6	6	6	6	5	5	4	3	2									84	126
6	6	7	8	7	7	7	6	6	6	5	5	4	3	2									85	127.5
6	6	7	8	8	7	7	6	6	6	5	5	4	3	2									86	129
6	7	7	8	8	7	7	6	6	6	5	5	4	3	2									87	130.5
6	7	7	8	8	7	7	7	6	6	5	5	4	3	2									88	132
6	7	7	8	8	8	7	7	6	6	5	5	4	3	2									89	133.5
6	7	7	8	8	8	7	7	6	6	6	5	4	3	2									90	135
6	7	8	8	8	8	7	7	6	6	6	5	4	3	2									91	136.5
6	7	8	8	8	8	7	7	7	6	6	5	4	3	2									92	138
7	7	8	8	8	8	7	7	7	6	6	5	4	3	2									93	139.5
7	7	8	8	8	8	8	7	7	6	6	5	4	3	2									94	141
7	8	8	8	8	8	8	7	7	6	6	5	4	3	2									95	142.5
7	8	8	9	8	8	8	7	7	6	6	5	4	3	2									96	144
7	8	8	9	9	8	8	7	7	6	6	5	4	3	2									97	145.5
7	8	8	9	9	8	8	7	7	7	6	5	4	3	2									98	147
7	8	9	9	9	8	8	7	7	7	6	5	4	3	2									99	148.5
7	8	9	9	9	9	8	7	7	7	6	5	4	3	2									100	150
7	8	9	9	9	9	8	7	7	7	6	5	4	3	2	1								101	151.5
7	8	9	9	9	9	8	7	7	7	6	5	4	3	2	2								102	153
7	8	9	9	9	9	8	7	7	7	6	5	4	3	3	2								103	154.5
7	8	9	9	9	9	8	7	7	7	6	5	4	4	3	2								104	156
7	8	9	9	9	9	8	7	7	7	6	5	5	4	3	2								105	157.5

Table TDA-6 (cont). Spill patterns for juvenile fish passage at The Dalles Dam.

Gate # (Opening in feet)																							Total Feet	Kcfs
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23		
7	8	9	9	9	9	8	7	7	7	6	6	5	4	3	2								106	159
7	8	9	9	9	9	8	7	7	7	6	6	5	4	3	2	1							107	160.5
7	8	9	9	9	9	8	7	7	7	6	6	5	4	3	2	2							108	162
7	8	9	9	9	9	8	7	7	7	6	6	5	4	3	3	2							109	163.5
7	8	9	9	9	9	8	7	7	7	6	6	5	4	4	3	2							110	165
7	8	9	9	9	9	8	7	7	7	6	6	5	5	4	3	2							111	166.5
7	8	9	9	9	9	8	7	7	7	6	6	5	5	4	3	2	1						112	168
7	8	9	9	9	9	8	7	7	7	6	6	5	5	4	3	2	2						113	169.5
7	8	9	9	9	9	8	7	7	7	6	6	5	5	4	3	3	2						114	171
7	8	9	9	9	9	8	7	7	7	6	6	5	5	4	4	3	2						115	172.5
7	8	9	9	9	9	8	8	7	7	6	6	5	5	4	4	3	2						116	174
7	8	9	9	9	9	9	8	7	7	6	6	5	5	4	4	3	2						117	175.5
7	8	9	9	9	9	9	8	8	7	6	6	5	5	4	4	3	2						118	177
7	8	9	9	9	9	9	8	8	7	7	6	5	5	4	4	3	2						119	178.5
7	8	9	9	9	9	9	8	8	7	7	6	6	5	4	4	3	2						120	180
7	8	9	9	9	9	9	8	8	7	7	6	6	5	5	4	3	2						121	181.5
7	8	9	9	10	9	9	8	8	7	7	6	6	5	5	4	3	2						122	183
7	8	9	9	10	9	9	8	8	7	7	6	6	6	5	4	3	2						123	184.5
7	8	9	9	10	9	9	8	8	7	7	7	6	6	5	4	3	2						124	186
7	8	9	9	10	9	9	8	8	8	7	7	6	6	5	4	3	2						125	187.5
7	8	9	9	10	9	9	9	8	8	7	7	6	6	5	4	3	2						126	189
7	8	9	9	10	10	9	9	8	8	7	7	6	6	5	4	3	2						127	190.5
7	8	9	9	10	10	9	9	8	8	7	7	7	6	5	4	3	2						128	192
7	8	9	9	10	10	9	9	8	8	8	7	7	6	5	4	3	2						129	193.5
7	8	9	9	10	10	9	9	9	8	8	7	7	6	5	4	3	2						130	195
7	8	9	10	10	10	9	9	9	8	8	7	7	6	5	4	3	2						131	196.5
7	8	9	10	10	10	10	9	9	8	8	7	7	6	5	4	3	2						132	198
7	8	9	10	10	10	10	9	9	8	8	7	7	6	6	4	3	2						133	199.5
7	8	9	10	10	10	10	9	9	8	8	7	7	6	6	4	3	2	1					134	201
7	8	9	10	10	10	10	9	9	8	8	7	7	6	6	4	3	2	2					135	202.5
7	8	9	10	10	10	10	9	9	8	8	8	7	6	6	4	3	2	2					136	204
7	8	9	10	10	10	10	9	9	9	8	8	7	6	6	4	3	2	2					137	205.5
7	8	9	10	10	10	10	9	9	9	8	8	7	6	6	4	3	3	2					138	207
7	8	9	10	10	10	10	9	9	9	8	8	7	6	6	4	4	3	2					139	208.5
7	8	9	10	10	10	10	9	9	9	8	8	7	6	6	5	4	3	2					140	210

Table TDA-6 (cont). Spill patterns for juvenile fish passage at The Dalles Dam.

Gate # (Opening in feet)																							Total Feet	Kcfs
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23		
7	8	9	10	10	10	10	10	9	9	8	8	7	6	6	5	4	3	2					141	211.5
7	8	9	10	10	10	10	10	9	9	9	8	7	6	6	5	4	3	2					142	213
7	8	9	10	10	10	10	10	10	9	9	8	7	6	6	5	4	3	2					143	214.5
7	8	9	10	10	10	10	10	10	9	9	8	7	7	6	5	4	3	2					144	216
8	8	9	10	10	10	10	10	10	9	9	8	7	7	6	5	4	3	2					145	217.5
8	8	9	10	10	10	10	10	10	9	9	8	8	7	6	5	4	3	2					146	219
8	9	9	10	10	10	10	10	10	9	9	8	8	7	6	5	4	3	2					147	220.5
8	9	9	10	10	10	10	10	10	9	9	9	8	7	6	5	4	3	2					148	222
8	9	9	10	10	10	10	10	10	10	9	9	8	7	6	5	4	3	2					149	223.5
8	9	10	10	10	10	10	10	10	10	9	9	8	7	6	5	4	3	2					150	225
8	9	10	10	10	10	10	10	10	10	9	9	8	7	6	5	4	3	2	1				151	226.5
8	9	10	10	10	10	10	10	10	10	9	9	8	7	6	5	4	3	2	2				152	228
8	9	10	10	10	10	10	10	10	10	9	9	8	7	6	5	4	3	2	2	1			153	229.5
8	9	10	10	10	10	10	10	10	10	9	9	8	7	6	5	4	3	2	2	2			154	231
8	9	10	10	10	10	10	10	10	10	9	9	8	7	6	5	4	3	2	2	2	1		155	232.5
8	9	10	10	10	10	10	10	10	10	9	9	8	7	6	5	4	3	2	2	2	2		156	234
8	9	10	10	10	10	10	10	10	10	9	9	8	7	6	5	4	3	2	2	2	2	1	157	235.5
8	9	10	10	10	10	10	10	10	10	9	9	8	7	6	5	4	3	2	2	2	2	2	158	237
8	9	10	10	10	10	10	10	10	10	9	9	8	7	6	5	4	3	3	2	2	2	2	159	238.5
8	9	10	10	10	10	10	10	10	10	9	9	8	7	6	5	4	3	3	3	2	2	2	160	240
8	9	10	10	10	10	10	10	10	10	9	9	8	7	6	5	4	3	3	3	3	2	2	161	241.5
8	9	10	10	10	10	10	10	10	10	9	9	8	7	6	5	4	3	3	3	3	3	2	162	243
8	9	10	10	10	10	10	10	10	10	9	9	8	7	6	5	4	3	3	3	3	3	3	163	244.5
8	9	10	10	10	10	10	10	10	10	9	9	8	7	6	5	4	4	3	3	3	3	3	164	246
8	9	10	10	10	10	10	10	10	10	9	9	8	7	6	5	4	4	4	3	3	3	3	165	247.5
8	9	10	10	10	10	10	10	10	10	9	9	8	7	6	5	5	4	4	3	3	3	3	166	249
8	9	10	10	10	10	10	10	10	10	9	9	8	7	6	5	5	4	4	4	3	3	3	167	250.5
8	9	10	10	10	10	10	10	10	10	9	9	8	7	6	5	5	4	4	4	4	3	3	168	252
8	9	10	10	10	10	10	10	10	10	9	9	8	7	6	5	5	4	4	4	4	4	3	169	253.5
8	9	10	10	10	10	10	10	10	10	9	9	8	7	6	5	5	4	4	4	4	4	4	170	255
8	9	10	10	10	10	10	10	10	10	9	9	8	7	6	5	5	5	4	4	4	4	4	171	256.5
8	9	10	10	10	10	10	10	10	10	9	9	8	7	6	5	5	5	5	4	4	4	4	172	258
8	9	10	10	10	10	10	10	10	10	9	9	8	7	6	5	5	5	5	5	4	4	4	173	259.5
8	9	10	10	10	10	10	10	10	10	9	9	8	7	6	5	5	5	5	5	5	4	4	174	261
8	9	10	10	10	10	10	10	10	10	9	9	8	7	6	5	5	5	5	5	5	5	4	175	262.5

Table TDA-6 (cont). Spill patterns for juvenile fish passage at The Dalles Dam.

Gate # (Opening in feet)																							Total Feet	Kcfs
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23		
8	9	10	10	10	10	10	10	10	10	9	9	8	7	6	5	5	5	5	5	5	5	5	176	264
8	9	10	10	10	10	10	10	10	10	9	9	8	7	6	6	5	5	5	5	5	5	5	177	265.5
8	9	10	10	10	10	10	10	10	10	10	9	8	7	6	6	5	5	5	5	5	5	5	178	267
8	9	10	10	10	10	10	10	10	10	10	9	8	7	7	6	5	5	5	5	5	5	5	179	268.5
8	9	10	10	10	10	10	10	10	10	10	9	8	8	7	6	5	5	5	5	5	5	5	180	270
8	9	10	10	10	10	10	10	10	10	10	9	9	8	7	6	5	5	5	5	5	5	5	181	271.5
8	9	10	10	10	10	10	10	10	10	10	9	9	8	7	6	6	5	5	5	5	5	5	182	273
8	9	10	10	10	10	10	10	10	10	10	10	9	8	7	6	6	5	5	5	5	5	5	183	274.5
8	9	10	10	10	10	10	10	10	10	10	10	9	8	7	7	6	5	5	5	5	5	5	184	276
8	9	10	10	10	10	10	10	10	10	10	10	9	8	8	7	6	5	5	5	5	5	5	185	277.5
8	9	10	10	10	10	10	10	10	10	10	10	9	9	8	7	6	5	5	5	5	5	5	186	279
8	9	10	10	10	10	10	10	10	10	10	10	10	9	8	7	6	5	5	5	5	5	5	187	280.5
8	9	10	10	10	10	10	10	10	10	10	10	10	9	8	7	6	6	5	5	5	5	5	188	282
8	9	10	10	10	10	10	10	10	10	10	10	10	9	8	7	7	6	5	5	5	5	5	189	283.5
8	9	10	10	10	10	10	10	10	10	10	10	10	9	8	8	7	6	5	5	5	5	5	190	285
8	9	10	10	10	10	10	10	10	10	10	10	10	9	9	8	7	6	5	5	5	5	5	191	286.5
8	9	10	10	10	10	10	10	10	10	10	10	10	10	9	8	7	6	5	5	5	5	5	192	288
9	9	10	10	10	10	10	10	10	10	10	10	10	10	9	8	7	6	5	5	5	5	5	193	289.5
9	10	10	10	10	10	10	10	10	10	10	10	10	10	9	8	7	6	5	5	5	5	5	194	291
9	10	11	10	10	10	10	10	10	10	10	10	10	10	9	8	7	6	5	5	5	5	5	195	292.5
9	10	11	11	10	10	10	10	10	10	10	10	10	10	9	8	7	6	5	5	5	5	5	196	294
9	10	11	11	11	10	10	10	10	10	10	10	10	10	9	8	7	6	5	5	5	5	5	197	295.5
9	10	11	11	11	11	10	10	10	10	10	10	10	10	9	8	7	6	5	5	5	5	5	198	297
9	10	11	11	11	11	11	10	10	10	10	10	10	10	9	8	7	6	5	5	5	5	5	199	298.5
9	10	11	11	11	11	11	11	10	10	10	10	10	10	9	8	7	6	5	5	5	5	5	200	300
9	10	11	11	11	11	11	11	11	10	10	10	10	10	9	8	7	6	5	5	5	5	5	201	301.5
9	10	11	11	11	11	11	11	11	11	10	10	10	10	9	8	7	6	5	5	5	5	5	202	303
9	10	11	11	11	11	11	11	11	11	11	10	10	10	9	8	7	6	5	5	5	5	5	203	304.5
9	10	11	11	11	11	11	11	11	11	11	11	10	10	9	8	7	6	5	5	5	5	5	204	306
9	10	11	11	11	11	11	11	11	11	11	11	11	10	9	8	7	6	5	5	5	5	5	205	307.5
10	10	11	11	11	11	11	11	11	11	11	11	11	10	9	8	7	6	5	5	5	5	5	206	309
10	11	11	11	11	11	11	11	11	11	11	11	11	10	9	8	7	6	5	5	5	5	5	207	310.5
10	11	12	11	11	11	11	11	11	11	11	11	11	10	9	8	7	6	5	5	5	5	5	208	312
10	11	12	12	11	11	11	11	11	11	11	11	11	10	9	8	7	6	5	5	5	5	5	209	313.5
10	11	12	12	12	11	11	11	11	11	11	11	11	10	9	8	7	6	5	5	5	5	5	210	315

Table TDA-6 (cont). Spill patterns for juvenile fish passage at The Dalles Dam.

Gate # (Opening in feet)																							Total Feet	Kcfs
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23		
10	11	12	12	12	12	11	11	11	11	11	11	11	10	9	8	7	6	5	5	5	5	5	211	316.5
10	11	12	12	12	12	12	11	11	11	11	11	11	10	9	8	7	6	5	5	5	5	5	212	318
10	11	12	12	12	12	12	12	11	11	11	11	11	10	9	8	7	6	5	5	5	5	5	213	319.5
10	11	12	12	12	12	12	12	12	11	11	11	11	10	9	8	7	6	5	5	5	5	5	214	321
10	11	12	12	12	12	12	12	12	12	11	11	11	10	9	8	7	6	5	5	5	5	5	215	322.5
10	11	12	12	12	12	12	12	12	12	12	11	11	10	9	8	7	6	5	5	5	5	5	216	324
10	11	12	12	12	12	12	12	12	12	12	12	11	10	9	8	7	6	5	5	5	5	5	217	325.5
10	11	12	12	12	12	12	12	12	12	12	12	11	10	9	8	7	6	6	5	5	5	5	218	327
10	11	12	12	12	12	12	12	12	12	12	12	11	10	9	8	7	7	6	5	5	5	5	219	328.5
10	11	12	12	12	12	12	12	12	12	12	12	11	10	9	8	8	7	6	5	5	5	5	220	330
10	11	12	12	12	12	12	12	12	12	12	12	11	10	9	9	8	7	6	5	5	5	5	221	331.5
10	11	12	12	12	12	12	12	12	12	12	12	11	10	10	9	8	7	6	5	5	5	5	222	333
10	11	12	12	12	12	12	12	12	12	12	12	11	11	10	9	8	7	6	5	5	5	5	223	334.5
10	11	12	12	12	12	12	12	12	12	12	12	12	11	10	9	8	7	6	5	5	5	5	224	336
10	11	12	12	12	12	12	12	12	12	12	12	12	11	10	9	8	7	6	6	5	5	5	225	337.5
10	11	12	12	12	12	12	12	12	12	12	12	12	11	10	9	8	7	7	6	5	5	5	226	339
10	11	12	12	12	12	12	12	12	12	12	12	12	11	10	9	8	8	7	6	5	5	5	227	340.5
10	11	12	12	12	12	12	12	12	12	12	12	12	11	10	9	9	8	7	6	5	5	5	228	342
10	11	12	12	12	12	12	12	12	12	12	12	12	11	10	10	9	8	7	6	5	5	5	229	343.5
10	11	12	12	12	12	12	12	12	12	12	12	12	11	11	10	9	8	7	6	5	5	5	230	345
10	11	12	12	12	12	12	12	12	12	12	12	12	12	11	10	9	8	7	6	5	5	5	231	346.5
10	11	12	12	12	12	12	12	12	12	12	12	12	12	11	10	9	8	7	6	6	5	5	232	348
10	11	12	12	12	12	12	12	12	12	12	12	12	12	11	10	9	8	7	7	6	5	5	233	349.5
10	11	12	12	12	12	12	12	12	12	12	12	12	12	11	10	9	8	8	7	6	5	5	234	351

Table TDA-7 . Spill patterns for adult fish passage at The Dalles Dam.

Gate # (Opening in feet)																							Total Feet	Kcfs
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23		
1																						0	1	1.5
1																						1	2	3
1	1																					1	3	4.5
1	1																				1	1	4	6
1	1	1																			1	1	5	7.5
1	1	1																		1	1	1	6	9
1	2	1																		1	1	1	7	10.5
1	2	1																		1	2	1	8	12
1	2	1	1																	1	2	1	9	13.5
1	2	1	1																1	1	2	1	10	15
2	2	1	1																1	1	2	1	11	16.5
2	2	1	1																1	1	2	2	12	18
2	2	1	1	1															1	1	2	2	13	19.5
2	2	1	1	1														1	1	1	2	2	14	21
2	2	1	1	1	1													1	1	1	2	2	15	22.5
2	2	1	1	1	1												1	1	1	1	2	2	16	24
2	2	1	1	1	1	1											1	1	1	1	2	2	17	25.5
2	2	1	1	1	1	1										1	1	1	1	1	2	2	18	27
2	2	1	1	1	1	1	1									1	1	1	1	1	2	2	19	28.5
2	2	1	1	1	1	1	1								1	1	1	1	1	1	2	2	20	30
2	2	1	1	1	1	1	1	1							1	1	1	1	1	1	2	2	21	31.5
2	2	1	1	1	1	1	1	1						1	1	1	1	1	1	1	2	2	22	33
2	2	1	1	1	1	1	1	1	1					1	1	1	1	1	1	1	2	2	23	34.5
2	2	1	1	1	1	1	1	1	1				1	1	1	1	1	1	1	1	2	2	24	36
2	2	1	1	1	1	1	1	1	1	0	1	0	1	1	1	1	1	1	1	1	2	2	25	37.5
2	2	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	2	2	26	39
2	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	27	40.5
2	2	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	28	42
2	3	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	29	43.5
2	3	2	1	1	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	30	45
2	3	2	1	1	2	1	1	1	1	1	1	1	1	1	2	1	1	1	1	1	2	2	31	46.5
2	3	2	1	1	2	1	2	1	1	1	1	1	1	1	2	1	1	1	1	1	2	2	32	48
2	3	2	1	1	2	1	2	1	1	1	1	1	2	1	2	1	1	1	1	1	2	2	33	49.5
2	3	2	1	1	2	1	2	1	1	1	2	1	2	1	2	1	1	1	1	1	2	2	34	51
2	3	2	1	1	2	1	2	1	2	1	2	1	2	1	2	1	1	1	1	1	2	2	35	52.5

Table TDA-7 (cont). Spill patterns for adult fish passage at The Dalles Dam.

Gate # (Opening in feet)																							Total Feet	Kcfs
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23		
2	3	2	1	1	2	1	2	1	2	1	2	1	2	1	2	1	1	1	2	1	2	2	36	54
2	3	2	2	1	2	1	2	1	2	1	2	1	2	1	2	1	1	1	2	1	2	2	37	55.5
2	3	2	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	2	38	57
2	3	2	2	1	2	1	2	1	2	2	2	1	2	1	2	1	2	1	2	1	2	2	39	58.5
3	3	2	2	1	2	1	2	1	2	2	2	1	2	1	2	1	2	1	2	1	2	2	40	60
3	3	2	2	1	2	1	2	2	2	2	2	1	2	1	2	1	2	1	2	1	2	2	41	61.5
3	3	2	2	1	2	2	2	2	2	2	2	1	2	1	2	1	2	1	2	1	2	2	42	63
3	3	2	2	2	2	2	2	2	2	2	2	1	2	1	2	1	2	1	2	1	2	2	43	64.5
3	3	2	2	2	2	2	2	2	2	2	2	1	2	1	2	1	2	2	2	1	2	2	44	66
3	3	2	2	2	2	2	2	2	2	2	2	2	2	1	2	1	2	2	2	1	2	2	45	67.5
3	3	2	2	2	2	2	2	2	2	2	2	2	2	1	2	1	2	2	2	2	2	2	46	69
3	3	2	2	2	2	2	2	2	2	2	2	2	2	2	2	1	2	2	2	2	2	2	47	70.5
3	3	2	2	2	2	2	2	2	3	2	2	2	2	2	2	1	2	2	2	2	2	2	48	72
3	3	2	2	2	2	2	2	2	3	2	2	2	2	2	2	2	2	2	2	2	2	2	49	73.5
3	3	2	2	2	3	2	2	2	3	2	2	2	2	2	2	2	2	2	2	2	2	2	50	75
3	3	2	2	2	3	2	2	2	3	2	3	2	2	2	2	2	2	2	2	2	2	2	51	76.5
3	3	2	2	2	3	2	2	2	3	2	3	2	3	2	2	2	2	2	2	2	2	2	52	78
3	3	2	2	2	3	2	2	2	3	2	3	2	3	2	2	2	2	2	2	2	3	2	53	79.5
3	3	2	3	2	3	2	2	2	3	2	3	2	3	2	2	2	2	2	2	2	3	2	54	81
3	3	2	3	2	3	2	2	2	3	2	3	2	3	2	3	2	2	2	2	2	3	2	55	82.5
3	3	2	3	2	3	2	2	2	3	2	3	2	3	2	3	2	3	2	2	2	3	2	56	84
3	3	2	3	2	3	2	3	2	3	2	3	2	3	2	3	2	3	2	2	2	3	2	57	85.5
3	3	2	3	2	3	2	3	2	3	2	3	3	3	2	3	2	3	2	2	2	3	2	58	87
3	3	2	3	2	3	2	3	3	3	2	3	3	3	2	3	2	3	2	2	2	3	2	59	88.5
3	3	2	3	2	3	2	3	3	3	3	3	3	3	2	3	2	3	2	2	2	3	2	60	90
3	3	2	3	2	3	2	3	3	3	3	3	3	3	3	3	2	3	2	2	2	3	2	61	91.5
3	3	2	3	2	3	3	3	3	3	3	3	3	3	3	3	2	3	2	2	2	3	2	62	93
3	3	2	3	2	3	3	3	3	3	3	3	3	3	3	3	2	3	3	2	2	3	2	63	94.5
3	3	2	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	2	2	2	3	2	64	96
3	3	2	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	2	2	3	2	65	97.5
3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	2	2	3	2	66	99
3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	2	3	2	67	100.5
3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	2	3	3	68	102
3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	69	103.5
3	3	3	3	3	3	3	3	3	3	3	4	3	3	3	3	3	3	3	3	3	3	3	70	105

Table TDA-7 (cont). Spill patterns for adult fish passage at The Dalles Dam.

Gate # (Opening in feet)																							Total Feet	Kcfs
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23		
3	3	3	3	3	3	3	3	3	3	3	4	3	4	3	3	3	3	3	3	3	3	3	71	106.5
3	3	3	3	3	3	3	3	3	4	3	4	3	4	3	3	3	3	3	3	3	3	3	72	108
3	3	3	3	3	3	3	3	3	4	3	4	3	4	3	4	3	3	3	3	3	3	3	73	109.5
3	3	3	3	3	3	3	4	3	4	3	4	3	4	3	4	3	3	3	3	3	3	3	74	111
3	3	3	3	3	3	3	4	3	4	4	4	3	4	3	4	3	3	3	3	3	3	3	75	112.5
3	3	3	3	3	3	3	4	4	4	4	4	3	4	3	4	3	3	3	3	3	3	3	76	114
3	3	3	3	3	3	3	4	4	4	4	4	4	4	3	4	3	3	3	3	3	3	3	77	115.5
3	3	3	3	3	3	4	4	4	4	4	4	4	4	3	4	3	3	3	3	3	3	3	78	117
3	3	3	3	3	3	4	4	4	4	4	4	4	4	4	4	3	3	3	3	3	3	3	79	118.5
3	3	3	3	4	3	4	4	4	4	4	4	4	4	4	4	3	3	3	3	3	3	3	80	120
3	3	3	3	4	3	4	4	4	4	4	4	4	4	4	4	4	3	3	3	3	3	3	81	121.5
3	3	3	3	4	3	4	4	4	4	4	4	4	4	4	4	4	3	4	3	3	3	3	82	123
3	3	3	3	4	3	4	4	4	5	4	4	4	4	4	4	4	3	4	3	3	3	3	83	124.5
3	3	3	3	4	3	4	4	4	5	5	4	4	4	4	4	4	3	4	3	3	3	3	84	126
3	3	3	3	4	3	4	4	5	5	5	4	4	4	4	4	4	3	4	3	3	3	3	85	127.5
3	3	3	3	4	4	4	4	5	5	5	4	4	4	4	4	4	3	4	3	3	3	3	86	129
3	3	3	3	4	4	4	5	5	5	5	4	4	4	4	4	4	3	4	3	3	3	3	87	130.5
3	3	3	4	4	4	4	5	5	5	5	4	4	4	4	4	4	3	4	3	3	3	3	88	132
3	3	3	4	4	4	5	5	5	5	5	4	4	4	4	4	4	3	4	3	3	3	3	89	133.5
3	3	4	4	4	4	5	5	5	5	5	4	4	4	4	4	4	3	4	3	3	3	3	90	135
3	4	4	4	4	4	5	5	5	5	5	4	4	4	4	4	4	3	4	3	3	3	3	91	136.5
3	4	4	4	4	4	5	5	5	5	5	4	4	4	4	4	4	4	4	3	3	3	3	92	138
3	4	4	4	4	4	5	5	5	5	5	4	4	4	4	4	4	4	4	4	3	3	3	93	139.5
3	4	4	4	4	5	5	5	5	5	5	4	4	4	4	4	4	4	4	4	3	3	3	94	141
3	4	4	4	4	5	5	5	6	5	5	4	4	4	4	4	4	4	4	4	3	3	3	95	142.5
3	4	4	4	4	5	5	5	6	5	5	4	4	4	4	4	4	4	4	4	4	3	3	96	144
3	4	4	4	5	5	5	5	6	5	5	4	4	4	4	4	4	4	4	4	4	3	3	97	145.5
3	4	4	4	5	5	6	5	6	5	5	4	4	4	4	4	4	4	4	4	4	3	3	98	147
3	4	4	4	5	5	6	5	6	5	5	4	4	4	4	4	4	4	4	4	4	4	3	99	148.5
3	4	4	4	5	5	6	6	6	5	5	4	4	4	4	4	4	4	4	4	4	4	3	100	150
3	4	4	4	5	5	6	6	6	6	5	4	4	4	4	4	4	4	4	4	4	4	3	101	151.5
3	4	4	4	5	5	6	6	6	6	5	5	4	4	4	4	4	4	4	4	4	4	3	102	153
3	4	4	5	5	5	6	6	6	6	5	5	4	4	4	4	4	4	4	4	4	4	3	103	154.5
3	4	4	5	5	5	6	6	6	6	5	5	5	4	4	4	4	4	4	4	4	4	3	104	156
3	4	4	5	5	5	6	6	6	6	6	5	5	4	4	4	4	4	4	4	4	4	3	105	157.5

Table TDA-7 (cont). Spill patterns for adult fish passage at The Dalles Dam.

Gate # (Opening in feet)																							Total Feet	Kcfs
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23		
3	4	4	5	5	6	6	6	6	6	6	5	5	4	4	4	4	4	4	4	4	4	3	106	159
3	4	4	5	5	6	6	6	7	6	6	5	5	4	4	4	4	4	4	4	4	4	3	107	160.5
3	4	4	5	5	6	6	7	7	6	6	5	5	4	4	4	4	4	4	4	4	4	3	108	162
3	4	4	5	5	6	6	7	7	6	6	6	5	4	4	4	4	4	4	4	4	4	3	109	163.5
3	4	4	5	5	6	6	7	7	6	6	6	5	5	4	4	4	4	4	4	4	4	3	110	165
3	4	4	5	5	6	6	7	7	6	6	6	5	5	5	4	4	4	4	4	4	4	3	111	166.5
3	4	4	5	5	6	6	7	7	6	6	6	5	5	5	5	4	4	4	4	4	4	3	112	168
3	4	4	5	5	6	6	7	7	6	6	6	5	5	5	5	5	4	4	4	4	4	3	113	169.5
3	4	4	5	5	6	6	7	7	6	6	6	5	5	5	5	5	5	4	4	4	4	3	114	171
3	4	4	5	5	6	6	7	7	6	6	6	5	5	5	5	5	5	5	4	4	4	3	115	172.5
3	4	5	5	5	6	6	7	7	6	6	6	5	5	5	5	5	5	5	4	4	4	3	116	174
3	4	5	5	6	6	6	7	7	6	6	6	5	5	5	5	5	5	5	4	4	4	3	117	175.5
3	4	5	5	6	6	7	7	7	6	6	6	5	5	5	5	5	5	5	4	4	4	3	118	177
3	4	5	5	6	6	7	7	7	7	6	6	5	5	5	5	5	5	5	4	4	4	3	119	178.5
3	4	5	5	6	6	7	7	7	7	6	6	6	5	5	5	5	5	5	4	4	4	3	120	180
3	4	5	5	6	6	7	7	7	7	7	6	6	5	5	5	5	5	5	4	4	4	3	121	181.5
3	4	5	5	6	6	7	7	8	7	7	6	6	5	5	5	5	5	5	4	4	4	3	122	183
3	4	5	5	6	6	7	7	8	7	7	7	6	5	5	5	5	5	5	4	4	4	3	123	184.5
3	4	5	5	6	6	7	7	8	7	7	7	6	6	5	5	5	5	5	4	4	4	3	124	186
3	4	5	5	6	6	7	7	8	7	7	7	6	6	6	5	5	5	5	4	4	4	3	125	187.5
3	4	5	5	6	6	7	7	8	7	7	7	7	6	6	5	5	5	5	4	4	4	3	126	189
3	4	5	5	6	6	7	7	8	8	7	7	7	6	6	5	5	5	5	4	4	4	3	127	190.5
3	4	5	5	6	6	7	7	8	8	7	7	7	6	6	6	5	5	5	4	4	4	3	128	192
3	4	5	5	6	6	7	7	8	8	8	7	7	6	6	6	5	5	5	4	4	4	3	129	193.5
3	4	5	5	6	6	7	7	8	8	8	7	7	6	6	6	5	5	5	5	4	4	3	130	195
3	4	5	5	6	6	7	7	8	8	8	7	7	6	6	6	5	5	5	5	5	4	3	131	196.5
3	4	5	5	6	7	7	7	8	8	8	7	7	6	6	6	5	5	5	5	5	4	3	132	198
3	4	5	6	6	7	7	7	8	8	8	7	7	6	6	6	5	5	5	5	5	4	3	133	199.5
3	4	5	6	6	7	7	8	8	8	8	7	7	6	6	6	5	5	5	5	5	4	3	134	201
3	4	5	6	6	7	7	8	8	8	8	7	7	7	6	6	5	5	5	5	5	4	3	135	202.5
3	4	5	6	6	7	7	8	8	8	8	7	7	7	6	6	6	5	5	5	5	4	3	136	204
3	5	5	6	6	7	7	8	8	8	8	7	7	7	6	6	6	5	5	5	5	4	3	137	205.5
3	5	5	6	6	7	7	8	8	8	8	7	7	7	7	6	6	5	5	5	5	4	3	138	207
3	5	6	6	6	7	7	8	8	8	8	7	7	7	7	6	6	5	5	5	5	4	3	139	208.5
3	5	6	6	6	7	7	8	8	8	8	7	7	7	7	6	6	6	5	5	5	4	3	140	210

Table TDA-7 (cont). Spill patterns for adult fish passage at The Dalles Dam.

Gate # (Opening in feet)																							Total Feet	Kcfs
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23		
3	5	6	6	7	7	7	8	8	8	8	7	7	7	7	6	6	6	5	5	5	4	3	141	211.5
3	5	6	6	7	7	7	8	8	8	8	7	7	7	7	7	6	6	5	5	5	4	3	142	213
3	5	6	6	7	7	8	8	8	8	8	7	7	7	7	7	6	6	5	5	5	4	3	143	214.5
3	5	6	6	7	8	8	8	8	8	8	7	7	7	7	7	6	6	5	5	5	4	3	144	216
3	5	6	6	7	8	8	8	8	8	8	7	7	7	7	7	6	6	6	5	5	4	3	145	217.5
3	5	6	6	7	8	8	8	8	8	8	7	7	7	7	7	6	6	6	6	5	4	3	146	219
3	5	6	7	7	8	8	8	8	8	8	7	7	7	7	7	6	6	6	6	5	4	3	147	220.5
3	5	6	7	7	8	8	8	8	8	8	7	7	7	7	7	6	6	6	6	5	5	3	148	222
3	5	6	7	7	8	8	8	8	8	8	7	7	7	7	7	7	6	6	6	5	5	3	149	223.5
3	5	6	7	7	8	8	8	8	8	8	7	7	7	7	7	7	7	6	6	5	5	3	150	225
3	5	6	7	7	8	8	8	8	8	8	7	7	7	7	7	7	7	7	6	5	5	3	151	226.5
3	5	6	7	7	8	8	8	8	8	8	8	7	7	7	7	7	7	7	6	5	5	3	152	228
3	5	6	7	7	8	8	8	8	8	8	8	8	7	7	7	7	7	7	6	5	5	3	153	229.5
3	5	6	7	8	8	8	8	8	8	8	8	8	7	7	7	7	7	7	6	5	5	3	154	231
3	5	6	7	8	8	8	8	8	8	8	8	8	8	7	7	7	7	7	6	5	5	3	155	232.5
3	5	6	7	8	8	8	8	8	8	8	8	8	8	8	7	7	7	7	6	5	5	3	156	234
3	5	6	7	8	8	8	8	9	8	8	8	8	8	8	7	7	7	7	6	5	5	3	157	235.5
3	5	6	7	8	8	8	8	9	9	8	8	8	8	8	7	7	7	7	6	5	5	3	158	237
3	5	6	7	8	8	8	8	9	9	9	8	8	8	8	7	7	7	7	6	5	5	3	159	238.5
3	5	6	7	8	8	8	8	9	9	9	8	8	8	8	8	7	7	7	6	5	5	3	160	240
3	5	6	7	8	8	8	8	9	9	9	8	8	8	8	8	8	7	7	6	5	5	3	161	241.5
3	5	7	7	8	8	8	8	9	9	9	8	8	8	8	8	8	7	7	6	5	5	3	162	243
3	5	7	7	8	8	8	8	9	9	9	8	8	8	8	8	8	8	7	6	5	5	3	163	244.5
3	5	7	7	8	8	8	8	9	9	9	8	8	8	8	8	8	8	7	6	6	5	3	164	246
3	5	7	7	8	8	8	8	9	9	9	8	8	8	8	8	8	8	7	7	6	5	3	165	247.5
3	5	7	7	8	8	8	8	9	9	9	8	8	8	8	8	8	8	8	7	6	5	3	166	249
3	5	7	8	8	8	8	8	9	9	9	8	8	8	8	8	8	8	8	7	6	5	3	167	250.5
3	5	7	8	8	8	8	8	9	9	9	9	8	8	8	8	8	8	8	7	6	5	3	168	252
3	5	7	8	8	8	8	8	9	9	9	9	9	8	8	8	8	8	8	7	6	5	3	169	253.5
3	5	7	8	8	8	9	8	9	9	9	9	9	8	8	8	8	8	8	7	6	5	3	170	255
3	5	7	8	8	8	9	9	9	9	9	9	9	8	8	8	8	8	8	7	6	5	3	171	256.5
3	5	7	8	8	8	9	9	9	9	9	9	9	9	8	8	8	8	8	7	6	5	3	172	258
3	5	7	8	8	9	9	9	9	9	9	9	9	9	8	8	8	8	8	7	6	5	3	173	259.5
3	5	7	8	8	9	9	9	10	9	9	9	9	9	8	8	8	8	8	7	6	5	3	174	261
3	5	7	8	8	9	9	9	10	10	9	9	9	9	8	8	8	8	8	7	6	5	3	175	262.5

Table TDA-7 (cont). Spill patterns for adult fish passage at The Dalles Dam.

Gate # (Opening in feet)																							Total Feet	Kcfs
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23		
3	5	7	8	8	9	9	9	10	10	10	9	9	9	8	8	8	8	8	7	6	5	3	176	264
3	5	7	8	8	9	9	9	10	10	10	9	9	9	9	8	8	8	8	7	6	5	3	177	265.5
3	5	7	8	9	9	9	9	10	10	10	9	9	9	9	8	8	8	8	7	6	5	3	178	267
3	5	7	8	9	9	9	9	10	10	10	9	9	9	9	9	8	8	8	7	6	5	3	179	268.5
3	5	7	8	9	9	9	9	10	10	10	10	9	9	9	9	8	8	8	7	6	5	3	180	270
3	5	7	8	9	9	9	9	10	10	10	10	9	9	9	9	9	8	8	7	6	5	3	181	271.5
3	5	7	9	9	9	9	9	10	10	10	10	9	9	9	9	9	8	8	7	6	5	3	182	273
3	5	7	9	9	9	9	10	10	10	10	10	9	9	9	9	9	8	8	7	6	5	3	183	274.5
3	5	7	9	9	9	10	10	10	10	10	10	9	9	9	9	9	8	8	7	6	5	3	184	276
3	5	7	9	9	9	10	10	10	10	10	10	10	9	9	9	9	8	8	7	6	5	3	185	277.5
3	5	7	9	9	9	10	10	11	10	10	10	10	9	9	9	9	8	8	7	6	5	3	186	279
3	5	7	9	9	9	10	10	11	11	10	10	10	9	9	9	9	8	8	7	6	5	3	187	280.5
3	5	7	9	9	9	10	10	11	11	11	10	10	9	9	9	9	8	8	7	6	5	3	188	282
3	5	7	9	9	9	10	10	11	11	11	10	10	9	9	9	9	8	8	7	7	5	3	189	283.5
3	5	7	9	9	9	10	11	11	11	11	10	10	9	9	9	9	8	8	7	7	5	3	190	285
3	5	7	9	9	9	10	11	11	11	11	10	10	9	9	9	9	8	8	8	7	5	3	191	286.5
3	5	7	9	9	9	10	11	11	11	11	11	10	9	9	9	9	8	8	8	7	5	3	192	288
3	5	7	9	9	9	10	11	11	11	11	11	10	10	9	9	9	8	8	8	7	5	3	193	289.5
3	5	7	9	9	10	10	11	11	11	11	11	10	10	9	9	9	8	8	8	7	5	3	194	291
3	5	7	9	9	10	10	11	11	11	11	11	10	10	10	9	9	8	8	8	7	5	3	195	292.5
3	5	7	9	10	10	10	11	11	11	11	11	10	10	10	9	9	8	8	8	7	5	3	196	294
3	5	7	9	10	10	10	11	11	11	11	11	10	10	10	9	9	9	8	8	7	5	3	197	295.5
3	5	7	9	10	10	10	11	11	11	11	11	10	10	10	9	9	9	9	8	7	5	3	198	297
3	5	7	9	10	10	10	11	11	11	11	11	10	10	10	10	9	9	9	8	7	5	3	199	298.5
3	5	7	9	10	10	10	11	11	11	11	11	10	10	10	10	9	9	9	9	7	5	3	200	300
3	5	7	9	10	10	10	11	11	11	11	11	10	10	10	10	10	9	9	9	7	5	3	201	301.5
3	5	7	9	10	10	10	11	12	11	11	11	10	10	10	10	10	9	9	9	7	5	3	202	303
3	5	7	9	10	10	10	11	12	12	11	11	10	10	10	10	10	9	9	9	7	5	3	203	304.5
3	5	7	9	10	10	10	11	12	12	11	11	11	10	10	10	10	9	9	9	7	5	3	204	306
3	5	7	9	10	10	10	11	12	12	12	11	11	10	10	10	10	9	9	9	7	5	3	205	307.5
3	5	7	9	10	10	10	11	12	12	12	11	11	11	10	10	10	9	9	9	7	5	3	206	309
3	5	7	9	10	10	11	11	12	12	12	11	11	11	10	10	10	9	9	9	7	5	3	207	310.5
3	5	7	9	10	10	11	11	12	12	12	11	11	11	10	10	10	10	9	9	7	5	3	208	312
3	5	7	9	10	10	11	11	12	12	12	11	11	11	11	10	10	10	9	9	7	5	3	209	313.5
3	5	7	9	10	10	11	12	12	12	12	11	11	11	11	10	10	10	9	9	7	5	3	210	315

Table TDA-7 (cont). Spill patterns for adult fish passage at The Dalles Dam.

Gate # (Opening in feet)																							Total Feet	Kcfs
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23		
3	5	7	9	10	10	11	12	12	12	12	12	11	11	11	10	10	10	9	9	7	5	3	211	316.5
3	5	7	9	10	11	11	12	12	12	12	12	11	11	11	10	10	10	9	9	7	5	3	212	318
3	5	7	9	10	11	11	12	12	12	12	12	11	11	11	11	10	10	9	9	7	5	3	213	319.5
3	5	7	9	10	11	11	12	12	12	12	12	12	11	11	11	10	10	9	9	7	5	3	214	321
3	5	7	9	10	11	11	12	13	12	12	12	12	11	11	11	10	10	9	9	7	5	3	215	322.5
3	5	7	9	10	11	11	12	13	12	12	12	12	12	11	11	10	10	9	9	7	5	3	216	324
3	5	7	9	10	11	11	12	13	12	12	12	12	12	11	11	10	10	10	9	7	5	3	217	325.5
3	5	7	9	10	11	12	12	13	12	12	12	12	12	11	11	10	10	10	9	7	5	3	218	327
3	5	7	9	10	11	12	12	13	13	12	12	12	12	11	11	10	10	10	9	7	5	3	219	328.5
3	5	7	9	10	11	12	12	13	13	13	12	12	12	11	11	10	10	10	9	7	5	3	220	330
3	5	7	9	10	11	12	12	13	13	13	12	12	12	11	11	11	10	10	9	7	5	3	221	331.5
3	5	7	9	10	11	12	12	13	13	13	12	12	12	12	11	11	10	10	9	7	5	3	222	333
3	5	7	9	10	11	12	12	13	13	13	13	12	12	12	11	11	10	10	9	7	5	3	223	334.5
3	5	7	9	10	11	12	12	13	13	13	13	12	12	12	11	11	11	10	9	7	5	3	224	336
3	5	7	9	10	11	12	12	13	13	13	13	12	12	12	12	11	11	10	9	7	5	3	225	337.5
3	5	7	9	10	11	12	12	13	13	13	13	12	12	12	12	12	11	10	9	7	5	3	226	339
3	5	7	9	10	11	12	12	13	13	13	13	13	12	12	12	12	11	10	9	7	5	3	227	340.5
3	5	7	9	10	11	12	13	13	13	13	13	13	12	12	12	12	11	10	9	7	5	3	228	342
3	5	7	9	10	11	12	13	13	13	13	13	13	13	12	12	12	11	10	9	7	5	3	229	343.5
3	5	7	9	10	11	12	13	13	13	13	13	13	13	13	12	12	11	10	9	7	5	3	230	345
3	5	7	9	10	11	12	13	13	13	13	13	13	13	13	13	12	11	10	9	7	5	3	231	346.5
3	5	7	9	10	11	13	13	13	13	13	13	13	13	13	13	12	11	10	9	7	5	3	232	348
3	5	7	9	10	12	13	13	13	13	13	13	13	13	13	13	12	11	10	9	7	5	3	233	349.5
3	5	7	9	11	12	13	13	13	13	13	13	13	13	13	13	12	11	10	9	7	5	3	234	351

SECTION 4

JOHN DAY DAM

John Day Dam

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

1.1. Juvenile Fish Passage

1.1.1 Juvenile Bypass Facilities Description. Juvenile fish bypass facilities at John Day Dam, completed in 1987, include one vertical barrier screen (VBS), submersible traveling screen (STS) and one 14" diameter orifice per gatewell in each of the project's 16 turbine units for a total of 48 orifices. The bypass collection conduit leads to a transport channel which carries collected juvenile fish to the river below the dam when the smolt monitoring facility is not in operation (bypass mode). Differential between the forebay and bypass conduit is controlled by the tainter gate, and has a criterion of 4' to 5' (water level in the conduit is measured at unit 16).

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

1.1.3. Juvenile Migration Timing. Juvenile passage timing has been determined by past gatewell and SMF sampling at John Day Dam (Table JDA-2.) Hydroacoustic monitoring has been conducted but was generally concentrated on peak days and hours of passage and, therefore, cannot be used to evaluate seasonal or diel passage patterns. Extended monitoring which was conducted into December at John Day Dam in 1982 and 1983 showed that less than 3% of subyearling chinook migrants move past John Day Dam after October 31. As a result, smolt monitoring is now discontinued on October 31. Maintenance of juvenile fish facilities is scheduled from approximately December 16 through March to minimize impact on downstream migrants and reduce the possibility of adult fallbacks through turbine units.

reserved for Figure JDA-1

reserved for Figure JDA-2

Table JDA-1. Dates of project operations for fish purposes at John Day Dam, 1999.

Diel passage was monitored by hydroacoustics and gatewell sampling (see Section 7. Endnotes [a b c d]). Peak passage occurs between 2300 and 2400 hours with a long period of elevated passage until dawn when passage decreases. Passage increases dramatically at dusk (about 2000 hours). Gatewell sampling data indicate that roughly 80% of the juvenile migrants pass John Day Dam between 2100 and 0600 hours. For example, the weighted average passage for subyearling chinook during these hours in July and August, 1986, was 82%. However, some variation from this pattern has been noted. In 1984 daytime passage at John Day Dam increased beginning on May 23. 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. Unit 3 gatewell sampling and hydroacoustic sampling confirmed the diel pattern. Note the above information is for powerhouse passage only. Recent radio-tracking and hydroacoustic information indicates different passage patterns for the spillway and project when spill is occurring 24 hours a day.

Table JDA-2. John Day Dam juvenile migration timing, 1992-1998.

% Past Project	Year/Date						
	1992	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**
Yearling Chinook							
10%	5/2	5/6	5/2	4/29	4/21	4/20	4/28
90%	6/10	6/1	6/18	5/29	5/28	5/28	6/2
Subyearling Chinook							
10%	6/24	6/21	7/8	6/8	5/12	5/1	6/11
90%	8/15	8/17	8/2	7/24	8/19	8/16	7/29
Steelhead (all)							
10%	5/3	----	----	----	----	----	----
90%	5/28	----	----	----	----	----	----
Steelhead (wild)							
10%	----	4/30	4/27	5/3	4/24	4/23	4/27
90%	----	5/26	5/26	5/25	5/24	5/24	5/29
Steelhead (hatchery)							
10%	----	5/10	5/9	5/7	4/28	4/27	5/4
90%	----	5/26	6/1	5/26	5/27	5/26	6/1
Coho							
10%	5/2	5/9	5/12	5/8	4/27	4/30	5/10
90%	5/27	5/30	5/29	5/21	5/21	6/9	6/2
Sockeye							
10%	5/8	5/16	5/11	5/9	5/3	5/10	5/8
90%	5/27	5/31	6/5	5/26	6/3	6/21	5/31

1.2. Adult Fish Passage.

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

1.2.2. Adult Migration Timing. Upstream migrant fish are present at John Day Dam throughout the year. Adult passage facilities are operated year round. However, passage through the winter months is relatively light and there is no regular fish counting. Fish counting at John Day Dam normally extends from April 1 through October 31. The adult fish counting schedule is shown in Table JDA-3. Annual winter maintenance of adult fish facilities is scheduled from December 1 through February 28 (in-water work period) to minimize the impact on upstream migrants and to minimize adult fall chinook and steelhead fallback.

Table JDA-3. Adult fish counting schedule.

Period	Counting Method
April 1 - October 31	Visual count 16 hours/day (0400-2000 PST)
November 1 – March 31	No Counting

Table JDA-4 shows fish counting periods by species and earliest and latest recorded dates of peak passage, from fish count data compiled by the Corps.

Table JDA-4. John Day Dam adult migration timing, 1968-1998.

Species	Count Period	Earliest Peak	Latest Peak
Spring chinook	4/1 - 6/5	4/17	5/22
Summer Chinook	6/6 - 8/5	6/7	8/2
Fall Chinook	8/6 - 10/31	9/2	9/25
Steelhead	4/1 - 10/31	9/6	10/6
Sockeye	4/1 - 10/31	6/23	7/10
Coho	4/1 - 10/31	9/4	10/12

2. Project Operation.

2.1. General.

2.1.1. Research, non-routine maintenance, other fish related activities, and construction activities will not be conducted within 100' of any fishway entrance or exit, within 50' of any other part of the adult fishway, or directly in, above, or adjacent to any fishway, unless concurred with by regional fish managers through ESA and other fish passage forums. Currently approved special operations are described in Appendix A. Alternate actions will be considered by district and project biologists in conjunction with the fish managers 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 in advance with the project.

2.2. Spill Management. Spill patterns formulated with spillway deflectors in place are provided in Table JDA-9. These will be used for both adult and juvenile patterns.

2.3. Dissolved Gas Management and Control. Spill management requests will be based upon total dissolved gas (TDG) monitoring data and the observed condition of migrating juveniles and adults, along with juvenile migration monitoring data. Total TDG monitoring will be conducted by the Corps at the John Day Dam forebay and tailrace automated stations and reported every four hours from April 1 through September 15. Related data reported at the same time, includes volume and total project flow. The TDG monitoring system is described in detail in Appendix D. 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. Prior to Juvenile Fish Passage Season (December 1 through March).

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

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

c. Inspect each STS and operate on trial run (dogged off at deck level).

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

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

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

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

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

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

j. Reinstall or repair avian predator control lines in present locations 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 measures as necessary in areas where avian lines are not practical. Continue operation of the avian water cannon on the JBS outfall as determined necessary when birds are present. Avian abatement measures shall be in place by April 1.

k. The results of all inspections and the readiness of the facility for operation will be reported at the FPOM meeting immediately prior to the start of the juvenile fish passage season.

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

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

2. All valves and auxiliary water systems.

3. Flushing water valves and their perforated plates.

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

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

6. PIT tag detectors.

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

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

a. Measure gatewell drawdown a minimum of once per week. Remove debris from forebay and trash racks as required to maintain less than 1.5' of drawdown in gatewell.

b. Units 1 through 5 will be raked every two weeks between April 1 and July 1. Units 6 through 10 or units 11 through 16 will be alternately raked with units 1 through 5 from April 1 through July 1. After July 1, units will be raked as needed to avoid exceeding gatewell drawdown criterion.

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

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

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

f. 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). Video inspections are acceptable. VBS inspections will occur immediately prior to peaks in the juvenile fish migrations (early-May and early-July). Inspections will be concentrated on the priority units and those others with longer operating times. More frequent inspections may be required under the following conditions: deterioration of fish condition, increased debris load in bypass system, and other indications of STS or VBS malfunction or failure. If STS or VBS damage or plugging is detected, follow procedures in Section 3., Fish Facilities Maintenance. Records of inspections will be reported in weekly fishway status reports and provided to FPOM. Screen inspections will not occur in unit 1 until after 1200 hours. Unit 2 will operate when unit 1 is out of service for STS inspections.

g. Operate all gatewell orifices. Inspect orifice lights daily to assure that the orifice lights are operating. Replace all burned out orifice lights within 24 hours. Close and open each orifice at least once daily, or more frequently if necessary due to heavy debris accumulations in gatewells.

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

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

j. A slight oily sheen is commonly found in many gatewells. This may come from sources such as lubricated lifting beams. But, when unusual accumulations of oil (e.g., oil slick) occur in gate slots, the JBS 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 FPC or NMFS. Regardless of unit operating status, oil accumulations will be dealt with promptly.

k. Coordinate gatewell cleaning with personnel operating the Smolt Monitoring Facility.

l. Reinstall or repair avian predator control lines in present locations 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 measures as necessary in areas where avian lines are not practical. These are performed under contract with the U.S. Department of Agriculture, Animal Damage Control. Abatement measures include selective hazing, pyrotechnics, propane cannon scare techniques, and lethal take where necessary. Maintain operation of the avian water cannon on the JBS outfall as needed. This could be delayed because of inclement weather and will be completed ASAP after the start of the juvenile fish passage season.

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

n. Inspect facilities twice each day, unless other guidance is provided elsewhere within this plan for specific facilities. At least three inspections per week will be performed by project fish biologist or fish biological staff.

o. Smolt Monitoring Facility.

1. The smolt monitoring facility (SMF) will be monitored on a 24 hours per day, 7 days per week basis by the project fish personnel to ensure its proper functioning and provide quick response to an emergency. Therefore, a three shift (day, swing, graveyard) system will be implemented while the SMF is in operation (dewatering structure is not dewatered).

2. A person on duty will perform a walking inspection of the entire SMF system every two hours to ensure safe passage condition. An inspection form designated for this purpose will indicate the areas which need to be checked.

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

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

5. When river temperatures reach 70°F or greater, all fish handling will be coordinated through FPOM.

2.4.1.3. Winter Maintenance Season (December 16 through March).

a. To reduce adult fallback mortality, the juvenile bypass system, or DSM channel will operate from November 30 through December 15. Priority units will be left screened during this period to the extent practicable, and screens from non-priority units will only be removed when necessary to begin maintenance. If units are required for operation during this period, and are unscreened, they will be operated on a last on/first off basis. After December 15, all STSs may be removed.

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

c. All units are available to meet power demands.

d. Inspect facilities once per day. These are to be performed at least three times per week by project fish staff.

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

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

2. All valves and auxiliary water systems.

3. Flushing water valves and their perforated plates.

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

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

6. Pit tag detectors.

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

2.5. Adult Fish Passage Facilities.

2.5.1. Operating Criteria.

2.5.1.1. Prior to Adult Passage Period (December 16 through March).

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

b. Dewater and inspect 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. Repair deficiencies.

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

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

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

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

2.5.1.2. Adult Fish Passage Period (March 1 through November).

a. All Adult Facilities.

1. Water depth over fish ladder weirs: 1' +/-0.1'. If shad passage becomes a problem, water depth should be increased to 1.3' +/- 0.1'.

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

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

4. A water velocity of 1.5' to 4 fps per second (optimum 2 fps) shall be maintained in all channels and the lower ends of the fish ladders which are below the tailwater.

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

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

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

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

9. Inspect facilities twice each day. At least three inspections per week will be performed by project fish staff. After November 1, inspect facilities at lease once per day.

10. Maintain netting and padding for both fishways that address the jumping problem. All holes in the netting large enough to catch or allow escapement of an adult salmonid must be closed.

b. North Fishway.

1. Operate one entrance weir (EW-1) at 8’or greater weir depth. Entrance head: 1’ to 2’ (prefer 1.5’). Testing will be conducted to determine if the use of one entrance at greater than 8’ depth allows better passage conditions.

2. Spill through bay 1 in the summer and fall (June 1 through October) with a gate opening of one stop from 0400 - 2000 hours.

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

d. Powerhouse.

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

2. Operate ten powerhouse floating orifices (1, 2, 3, 6, 9, 12, 15, 17, 18, and 19) and open associated auxiliary water diffusers.

3. From 0400 to 2000 hours, operate unit 1 near 100 megawatts (+/- 10 MW) to facilitate best entrance conditions. If additional load is required, to meet the load requirements of the BPA administrator (in accordance with the BPA load shaping guidelines, Appendix C), to be in compliance with other coordinated fish measures, or to avoid forcing an unscreened unit to operate to provide required load, the 100MW limit may be exceeded. If unit 1 is operated at 155 MW, it should be the last to be brought up to full load when demand increases and the first to drop off when demand decreases.

2.5.1.3. Winter Operating Period and In-water Work Period (December 16 through February).

a. Adult Fish Facilities.

1. 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. 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 fish agencies and tribes through FPOM. However, operation of unit 2 may be substituted for unit 1 without special coordination.

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

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

5. Inspect the operating facilities once per day. These are to be performed at least three times per week by project fish staff.

2.6. Facility Monitoring and Reporting. Project staff shall inspect fish passage facilities at the frequencies listed in the juvenile and adult fish facilities operating criteria sections. Additional fishway inspections may be performed by FFU and/or fish agencies. 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: any out of criteria situations observed and subsequent corrective actions taken; any equipment malfunctions, breakdowns, or damage along with a summary of resulting repair activities; adult fishway control calibrations; STS and VBS inspections; and any usual activities which occurred at the project which may affect fish passage. The weekly reports shall cover a Sunday through Saturday time period and shall be sent to CENWP-OP as soon as possible the following week via electronic mail, with a copy to RCC, Attention: Fish Team. The project biologist shall prepare an annual report by January 31 summarizing the operation of the project fish passage facilities for the previous year. The report will cover from the beginning of an adult fish facilities winter maintenance season to the beginning of the next winter maintenance season. The annual report will be provided to CENWP-OP in time for distribution to FPOM members at the February meeting.

3. Fish Facilities Maintenance.

3.1. General.

3.1.1. Scheduled 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 effect fish passage, will be reported in the weekly reports (section 2.6).

3.1.1.1. Staff gauges will be installed, cleaned, and/or repaired as required.

3.1.1.2. A 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.

3.2. Juvenile Fish Passage Facilities.

3.2.1. Scheduled Maintenance.

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

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

3.2.1.3. 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 which 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.

3.2.2. Unscheduled Maintenance. Unscheduled 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-OP biologists. The CENWP-OP 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-OP when delay of the work will result in an unsafe situation for people, property, or fish. Information required by CENWP-OP includes:

a. Description of the problem.

b. Type of outage required.

c. Impact on facility operation.

d. Length of time for repairs.

e. Expected impacts on fish passage.

3.2.2.1. Submersible Traveling Screens. If an STS or VBS is damaged or inoperative in an operating unit, the unit will be regarded as an unscreened unit. The screen will be repaired or replaced before returning the unit to service. Crews will work overtime or on weekends as required during juvenile passage season.

3.2.2.2. Juvenile Bypass System.

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

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

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

d. During fishway inspection activities, VBSs may be found plugged with debris or damaged. In these cases, the associated unit will be regarded as if unscreened and repairs will be made before returning the unit to operation.

3.2.2.3. Turbines and Spillways.

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

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

3.3. Adult Passage Facilities.

3.3.1. Scheduled Maintenance. Maintenance activities that occur during the fish passage period and that may affect fish passage will be reported in the weekly reports (section 2.6).

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

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

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

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

3.3.2. Unscheduled Maintenance. Maintenance activities that occur during the fish passage period and that may affect fish passage will be reported in the weekly reports (section 2.6.). Unscheduled 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 unscheduled maintenance of adult facilities are the same as for juvenile facilities (section 3.2.2).

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

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

1. Increase discharge of the remaining unit to maximum capacity.
2. Close NE-1.

3. Raise the south powerhouse entrance weir (SE-1) in 1' increments to 6' depth below the tailwater surface.

4. Close the center five floating submerged orifice gate entrances starting at the north end (17, 15, 12, 9, 6).

5. If the above criteria are still not achieved, then leave in this configuration until more auxiliary water becomes available. Then reverse the above procedure.

If all three turbine units fail, bulkheads will be installed in the failed turbine discharge conduits and the adult fish facility will be operated as follows until repairs can be made.

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

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

3. The floating orifice gate in front of unit 2 will be closed, leaving the floating orifice gate in front of unit 1 open.

b. North Ladder. This system can not operate according to the adult fishway criteria under any conditions due to design limitations. Three of the six available pumps can be operated simultaneously. If one pump fails, one of the standby pumps will be started. This routine will be followed until the available pumps can no longer meet the adult fishway criteria. If this occurs, EW2 will be closed and EW1 will be set at the maximum weir depth needed to maintain fishway criteria.

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

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

3.3.2.4. Diffuser Gratings. Diffuser chambers for adding auxiliary water to fish ladders and collection channels are covered by gratings attached by several different methods. Diffuser gratings are normally inspected during the winter maintenance period to assure integrity. These inspections are done by either dewatering the fishway and/or collection channel , or by using video cameras and divers or other methods to inspect the gratings underwater. Diffuser gratings may come loose during the fish passage season due to a variety of reasons. Daily inspections of fish ladders and collection systems should include looking for any flow changes which 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, 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.

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

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

Season	Time of Day	Unit Operating Priority
March 1 through November	24 hours/day	5, 1, 2, 3, then 4 and 6-16 in any order.
December 1 through February	0600-2000 hrs	5, 1, then unpaired units in any order
	2000-0600 hrs	5, 1, then any unit
April 15 through October	1800-0600 hrs	11-14 only run for synchronous condensing [a]

[a] At BPA's request, these units may be run to meet power demands.

4.1. Guidelines for operating units within the 1% turbine efficiency range at various heads are shown in Tables JDA-6 to JDA-8. To the extent technically feasible, turbines will be operated within +/- 1% of best turbine efficiency, unless operation outside of that range is necessary to meet load requirements of the BPA administrator, consistent with the BPA System Load Shaping Guidelines (Appendix C), or to comply with other coordinated fish measures. The System Load Shaping Guidelines apply between March 15 and October 31. However, during the rest of the year, the project will continue to operate units within the 1% turbine efficiency range, except as specifically requested by BPA for power production.

4.2. 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. Dewatering Plans. Guidelines for dewatering and fish handling plans (Appendix G) have been developed and are followed for dewatering project facilities. These plans include consideration for fish safety and are consistent with the following general guidance. The appropriate plans are reviewed by participants before each salvage operation. The project fish biologist and/or alternate Corps fish personnel will attend all project activities involving fish handling. The fish agencies and tribes will be encouraged to participate in all ladder dewaterings.

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

Head (Feet)	Lower Generator Limits		Upper Generator Limits	
	MW	CFS	MW	CFS
85	75	12,168	137	22,317
86	76	12,168	140	22,441
87	76	12,010	141	22,331
88	77	12,009	142	22,238
89	78	12,006	144	22,151
90	79	12,003	145	22,067
91	79	11,872	146	21,982
92	80	11,874	149	22,106
93	81	11,878	150	22,023
94	82	11,887	151	21,943
95	83	11,897	152	21,866
96	83	11,790	154	21,792
97	84	11,803	155	21,724
98	85	11,813	155	21,478
99	86	11,814	155	21,237
100	86	11,713	155	21,024
101	87	11,717	155	20,816
102	88	11,720	155	20,588
103	89	11,723	155	20,365
104	89	11,628	155	20,146
105	90	11,733	155	19,954

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

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

Head (Feet)	Lower Generator Limits		Upper Generator Limits	
	MW	CFS	MW	CFS
85	69	11,204	128	20,769
86	70	11,256	130	20,866
87	72	11,308	133	20,963
88	73	11,360	135	21,058
89	74	11,424	137	21,177
90	75	11,462	140	21,247
91	77	11,525	142	21,364
92	78	11,575	144	21,457
93	79	11,611	147	21,523
94	80	11,673	149	21,638
95	82	11,708	151	21,703
96	83	11,742	154	21,767
97	84	11,803	155	21,724
98	86	11,850	155	21,478
99	87	11,897	155	21,237
100	88	11,957	155	21,024
101	89	12,017	155	20,816
102	91	12,062	155	20,588
103	92	12,107	155	20,365
104	93	12,152	155	20,146
105	95	12,210	155	19,954

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

Table JDA-8. Turbine units without screens:

Head (Feet)	Lower Generator Limits		Upper Generator Limits	
	MW	CFS	MW	CFS
85	75	12,168	137	22,317
86	76	12,168	140	22,441
87	76	12,010	141	22,331
88	77	12,009	142	22,238
89	78	12,006	144	22,151
90	79	12,003	145	22,067
91	79	11,872	146	21,982
92	80	11,874	149	22,106
93	81	11,878	150	22,023
94	82	11,887	151	21,943
95	83	11,897	152	21,866
96	83	11,790	154	21,792
97	84	11,803	155	21,724
98	85	11,813	155	21,478
99	86	11,814	155	21,237
100	86	11,713	155	21,024
101	87	11,717	155	20,816
102	88	11,720	155	20,588
103	89	11,723	155	20,365
104	89	11,628	155	20,146
105	90	11,733	155	19,954

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

5.2. Adult Fish Ladders.

5.2.1. Scheduled Maintenance.

5.2.1.1. When possible, operate ladders to be dewatered at reduced flow for at least 24 hours, but not more than 96 hours prior to dewatering. Reduced flow is defined as less than criterion operation, but more than orifice flow.

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

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

5.2.1.4. 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. Rescue personnel will walk the inside of the ladder from the ladder exit bulkheads to tailwater, salvaging all fish either by moving fish to tailwater within the ladder flow, or capturing and placing the fish in a large water filled tank. 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.

5.2.1.5. 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 accidentally left in place after fishway water-up.

5.2.2. Unscheduled Maintenance.

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

5.2.2.2. Follow guidance in paragraphs 5.4.1.3. through 5.4.1.6.

5.3. Powerhouse Fish Collection System.

5.3.1. Scheduled Maintenance. During the pumping or draining operation to dewater a portion or all of the collection channel, the water will not be allowed to drop to a level which strands fish. Adequate inspections will be conducted 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.

5.4. Juvenile Bypass System.

5.4.1. Scheduled Maintenance. It is normal practice, when draining the juvenile bypass channel, to flush the channel with only the bypass orifices in bay 16 open. The associated gatewells will be dipped in advance to minimize the number of fish contained in this flushing water.

5.5. Turbines.

5.5.1. Remove juvenile fish from the gatewell(s) which will be drained. This is done by use of a special dipping basket. Immediately before setting the headgates, spin the unit to move fish out of the draft tube.

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

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

5.5.4. 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 two weeks to accommodate fish trapped in the draft tube. 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.

5.5.5. 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.

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

6. 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. Debris can be removed from the forebay by: physically encircling the debris with log booms and pulling it to shore with boats where it can be removed with a crane, removing the debris from the top of the dam using a crane and scoop, or passing the debris through the spillway with special powerhouse operations and spill. The preferred option is to remove debris at each project when possible to avoid passing a debris problem on to the next project downstream. This is not always possible at each project as some projects do not have forebay debris removal capability. In this case, the only viable alternative is to spill to pass the debris.

All special spills (other than normal spill patterns for ongoing spill operations) and project operations for passing debris will be coordinated prior to the operations taking place. Each project shall contact CENWP-OP at least two work days prior to the day they want the special project operations for spilling to pass debris. CENWP-OP shall coordinate the special operations with the FPOM. Project personnel shall provide CENWP-OP 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.

7. Endnotes.

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

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

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

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

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

Bay Number																				Stops	Kcfs
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20		
2	2	2																		6	9.6
2	3	2																		7	11.2
2	3	2	1																	8	12.8
2	3	2	2																	9	14.4
2	3	3	2																	10	16
2	3	3	2	1																11	17.6
2	3	3	2	2																12	19.2
2	3	3	2	2	1															13	20.8
2	3	3	2	2	2															14	22.4
2	3	3	2	2	2	1														15	24
2	3	3	2	2	2	2														16	25.6
2	3	3	2	2	2	2	1													17	27.2
2	3	3	3	2	2	2	1													18	28.8
2	3	3	3	2	2	2	2													19	30.4
2	3	3	3	2	2	2	2	1												20	32
2	3	3	3	3	2	2	2	1												21	33.6
2	3	3	3	3	3	2	2	1												22	35.2
2	3	3	3	3	3	2	2	2												23	36.8
2	3	3	3	3	3	2	2	2	1											24	38.4
2	3	3	3	3	3	2	2	2	2											25	40
2	3	3	3	3	3	2	2	2	2	1										26	41.6
2	3	3	3	3	3	2	2	2	2	2										27	43.2
2	3	3	3	3	3	2	2	2	2	2	1									28	44.8
2	3	3	3	3	3	2	2	2	2	2	2									29	46.4
2	3	3	3	3	3	3	2	2	2	2	2									30	48
2	3	3	3	3	3	3	2	2	2	2	2	1								31	49.6
2	3	3	3	3	3	3	2	2	2	2	2	2								32	51.2
2	3	3	3	3	3	3	2	2	2	2	2	2	1							33	52.8
2	3	3	3	3	3	3	3	2	2	2	2	2	1							34	54.4
2	3	3	3	3	3	3	3	2	2	2	2	2	2							35	56
2	3	3	3	3	3	3	3	2	2	2	2	2	2	1						36	57.6
2	3	3	3	3	3	3	3	2	2	2	2	2	2	2						37	59.2
2	3	3	3	3	3	3	3	2	2	2	2	2	2	2	1					38	60.8
2	3	3	3	3	3	3	3	2	2	2	2	2	2	2	2					39	62.4
2	3	3	3	3	3	3	3	2	2	2	2	2	2	2	2	1				40	64
2	4	3	3	3	3	3	3	2	2	2	2	2	2	2	2	1				41	65.6
2	4	4	3	3	3	3	3	2	2	2	2	2	2	2	2	1				42	67.2
2	4	4	4	3	3	3	3	2	2	2	2	2	2	2	2	1				43	68.8
2	4	4	4	4	3	3	3	2	2	2	2	2	2	2	2	1				44	70.4
2	4	4	4	4	3	3	3	3	2	2	2	2	2	2	2	1				45	72
2	4	4	4	4	3	3	3	3	3	2	2	2	2	2	2	1				46	73.6
3	4	4	4	4	3	3	3	3	3	2	2	2	2	2	2	1				47	75.2

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

Bay Number																				Stops	Kcfs
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20		
3	5	4	4	4	3	3	3	3	3	2	2	2	2	2	2	1				48	76.8
3	5	5	4	4	3	3	3	3	3	2	2	2	2	2	2	1				49	78.4
3	5	5	4	4	4	3	3	3	2	2	2	2	2	2	2	2				50	80
3	5	5	4	4	4	3	3	3	2	2	2	2	2	2	2	2	1			51	81.6
3	5	5	4	4	4	3	3	3	3	2	2	2	2	2	2	2	1			52	83.2
3	5	5	4	4	4	3	3	3	3	3	2	2	2	2	2	2	1			53	84.8
3	5	5	4	4	4	3	3	3	3	3	3	2	2	2	2	2	1			54	86.4
3	5	5	5	4	4	3	3	3	3	3	3	2	2	2	2	2	1			55	88
3	5	5	5	4	4	4	3	3	3	3	3	2	2	2	2	2	1			56	89.6
3	5	5	5	4	4	4	3	3	3	3	3	3	2	2	2	2	1			57	91.2
3	5	5	5	4	4	4	3	3	3	3	3	3	3	2	2	2	1			58	92.8
3	5	5	5	4	4	4	3	3	3	3	3	3	3	3	2	2	1			59	94.4
3	5	5	5	4	4	4	3	3	3	3	3	3	3	3	3	2	1			60	96
3	5	5	5	4	4	4	4	3	3	3	3	3	3	3	3	2	1			61	97.6
3	5	5	5	4	4	4	4	4	3	3	3	3	3	3	3	2	1			62	99.2
3	5	5	5	5	4	4	4	4	3	3	3	3	3	3	3	2	1			63	100.8
3	5	5	5	5	4	4	4	4	3	3	3	3	3	3	3	2	2			64	102.4
3	5	5	5	5	4	4	4	4	4	3	3	3	3	3	3	2	2			65	104
3	5	5	5	5	4	4	4	4	4	3	3	3	3	3	3	2	2	1		66	105.6
3	5	5	5	5	4	4	4	4	4	3	3	3	3	3	3	3	2	1		67	107.2
4	4	4	4	4	3	3	3	3	3	3	3	3	3	4	3	4	3	4	3	68	108.8
4	4	4	4	4	3	3	4	3	3	3	3	3	3	4	3	4	3	4	3	69	110.4
4	4	4	4	4	3	3	4	3	4	3	3	3	3	4	3	4	3	4	3	70	112
4	4	4	4	4	3	3	4	3	4	3	4	3	3	4	3	4	3	4	3	71	113.6
4	4	4	4	4	4	3	4	3	4	3	4	3	3	4	3	4	3	4	3	72	115.2
4	4	4	4	4	4	3	4	3	4	3	4	3	3	4	3	4	4	4	3	73	116.8
4	4	4	4	4	4	3	4	3	4	3	4	3	3	4	4	4	4	4	3	74	118.4
4	4	4	4	4	4	3	4	3	4	3	4	3	4	4	4	4	4	4	3	75	120
4	4	4	4	4	4	4	4	3	4	3	4	3	4	4	4	4	4	4	3	76	121.6
4	4	4	4	4	4	4	4	4	4	3	4	3	4	4	4	4	4	4	3	77	123.2
4	4	4	4	4	4	4	4	4	4	4	4	3	4	4	4	4	4	4	3	78	124.8
4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	3	79	126.4
4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	80	128
5	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	81	129.6
5	5	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	82	131.2
5	5	5	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	83	132.8
5	5	5	5	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	84	134.4
5	5	5	5	4	4	4	4	4	4	4	4	4	4	4	4	4	4	5	4	85	136
5	5	5	5	4	4	4	4	4	4	4	4	4	4	4	4	5	4	5	4	86	137.6
5	5	5	5	4	4	4	4	4	4	4	4	4	4	5	4	5	4	5	4	87	139.2

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

Bay Number																				Stops	Kcfs
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20		
5	5	5	5	5	4	4	4	4	4	4	4	4	4	5	4	5	4	5	4	88	140.8
5	5	5	5	5	4	4	5	4	4	4	4	4	4	5	4	5	4	5	4	89	142.4
5	5	5	5	5	4	4	5	4	5	4	4	4	4	5	4	5	4	5	4	90	144
5	5	5	5	5	4	4	5	4	5	4	5	4	4	5	4	5	4	5	4	91	145.6
5	5	5	5	5	5	4	5	4	5	4	5	4	4	5	4	5	4	5	4	92	147.2
5	5	5	5	5	5	4	5	4	5	4	5	4	4	4	5	5	5	5	4	93	148.8
5	5	5	5	5	5	4	5	4	5	4	5	4	4	5	5	5	5	5	4	94	150.4
5	5	5	5	5	5	5	5	4	5	4	5	4	4	5	5	5	5	5	4	95	152
5	5	5	5	5	5	5	5	4	5	4	5	4	5	5	5	5	5	5	4	96	153.6
5	5	5	5	5	5	5	5	5	5	4	5	4	5	5	5	5	5	5	4	97	155.2
5	5	5	5	5	5	5	5	5	5	5	5	4	5	5	5	5	5	5	4	98	156.8
5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	4	99	158.4
5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	100	160
6	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	101	161.6
6	6	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	102	163.2
6	6	6	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	103	164.8
6	6	6	6	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	104	166.4
6	6	6	6	5	5	5	5	5	5	5	5	5	5	5	5	5	5	6	5	105	168
6	6	6	6	5	5	5	5	5	5	5	5	5	5	5	5	6	5	6	5	106	169.6
6	6	6	6	5	5	5	5	5	5	5	5	5	5	6	5	6	5	6	5	107	171.2
6	6	6	6	6	5	5	5	5	5	5	5	5	5	6	5	6	5	6	5	108	172.8
6	6	6	6	6	5	5	6	5	5	5	5	5	5	6	5	6	5	6	5	109	174.4
6	6	6	6	6	5	5	6	5	6	5	5	5	5	6	5	6	5	6	5	110	176
6	6	6	6	6	5	5	6	5	6	5	6	5	5	6	5	6	5	6	5	111	177.6
6	6	6	6	6	6	5	6	5	6	5	6	5	5	6	5	6	5	6	5	112	179.2
6	6	6	6	6	6	5	6	5	6	5	6	5	5	6	5	6	6	6	5	113	180.8
6	6	6	6	6	6	5	6	5	6	5	6	5	5	6	6	6	6	6	5	114	182.4
6	6	6	6	6	6	6	6	5	6	5	6	5	5	6	6	6	6	6	5	115	184
6	6	6	6	6	6	6	6	5	6	5	6	5	6	6	6	6	6	6	5	116	185.6
6	6	6	6	6	6	6	6	6	6	5	6	5	6	6	6	6	6	6	5	117	187.2
6	6	6	6	6	6	6	6	6	6	6	6	5	6	6	6	6	6	6	5	118	188.8
6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	5	119	190.4
6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	120	192
7	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	121	193.6
7	7	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	122	195.2
7	7	7	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	123	196.8
7	7	7	7	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	124	198.4
7	7	7	7	6	6	6	6	6	6	6	6	6	6	6	6	6	6	7	6	125	200
7	7	7	7	6	6	6	6	6	6	6	6	6	6	6	6	7	6	7	6	126	201.6
7	7	7	7	6	6	6	6	6	6	6	6	6	6	7	6	7	6	7	6	127	203.2

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

Bay Number																				Stops	Kcfs
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20		
7	7	7	7	7	6	6	6	6	6	6	6	6	6	7	6	7	6	7	6	128	204.8
7	7	7	7	7	6	6	7	6	6	6	6	6	6	7	6	7	6	7	6	129	206.4
7	7	7	7	7	6	6	7	6	7	6	6	6	6	7	6	7	6	7	6	130	208
7	7	7	7	7	6	6	7	6	7	6	7	6	6	7	6	7	6	7	6	131	209.6

SECTION 5

MCNARY DAM

McNary Dam

1. Fish Passage Information. The locations of fish passage facilities are shown on the general site plan for McNary Lock and Dam (Figure MCN-1). Dates of project operations for fish purposes and special operations are listed in Table MCN-1.

1.1. Juvenile Fish Passage.

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

1.1.2. Juvenile Migration Timing. Juvenile migration timing at McNary Dam is indicated in Table MCN-2. The dates in the table are based on juvenile fish collection numbers and do not reflect FGE or spill passage. Maintenance of juvenile fish passage facilities, which may impact juvenile fish passage or facility operations, should be conducted during the maintenance season.

1.2. Adult Fish Passage.

1.2.1. Facilities Description. The adult fish passage facilities at McNary consist of separate north and south shore facilities. The north shore facilities are made up of a fish ladder with counting station, 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 2 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

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Table MCN-1. Dates of project operations for fish purposes at McNary Dam, 2000.

Reserved for page 2 of Table MCN-1.

Table MCN-2. Juvenile migration timing at McNary Dam based on juvenile fish collection numbers.

% Collection	1995	1996	1997	1998	1999
Yearling Chinook					
10%	4/24	4/23	4/20	4/10	4/14
90%	5/28	5/26	5/26	5/24	5/26
Subyearling Chinook					
10%	6/22	6/20	6/22	6/20	6/18
90%	7/21	8/14	8/10	7/22	8/10
Hatchery Steelhead					
10%	4/29	4/25	4/24	4/20	4/10
90%	5/24	5/24	5/23	5/27	6/1
Wild Steelhead					
10%	4/24	4/23	4/20	4/18	4/22
90%	5/24	5/24	5/23	5/29	5/31
Sockeye					
10%	5/2	5/1	5/7	5/4	5/6
90%	5/25	5/26	6/6	5/23	5/27

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

1.2.2. Adult Migration Timing. Upstream migrants are present at McNary Dam year round. Maintenance of upstream passage facilities is scheduled for January and February to minimize impacts on upstream migrants. Table MCN-3 shows primary passage periods by species and the earliest and latest dates of peak passage on record, from fish count data compiled by the Corps of Engineers. Adult fish are normally counted 16 hours per day (0400 through 2000 Pacific Standard Time) from April 1 through October 31.

Table MCN-3. Adult migration timing at McNary Dam based on fish counts, 1954-1999.

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

2. Project Operation.

2.1. Spill Management. Involuntary spill at McNary is the result of river flow exceeding powerhouse capacity, insufficient generation loads to pass the river flow, turbine unit outages (forced or scheduled), or the failure of a key component of the juvenile fish passage facility which forces the project to spill to provide juvenile fish passage. Spill at McNary shall be distributed in accordance with the adult fish passage spill pattern included at the end of this section in Table MCN-5. Special spills for juvenile fish passage may be provided as detailed in Appendix A (Special Project Operations and Research). Special spills for juvenile fish passage normally occur during the spring, from April 20 through approximately late June, when the project is bypassing collected fish. Spill may continue after this date in accordance with Appendix A or if involuntary spill occurs. If possible, when powerhouse generation load/spill changes greater then 50,000 cfs are made, they should be ramped over a one-hour period to minimize rapid flow changes in the juvenile fish collection channel.

2.2. Dissolved Gas Management and Control. Total dissolved gas (TDG) levels at McNary are monitored in accordance with the Dissolved Gas Monitoring Program, Appendix D. The TDG levels are monitored at two locations in the McNary forebay: at the navigation lock on the north shore, to monitor the mid-Columbia arm of the McNary pool, and on the south end of the powerhouse, to monitor Snake River inflow. The TDG levels will also be monitored in the McNary tailrace. The TDG will be recorded every half-hour and reported hourly via computer year-round. Related data collected at the same time for McNary Project include spill volume and total project flow. Implementation of spill requests at McNary will be based in part upon TDG monitoring data and the observed condition of migrant juveniles and adults, along with juvenile migrant monitoring data. Spill requests will be coordinated through the Technical Management Team (TMT).

2.3. Operating Criteria.

2.3.1. Juvenile Fish Passage Facilities. From April 1 through December 15 operate according to criteria listed below and in Appendix B (Corps Juvenile Fish Transportation Program Operating Criteria) for the bypassing, collection, and transportation of juvenile salmonids. The transportation program may be revised in accordance with the ESA Section 10 permit and NMFS biological opinions. In late November and December, adverse weather may cause ice to form in parts of the juvenile bypass system. If this happens, the McNary Project Manager will decide when the juvenile bypass system must be unwatered to protect the integrity of the system or for personnel safety. Bad road conditions between McNary Dam and Bonneville Dam may also halt the juvenile fish transportation program prior to its scheduled completion date. The NMFS will be consulted prior to unwatering the bypass system.

2.3.1.1. Winter Maintenance Period (December 16 through March 31). Check and maintain as needed the items listed below.

a. Forebay Area and Intakes.

1. Remove debris from forebay and trash racks.

2. Rake trash racks.

3. Remove debris from gatewell slots.

4. Measure and log drawdown in gatewell slots.

b. Extended Length Bar Screens (ESBS), Flow Vanes, and Vertical Barrier Screens (VBS).

1. Maintenance completed on all ESBSs.

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

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

4. Inspect all VBSs at least once per year.

c. Collection Channel.

1. Orifice lights are operational.

2. Orifices are clean and valves operate correctly.

3. Orifice air back flush system works correctly.

4. Netting over handrails and orifice chutes maintained and in good condition. Repair or replace as needed.

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

d. Dewatering Structure and Flume.

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

2. Cleaning brush systems are maintained and operating correctly.

3. All valves in good condition and operating correctly.

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

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

e. Transportation Facilities.

1. Flume switch gate is maintained and operational.

2. Flume is smooth with no rough edges.

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

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

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

6. Crowders maintained and operating properly.

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

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

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

10. Barge loading boom maintained and tested.

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

f. Avian Predation Areas (Forebay and Tailrace). Inspect bird wires 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.

g. Fish Transport Trailers.

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

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

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

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

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

6. All air and water valves should operate correctly.

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

h. Maintenance Records. Record all maintenance and inspections.

2.3.1.2. Fish Passage Period (April 1 through December 15). Operate facilities as detailed below.

a. Forebay Area and Intakes.

1. Remove debris from forebay.

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

3. If a visible accumulation of contaminating substances (such as oil) is detected in a gatewell and it cannot removed within 24 hours, the gatewell orifices shall be closed and the turbine unit shut down until the material has been removed and any problems corrected. Action should be taken as soon as possible to remove the oil from the gatewell so the orifice can be reopened to allow the fish to exit the gatewell. Orifices shall not be closed for longer than 48 hours.

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

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

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

b. Extended Length Bar Screens (ESBS), Flow Vanes, and Vertical Barrier Screens (VBS).

1. Operate ESBSs with flow vanes attached to screen.

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

3. Inspect ESBSs in at least 3 operating turbine units per week.

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

5. If an ESBS is damaged or fails during the juvenile fish passage season, follow procedures detailed under unscheduled maintenance of ESBSs. In no case should a turbine unit be operated with a missing or a known non-operating or damaged ESBS, or VBS. Turbine units shall not operate for more than 10 hours with ESBSs in place and orifices closed.

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

7. Measure head differentials across VBSs daily during times of debris. Clean 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 can not be cleaned within 8 hours, to minimize loading on the VBS and potential fish impingement.

8. Inspect at least 4 VBSs at random across the powerhouse between the spring and summer migration periods. If a debris accumulation is noted, inspect other VBSs and clean debris as necessary.

9. Inspect all vertical barrier screens at least once per year and whenever pulled for cleaning. Repair as needed.

c. Collection Gallery.

1. Operate at least one orifice per gate slot (preferably the south orifice). If orifices must be closed to repair any part of the facility, <u>do not close orifices in operating turbine units with ESBSs in place for longer than 10 hours</u>. During periods of high fish numbers or high debris, this time period may be less. Monitor fish condition in gatewells

hourly during orifice closure.

2. Orifices are clean of debris and operating correctly.

3. Orifice lights are operating on open orifices.

4. Orifice jets are hitting no closer than 3' from wall (bypass gallery full).

5. Orifice valves are either full open or closed.

6. Backflush orifices at least once per day. During periods of high debris, orifices should be inspected and backflushed several times per day, as determined by the project biologist, to keep orifices clean.

d. Dewatering Structure.

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

2. Trash sweeps operating correctly.

3. The project biologist shall determine the frequency of operation of the trash sweeps. The sweeps should operate at a frequency to maintain a clean screen given present debris loads. Frequency of operation may vary from as low as once every 15 minutes to once every 2 or more hours.

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

5. The dewatering structure may be dewatered twice during the season, during low fish passage periods in June and September, for inspection and cleaning of the dewatering screens.

e. Transportation Facilities.

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

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

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

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

5. Truck and barge loading facilities should be kept in good operating condition.

f. Avian Predation Areas (Forebay and Tailrace).

1. Bird wires and other avian deterrent devices should be monitored to assure they are in good condition. Any broken wires or devices should be replaced as soon as possible.

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

3. Project biologists shall routinely monitor project areas to determine areas of active avian predation and, if possible, adjust harassment program to cover these areas or install bird wires or other deterrent devices to discourage avian predation activities.

g. Facility Inspections. Inspect all facilities according to fish facilities monitoring plan. Record all inspections.

2.3.2. Adult Fish Passage Facilities. Operate the adult fish passage facilities according to the criteria listed below.

2.3.2.1. Winter Maintenance Period (January 1 through March 1).

a. Inspect all staff gauges and water level indicators: repair and/or clean where necessary.

b. Dewater all ladders and inspect all sections of fish facilities for projections, debris, or plugged orifices which could injure fish or impede fish passage up the ladder. Inspect all diffuser gratings and chambers annually by dewatering and physically inspecting the gratings and chambers or by using divers or video inspection techniques. Once collection channel stoplogs are replaced, all diffuser gratings and chambers are to be dewatered and physically inspected at least every 3 years. Repair deficiencies.

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

d. Calibrate all mechanical water level sensing devices, as necessary, for proper facilities operations.

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

2.3.2.2. Fish Passage Period (March 1 through December 31).

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

b. Counting Window Widths. Counting windows should be operated as far out as possible (minimum of 18") while maintaining adequate counting conditions.

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

d. Collection Channel Transportation Velocity. 1.5' to 4' per second.

e. North Shore Entrances (WFE 1 & 2).

1. Operate 2 downstream gates (Controlled by North Wasco County PUD)

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

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

1. Operate 2 downstream gates.

2. Weir depth: 9' or greater below tailwater.

g. Powerhouse Collection System Floating Orifices. Operate 12 floating orifices (O.G. numbers 1, 3, 4, 8, 14, 21, 26, 32, 37, 41, 43, and 44).

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

1. Operate 2 entrances.

2. Weir depth: 9' or greater below tailwater.

i. Head on Trashracks.

1. Maximum head of 0.5' on ladder exits.

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

j. Staff Gauges and Water Level Indicators. Shall be readable at all water levels encountered during the fish passage period.

k. Facility Inspections.

1. Powerhouse operators shall inspect facilities once per day.

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

3. 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.

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

5. Record all inspections.

2.3.3. Facility monitoring and reporting. Project biologists shall inspect fish passage facilities at the frequencies listed in the juvenile and adult fish facilities operating criteria sections. Project biologists shall prepare weekly reports, from March 1 through December 31, summarizing project operations. The weekly reports should provide an overview of how the project and the fish passage facilities operated during the week and an evaluation of resulting fish passage conditions. The reports shall include: any out of criteria situations observed and subsequent corrective actions taken; any equipment malfunctions, breakdowns, or damage along with a summary of resulting repair activities; adult fishway control calibrations; ESBS and VBS inspections; and any unusual activities that occurred at the project that may effect fish passage. The weekly reports shall cover a Friday through Thursday time period and shall be sent to CENWW-OD-TF by noon the following Monday via electronic mail. 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. Project biologists also inspect project facilities once per month and during dewaterings for the presence of zebra mussels. Biologists shall provide a report to CENWW-OD-TF on a monthly basis summarizing zebra mussel inspections.

3. Project Maintenance. Project biologists should be present to provide technical guidance at all project activities that may involve fish handling. All dewaterings shall be accomplished in accordance with approved project dewatering and fish handling plans. Dewatering and fish handling plans were reviewed and revised in 1997 to ensure that they comply with Appendix G, Guidelines for Dewatering and Fish Handling Plans.

3.1. Juvenile Fish Passage Facilities.

3.1.1. Scheduled Maintenance. Scheduled maintenance of the juvenile facilities is conducted during the entire year. Long-term maintenance or modification 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 to 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 which will impact fish passage and/or survival. Maintenance of facilities such as fish screens, which sometimes break down during the fish passage season, will be carried out as described below. Unscheduled maintenance that will have a significant impact on juvenile fish passage shall be coordinated with the CBFWA (through the FPC) and NMFS on a case-by-case basis by CENWW-OD-TF. CENWW-OD-TF will be notified as soon as possible after it becomes apparent that maintenance repairs are required. The Project Manager has the authority to initiate work prior to notifying CENWW-OD-TF when in his opinion delay of the work will result in an unsafe situation for people, property, or fish. Information required by CENWW-OD-TF includes:

a. Description of the problem.

b. Type of outage required.

c. Impact on facility operation.

d. Length of time for repairs.

e. Expected impacts on fish passage and proposed measures to mitigate them.

3.1.2.1. Extended-Length Submersible Bar Screens (ESBS). The ESBSs are inspected periodically throughout the juvenile migration season with a video monitoring system. If a screen is found to be damaged it will be removed and either replaced with a spare ESBS or repaired and returned to service. A turbine unit shall not be operated with a known damaged or nonfunctioning ESBS or VBS, or without a full compliment of ESBSs, flow vanes, and VBSs. If a screen fails on a weekend or at night when maintenance crews are not available, the respective turbine unit will be shut down and generation switched to another, fully screened unit. If all screened turbine units are in service, water may be spilled until the affected screen can be removed and repaired or replaced.

3.1.2.2. Vertical Barrier Screen (VBS) Cleaning. The ESBSs deflect fish and water up the gatewell slots as part of the fish collection process. Each gatewell has a VBS located vertically between the bulkhead slot and the operating gate slot. The VBSs keep guided juvenile and adult fish from passing through the bulkhead slot into the operating gate slot where the fish can pass back into the turbine intake. The VBSs are designed to distribute the flow evenly through the screens to minimize fish impingement and descaling. The water surface elevations in the gatewells are routinely measured to determine head differential across the VBSs caused by debris plugging the VBSs. VBSs are to be pulled and cleaned when head differentials reach 1.5'. Prior to pulling a VBS for cleaning, the turbine unit loading will be lowered to the lower end of the 1% turbine efficiency range and the gatewell dipped with a gatewell basket to remove all fish present in the gatewell unless doing so results in increased mortality (i.e. high adult shad numbers in gatewells). Immediately after dipping, the VBS shall be raised and impinged debris hosed off. The turbine unit shall remain operating at the lower end of the 1% turbine efficiency range while the VBS is being cleaned so gatewell flow will carry the debris into the operating gatewell, where it will pass through the turbine unit. Immediately after cleaning the VBS, the VBS shall be lowered to the normal operating position to prevent fish passage from the bulkhead slot into the operating gate slot. The VBSs shall not be raised longer than 30 minutes with the turbine unit running. If VBSs can not be cleaned within one work day of the head differential reaching 1.5', the turbine unit loading will be lowered to the lower end of the 1% turbine efficiency range until the VBS can be cleaned. If the cleaning frequency of VBSs exceeds project personnel’s cleaning capability of approximately 10 VBSs per day, 7 days per week, project personnel will notify CENWW-OP-TF. Then CENWW-OP-TF will coordinate with NMFS regarding an exemption to dipping gatewells prior to cleaning VBSs. An exemption to dipping gatewells prior to cleaning VBSs will be based on fish numbers and TDG levels. If a VBS is found to be damaged during an inspection or cleaning, the VBS panel will be repaired or replaced with a spare panel. The turbine unit will not be operated with a known damaged VBS.

3.1.2.3. Gatewell Orifices. Each gatewell has two orifices with valves to allow fish to exit the gatewell. Under normal operation, one orifice per gatewell (normally the south orifice) is operated. If an orifice becomes blocked with debris or is damaged, it will be closed and the alternate orifice for that gatewell operated until repairs can be made. If both orifices are blocked with debris or damaged, the turbine unit will be taken out of service until repairs can be made. If there is a major failure with the bypass system that prevents the gatewell orifices from operating, traveling screens and bar screens will remain in operation. Turbine units shall not be operated with blocked or closed orifices for longer than 10 hours. During any orifice closure, project personnel shall monitor gatewells for signs of fish problems or mortality. If repairs are expected to take longer than two days, a salvage program will be initiated to dip the juveniles from the gatewells with a gatewell basket until repairs are made and the system watered up again or orifices opened. Juvenile fish shall not remain in gatewells longer than 48 hours. During periods of high fish passage, it may be necessary to cease operation of turbine units with ESBSs in place and with closed orifices in less than 10 hours, depending on fish numbers and condition. Spill may occur to provide an alternate avenue for fish passage during facility outages.

3.1.2.4. Dewatering Structure. The dewatering structure acts as a transition from the collection channel to the bypass pipe/flume. An inclined screen and a side dewatering screen allow excess water to be bled off, with all fish and remaining water transitioning into the bypass pipe. Some of the excess water is discharged into the adult fish facility auxiliary water supply system and some is used as the water supply for the transportation facilities. The dewatering structure contains trash sweeps and an air-burst system for cleaning the dewatering screens of impinged debris. If a trash sweep breaks and interferes with juvenile fish passage through the structure or if a screen is damaged, an emergency bypass system in the collection channel may be used to bypass juveniles while repairs are made. Operation of the emergency bypass system requires the juvenile bypass system to be unwatered and stoplogs inserted at the upstream end of the inclined screen. The emergency bypass is then opened and the bypass system operated with one orifice per gatewell open. Spill may also be required to bypass juvenile fish while in emergency bypass operations. Prior to any emergency dewatering of the collection channel, CENWW-OD-TF will be notified. Then CENWW-OD-TF will be responsible for notifying NMFS and FPC of the action and coordinating changes in spill or other project operations.

3.1.2.5. Bypass Pipe/Flume. The bypass pipe/corrugated metal flume transports juveniles to either the transportation facilities or to the river below the project through the primary bypass pipe. If there is a problem with the flume that interferes with its operation, the emergency bypass system in the collection system can be opened and all of the fish in the bypass system diverted into the ice and trash sluiceway and passed to the river through the north powerhouse ice and trash sluiceway exit.

3.1.2.6. Transportation Facilities. The transportation facilities can be operated to either collect and hold juveniles for the transportation program or to separate fish by species (based on fish size), enumerate the fish through the sampling system, and bypass part or all of the fish back to the river (secondary bypass). If part of the facility malfunctions or is damaged, efforts will first be made to bypass the fish around the damaged area. If this is not possible, the switch gate in the bypass flume will be used to bypass fish directly to the river until repairs can be made (primary bypass).

3.2. Adult Fish Passage Facilities.

3.2.1. Scheduled Maintenance. Scheduled maintenance of a facility which must be unwatered 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 not affect fish passage may be conducted during the rest of the year. 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 the normal operating criteria, unless otherwise coordinated with the fish agencies and tribes.

3.2.2. Unscheduled Maintenance. Unscheduled maintenance that will significantly affect the operation of a facility will be coordinated with the CBFWA (through the FPC) and NMFS. Coordination procedures for unscheduled maintenance of adult facilities are the same as for juvenile facilities. 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 so there will be less impact of it being unwatered or taken out of service. If part of a facility is damaged or malfunctions that may significantly impact fish passage, it will be repaired as soon as possible.

3.2.2.1. Fish Ladders and Counting Stations. The fish ladders contain tilting weirs, fixed weirs, counting stations with picket leads, and fish exits with trash racks. 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 it without unwatering the ladder. Trash racks, picket leads, tilting weir mechanisms, and counting stations can sometimes be repaired or maintained without unwatering the ladder. The decision on whether to unwater the ladder and make repairs during the fish passage season or wait until the winter maintenance period will be made after consultation with the fish agencies and tribes.

3.2.2.2. North Shore Auxiliary Water Supply System. The auxiliary water for the north shore fish ladder is provided by gravity-flow from the forebay. The water passes either through a turbine unit or through a bypass system. The turbine/bypass system is operated by North Wasco County PUD. During normal operations, when the turbine unit is operating, water passes through conduits 3 and 4 to the turbine unit. From the turbine unit, the water discharges into an open pool where it feeds into ladder diffusers. If there are problems with the turbine unit, automatic valves close and the auxiliary water is diverted through conduits 1 and 3A to the baffled bypass system within the old fish lock, where the hydraulic head is dissipated and the water discharged into the diffuser pool.

3.2.2.3. South Shore Auxiliary Water Supply System. The south shore auxiliary water is made up of a combination of gravity flow from the forebay and pumped water from the tailrace. The gravity flow supplies the diffusers above weir 253 (diffusers 7 through 14) and the pumps supply the diffusers below weir 253 (diffusers 1 through 7 and the main unit diffusers). Diffuser 7 is where both systems meet and is supplied by either gravity flow or pumped flow. The gravity flow diffusers are regulated by rotovalves and the pumped flow diffusers by sluice gates. If a rotovalve fails, the nearest closed rotovalve will be opened to supply the flow. If more rotovalves fail than there are closed valves the sluice gates in diffusers 3 through 7 will be opened more to provide the required transportation flows. If any sluice gates fail, the sluice gates nearest it will be opened further to make up the water. If one pump fails, the other two pumps will be operated to maintain the facilities within criteria. If two pumps fail, SFE2 and NFE3 will be closed and SFE1 and NFE2 will be operated as deep as possible to maintain the 1' to 2' head differential. If all three pumps fail, the powerhouse transportation channel will be bulkheaded off at the junction pool and SFE1 and SFE2 operated a deep as possible and to maintain the 1' to 2' head differential. If a depth of 6' on both gates cannot be maintained, SFE2 will be closed. If the gravity flow and pumped auxiliary water supply systems both fail, the powerhouse transportation channel will be bulkheaded off at the junction pool, SFE2 closed, and SFE1 operated at 6' below tailwater until repairs can be made.

3.2.2.4. Fishway Entrances. The fishway entrances are made up of main entrance weirs with hoists and automatic controls, and floating orifices which are designed to regulate themselves with tailwater fluctuations. If any of the automatic controls malfunction the weirs can usually be operated manually by project personnel and kept within criteria. If there is a further failure, which prevents the entrance from being operated manually, the entrance may be lowered down and left in an operating position or an alternate entrance opened until repairs can be made. If a floating orifice fails, it will be pulled out of the water and replaced with a spare floating orifice.

3.2.2.5. Diffuser Gratings. Diffuser chambers for adding auxiliary water to fish ladders and collection channels are covered by gratings attached by several different methods. Diffuser gratings are normally checked during the winter maintenance period to make sure they are in place. These inspections are done by either dewatering the fish passageway and physically inspecting the diffuser gratings, or by 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. 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 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. Coordination of the problems should begin immediately through the established unscheduled maintenance coordination procedure (see paragraph

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

4. Turbine Unit Operation and Maintenance.

4.1. Turbine Unit Operation. When in operation, turbine units will be operated to enhance adult and juvenile fish passage from March 1 through November 30. During this time period, turbine units will be operated (as needed to meet generation requirements) in the following order: 1, 2, 3 through 10 (in any order), and then 11 through 14 (in any order) when units are available for operation. Unit operating priority may be coordinated differently to allow for fish research, construction, or project maintenance activities. If the project is bypassing juvenile fish back to the river through the juvenile release pipe, turbine units 1 through 4 shall be operated first (if available for operation) to provide positive downstream flows at the outfall. During the summer, (when all collected fish are transported) turbine operating priority may change to north powerhouse loading if warm water temperatures result in increased juvenile fish mortality or if project temperature monitoring indicates a temperature gradient exists across the powerhouse. Under north powerhouse loading, turbine units shall be loaded consecutively from unit 14 back towards unit 1. Turbine units 1, 2, and 3 may also be taken off-line during parts of the summer to avoid adding warmer water to the juvenile fish collection channel. Starting and stopping of units should be avoided if possible during periods of warm water, especially between 1000 and 2400 hours.

Turbine units will be operated within 1% of best efficiency from March 15 through October 31 (or as specified in BPA's load shaping guidelines, Appendix C) unless operation outside of that range is necessary to: 1) meet the load requirements of the BPA Administrator whose load requests will be made in accordance with BPA's policy, statutory requirements, and load shaping guidelines or 2) be in compliance with other coordinated fish measures. Project personnel shall record when turbine units are operated outside the 1% turbine efficiency range and shall provide the information to BPA on a weekly basis according to the load shaping guidelines. Between November 1 and March 15, turbine units will continue to be operated within the 1% efficiency range except when BPA load requests require the units to be operated outside the 1% range.

Guidelines for operation of the turbine units within the 1% efficiency range at various heads are listed in Table MCN-4.

Table MCN-4. Turbine unit operating range with extended-length submersible bar screens installed for 1% best efficiency, McNary Dam.

Head (Feet)	Lower Generator Limits		Upper Generator Limits	
	(MW)	(CFS)	(MW)	(CFS)
67	37.5	7,934	56.7	11,997
68	38.0	7,911	58.2	12,121
69	38.5	7,887	59.7	12,240
70	39.0	7,864	61.2	12,355
71	39.6	7,874	62.1	12,355
72	40.2	7,883	62.8	12,298
73	40.9	7,892	63.4	12,242
74	41.5	7,901	64.1	12,188
75	42.2	7,909	65.8	12,350
76	42.8	7907	66.4	12,282
77	43.4	7,905	67.1	12,216
78	44.0	7,903	67.7	12,151
79	44.6	7,900	68.3	12,088
80	45.2	7,897	68.9	12,026
81	45.9	7,893	70.0	12,039
82	46.5	7,889	71.1	12,050
83	47.2	7,884	72.2	12,061

Note: The turbine efficiency table was revised in June 1999 to reflect new information regarding ESBSs using the 1998 index test and 1955 Prototype Hill Curve. This table contains the best information currently available.

Table MCN-4.1. Turbine unit operating range without extended-length submersible bar screens installed for 1% best efficiency, McNary Dam.

Head (Feet)	Lower Generator Limits (MW)	Lower Generator Limits (CFS)	Upper Generator Limits (MW)	Upper Generator Limits (CFS)
67	37.7	7,739	57.9	11,887
68	38.2	7,716	59.4	12,009
69	38.7	7,694	60.9	12,128
70	39.2	7,671	62.5	12,243
71	39.8	7,681	63.4	12,243
72	40.0	7,691	64.4	12,242
73	41.1	7,699	65.3	12,241
74	41.7	7,708	66.3	12,240
75	42.4	7,716	67.2	12,239
76	43.0	7,714	67.9	12,172
77	43.6	7,713	68.5	12,107
78	44.2	7,711	69.1	12,043
79	44.8	7,709	69.7	11,980
80	45.5	7,706	70.3	11,920
81	46.1	7720	71.5	11,961
82	46.8	7,734	72.6	12,000
83	47.4	7,747	73.7	12,038

Note: The turbine efficiency table was revised to reflect new information using the 1998 index test and 1955 Prototype Hill Curve. This table contains the best information currently available.

4.2. Turbine Unit Maintenance. The project turbine unit maintenance schedule will be reviewed annually by project and Operations Division biologists for fish impacts. If possible, maintenance of priority units will be scheduled for non-fish passage periods, or when there are low numbers of fish passing the project. Each turbine unit requires annual maintenance which may take from several days to two weeks. Annual maintenance of all turbine units is normally scheduled during the mid-July to late December time frame. The maintenance of priority units for adult passage is normally conducted in mid-August or November and December, when fewer adults are migrating, to minimize impacts on migrating adults. Turbine units may occasionally require overhauls to repair major problems with the turbine or generator. Overhauls may take over one year to accomplish. Turbine units, governors, exciters, and control systems require periodic maintenance, calibration, and testing which may take them outside of the one percent best efficiency range. This work will be scheduled in compliance with BPA load shaping guidelines (Appendix C) to minimize impacts on juvenile fish.

Turbine units at McNary Dam are to be operated with raised operating gates to improve fish passage conditions when ESBSs are installed. To facilitate annual maintenance, operating gates are used to unwater the turbine units. To minimize turbine outage periods to the actual time required for maintenance (during the August 1 through December 15 time period), operating gates may be lowered to the standard operating position and connected to hydraulic cylinders on the afternoon of the last regular work day (normally Thursday) prior to the start of the maintenance. With the operating gate in the standard operating position, turbine units may be operated until 0700 hours of the next regular work day (normally Monday) with generation loads restricted to 60 MWs or less. On the completion of maintenance, the turbine unit can be operated with the operating gates in the stored position at 60 MWs or less until the 0700 hours of the first regular work day after the maintenance is completed. If turbine maintenance or the raising of the operating gates to the raised operating position is delayed after the time periods stated above, the turbine unit shall be immediately taken out of service until the work can be accomplished. Operation of turbine units with operating gates in the standard operating position shall be restricted to the August 1 through December 15 time period, and shall not begin until juvenile fish collection numbers drop to less than 10,000 fish per day. No more than 2 turbine units at a time shall be operated with operating gates in the standard operating position and the turbine units will be operated on last on, first off operating priority.

Unwatering turbine units should be accomplished in accordance with project dewatering plans. Prior to dewatering a turbine unit for maintenance, the turbine unit should be spun at speed-no-load, if possible, immediately before installing tailrace stoplogs and headgates to minimize the number of fish in the draft tube and scroll case. If a turbine unit is out of service for maintenance for an extended period of time without tailrace stoplogs in place, efforts should be made to not open the wicket gates if the scroll case must be dewatered at a later date without the unit being spun before hand.

5. Forebay Debris Removal. Debris at projects can impact fish passage conditions. Debris can plug or block trashracks, VBSs, gatewell orifices, dewatering screens, separators, and facility piping resulting in impingement, injuries, and descaling of fish. Removing debris at its source in the forebay is sometimes necessary to maintain safe and efficient fish passage conditions, navigation, and other project activities. Debris can be removed from the forebay by: physically encircling the debris with log booms and pulling it to shore with boats where it can be removed with a crane, removing the debris from the top of the dam using a crane and scoop, or passing the debris through the spillway with special powerhouse operations and spill. The preferred option is to remove debris at each project when possible to avoid passing debris on to the next project downstream. This is not always possible at each project as some projects do not have forebay debris removal capability. In this case, the only viable alternative is to spill to pass the debris.

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-TF at least two work days prior to the day they want the special project operations for spilling to pass debris. Then CENWW-OD-TF shall coordinate the special operations with Reservoir Control Center (RCC) and NMFS. Project personnel shall provide CENWW-OD-TF the reason for the debris spill request including an explanation of project facilities being impacted by the debris, the date and time of the requested spill, and any special powerhouse or other operations required to move the debris to the spillway. When a debris spill is coordinated and approved, RCC shall issue a teletype detailing the specifics of the special operations.

Table MCN-5. McNary Dam spill pattern for adult fish passage (Discharges in kcfs at forebay elevation 339).

KCFS Spill	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	Total Stops
1.4	1																					1
4.2	1	1																			1	3
7.6	1	1	1																	1	1	5
11.6	1	1	1	1															1	1	1	7
13.8	1	2	1	1															1	1	2	9
17.8	1	2	1	1	1													1	1	1	2	11
21.8	1	2	1	1	1	1											1	1	1	1	2	13
25.8	1	2	1	1	1	1	1									1	1	1	1	1	2	15
29.8	1	2	1	1	1	1	1	1							1	1	1	1	1	1	2	17
33.8	1	2	1	1	1	1	1	1	1					1	1	1	1	1	1	1	2	19
34.9	2	2	1	1	1	1	1	1	1					1	1	1	1	1	1	1	2	20
38.9	2	2	1	1	1	1	1	1	1	1			1	1	1	1	1	1	1	1	2	22
42.9	2	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	24
46.5	2	2	1	1	1	1	1	1	1	1	1	2	2	1	1	1	1	1	1	1	2	26
51.9	2	2	1	1	1	1	1	2	1	1	1	2	2	1	2	1	1	1	1	1	2	28
55.5	2	2	1	1	1	2	1	2	1	1	1	2	2	1	2	1	2	1	1	1	2	30
57.7	2	3	1	1	1	2	1	2	1	1	1	2	2	1	2	1	2	1	1	1	3	32
61.3	2	3	1	2	1	2	1	2	1	1	1	2	2	1	2	1	2	1	2	1	3	34
64.9	2	3	1	2	1	2	1	2	1	2	2	2	2	1	2	1	2	1	2	1	3	36
66.7	2	3	1	2	1	2	1	2	2	2	2	2	2	2	2	1	2	1	2	1	3	38
68.8	3	3	1	2	1	2	1	2	2	2	2	2	2	2	2	1	2	1	2	1	3	39
71.4	3	3	1	2	1	2	2	2	2	2	2	2	2	2	2	2	2	1	2	1	3	41
73.6	3	4	1	2	1	2	2	2	2	2	2	2	2	2	2	2	2	1	2	1	4	43
76.8	3	4	1	2	1	2	2	2	2	2	2	3	3	2	2	2	2	1	2	1	4	45
80.3	3	4	2	2	1	2	2	2	2	2	2	3	3	3	2	2	2	1	2	1	4	47
83.4	3	4	2	2	1	2	2	2	2	3	3	3	3	3	2	2	2	1	2	1	4	49
87.0	3	4	2	2	2	2	2	2	2	3	3	3	3	3	2	2	2	2	2	1	4	51
90.2	3	4	2	2	2	2	2	3	2	3	3	3	3	3	2	2	3	2	2	1	4	53
93.4	3	4	2	2	2	2	2	3	3	3	3	3	3	3	3	2	3	2	2	1	4	55
96.6	3	4	2	2	2	3	2	3	3	3	3	3	3	3	3	3	3	2	2	1	4	57
99.9	3	4	2	2	2	3	3	3	3	3	3	3	3	3	4	3	3	2	2	1	4	59
102.1	3	5	2	2	2	3	3	3	3	3	3	3	3	3	4	3	3	2	2	2	4	61
105.4	3	5	2	2	3	3	3	3	3	3	4	3	3	3	4	3	3	2	2	2	4	63
108.2	4	5	2	2	3	3	3	3	3	3	4	3	3	4	4	3	3	2	2	2	4	65
109.8	4	5	2	2	3	3	3	3	3	3	4	3	3	4	4	3	3	3	2	2	4	66
112.6	4	5	2	2	3	3	3	3	3	4	4	3	3	4	4	3	3	3	2	2	5	68

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Table MCN-5. McNary Dam Spill Pattern for Adult Fish Passage (Continued).

KCFS Spill	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	Total Stops
114.2	4	5	2	2	2	3	3	3	3	4	4	3	3	4	4	3	3	3	2	2	5	69
117.6	4	5	2	2	3	3	3	3	4	4	4	3	3	4	4	4	3	3	3	2	5	71
121.0	4	5	2	2	3	3	3	3	4	4	4	3	4	4	4	4	4	3	3	2	5	73
123.1	4	5	2	2	3	3	3	3	4	4	4	3	4	4	4	4	4	3	3	3	6	75
126.5	4	5	2	2	3	3	3	3	4	4	4	4	4	4	4	4	4	3	4	3	6	77
129.2	5	5	2	3	3	3	3	3	4	4	4	4	4	4	4	4	4	3	4	3	6	79
130.9	5	5	2	3	3	3	3	4	4	4	4	4	4	4	4	4	4	3	4	3	6	80
133.0	5	6	2	3	3	3	3	4	4	4	4	4	4	4	4	4	4	3	4	4	6	82
136.3	5	6	3	3	3	4	3	4	4	4	4	4	4	4	4	4	4	3	4	4	6	84
139.0	6	6	3	4	3	4	3	4	4	4	4	4	4	4	4	4	4	3	4	4	6	86
142.2	6	6	3	4	3	4	3	4	4	4	5	4	5	4	4	4	4	3	4	4	6	88
144.4	6	7	3	4	3	4	3	4	4	4	5	4	5	4	4	4	4	3	4	4	7	90
147.7	6	7	3	4	3	4	4	4	4	4	5	4	5	5	4	4	4	3	4	4	7	92
148.8	7	7	3	4	3	4	4	4	4	4	5	4	5	5	4	4	4	3	4	4	7	93
152.0	7	7	3	4	3	4	4	5	4	4	5	4	5	5	5	4	4	3	4	4	7	95
155.2	7	7	3	4	3	4	4	5	4	5	5	5	5	5	5	4	4	3	4	4	7	97
158.6	7	7	4	4	3	4	4	5	4	5	5	5	5	5	5	4	4	4	4	4	7	99
161.3	7	8	4	4	3	4	4	5	4	5	5	5	6	5	5	4	4	4	4	4	7	101
164.5	7	8	4	4	3	4	4	5	5	5	5	5	6	5	5	4	5	4	4	4	7	103
167.9	7	8	4	4	4	4	4	5	5	5	6	5	6	5	5	4	5	4	4	4	7	105
171.2	7	8	4	4	4	5	4	5	5	5	6	6	6	5	5	4	5	4	4	4	7	108
173.9	8	8	4	4	4	5	4	5	5	6	6	6	6	5	5	4	5	4	4	4	7	109
177.3	8	8	4	4	4	5	4	5	6	6	6	6	6	6	5	4	5	4	4	4	7	111
179.9	8	8	4	4	4	5	4	5	6	6	6	7	6	6	5	4	5	4	4	4	8	113
183.1	8	8	4	4	4	5	4	5	6	6	7	7	7	6	5	4	5	4	4	4	8	115
186.3	8	8	4	4	4	5	5	5	6	6	7	7	7	6	5	5	5	4	4	4	8	117
189.6	8	8	4	4	4	5	5	5	6	7	7	7	7	6	6	5	5	4	4	4	8	119
192.2	8	9	4	4	4	5	5	6	6	7	7	7	7	6	6	5	5	4	4	4	8	121
195.4	8	9	4	4	4	5	5	6	7	7	7	8	7	6	6	5	5	4	4	4	8	123
198.6	8	9	4	5	4	5	5	6	7	7	7	8	7	6	6	5	5	4	5	4	8	125
199.5	9	9	4	5	4	5	5	6	7	7	7	8	7	6	6	5	5	4	5	4	8	126
222.4	9	10	4	5	5	6	5	6	7	8	8	9	9	9	7	6	5	5	5	4	9	141
247.6	10	11	5	6	5	6	6	6	7	8	9	10	10	10	9	8	6	5	6	5	10	158

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SECTION 6

ICE HARBOR DAM

Ice Harbor Dam

1. Fish Passage Information. The locations of fish passage facilities are shown on the general site plan for Ice Harbor Lock and Dam in Figure IHR-1. Dates of project operations for fish purposes and special operations are listed in Table IHR-1.

1.1. Juvenile Fish Passage.

1.1.1. Facilities Description. The juvenile fish passage facilities at Ice Harbor consist of standard length STSs, vertical barrier screens, 12" orifices, collection channel and dewatering structure, sampling facilities, and transportation flume/pipe to the tailrace below the project.

1.1.2. Juvenile Migration Timing. Juvenile passage timing at Ice Harbor Dam corresponds closely with juvenile passage at Lower Monumental Dam. Maintenance of juvenile fish passage facilities is scheduled during the winter maintenance periods detailed in the facility operating criteria and project maintenance sections.

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 three electric pumps with all three pumps normally operated. 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, twelve floating orifices, and a common transportation channel. One of the downstream north powerhouse entrances and seven 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.

Insert Figure IHR-1

Table IHR-1. Dates of project operations for fish purposes at Ice Harbor Dam, 2000.

1.2.2. Adult Migration Timing. Migrants are present at Ice Harbor year around. Maintenance of adult passage facilities is scheduled for January and February to minimize impacts on adult migrants. Table IHR-2 shows primary passage periods for each species and shows earliest and latest date of peak passage on record from fish count data compiled by the Corps of Engineers. Adult fish are counted from April 1 through December 15. From April 1 through October 31, adult fish are counted 24 hours per day. Fish are visually counted by fish counters 16 hours per day (from 0400 to 2000 hours Pacific Standard Time) with nighttime passage from 2000 to 0400 hours videotaped with later interrogation by fish counters. From November 1 through December 15, fish passage is videotaped 24 hours per day with later interrogation by fish counters.

Table IHR-2. Adult migration timing at Ice Harbor Dam from 1962-1999 based on fish counts.

Species	Counting Period	Date of Peak Passage	
		Earliest	Latest
Spring Chinook	4/1 - 6/11	4/24	5/26
Summer Chinook	6/12 - 8/11	6/12	7/23
Fall Chinook	8/12- 12/15	9/07	9/30
Steelhead	4/1 – 12/15	9/15	10/12
Sockeye	4/1 - 12/15	7/01	9/22

2. Project Operation.

2.1. Spill Management. 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 adult spill pattern listed in Table IHR-3. Special spills for juvenile fish passage may be provided as detailed in Appendix A (Special Project Operations and Research). Special spills for juvenile fish passage normally occur during the spring and summer, from April 3 through August 31.

2.2. Dissolved Gas Management and Control. Total dissolved gas TDG) levels at Ice Harbor are monitored in accordance with the Dissolved Gas Monitoring Program, Appendix D. The TDG will be monitored in the Ice Harbor forebay and tailrace. The TDG data will be collected every half-hour and transmitted hourly via computer year-round. Related data collected at the same time will be spill volume and total project flow. Implementation of requests for spill will be based in part upon TDG monitoring data along with juvenile migration data. Requests for spill will be coordinated through the Technical Management Team (TMT).

2.3. Operating Criteria.

2.3.1. Juvenile Fish Passage Facilities. Operate from April 1 through October 31 for juvenile fish passage and from November 1 through December 15 for protecting adult fallbacks. The facilities should be operated according to the following criteria:

2.3.1.1. Winter Maintenance Period (December 16 through March 31). Check and maintain, as needed, the items listed below.

a. Forebay Area and Intakes.

1. Remove debris from forebay and gatewell slots.

2. Rake trash racks just prior to the operating season.

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

b. Submersible Traveling Screens (STS) and Vertical Barrier Screens (VBS).

1. Maintenance completed on all screens.

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

3. Log trial Run.

3. Inspect all VBSs at least once per year. Repair as needed.

c. Collection Gallery.

1. Water-up valve operating correctly.

2. Orifice lights are operational.

3. Orifices clean and valves operating correctly.

4. Netting along handrails maintained and in good condition. Repair or replace as needed.

5. Netting or covers over orifice chutes maintained and in good condition. Repair or replace as needed.

d. Dewatering Structure and Flume.

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

missing silicone.

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

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

4. All valves should be operating correctly.

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

e. Sampling Facilities.

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

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

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

4. All dewatering screens and seals in separator and flume must be in good condition with no holes or gaps between panels, or sharp edges.

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

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

f. Avian Predation Areas (Forebay and Tailrace). Inspect bird wires 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.

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

a. Forebay Area and Intakes.

1. Remove debris from forebay.

2. Remove debris from trashracks as required to maintain less than 1' of additional drawdown in gate slots. Additional raking may be required when heavy debris loads are present in the river. Coordinate turbine unit outages with other project work activities, if possible, to minimize turbine unit

outages during the spring.

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

4. If a visible accumulation of contaminating substances (such as oil) is detected in a gatewell and it cannot be removed within 24 hours, the gatewell orifices shall be closed and the turbine unit shut done until the material has been removed and any problems corrected. Action should be taken as soon as possible to remove the oil from the gatewell so the orifice can be reopened to allow the fish to exit the gatewell. Orifices shall not be closed for longer than 48 hours.

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

b. Submersible Traveling Screens (STS) and Vertical Barrier Screens (VBS).

1. Operate STSs in cycling mode when average fork length of subyearling chinook or sockeye is greater than 120 mm at Lower Monumental collection facility.

2. Operate STSs in continuous operational mode when average fork length of subyearling chinook or sockeye is less than 120 mm at Lower Monumental collection facility, or if there is other evidence that smaller juvenile fish are present at the project.

3. Inspect each STS once per month.

4. Record STS amp readings daily.

5. If an STS or VBS is damaged or fails during the juvenile fish passage season, follow procedures detailed under unscheduled maintenance of STSs. In no case should a turbine unit be operated with a missing or a known non-operating or damaged STS or VBS.

6. Up to one-half of the STSs may be removed after October 1 for annual maintenance provided there is no operation of units without screens.

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

8. Inspect at least 2 VBSs at random across the powerhouse between the spring and summer migration periods. If a debris accumulation is noted, inspect other VBSs and clean debris as necessary.

c. Collection Gallery Checks.

1. Orifices clean and operating. Operate at least one 12" orifice per slot (preferably the north orifice). If the project is operating at MOP, additional orifices may be operated to maintain full collection channel.

2. Orifice lights operational and operating on open orifices.

3. Orifice jets hitting no closer than 3' from the opposite wall (bypass channel full).

4. Back flush orifices at least once per day and more frequently if required. During periods of high debris, orifices should be inspected and back flushed several times per day, as determined by the project biologist, to keep orifices clean.

5. Water-up valve operational.

6. The netting along handrails should be maintained in good condition with no holes or gaps in the netting. Repair or replace as needed.

7. Netting or covers over orifice chutes in good condition. Repair or replace as needed.

d. Dewatering Structure.

1. Trash sweep operating correctly. The frequency of sweep should be set as necessary to maintain a clean screen, with a minimum operation of at least once per hour. If automated cleaning system problems occur, operate manually at least once per work shift as feasible to maintain a clean screen.

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

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

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

e. Sampling Facilities.

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

2. Operate wet separator and fish distribution system as designed. Sample fish twice per week during the main juvenile bypass season to monitor juvenile fish descaling and other fish condition parameters. Provide information in project weekly report.

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

4. Operate preanesthetic system as designed.

f. Avian Predation Areas (Forebay and Tailrace).

1. Bird wires and other avian deterrent devices should be monitored to assure they are in good condition. Any broken wires or devices should be replaced as soon as possible.

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

3. Project biologists shall routinely monitor project areas to determine areas of active avian predation and, if possible, adjust harassment program to cover these areas or install bird wires or other deterrent devices to discourage avian predation activities.

g. Inspection and Record Keeping. Inspect all facilities according to fish facilities monitoring plans. Record all maintenance and inspections.

2.3.2. Adult Fish Passage Facilities. Operate the adult fish passage facilities according to the following criteria.

2.3.2.1. Winter Maintenance Period (January 1 through March 1).

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

b. Dewater all ladders and inspect all dewatered sections of fish facilities for projections, debris, or plugged orifices which could injure fish or impede fish passage up the ladder. Inspect all diffuser gratings and chambers annually by dewatering and physically inspecting the gratings and chambers or by using divers or video inspection techniques. All diffuser gratings and chambers are to be dewatered and physically inspected at least every 3 years. Repair deficiencies.

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

d. Calibrate all mechanical water level sensing devices, as necessary, for proper facilities operations.

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

2.3.2.2. Fish Passage Period (March 1 through December 31). [**Note**: During extremely high flow periods when tailwater level exceeds elevation 363' msl, the fish pumps may have to be turned off so that the head differential on the auxiliary water supply conduit ceiling slab does not exceed structural design criteria.]

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

b. Counting Window Widths. Counting windows should be operated as far out as possible while maintaining adequate counting conditions. When possible, the minimum counting slot width should be 18". All equipment should be maintained and in good condition.

c. Head On All Entrances. Head range: 1' to 2'

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

1. Operate downstream gate closest to shore.

2. Weir depth: 8' or greater below tailwater. At tailwaters less than elevation 340.25', weirs should be on sill. Note that at low river flow and tailwater, some of the diffusers are above tailwater and project may only be able to maintain a 6' weir depth.

e. North Powerhouse Entrance (NFE 1 and 2). Elevation of top of gate when on sill = 332.25'.

1. Operate 1 downstream gate.

2. Weir depth: 8' or greater below tailwater. At tailwaters less than elevation 340.25', weirs should be on sill.

[**Note:** At low tailwater, weirs will bottom out and will be less than 8' below tailwater.]

f. Powerhouse Collection System. Operate 7 floating orifices (O.G. numbers 1, 2, 4, 6, 8, 10, and 12).

g. South Shore Entrance (SFE-1). Elevation of top of gate when on sill = 332.25'.

1. Operate entrance closest to powerhouse.

2. Weir depth: 8' or greater below tailwater. At tailwaters less than elevation 340.25', weirs should be on sill.

[**Note:** At low tailwater, weirs will bottom out and will be less than 8' below tailwater.]

h. Channel Transportation Velocity. 1.5' to 4' per second.

i. Head on Trashracks.

1. Maximum head of 0.5' on ladder exits.

2. Maximum head on picket leads shall be 0.3'.

j. Staff Gages and Water Level Indicators. Shall be readable at all water levels encountered during fish passage period. Repair or clean as necessary throughout the passage season.

k. Facility Inspections.

1. Powerhouse operators shall inspect facilities once per day. Maintain computerized fishway control system record keeping system.

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

3. Project personnel shall check computerized fishway control system twice per month to ensure that it is kept within calibrations.

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

5. Record all inspections.

2.3.3. Facility Monitoring and Reporting. Project biologists shall inspect fish passage facilities at the frequencies listed in the juvenile and adult fish facilities operating criteria sections. Project biologists shall prepare weekly reports, from March 1 through December 31, summarizing project operations. The weekly reports should provide an overview of how the project and the fish passage facilities operated during the week and an evaluation of resulting fish passage conditions. The reports shall include: any out of criteria situations observed and subsequent corrective actions taken; any equipment malfunctions, breakdowns, or damage along with a summary of resulting repair activities; adult fishway control calibrations; STS and VBS inspections; and any unusual activities that occurred at the project that may effect fish passage. The weekly reports shall cover a Friday through Thursday time period and shall be sent to CENWW-OD-TF by noon the following Monday via electronic mail. 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. Project biologists also inspect project facilities once per month and during dewaterings for the presence of zebra mussels. Biologists shall provide a report to CENWW-OD-TF on a monthly basis summarizing zebra mussel inspections.

3. Project Maintenance. Project biologists should be present to provide technical guidance at all project activities that may involve fish handling. All dewaterings shall be accomplished in accordance with approved project dewatering plans. Dewatering and fish handling plans were reviewed and revised in 1997 to ensure that they comply with Appendix G, Guidelines for Dewatering and Fish Handling Plans.

3.1. Juvenile Fish Passage Facilities.

3.1.1. Scheduled Maintenance. Scheduled maintenance of the juvenile facilities is conducted during the non-fish passage season from December 16 to March 31. Long-term maintenance or modifications to the facilities that requires them to be out of service is done during this period. During the fish passage season, the facilities are inspected on a daily basis to insure that they are operating correctly.

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 and survival. Unscheduled maintenance of facilities such as submersible traveling screens, which sometimes break down during the fish passage season, will be carried out according to procedures described below. In these cases, repairs will be made as prescribed and CENWW-OP-TF notified for further coordination. Unscheduled maintenance that will have a significant impact on juvenile fish passage shall be coordinated with the CBFWA (through the FPC) and NMFS on a case-by-case basis by CENWW-OD-TF. Then CENWW-OD-TF will be notified as soon as possible after it becomes apparent that maintenance repairs are required. The Project Manager has the authority to initiate work prior to notifying CENWW-OD-TF when in his opinion delay of the work will result in an unsafe situation for people, property, or fish. Information required by CENWW-OD-TF includes:

a. Description of the problem.

b. Type of outage required.

c. Impact on facility operation.

d. Length of time for repairs.

e. Expected impacts on fish passage and proposed measures to mitigate them.

3.1.2.1. Submersible Traveling Screens (STS). The STSs are inspected periodically throughout the juvenile migration season with a video monitoring system. If an STS 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 compliment of STSs. If an STS fails on a weekend or at night when maintenance crews are not available, the respective turbine unit will be shut down and generation switched to another fully screened unit. If all screened turbine units are in service, additional water may be spilled until the effected STS can be removed and repaired or replaced.

3.1.2.2. Gatewell Orifices. Each gatewell has two 12" orifices with air operated valves to allow fish to exit the gatewell. Under normal operation, one orifice per gatewell is operated. To minimize blockage from debris, orifices are cycled and back flushed at least once per day, and more frequently if required by heavy debris loads. If an air valve fails or is blocked with debris, the valve should be closed and the alternate orifice for that gatewell operated until repairs can be made. If both orifices are blocked with debris or damaged, the turbine unit will be taken out of service until repairs can be made. If repairs are to take longer than 48 hours, juvenile fish will be dipped from the gatewell with a gatewell dip basket in accordance with the project dewatering and fish-handling plan.

3.1.2.3. Dewatering Structure. The dewatering structure acts as a transition from the collection channel to the corrugated metal flume. An inclined screen allows excess water to be bled off, with all fish and remaining water transitioning into the corrugated metal flume. The excess water is discharged into the adult fish facility auxiliary water supply system and is also used as the water supply for the sampling facilities. The dewatering structure contains a trash sweep for cleaning the rectangular portion of the inclined screen, and an air blow back system for cleaning the transition (trapezoidal) section of the screen. 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 unwatered, the traveling screens will remain in operation. Fish will be allowed to accumulate in the gatewells for up to 2 days. If repairs are expected to take longer than 2 days, a salvage program will be initiated to remove fish from gatewells, with a gatewell dip basket, until repairs can be made and the system watered up again. While the collection channel is out of service, project personnel shall monitor gatewells for signs of fish problems or mortality. Spill may be provided as an alternative avenue for fish passage during the collection channel outage.

3.1.2.4. Bypass Flume/Pipe. The bypass flume/pipe transports fish to the sampling facilities and to the tailrace below the project. If there is a problem with the flume/pipe that requires it to be unwatered, procedures will be taken similar to paragraph 3.1.2.3.

3.1.2.5. Sampling Facilities. Under normal operation, juvenile fish are routed around the sampling facilities, except when sampling is being conducted. If there is a problem with the sampling facilities when it is in operation, the drop gate will be lowered to keep all juvenile fish in the bypass flume/pipe to bypass them directly to the river below the project. All fish in the sampling facility will then be released back to the river prior to sampling if there are any problems with holding them in the sample tank until they can be sampled.

3.2. Adult Fish Passage Facilities.

3.2.1. Scheduled Maintenance. Scheduled maintenance of a facility which must be unwatered 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 not have a significant affect on fish passage may be conducted during the rest of the year. Maintenance is normally conducted on one fish ladder at a time during the winter to provide some fish passage past 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 the fish agencies and tribes.

3.2.2. Unscheduled Maintenance. Unscheduled maintenance that will significantly effect the operation of a facility will be coordinated with NMFS and FPOM. Coordination procedures for unscheduled maintenance of adult facilities are the same as for juvenile facilities. 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 affects 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 and 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 trash racks. If any part of the ladder fails or is blocked with debris during the fish passage season, efforts will first be made to correct it without unwatering the ladder. Trash racks, picket leads, and counting stations can sometimes be repaired or maintained without unwatering the ladder. The decision on whether to unwater 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 or three pumps are required, depending on the tailwater elevation, to provide the necessary auxiliary water. If a pump fails during a two-pump operation, the pump on standby will be operated to provide the necessary flows. If a pump fails during a three-pump operation, NEW1 will be raised until the required 1' to 2' head differential is achieved. If this cannot be met by the time the weir reaches 6' below tailwater, the gate will remain at that level regardless of the head. If two or all three pumps fail, the weir will be maintained at a level of 6' below tailwater until repairs are made.

3.2.2.3. South Shore Auxiliary Water Supply System. The south shore auxiliary water is supplied by eight electric pumps and 150 to 180 cfs of excess water from the juvenile fish passage facilities. Fluctuating tailwater levels require from six to eight pumps to be operated to provide the auxiliary water. If one pump fails, a standby pump will be started to keep the fishway within criteria. If more pumps fail, this procedure will continue until all the standby pumps are in operation. If criteria cannot be met, the floating orifices should be closed in the following order: OG-12, OG-10, OG-8, and OG-6. If the required head differential of 1' to 2' cannot be reached when the floating orifices are closed, SSE 1 and NFE 2 will be closed equally at 1' intervals until it is reached or until the weirs are 5' below tailwater. Then the remaining floating orifices should be closed in the following order: OG-4, OG-1, and OG-2. If there is still not enough auxiliary water to maintain the head differential on the two main entrances, NFE 2 will be closed, the transportation channel bulkheaded off at the junction pool, and SSE 1 operated as deep as possible to maintain the head differential. If it cannot be maintained at a depth of 6' or greater, the weir will remain at 6' regardless of the head.

3.2.2.4. Fishway Entrances. The fishway entrances are made up 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 usually 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 the fish passageway and physically inspecting the diffuser gratings, or by 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. 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 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. Coordination of the problems should begin immediately through the established unscheduled maintenance coordination procedure (see paragraph 3.1.2). If possible, a video inspection should be made as soon as possible to determine the extent of the problem. If diffuser gratings are found to be missing or displaced, creating openings into the diffuser chambers, a method of repair shall be developed and coordinated with the fish agencies and tribes through the established coordination procedure. Repairs shall be made as quickly as possible unless coordinated differently.

4. Turbine Unit Operation and Maintenance.

4.1. Turbine Unit Operation. When in operation, turbine units will be operated to enhance adult and juvenile fish passage from March 1 through November 30. During these dates turbine units will be operated as needed to meet generation requirements in the priority order shown in table IHR-3. Model studies of Ice Harbor Dam show that spilling at lower river flows can cause eddying in front of the powerhouse. To provide the best fish passage conditions during periods of spill, it is extremely important that the turbine units operate in a specific operating order to minimize eddying conditions. Results from the model studies and preferred operations to reduce eddying are reflected in Table IHR-3.

Table IHR-3. Turbine unit operating priority for Ice Harbor Dam.

Season	Time of Day	Unit Priority*
March 1 – November 30 (Project NOT Spilling)	24 hours	1, 3, 4, 2, then 5 and 6 (any order)
March 1 – November 30 (Project IS Spilling)	Daytime (0600 to 1800 hours)	1, 3, 6, 4, 2, and 5
	Nighttime (1800 to 0600 hours)	3, 1, 6, 4, 2, and 5
December 1 – February 28	24 hours	Any Order

Note: If unit 1 is out of service, operate unit 2 in place of unit 1. If unit 3 is out of service, operate unit 4 in place of unit 3.

The hours of operations may be coordinated and adjusted in-season by CENWW-OD-TF (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.

Turbine units will be operated within 1% of best efficiency from March 15 through November 30 (or as specified in BPA's load shaping guidelines, Appendix C) unless operation outside of that range is necessary to: 1) meet the load requirements of the BPA administrator whose load requests will be made in accordance with BPA's policy, statutory requirements, and load shaping guidelines, or 2) be in compliance with other coordinated fish measures. Project personnel shall record when turbine units are operated outside the 1% turbine efficiency range and shall provide the information to BPA on a weekly basis according to the load shaping guidelines. Between December 1 and March 15, turbine units will continue to be operated within the 1% turbine efficiency range except when BPA load requests require the units to be operated outside the 1% range.

Ranges for operation of the turbine units within 1% of best turbine efficiency at various heads are shown in Tables IHR-4 through IHR-6. The 1% turbine efficiency ranges for units 1-3 were calculated using results from 1994 index testing of turbine unit 3. Maximum generation of units 1 through 3 at 115% overload is 103 MW. The 1% best efficiency ranges for units 4-6 were calculated using results from January 1994 index testing on unit 6 and are with submersible traveling screens installed. Maximum generation of units 4 through 6 at 115% overload is 127 MW.

Table IHR-4. The 1% best efficiency ranges for turbine units 1-3 with standard length submersible traveling screens installed[a].

Head (Ft)	Lower Generator Limits	Upper Generator Limits

	(MW)	(CFS)	(MW)	(CFS)
85	50	7,801	74	11,708
86	50	7,838	76	11,763
87	51	7,874	77	11,818
88	52	7,919	78	11,886
89	53	7,955	80	11,939
90	54	8,000	81	12,006
91	55	8,044	82	12,073
92	56	8,079	84	12,125
93	57	8,123	85	12,191
94	58	8,166	86	12,256
95	59	8,210	88	12,321
96	59	8,253	89	12,386
97	60	8,286	91	12,436
98	61	8,329	92	12,500
99	62	8,371	93	12,564
100	63	8,414	95	12,627
101	64	8,455	96	12,690
102	65	8,497	98	12,753
103	66	8,548	99	12,830
104	67	8,590	101	12,892
105	68	8,631	102	12,954

[a] The turbine efficiency tables are being revised to reflect new information. These tables contain the best information currently available.

Table IHR-5. The 1% best efficiency ranges for turbine units 1-3 without standard length submersible traveling screens installed[a].

Head (Ft)	Lower Generator Limits (MW)	Lower Generator Limits (CFS)	Upper Generator Limits (MW)	Upper Generator Limits (CFS)
85	50	7,897	85	13,448
86	51	7,934	87	13,512
87	52	7,971	88	13,575
88	53	8,017	90	13,653
89	54	8,053	92	13,714
90	55	8,098	93	13,791
91	56	8,143	95	13,868
92	56	8,178	96	13,928
93	57	8,223	98	14,003
94	58	8,267	99	14,079
95	59	8,311	101	14,153
96	60	8,354	103	14,212
97	61	8,388	103	14,065
98	62	8,431	103	13,922
99	63	8,474	103	13,781
100	64	8,517	103	13,644
101	65	8,559	103	13,508
102	66	8,602	103	13,376
103	67	8,653	103	13,246
104	68	8,695	103	13,119
105	69	8,737	103	12,994

[a] The turbine efficiency tables are being revised to reflect new information. These tables contain the best information currently available.

Table IHR-6. The 1% best efficiency ranges for turbine units 4-6 with standard length submersible traveling screens installed[a].

Head (Ft)	Lower Generator Limits (MW)	Lower Generator Limits (CFS)	Upper Generator Limits[b] (MW)	Upper Generator Limits[b] (CFS)
85	58	9,174	122	19,234
86	59	9,222	123	19,194
87	60	9,157	124	18,925
88	60	9,132	125	19,037
89	61	9,121	127	18,900
90	62	9,167	127	18,692
91	63	9,155	127	18,486
92	64	9,258	127	18,285
93	64	9,128	127	18,089
94	65	9,172	127	17,896
95	66	9,151	127	17,708
96	67	9,189	127	17,524
97	67	9,058	127	17,343
98	68	9,225	127	17,166
99	69	9,201	127	16,992
100	70	9,248	127	16,823
101	70	9,167	127	16,656
102	71	9,207	127	16,493
103	72	9,191	127	16,333
104	73	9,241	127	16,176
105	73	9,166	127	16,021

[a] The turbine efficiency tables are being revised to reflect new information. These tables contain the best information currently available.
[b] If screens are not installed, upper generator limits are 10 MWs lower.

4.2. Turbine Unit Outages During High River Flow Periods. During high spring flows, turbine unit outages for inspecting fish screens, repairing research equipment such as hydroacoustic or radio telemetry equipment, and other fish items may cause increased spill at a project in order to maintain reservoirs 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 Dam, 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.

For scheduled inspection or repair of research equipment, reservoirs shall be drafted to the bottom of MOP and allowed to fill to 1' above the MOP operating range as the work is accomplished. After the work, reservoirs will be slowly drafted back to the MOP operating range. When inspection or repair work can be scheduled ahead of time, the following process will be followed:

a. Project personnel shall schedule turbine unit outages through the approved turbine outage scheduling procedure by noon of the Tuesday of the week prior to the outage.

b. Project personnel shall also contact CENWW-OD-TF and Reservoir Control Center (RCC) by the same time period and inform them of the intended work.

c. Then RCC will coordinate the work activities with regional parties at the TMT meeting on the following Wednesday.

d. After coordination with the TMT, RCC shall issue a teletype through the CBTT issuing instructions to project and BPA personnel for the scheduled work.

e. Spill will be increased by one spill bay stop setting (about 1.7 kcfs) above passing inflow to slowly lower the level of Ice Harbor pool to the bottom of the MOP range prior to the scheduled work taking place.

f. When the work takes place, additional spill will not be provided and the reservoir will be allowed to refill until the reservoir is 1' above the normal MOP range (a 2' pondage from where the pool was when the work started). At this point, screen inspections shall be stopped. (At Snake River projects, this should allow about one normal work day for the scheduled work.)

g. At the conclusion of the work, the reservoir shall be drafted back down to the MOP range utilizing a one spill bay stop increase in spill above passing inflow.

h. If work, such as screen inspections, is not finished, project personnel shall schedule another turbine unit outage for a date where it can be implemented again.

If the work that needs to be done is of an emergency nature that does not normally require the turbine unit to be taken out of service (such as a failed hydroacoustic transducer versus a failed fish screen), and can not wait for the above process to be implemented, project personnel shall notify CENWW-OD-TF and RCC to get approval to do the work. If approval to do the work is given, the turbine unit shall be taken out of service and the reservoir level allowed to increase until it reaches 1' above the MOP operating range. At this point, the turbine unit must be returned to service and the reservoir will be drafted back to the MOP range using one spill bay stop setting above passing inflows.

4.3. Turbine Unit Maintenance. The project turbine unit maintenance schedule will be reviewed annually by project and Operations Division biologists for fish impacts. If possible, maintenance of priority units will be scheduled for non-fish passage periods, or when there are low numbers of fish passing the project. Each turbine unit requires annual maintenance that may take from several days to two weeks. Annual maintenance of all turbine units is normally scheduled during the mid-July to late November time frame. The maintenance of priority units for adult passage is normally conducted in mid-August, when fewer adults are migrating, to minimize impacts on migrating adults. Turbine units may occasionally require overhauls to repair major problems with the turbine or generator. Overhauls may take over one year to accomplish. Turbine units, governors, exciters, and control systems require periodic maintenance, calibration, and testing which may take them outside of the 1% turbine efficiency range. This work will be scheduled in compliance with BPA load shaping guidelines (Appendix C) to minimize impacts on juvenile fish.

Unwatering turbine units should be accomplished in accordance with project dewatering plans. Prior to dewatering a turbine unit for maintenance, the turbine unit should be spun at speed-no-load, if possible, immediately before installing tailrace stoplogs and headgates to minimize the number of fish in the draft tube and scroll case. If a turbine unit is out of service for maintenance for an extended period of time without tailrace stoplogs in place, efforts should be made to not open the wicket gates if the scroll case must be dewatered at a later date without the unit being spun before hand.

5. Forebay Debris Removal. Debris at projects can impact fish passage conditions. Debris can plug or block 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. 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.

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-TF at least two work days prior to the day they want the special project operations for spilling to pass debris. CENWW-OD-TF shall coordinate the special operations with RCC and NMFS. Project personnel shall provide CENWW-OD-TF the reason for the debris spill request, including an explanation of project facilities being impacted by the debris, the date and time of the requested spill, and any special powerhouse or other operations required to move the debris to the spillway. When a debris spill is coordinated and approved, RCC shall issue a teletype detailing the specifics of the special operations.

Table IHR-7. Ice Harbor daytime adult fish passage spill pattern with deflectors in all spill bays.

Spill Bay										Total Stops	Total Spill (kcfs)
1	2	3	4	5	6	7	8	9	10		
1										1	1.7
1									1.5	2.5	3.5
1	1								1.5	3.5	5.2
1	1							1	1.5	4.5	6.9
1	1	1						1	1.5	5.5	8.7
1	1	1					1	1	1.5	6.5	10.4
1	1	1	1				1	1	1.5	7.5	12.1
1	1	1	1			1	1	1	1.5	8.5	13.8
1	1	1	1	1		1	1	1	1.5	9.5	15.6
1	1	1	1	1	1	1	1	1	1.5	10.5	17.3
1	1	1	1	1	1	1	1	1	2	11	19.0
1	2	1	1	1	1	1	1	1	2	12	20.7
1	2	2	1	1	1	1	1	1	2	13	22.5
1	2	2	2	1	1	1	1	1	2	14	24.2
1	2	2	2	2	1	1	1	1	2	15	25.9
1	2	2	2	2	2	1	1	1	2	16	27.6
1	2	2	2	2	2	2	1	1	2	17	29.3
1	2	2	2	2	2	2	2	1	2	18	31.1
1	2	2	2	2	2	2	2	2	2	19	32.8
2	2	2	2	2	2	2	2	2	2	20	34.5
2	3	2	2	2	2	2	2	2	2	21	36.2
2	3	3	2	2	2	2	2	2	2	22	37.9
2	3	3	3	2	2	2	2	2	2	23	39.6
2	3	3	3	3	2	2	2	2	2	24	41.3
2	3	3	3	3	3	2	2	2	2	25	43.0
2	3	3	3	3	3	3	2	2	2	26	44.7
2	3	3	3	3	3	3	3	2	2	27	46.4
2	3	3	3	3	3	3	3	3	2	28	48.1
2	4	3	3	3	3	3	3	3	2	29	49.8
2	4	4	3	3	3	3	3	3	2	30	51.5
2	4	4	4	3	3	3	3	3	2	31	53.2
2	4	4	4	4	3	3	3	3	2	32	54.9
2	4	4	4	4	4	3	3	3	2	33	56.6
2	4	4	4	4	4	4	3	3	2	34	58.3
2	4	4	4	4	4	4	4	3	2	35	60.0
2	4	4	4	4	4	4	4	4	2	36	61.7
2	5	4	4	4	4	4	4	4	2	37	63.4
2	5	5	4	4	4	4	4	4	2	38	65.1
2	5	5	5	4	4	4	4	4	2	39	66.7
2	5	5	5	5	4	4	4	4	2	40	68.4

Table IHR-7. Ice Harbor daytime adult fish passage spill pattern with deflectors in all spill bays (continued).

Spill Bay										Total Stops	Total Spill (kcfs)
1	2	3	4	5	6	7	8	9	10		
2	5	5	5	5	5	4	4	4	2	41	70.1
2	5	5	5	5	5	5	4	4	2	42	71.8
2	5	5	5	5	5	5	5	4	2	43	73.5
2	5	5	5	5	5	5	5	5	2	44	75.1
2	6	5	5	5	5	5	5	5	2	45	76.8
2	6	6	5	5	5	5	5	5	2	46	78.5
2	6	6	6	5	5	5	5	5	2	47	80.2
2	6	6	6	6	5	5	5	5	2	48	81.8
2	6	6	6	6	6	5	5	5	2	49	83.5
2	6	6	6	6	6	6	5	5	2	50	85.2
2	6	6	6	6	6	6	6	5	2	51	86.8
2	6	6	6	6	6	6	6	6	2	52	88.5
2	7	6	6	6	6	6	6	6	2	53	90.1
2	7	7	6	6	6	6	6	6	2	54	91.7
2	7	7	7	6	6	6	6	6	2	55	93.3
2	7	7	7	7	6	6	6	6	2	56	94.9
2	7	7	7	7	7	6	6	6	2	57	96.5
2	7	7	7	7	7	7	6	6	2	58	98.1
2	7	7	7	7	7	7	7	6	2	59	99.7
2	7	7	7	7	7	7	7	7	2	60	101.3
2	8	7	7	7	7	7	7	7	2	61	103.0
2	8	8	7	7	7	7	7	7	2	62	104.7
2	8	8	8	7	7	7	7	7	2	63	106.4
2	8	8	8	8	7	7	7	7	2	64	108.1
2	8	8	8	8	8	7	7	7	2	65	109.8
2	8	8	8	8	8	8	7	7	2	66	111.5
2	8	8	8	8	8	8	8	7	2	67	113.2
2	8	8	8	8	8	8	8	8	2	68	114.9
2	9	8	8	8	8	8	8	8	2	69	116.5
2	9	9	8	8	8	8	8	8	2	70	118.1
2	9	9	9	8	8	8	8	8	2	71	119.7
2	9	9	9	9	8	8	8	8	2	72	121.3
2	9	9	9	9	9	8	8	8	2	73	122.9
2	9	9	9	9	9	9	8	8	2	74	124.5
2	9	9	9	9	9	9	9	8	2	75	126.1
2	9	9	9	9	9	9	9	9	2	76	127.7
2	10	9	9	9	9	9	9	9	2	77	129.3
2	10	10	9	9	9	9	9	9	2	78	130.9
2	10	10	10	9	9	9	9	9	2	79	132.5
2	10	10	10	10	9	9	9	9	2	80	134.1

Table IHR-7. Ice Harbor daytime adult fish passage spill pattern with deflectors in all spill bays (continued).

Spill Bay										Total Stops	Total Spill (kcfs)
1	2	3	4	5	6	7	8	9	10		
2	10	10	10	10	10	9	9	9	2	81	135.7
2	10	10	10	10	10	10	9	9	2	82	137.3
2	10	10	10	10	10	10	10	9	2	83	138.9
2	10	10	10	10	10	10	10	10	2	84	140.5
2	11	10	10	10	10	10	10	10	2	85	142.2
2	11	11	10	10	10	10	10	10	2	86	143.9
2	11	11	11	10	10	10	10	10	2	87	145.6
2	11	11	11	11	10	10	10	10	2	88	147.3
2	11	11	11	11	11	10	10	10	2	89	149.0
2	11	11	11	11	11	11	10	10	2	90	150.7
2	11	11	11	11	11	11	11	10	2	91	152.4
2	11	11	11	11	11	11	11	11	2	92	154.1
2	12	11	11	11	11	11	11	11	2	93	155.7
2	12	12	11	11	11	11	11	11	2	94	157.3
2	12	12	12	11	11	11	11	11	2	95	158.9
2	12	12	12	12	11	11	11	11	2	96	160.5
2	12	12	12	12	12	11	11	11	2	97	162.1
2	12	12	12	12	12	12	11	11	2	98	163.7
2	12	12	12	12	12	12	12	11	2	99	165.3
2	12	12	12	12	12	12	12	12	2	100	166.9
2	13	12	12	12	12	12	12	12	2	101	168.5
2	13	13	12	12	12	12	12	12	2	102	170.1
2	13	13	13	12	12	12	12	12	2	103	171.7
2	13	13	13	13	12	12	12	12	2	104	173.3
2	13	13	13	13	13	12	12	12	2	105	174.9

SECTION 7

LOWER MONUMENTAL DAM

Lower Monumental Dam

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

1.1. Juvenile Fish Passage.

1.1.1. Facilities Description. The Lower Monumental juvenile facilities consist of standard length submersible traveling screens (STS), vertical barrier screens (VBS), 12" orifices, collection gallery, dewatering structure, and bypass flume to the tailrace below the project. Transportation facilities consist of a separator to sort juvenile fish by size and to separate them from adult fish, sampling facilities, raceways, office and sampling building, truck and barge loading facilities, and PIT tag detection and deflector systems.

1.1.2. Juvenile Migration Timing. Juvenile migration timing at Lower Monumental Dam is indicated in Table LMN-1. The dates in the table are based on juvenile fish collection numbers and do not reflect FGE or spill passage. Maintenance of juvenile fish passage facilities which may impact juvenile fish passage or facility operations should be conducted during the maintenance season.

Table LMN-1. Juvenile migration timing at Lower Monumental Dam based on juvenile fish collection numbers.

% Collection	1995	1996	1997	1998	1999
Yearling Hatchery Chinook					
10%	5/2	4/16	4/23	4/24	4/24
90%	5/21	5/25	5/19	5/17	5/25
Yearling Wild Chinook					
10%	4/26	4/22	4/21	4/24	4/21
90%	6/8	5/28	5/20	5/27	5/31
Subyearling Chinook					
10%	7/10	6/7	7/4	6/16	6/24
90%	9/1	8/11	9/1	8/3	8/4
Hatchery Steelhead					
10%	5/7	4/25	4/28	5/1	5/2
90%	5/26	5/23	5/27	5/27	5/29
Wild Steelhead					
10%	5/5	4/17	4/22	5/1	4/28
90%	5/22	5/22	5/21	5/28	5/29

Insert Figure LMN-1

Table LMN-2. Dates of project operations for fish purposes at Lower Monumental Dam, 2000.

1.2. Adult Fish Passage.

1.2.1. Facilities Description. The adult fish passage facilities at Lower Monumental are comprised of north and south shore fish ladders and collection systems with a common auxiliary water supply. The north shore fish ladder connects to two north shore entrances and the powerhouse collection system. The powerhouse collection system has two downstream entrances and one side entrance into the spillway basin at the south end of the powerhouse, ten floating orifices, and a common transportation channel. Two north shore entrances, two downstream south powerhouse entrances, and five of the floating orifices are used during normal operation. The south shore fish ladder has two downstream entrances and a side entrance into the spillway basin. The two downstream entrances are used during normal operation. The auxiliary water is supplied by three turbine-driven pumps located in the powerhouse on the north side of the river. The water is pumped into a supply conduit that travels under the powerhouse collection channel, distributing water to the powerhouse diffusers, and then under the spillway to the diffusers in the south shore collection system. Excess water from the juvenile fish bypass system (approximately 200-240 cfs) is added to the auxiliary water supply system for the powerhouse collection system.

1.2.2. Adult Migration Timing. Upstream migrants are present at Lower Monumental dam all year. Maintenance of adult fish facilities is scheduled in January and February to minimize impacts to adult migrants. Facilities are usually shut down one shore at a time for maintenance to minimize impacts on adult fish passage. Table LMN-3 shows the primary passage periods by species and shows the latest and earliest recorded dates of peak passage from fish count records complied by the Corps. Adult fish are normally counted 16-hours per day (0400 to 2000 Pacific Standard Time) from April 1 through October 31. Adult fish passage is video taped with later interrogation and counting done by fish counters.

2. Project Operation.

2.1. Spill Management. 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), 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

Table LMN-3. Adult migration timing at Lower Monumental Dam from 1969-1999 based on fish counts.

Species	Counting Period	Date of Peak Passage	
		Earliest	Latest
Spring Chinook	4/1 - 6/13	4/20	5/27
Summer Chinook	6/14 - 8/13	6/14	7/12
Fall Chinook	8/14 - 10/31	9/13	9/30
Steelhead	4/1 - 10/31	9/15	10/13
Sockeye	4/1 - 10/31	6/24	7/25

provide juvenile fish passage. Spill at Lower Monumental will be distributed across the spillway in accordance with the spill pattern in Table LMN-9. Special spills for juvenile fish passage will be provided as detailed in Appendix A. Spills for juvenile fish passage normally take place during the spring, from April 3 through June 20.

2.2. Total Dissolved Gas Management and Control. Total dissolved gas (TDG) levels at Lower Monumental are monitored in accordance with the Dissolved Gas Monitoring Program, Appendix D. The TDG levels are monitored in the Lower Monumental Dam forebay and tailrace from April 1 through September 30. Data will be collected every half-hour and transmitted via computer every hour. Implementation of spill management requests will be based upon TDG monitoring and juvenile migration data. Requests for spill will be coordinated through the Technical Management Team (TMT).

2.3. Operating Criteria.

2.3.1. Juvenile Fish Passage Facilities. Operate from April 1 through October 31 for juvenile fish bypass, collection and transportation, and from November 1 through December 15 for bypassing adult fallbacks. Operate the juvenile facilities according to the criteria listed below and in Appendix B for bypassing, collection, and transportation of juvenile salmonids.

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

a. Forebay Area and Intakes.

1. Remove debris from forebay and gatewell slots.

2. Rake trash racks just prior to the operating season.

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

b. Submersible Traveling Screens and Vertical Barrier Screens.

1. Maintenance completed on all screens.

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

3. Log results of trial run.

4. Inspect all VBSs at least once per year. Repair as needed.

c. Collection Gallery.

1. Water-up valve operating correctly.

2. Orifice lights are operational.

3. Orifices clean and valves operating correctly.

d. Dewatering Structure and Flume.

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

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

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

4. All valves should be operating correctly.

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

e. Transportation Facilities.

1. Primary bypass flume switch gate maintained and in good operating condition.

2. Flume interior smooth with no rough edges.

3. Perforated plate edges smooth with no rough edges.

4. Wet separator and fish distribution system should be maintained and ready for operation as designed.

5. Brushes and screens on crowders in good condition with no holes in screens or rough edges.

6. Crowders maintained, tested, and operating correctly.

7. All valves, slide gates, and switch gates maintained and in good operating condition.

8. Retainer screens in place with no holes in screens or sharp wires protruding.

9. Barge and truck loading pipes should be free of debris, cracks, or blockages. Truck and barge loading hose couplings should have no rough edges and barge loading boom should be maintained and tested.

10. All sampling equipment should maintained and in good operating condition prior to watering up the facilities.

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

g. Maintenance Records. Record all maintenance and inspections.

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

a. Forebay Area and Intakes.

1. Remove debris from forebay.

2. Log gatewell drawdown differentials in bulkhead slots at least once a week.

3. Remove debris from forebay and trashracks as required to maintain less than 1' of additional drawdown in gate slots. Additional raking may be required when heavy debris loads are present in the river. Coordinate turbine unit outages with other project work activities, if possible, to minimize turbine unit outages during the spring.

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

5. If a visible accumulation of contaminating substances (such as oil) is detected in a gatewell and it cannot be removed within 24 hours, the gatewell orifices shall be closed and the turbine unit shut down until the material has been removed and any problems corrected. 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 then 48 hours.

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

7. Dip bulkhead gatewell slots to remove fish prior to installing bulkhead for unwatering bulkhead slot.

b. Submersible Traveling Screens (STS) and Vertical Barrier Screens (VBS).

1. Operate STSs in cycling mode when average fork length of subyearling or sockeye is greater than 120 mm.

2. Operate STSs in continuous operational mode when average fork length of subyearling chinook or sockeye is less than 120 mm or if fish condition deteriorates.

3. Inspect each STS once per month.

4. Record STS amp readings daily.

5. If an STS is damaged or fails during the juvenile fish passage season, follow procedures detailed under unscheduled maintenance of STSs. In no case should a turbine unit be

operated with a missing or a known non-operating or damaged STS.

6. Half of the STSs may be pulled after October 1 for maintenance as long as unscreened turbine units are not operated.

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

8. Inspect at least 2 VBSs at random across the powerhouse between the spring and summer migration periods. If a debris accumulation is noted, inspect other VBSs and clean debris as necessary.

c. Collection Gallery Checks.

1. Orifices clean and operating. Operate at least one 12" orifice per slot (preferably the north orifice). If the project is operating at MOP, additional orifices may be operated to maintain a full collection channel.

2. Orifice lights operational and operating on open orifices.

3. Operate with bypass gallery full to ensure orifice jets are hitting in the middle of the channel.

4. Backflush orifices at least once per day, and more frequently if required. During periods of high debris, orifices should be inspected and backflushed several times per day (including swing and graveyard shifts), as determined by the project biologist, to keep orifices clean.

5. Water-up valve operational.

d. Dewatering Structure.

1. Trash sweep operating correctly. The frequency of the sweep should be set as necessary to maintain a clean screen, with a minimum operation of at least once per hour. Operate the air flush as specified by the project biologist to maintain a clean screen.

2. Hand clean trapezoidal section as often as required to maintain in clean condition, with a minimum of once per day.

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

4. There should be no gaps between screen panels or

damaged panels in the inclined screen.

e. Transportation Facilities.

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

2. Crowder screen brushes should be maintained in good operating condition, with no holes or sharp edges on crowder screens.

3. Inspect raceway and tank retainer screens to make sure they are clean with no holes or protruding wires.

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

5. Truck and barge loading facilities in good operating condition.

f. Avian Predation Areas (Forebay and Tailrace).

1. Bird wires and other avian deterrent devices should be monitored to assure they are in good condition. Any broken wires or devices should be replaced as soon as possible.

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

3. Project biologists shall routinely monitor project areas to determine areas of active avian predation and, if possible, adjust harassment program to cover these areas or install bird wires or other deterrent devices to discourage avian predation activities.

g. Inspection and Record Keeping.

1. Inspect fish facilities once each shift. Inspect all facilities according to fish facilities monitoring program.

2. Record all maintenance and inspections.

2.3.2. Adult Fish Passage Facilities. Operate the adult fish passage facilities according to the following criteria:

2.3.2.1. Winter Maintenance Period (January 1 through March 1).

a. Inspect all staff gauges and water level indicators, repair and/or clean where necessary.

b. Dewater all ladders and inspect all dewatered sections of fish facilities for projections, debris, or plugged orifices which could injure fish or impede fish passage up the ladder. Inspect all diffuser gratings and chambers annually by dewatering and physically inspecting the gratings and chambers or by using divers or video inspection techniques. All diffuser gratings and chambers are to be dewatered and physically inspected at least every 3 years. Repair deficiencies.

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

d. Calibrate all mechanical and electronic water level measuring devices, as necessary, for proper facility operations.

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

f. Fish pumps maintained and debris cleaned out of turbine unit wicket gates.

2.3.2.2. Fish Passage Period (March 1 through December 31).

Note: Ice Harbor pool may be operated at minimum operating pool (MOP), between elevations 437' and 438' msl, as part of the Corps' efforts for improving migration conditions for juvenile salmonids. This will result in some of the adult fishway entrances at Lower Monumental Dam bottoming out on their sills prior to reaching criteria depths. Continuous operation at MOP may also result in increased pumping head on the auxiliary water supply pumps, decreasing the amount of water supplied by the pumps.

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

b. Head on all Entrances. Head range: 1' to 2'

c. North Shore Entrances (NSE 1 & 2). Elevation of top of gate when on sill = 429'.

1. Operate both gates.

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

d. Powerhouse Collection System. Operate 5 floating orifices (O.G numbers 1, 3, 5, 7, 9). All floating orifices will be closed for the 2000 operating season as part of an adult fish passage study.

e. South Powerhouse Entrances (SPE 1 & 2). Elevation of top of gate when on sill = 432'.

1. Operate both downstream gates.

2. Weir depth: 8' or greater below tailwater. At tailwaters below elevation 440', weirs should be on sill.

f. South Shore Entrances (SSE 1 & 2). Elevation of top of gate when on sill = 431'.

1. Operate both downstream gates.

2. Weir depth: SSE 1 operate 8' or greater below tailwater. SSE 2 raised 6' above sill. At tailwaters below elevation 439', SSE 1 weir should be on sill.

g. Transportation Velocity. 1.5' to 4' per second.

h. Head on Trashracks.

1. Maximum head of 0.5' on ladder exits.

2. Maximum head on south shore picket leads shall be 0.3'. Maximum head on north shore picket leads shall be 0.4'.

i. Staff Gages and Water Level Indicators. Gages shall be readable at all water levels encountered during fish passage period.

j. Facility Inspections.

1. Powerhouse operators shall inspect facilities once per day.

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

3. Project personnel shall check calibration of fishway control system twice per month to ensure that it is kept within

calibration.

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

5. Record all inspections.

2.3.3. Facility Monitoring and Reporting. Project biologists shall inspect fish passage facilities at the frequencies listed in the juvenile and adult fish facilities operating criteria sections. Project biologists shall prepare weekly reports, from March 1 through December 31, summarizing project operations. The weekly reports should provide an overview of how the project and the fish passage facilities operated during the week and an evaluation of resulting fish passage conditions. The reports shall include: any out of criteria situations observed and subsequent corrective actions taken; any equipment malfunctions, breakdowns, or damage along with a summary of resulting repair activities; adult fishway control calibrations; STS and VBS inspections; and any unusual activities that occurred at the project that may effect fish passage. The weekly reports shall cover a Friday through Thursday time period and shall be sent to CENWW-OD-TF by noon the following Monday via electronic mail. 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. Project biologists also inspect project facilities once per month and during dewaterings for the presence of zebra mussels. Biologists shall provide a report to CENWW-OD-TF on a monthly basis summarizing zebra mussel inspections.

3. Project Maintenance.

Project biologist 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 plans. Dewatering and fish handling plans were reviewed and revised in 1997 to ensure that they comply with Appendix G, Guidelines for Dewatering and Fish Handling Plans.

3.1. Juvenile Fish Passage Facilities.

3.1.1. Scheduled Maintenance. Scheduled maintenance of the juvenile facilities is conducted during the entire year. Long-term maintenance or modifications to the 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 and/or survival. Unscheduled maintenance of facilities such as submersible traveling screens, which sometimes break down during the fish passage season, will be carried out according to procedures described below. In these cases, repairs will be made as prescribed and CENWW-OD-TF notified for further coordination. Unscheduled maintenance that will have a significant effect on fish passage will be coordinated with NMFS and FPOM on a case-by-case basis by CENWW-OD-TF. The CENWW-OD-TF will be notified as soon as possible after it becomes apparent that maintenance repairs are required. The Project Manager has the authority to initiate work prior to notifying CENWW-OD-TF when in his opinion delay of the work will result in an unsafe situation for people, property, or fish. Information required by CENWW-OD-TF includes:

a. Description of the problem.

b. Type of outage required.

c. Impact on facility operation.

d. Length of time for repairs.

e. Expected impacts on fish passage and proposed measures to mitigate them.

3.1.2.1. Submersible Traveling Screens. The STSs are inspected periodically throughout the juvenile migration season with a video monitoring system. If a screen is found to be damaged it will be removed and either replaced with the spare STS or repaired and returned to service. A turbine unit shall not be operated with a known damaged or nonfunctioning STS or without a full compliment 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 or damaged, 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 unwatered and stoplogs inserted at the upstream end of the inclined screen. The emergency bypass is then opened and the bypass system operated with 6 gatewell orifices open. Orifices will then need to be routinely rotated, every three hours, in order to let juveniles emigrate from all of the gatewells. While the facilities are in emergency bypass operation, project personnel shall monitor gatewells for signs of fish problems or mortality. Spill may be provided as an alternative avenue for fish passage during a collection channel outage.

3.1.2.4. Bypass Flume. The corrugated metal flume transports juveniles to either the transportation facilities or to the river below the project (primary bypass). If there is a problem with the flume that interferes with its operation, the emergency bypass system at the upper end of the flume can be opened and all of the fish in the bypass system diverted to the river below the project through the emergency bypass pipe while repairs are made.

3.1.2.5. Transportation Facilities. The transportation facilities can be operated to collect and hold juveniles for the transportation program or to bypass them back to the river (secondary bypass). If part of the facility malfunctions or is damaged, efforts will first be made to bypass the fish around the damaged area. If this is not possible, the fish will be bypassed to the river via the primary bypass pipe.

3.2. Adult fish Passage Facilities.

3.2.1. Scheduled Maintenance. Scheduled maintenance of a facility that must be unwatered 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 not have a significant affect on fish passage may be conducted during the rest of the year. Fishway auxiliary water supply pumps require monthly, semi-annual, and annual maintenance. Monthly maintenance requires a one-day outage per pump, semi-annual maintenance requires a two-day outage per pump in July, and annual maintenance requires a two-week outage per pump during the winter maintenance period. 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 operating criteria unless otherwise coordinated with the fish agencies and tribes.

3.2.2. Unscheduled Maintenance. Unscheduled maintenance that will significantly affect the operation of a facility will be coordinated with NMFS and FPOM. Coordination procedures for unscheduled maintenance of adult facilities are the same as for juvenile facilities. 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 affects 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 and 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 trash racks. If any part of the ladder fails or is blocked with debris during the fish passage season, efforts will first be made to correct it without unwatering the ladder. Trash racks, picket leads, and counting stations can sometimes be repaired or maintained without unwatering the ladder. The decision on whether 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 all three pumps being required for normal operation. If one, two, or all three pumps fail, the fishway will be adjusted in the following manner until repairs can be made: SPE 2 and SSE 2 will be closed and SPE 1 raised to provide the required 1' to 2' head differential in the system. If the desired head differential cannot be reached by the time SPE 1 reaches 5' below tailwater, the floating orifices should be closed starting at OG-9 and working north across the powerhouse. (Note: The floating orifices will be closed during the 2000 operating season as part of an adult fish passage study.) If the head differential still cannot be maintained when all the floating orifices are closed, 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 are made up 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 is damaged, it will be pulled out of the water and the entrance bulkheaded off until it is repaired.

3.2.2.4. Diffuser Gratings. Diffuser chambers for adding auxiliary water to fish ladders and collection channels are covered by gratings attached by several different methods. Diffuser gratings are normally checked during the winter maintenance period to make sure they are in place. These inspections are done by either dewatering the fish passageway and physically inspecting the diffuser gratings, or by 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. 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 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. Coordination of the problems should begin immediately through the established unscheduled maintenance coordination procedure (see paragraph 3.1.2). If possible, a video inspection should be made as soon as possible to determine the extent of the problem. If diffuser gratings are found to be missing or displaced, creating openings into the diffuser chambers, a method of repair shall be developed and coordinated with the fish agencies and tribes through the established coordination procedure. Repairs shall be made as quickly as possible unless coordinated differently.

4. Turbine Unit Operation and Maintenance.

4.1. Turbine Unit Operation. When in operation, turbine units at Lower Monumental will be operated to enhance adult 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 order shown in Table LMN-4. 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.

Table LMN-4. Turbine unit operating priority for Lower Monumental Dam.

Season	Time of Day	Unit Priority
March 1 – November 30	Daytime (0600-1800 hours)	1, 2, 3, then 4 through 6 (any order)
	Nighttime (1800-0600 hours)	1, 2, 3, 4, 5, then 6
December 1 – February 28	24 hours	Any Order

Turbine units will be operated within 1% of best efficiency from March 15 through November 30 (or as specified in BPA's load shaping guidelines) unless operation outside of that range is necessary to: 1) meet the load requirements of the BPA administrator whose load requests will be made in accordance with BPA's policy, statutory requirements and load shaping guidelines (Appendix C); or 2) be in compliance with other coordinated fish measures. Project personnel shall record when turbine units are operated outside the 1% turbine efficiency range and shall provide the information to BPA on a weekly basis according to the load shaping guidelines. Between December 1 and March 15, turbine units will continue to be operated within the 1% turbine efficiency range except when BPA load requests require the units to be operated outside the 1% range.

Guidelines for operation of the turbine units within the 1% range at various heads are shown in Tables LMN-5 through LMN-8. These 1% turbine efficiency ranges were calculated using results from 1994 index testing of turbine unit 3 at Little Goose Dam. Maximum generation of turbine units at 115% overload is 155 MW.

4.2. Turbine Unit Outages During High River Flow Periods. During high spring flows, turbine unit outages for inspecting fish screens, repairing research equipment such as hydroacoustic or radio telemetry equipment, and other fish items may cause increased spill at a project in order to maintain reservoir levels within operating levels. This may result in TDG levels exceeding standards. It is important that this work be conducted when scheduled to ensure that facilities are working correctly and not injuring migrating fish, and that important fish research data is collected. To facilitate this work, reservoir storage may be utilized to minimize impacts from taking turbine units out of service and increasing spill. At Lower Monumental, this special operation shall take place when river flows are above 120 kcfs or when increasing spill levels will result in TDG levels exceeding standards. The activities covered under these operations will be coordinated with and approved by the TMT whenever possible.

For scheduled inspection or repair of research equipment, reservoirs shall be drafted to the bottom of MOP and allowed to fill to 1' above the MOP operating range as the work is accomplished. After the work, reservoirs will be slowly drafted back to the MOP operating range. When inspection or repair work can be scheduled ahead of time, the following process will be followed:

a. Project personnel shall schedule turbine unit outages through the approved turbine outage scheduling procedure by noon of the Tuesday of the week prior to the outage.

Table LMN-5. Lower Monumental 1% operating efficiency range for turbine units 1-3 with standard length submersible traveling screens installed.

Head (ft)	Lower Generator Limits (MW)	Lower Generator Limits (CFS)	Upper Generator Limits (MW)	Upper Generator Limits (CFS)
85	80	12,966	137	22,317
86	81	12,966	140	22,441
87	81	12,797	141	22,331
88	82	12,796	142	22,239
89	83	12,793	144	22,151
90	84	12,790	145	22,067
91	84	12,651	146	21,982
92	85	12,653	149	22,106
93	87	12,657	150	22,023
94	88	12,666	151	21,943
95	89	12,677	152	21,866
96	89	12,563	154	21,793
97	90	12,577	155	21,724
98	91	12,588	155	21,478
99	92	12,589	155	21,237
100	92	12,481	155	21,024
101	93	12,486	155	20,816
102	94	12,489	155	20,588
103	95	12,492	155	20,365
104	95	12,390	155	20,146
105	96	12,502	155	19,954

NOTE: The turbine efficiency tables are being revised to reflect new information. These tables contain the best information currently available.

Table LMN-6. Lower Monumental 1% operating efficiency range for turbine units 1-3 without standard length submersible traveling screens.

Head (ft)	Lower Generator Limits (MW)	Lower Generator Limits (CFS)	Upper Generator Limits (MW)	Upper Generator Limits (CFS)
85	75	12,168	137	22,317
86	76	12,168	140	22,441
87	76	12,010	141	22,331
88	77	12,009	142	22,238
89	78	12,006	144	22,151
90	79	12,003	145	22,067
91	79	11,872	146	21,982
92	80	11,874	149	22,106
93	81	11,878	150	22,023
94	82	11,887	151	21,943
95	83	11,897	152	21,866
96	83	11,790	154	21,792
97	84	11,803	155	21,724
98	85	11,813	155	21,478
99	86	11,814	155	21,237
100	86	11,713	155	21,024
101	87	11,717	155	20,816
102	88	11,720	155	20,588
103	89	11,723	155	20,365
104	89	11,628	155	20,146
105	90	11,733	155	19,954

NOTE: The turbine efficiency tables are being revised to reflect new information. These tables contain the best information currently available.

Table LMN-7. Lower Monumental 1% operating efficiency range for turbine units 4-6 with standard length submersible traveling screens installed.

Head (ft)	Lower Generator Limits		Upper Generator Limits	
	(MW)	(CFS)	(MW)	(CFS)
85	86	13,525	120	18,945
86	87	13,516	122	19,014
87	88	13,509	124	19,080
88	89	13,502	126	19,142
89	90	13,495	128	19,200
90	91	13,487	130	19,255
91	92	13,480	132	19,310
92	93	13,477	134	19,364
93	94	13,475	135	19,255
94	95	13,472	137	19,305
95	96	13,469	138	19,203
96	98	13,559	139	19,264
97	99	13,554	140	19,180
98	100	13,547	141	19,102
99	102	13,632	142	19,027
100	104	13,720	143	18,956
101	106	13,808	143	18,746
102	107	13,801	143	18,542
103	108	13,796	143	18,342
104	109	13,791	145	18,418
105	110	13,785	147	18,434

NOTE: The turbine efficiency tables are being revised to reflect new information. These tables contain the best information currently available.

Table LMN-8. Lower Monumental 1% operating efficiency range for turbine units 4-6 without standard length submersible traveling screens.

Head (ft)	Lower Generator Limits (MW)	(CFS)	Upper Generator Limits MW)	(CFS)
85	98	15,421	126	19,896
86	99	15,410	128	19,968
87	100	15,402	131	20,037
88	102	15,394	133	20,103
89	103	15,386	135	20,164
90	104	15,377	137	20,221
91	105	15,370	139	20,279
92	106	15,366	141	20,336
93	107	15,364	142	20,221
94	108	15,361	144	20,273
95	110	15,357	145	20,167
96	112	15,460	147	20,231
97	113	15,454	148	20,142
98	114	15,446	149	20,060
99	116	15,543	150	19,982
100	119	15,643	151	19,907
101	121	15,744	151	19,686
102	122	15,736	151	19,472
103	123	15,730	151	19,262
104	124	15,724	153	19,343
105	126	15,717	155	19,359

NOTE: The turbine efficiency tables are being revised to reflect new information. These tables contain the best information currently available.

b. Project personnel shall also contact CENWW-OD-TF and RCC by the same time period and inform them of the intended work.

c. The RCC will coordinate the work activities with regional parties at the TMT meeting on the following Wednesday.

d. After coordination with the TMT, RCC shall issue a teletype through the CBTT issuing instructions to project and BPA personnel for the scheduled work.

e. Spill will be increased by one spillbay stop setting (about 1.7 kcfs) above passing inflow to slowly lower the level of Lower Monumental pool to the bottom of the MOP range prior to the scheduled work taking place.

f. When the work takes place, additional spill will not be provided and the reservoir will be allowed to refill until the reservoir is 1' above the normal MOP range (a 2' pondage from where the pool was when the work started). At this point, screen inspections shall stop. (At Snake River projects, this should allow about one normal work day for the scheduled work.)

g. At the conclusion of the work, the reservoir shall be drafted back down to the MOP range utilizing a one spillbay stop increase in spill above passing inflow.

h. If work, such as screen inspections, is not finished, project personnel shall schedule another turbine unit outage for a date where it can be implemented again.

If the work that needs to be done is of an emergency type nature that does not normally require the turbine unit to be taken out of service (such as a failed hydroacoustic transducer versus a failed fish screen), and can not wait for the above process to be implemented, project personnel shall notify CENWW-OP-TF and RCC to get approval to do the work. If approval to do the work is given, the turbine unit shall be taken out of service and the reservoir level allowed to increase until it reaches 1' above the MOP operating range. At this point, the turbine unit must be returned to service and the reservoir will be drafted back to the MOP range using one spillbay stop setting above passing inflows.

4.3. Turbine Unit Maintenance. The project turbine unit maintenance schedule will be reviewed annually by project and Operations Division biologists for fish impacts. If possible, maintenance of priority units will be scheduled for non-fish passage periods, or when there are low numbers of fish passing the project. Each turbine unit requires annual maintenance that may take from several days to two weeks. Annual maintenance of all turbine units is normally scheduled during the mid-July to late November time frame. The maintenance of priority units for adult passage is normally conducted in mid-August, when fewer adults are migrating, to minimize impacts on migrating adults. Turbine units may occasionally require overhauls to repair major problems with the turbine or generator. Overhauls may take over one year to accomplish. Turbine units, governors, exciters, and control systems require periodic maintenance, calibration, and testing which may take them outside of the one percent best efficiency range. This work will be scheduled in compliance with BPA load shaping guidelines (Appendix C) to minimize impacts on juvenile fish. Transformers are Doble tested every 3 years. Testing may need to be more frequent if there is a known problem with a transformer. These tests normally take 2 to 3 work days. To conduct the testing, the distribution lines have to be disconnected from the transformers and normal generation stopped. One turbine unit will operate in a speed-no-load condition to provide project power and operation of fish passage facilities. Spill may be provided to meet minimum required project discharges during the testing hours. The Doble tests are normally scheduled for the August or early September time period to minimize impacts on adult and juvenile fish passage.

Unwatering turbine units should be accomplished in accordance with project dewatering plans. Prior to dewatering a turbine unit for maintenance, the turbine unit should be spun at speed-no-load, if possible, immediately before installing tailrace stoplogs and headgates to minimize the number of fish in the draft tube and scroll case. If a turbine unit is out of service for maintenance for an extended period of time without tailrace stoplogs in place, efforts should be made to not open the wicket gates if the scroll case must be dewatered at a later date without the unit being spun before hand.

5. Forebay Debris Removal. Debris at projects can impact fish passage conditions. Debris can plug or block trashracks, VBSs, gatewell orifices, dewatering screens, separators, and facility piping resulting in impingement, injuries, and descaling of fish. Removing debris at its source in the forebay is sometimes necessary to maintain safe and efficient fish passage conditions, navigation, and other project activities. Debris can be removed from the forebay by: physically encircling the debris with log booms and pulling it to shore with boats where it can be removed with a crane, removing the debris from the top of the dam using a crane and scoop, or passing the debris through the spillway with special powerhouse operations and spill. The preferred option is to remove debris at each project when possible to avoid passing debris on to the next project downstream. This is not always possible at each project as some projects do not have forebay debris removal capability. In this case, the only viable alternative is to spill the debris.

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-TF at least two work days prior to the day they want the special project operations for spilling to pass debris. The CENWW-OD-TF shall coordinate the special operations with RCC and NMFS. Project personnel shall provide CENWW-OD-TF the reason for the debris spill request including an explanation of project facilities being impacted by the debris, the date and time of the requested spill, and any special powerhouse or other operations required to move the debris to the spillway. When a debris spill is coordinated and approved, RCC shall issue a teletype detailing the specifics of the special operations.

Table LMN-9. Lower Monumental Dam spill pattern for adult fish passage and for minimizing total dissolved gas levels.

Spill Bay								Total	Total
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**Stops**	**Spill**
	1							1	1.10
	1	1						2	2.20
	1	1	1					3	3.30
	1	1	1	1				4	4.40
	1	1	1	1	1			5	5.50
	1	1	1	1	1	1		6	6.60
	2	1	1	1	1	1		7	8.30
	2	2	1	1	1	1		8	10.00
	2	2	2	1	1	1		9	11.70
	2	2	2	2	1	1		10	13.40
	2	2	2	2	2	1		11	15.10
	2	2	2	2	2	2		12	16.80
	3	2	2	2	2	2		13	18.60
	3	3	2	2	2	2		14	20.40
	3	3	3	2	2	2		15	22.20
	3	3	3	3	2	2		16	24.00
	3	3	3	3	3	2		17	25.80
	3	3	3	3	3	3		18	27.60
	4	3	3	3	3	3		19	29.20
	4	4	3	3	3	3		20	30.80
	4	4	4	3	3	3		21	32.40
	4	4	4	4	3	3		22	34.00
	4	4	4	4	4	3		23	35.60
	4	4	4	4	4	4		24	37.20
	5	4	4	4	4	4		25	38.90
	5	5	4	4	4	4		26	40.60
	5	5	5	4	4	4		27	42.30
	5	5	5	5	4	4		28	44.00
	5	5	5	5	5	4		29	45.70
	5	5	5	5	5	5		30	47.40
	6	5	5	5	5	5		31	49.10
	6	6	5	5	5	5		32	50.80
	6	6	6	5	5	5		33	52.50
	6	6	6	6	5	5		34	54.20
	6	6	6	6	6	5		35	55.90
	6	6	6	6	6	6		36	57.60
	7	6	6	6	6	6		37	59.30
	7	7	6	6	6	6		38	61.00
	7	7	7	6	6	6		39	62.70

Table LMN-9 (cont). Lower Monumental Dam spill pattern for adult fish passage and for minimizing total dissolved gas levels.

Spill Bay								Total	Total
1	2	3	4	5	6	7	8	Stops	Spill
	7	7	7	7	6	6		40	64.40
	7	7	7	7	7	6		41	66.10
	7	7	7	7	7	7		42	67.80
	8	7	7	7	7	7		43	69.60
	8	8	7	7	7	7		44	71.40
	8	8	8	7	7	7		45	73.20
	8	8	8	8	7	7		46	75.00
	8	8	8	8	8	7		47	76.80
	8	8	8	8	8	8		48	78.60
	9	8	8	8	8	8		49	80.30
	9	9	8	8	8	8		50	82.00
	9	9	9	8	8	8		51	83.70
	9	9	9	9	8	8		52	85.40
	9	9	9	9	9	8		53	87.10
	9	9	9	9	9	9		54	88.80
	10	9	9	9	9	9		55	90.50
	10	10	9	9	9	9		56	92.20
	10	10	10	9	9	9		57	93.90
	10	10	10	10	9	9		58	95.60
	10	10	10	10	10	9		59	97.30
	10	10	10	10	10	10		60	99.00
	11	10	10	10	10	10		61	100.70
	11	11	10	10	10	10		62	102.40
	11	11	11	10	10	10		63	104.10
	11	11	11	11	10	10		64	105.80
	11	11	11	11	11	10		65	107.50
	11	11	11	11	11	11		66	109.20
	12	11	11	11	11	11		67	111.00
	12	12	11	11	11	11		68	112.80
	12	12	12	11	11	11		69	114.60
	12	12	12	12	11	11		70	116.40
	12	12	12	12	12	11		71	118.20
	12	12	12	12	12	12		72	120.00
	13	12	12	12	12	12		73	121.70
	13	13	12	12	12	12		74	123.40
	13	13	13	12	12	12		75	125.10
	13	13	13	13	12	12		76	126.80
	13	13	13	13	13	12		77	128.50
	13	13	13	13	13	13		78	130.20

Table LMN-9 (cont). Lower Monumental Dam spill pattern for adult fish passage and for minimizing total dissolved gas levels.

Spill Bay								Total Stops	Total Spill
1	2	3	4	5	6	7	8		
	14	13	13	13	13	13		79	131.90
	14	14	13	13	13	13		80	133.60
	14	14	14	13	13	13		81	135.30
	14	14	14	14	13	13		82	137.00
	14	14	14	14	14	13		83	138.70
	14	14	14	14	14	14		84	140.40
	15	14	14	14	14	14		85	142.20
	15	15	14	14	14	14		86	144.00
	15	15	15	14	14	14		87	145.80
	15	15	15	15	14	14		88	147.60
	15	15	15	15	15	14		89	149.40
	15	15	15	15	15	15		90	151.20
	16	15	15	15	15	15		91	152.90
	16	16	15	15	15	15		92	154.60
	16	16	16	15	15	15		93	156.30
	16	16	16	16	15	15		94	158.00
	16	16	16	16	16	15		95	159.70
	16	16	16	16	16	16		96	161.40

SECTION 8

LITTLE GOOSE DAM

Little Goose Dam

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

1.1. Juvenile Fish Passage.

1.1.1. Facilities Description. The Little Goose juvenile facilities consist of a bypass system and juvenile transportation facilities. The bypass system contains extended length submersible bar screens (ESBS) with flow vanes, vertical barrier screens (VBS), 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 a corrugated metal flume to transport the fish to either the transportation facilities or to the river. The transportation facilities include a separator structure, raceways for holding fish, a distribution system for distributing the fish among the raceways, a sampling and marking building, truck and barge loading facilities, and PIT tag detection and deflection systems.

1.1.2. Juvenile Migration Timing. Juvenile migration timing at Little Goose Dam is indicated in Table LGS-2. The dates in the table are based on juvenile fish collection numbers and do not reflect FGE or spill passage. Maintenance of juvenile fish passage facilities that may impact juvenile fish passage or facility operations should be conducted during the maintenance season.

1.2. Adult Fish Passage.

1.2.1. Facilities Description. The adult fish passage facilities at Little Goose are comprised of one fish ladder on the south shore, two south shore entrances, a powerhouse collection system, north shore entrances with a transportation channel underneath the spillway to the powerhouse collection system, and auxiliary water supply system. The powerhouse collection system is comprised of 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. The four floating orifices and the two downstream entrances at the north end of the collection system are normally used. The north shore entrances are made up of two

Insert Figure LGS-1

Table LGS-1. Dates of project operations for fish purposes at Little Goose Dam, 1999.

Table LGS-2. Juvenile migration timing at Little Goose Dam based on juvenile fish collection numbers.

% Collection	1995	1996	1997	1998	1999
Yearling Hatchery Chinook					
10%	5/1	4/27	4/25	4/26	4/27
90%	5/24	5/25	5/23	5/16	5/25
Yearling Wild Chinook					
10%	4/22	4/21	4/19	4/25	4/20
90%	6/12	5/22	5/18	5/28	5/31
Subyearling Chinook					
10%	7/13	6/25	7/7	7/5	6/21
90%	8/30	8/13	8/25	8/12	8/7
Hatchery Steelhead					
10%	5/6	4/23	4/25	5/1	4/28
90%	5/26	5/21	5/25	5/26	5/29
Wild Steelhead					
10%	5/1	4/14	4/22	4/29	4/25
90%	5/25	5/21	5/19	5/27	5/30

downstream facing entrances and a side entrance into the spillway basin with the two downstream entrances operated. The auxiliary water is supplied by three turbine-driven pumps that pump water from the tailrace into the distribution system for the diffusers. Additional water is supplied to the auxiliary water supply system from the juvenile fish facilities primary dewatering structure.

1.2.2. Adult Migration Timing. Upstream migrants are present at the project year around. Maintenance of upstream passage facilities is scheduled for January and February to minimize the impact on upstream migrants. Table LGS-3 lists primary passage periods by species and shows the earliest and latest date of peak passage that have been recorded from compilation of fish counts by the Corps. Adult fish are normally counted 16 hours per day (0400 to 2000 Pacific Standard Time) from April 1 through October 31. Adult fish passage is videotaped with later interrogation by fish counters.

2. Project Operations.

2.1. Spill Management. Involuntary spill at Little Goose is the result of river flow exceeding powerhouse capacity, insufficient generation loads to pass the river flow, turbine unit outages (forced or scheduled), or the failure of a key component of the juvenile fish passage facility which forces the project to spill to provide juvenile fish passage. Spill at Little Goose shall be distributed in accordance with the spill pattern included at the end of this section, Table LGS-8. Special spills for juvenile

Table LGS-3. Adult migration timing at Little Goose Dam from 1969-1999 based on fish counts.

Species	Counting Period	Date of Peak Passage	
		Earliest	Latest
Spring Chinook	4/1 - 6/15	4/20	5/27
Summer Chinook	6/16 - 8/15	6/14	7/12
Fall Chinook	8/16 - 10/31	9/14	9/30
Steelhead	4/1 - 10/31	9/15	10/14
Sockeye	6/15 - 10/31	6/24	7/25

fish passage will be provided as detailed in Appendix A (Special Project Operations and Research). Spills for juvenile fish passage normally take place during the spring, from April 3 through June 20.

2.2. Dissolved Gas Management and Control. Total dissolved gas (TDG) levels at Little Goose are monitored in accordance with the Dissolved Gas Monitoring Program, Appendix D. The TDG levels will be monitored in the Little Goose forebay and tailrace from April 1 through September 30. Data will be collected every half-hour and transmitted via computer every hour. Data on spill volume and total project flow will be reported at the same time. Implementation of spill management requests will be based in part upon TDG monitoring data and the observed condition of migrant juveniles and adults, along with juvenile migration monitoring data. Requests for spill will be coordinated through the Technical Management Team (TMT).

2.3. Operating Criteria.

2.3.1. Juvenile Fish Passage Facilities. Operate from April 1 through October 31 for juvenile fish bypass, collection, and transportation and from November 1 through December 15 for bypassing adult fallbacks. Operate according to the criteria listed below and in Appendix B (Corps' Juvenile Fish Transportation Program Operating Criteria) for the bypassing, collection, and transportation of juvenile salmonids. The transportation program may be revised in accordance with the ESA Section 10 permit and the NMFS biological opinion.

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

a. Forebay Area and Intakes.

1. Remove debris from forebay and gatewell slots.

2. Rake trashracks just prior to the operating season.

3. Measure drawdown in gatewell slots after cleaning trashracks and with ESBSs in place.

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

1. Maintenance completed on all screens.

2. Inspect ESBSs prior to installation and operate debris cleaner (dogged off on deck) to ensure proper operation.

3. Log results of trial run.

4. Inspect VBSs at least once per year. Repair as needed.

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

c. Collection Gallery.

1. Water-up valve operating correctly.

2. Orifice lights are operational.

3. Orifices clean and valves operating correctly.

4. Automatic orifice cycling and backflush system maintained and operating correctly.

d. Dewatering Structure.

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

2. Cleaning brush and air burst systems maintained and operating correctly.

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

4. All valves should be operating correctly.

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

e. Transportation Facilities.

1. Flume switch gate maintained and in good operating condition.

2. Flume interior smooth with no rough edges.

3. Perforated plate smooth with no rough edges.

4. Wet separator and fish distribution system maintained and ready for operation as designed.

5. Brushes and screens on crowders in good condition with no holes in screens or rough edges.

6. Crowders maintained, tested, and operating correctly.

7. All valves, slide gates, and switch gates maintained and in good operating condition.

8. Retainer screens in place with no holes in screens or sharp wires protruding.

9. Barge and truck loading pipes free of debris, cracks, or blockages and barge loading boom maintained and tested.

10. All sampling equipment should be maintained and in good operating condition prior to watering up the facilities.

f. Avian Predation Areas (Forebay and Tailrace). Inspect bird wires 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.

g. Maintenance Records. Record all maintenance and inspections.

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

a. Forebay Area and Intakes.

1. Remove debris from forebay.

2. Log drawdown differentials in bulkhead slots at least once a week.

3. Remove debris from forebay and trashracks as required to maintain less than 1' of additional drawdown in gate slots. Additional raking may be required when heavy debris loads are present in the river or when fish condition requires it.

4. Inspect gatewell slots daily (preferably early in day shift) for debris, fish buildup, and contaminating substances (particularly oil). Clean gatewells before they become half covered with debris. If, due to the volume of the debris, it is not possible to keep the gatewell at least half clear, they should be cleaned at least once daily. If flows through an

orifice, or fish conditions give indications that an orifice may be partially obstructed with debris, the orifice will be close and backflushed to remove the obstruction. If the obstruction can not be removed, the orifice shall be closed and the alternate orifice for that gatewell slot shall be operated. If both orifices become obstructed or plugged with debris the turbine unit will not be operated until the gatewell and orifices are cleared of debris.

5. If a visible accumulation of contaminating substances (such as oil) is detected in a gatewell and it cannot removed within 24 hours, the gatewell orifices shall be closed and the turbine unit shut down until the material has been removed and any problems corrected. Action should be taken as soon as possible to remove the oil from the gatewell so the orifice can be reopened to allow the fish to exit the gatewell. Orifices shall not be closed for longer than 48 hours.

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

7. Dip bulkhead gatewell slots to remove fish prior to installing bulkhead for unwatering a bulkhead slot.

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

1. Operate ESBSs with flow vanes attached to screen.

2. Operate ESBSs with debris cleaners in automatic mode. Set cleaning frequency as required to maintain clean screens and good fish condition. Change cleaning frequency as needed.

3. Inspect each ESBS once per month.

4. If an ESBS is damaged or fails during the juvenile fish passage season, follow procedures detailed under unscheduled maintenance of ESBSs (see paragraph 3.1.2.1). In no case should a turbine unit be operated with a missing or a known non-operating or damaged ESBS, except as noted.

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

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

7. Measure head differentials across VBSs at least once per week from April 1 through June 30 (more frequently if required) and biweekly for the remainder of the operating season. Clean VBS when head differentials reach 1.5'. When a head differential of 1.5' is reached, the respective turbine unit

should be operated at a reduced loading, not more than 110 MW, to minimize loading on the VBS and potential fish impingement until the VBS can be cleaned. Clean VBSs as soon as possible after a 1.5' head differential is reached.

8. Inspect at least 2 VBSs at random across the powerhouse between the spring and summer migration periods. If a debris accumulation is noted, inspect other VBSs and clean debris as necessary.

c. Collection Gallery Checks.

1. Orifices clean and operating. Operate at least one 12" 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 gallery. If orifices must be closed to repair any part of the facility, <u>do not close orifices in operating turbine units with ESBSs in place for longer than 5 hours</u>. Monitor fish conditions in gatewells hourly during orifice closure period.

2. Orifice lights operational and operating on open orifices.

3. Orifice jets hitting no closer than 3' from wall (bypass gallery full).

4. Backflush orifices at least once per day, and more frequently if required. During periods of high debris, orifices should be inspected and backflushed several times per day, 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.

5. If utilizing the automatic orifice backflush system, inspect as determined by the project biologist (but at least once per work shift unless coordinated differently) to ensure that the orifices are opening and closing correctly and are clear of debris. The project biologist will determine the frequency of automatic orifice cycling and backflushing to maintain clear orifices.

6. Water-up valve operational.

d. Dewatering Structure.

1. Trash sweep and air burst systems operating correctly. The frequency of screen cleaning should be set as necessary to maintain a clean screen.

2. Hand clean trapezoidal section as often as required to maintain in clean condition, with a minimum of once per day.

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

4. There should be no gaps between screen panels or damaged panels in the inclined screen. Screen panels in place and tightly secured.

e. Transportation Facilities.

1. Operate wet separator and fish distribution system as designed.

2. Crowder screen brushes should be maintained in good operating condition, with no holes or sharp edges on crowder screens. Crowders in good operating condition

3. Inspect raceway and tank retainer screens to make sure they are clean with no holes or protruding wires.

4. Barge and truck loading pipes and related equipment free of debris, cracks, or blockages and in good condition. Barge loading boom in good operating condition

f. Avian Predation Areas (Forebay and Tailrace).

1. Bird wires and other avian deterrent devices should be monitored to assure they are in good condition. Any broken wires or devices should be replaced as soon as possible.

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

3. Project biologists shall routinely monitor project areas to determine areas of active avian predation and, if possible, adjust harassment program to cover these areas or install bird wires or other deterrent devices to discourage avian predation activities.

g. Inspection and Record Keeping.

1. Inspect fish facilities once each shift. Inspect all facilities according to fish facilities monitoring program.

2. Record all maintenance and inspections.

2.3.2. Adult Fish Passage Facilities. Operate the adult fish passage facilities according to the following criteria:

2.3.2.1. Winter Maintenance Period (January 1 through February

28).

a. Inspect all staff gauges and water level indicators, repair and/or clean where necessary.

b. Dewater all ladders and inspect all dewatered sections of fish facilities for projections, debris, or plugged orifices which could injure fish or impede fish passage up the ladder. Inspect all diffuser gratings and chambers annually by dewatering and physically inspecting the gratings and chambers or by using divers or video inspection techniques. All diffuser gratings and chambers are to be dewatered and physically inspected at least every 3 years. Repair deficiencies.

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

d. Calibrate all mechanical and electronic water level measuring devices, as necessary, for proper facility operations.

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

f. Fish pumps maintained and ready for operation.

2.3.2.2. Fish Passage Period (March 1 through December 31).

Note: Lower Monumental pool may be operated at minimum operating pool (MOP), between elevations 537' and 538' msl, as part of the Corps' efforts to improve migration conditions for juvenile salmonids. This may result in some of the adult fishway entrances at Little Goose bottoming out on their sills prior to reaching criteria depths. Continuous operation at MOP may also result in increased pumping head on the auxiliary water supply pumps, decreasing the amount of water supplied by the pumps.

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

b. Counting Window. The counting window and backboard should be clean to allow best video taping of adult fish passing through the counting slot. When possible, the minimum counting slot width should be 18". All equipment should be maintained and in good condition.

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

d. North Shore Entrances (NSE 1 & 2). Elevation of top of gates when on sill = 529'.

1. Operate both downstream gates.

2. Weir depth: 6' or greater below tailwater.

e. North Powerhouse Entrances (NPE 1 & 2). Elevation of top of gates when on sill = 532'.

1. Operate both downstream gates.

2. Weir Depth: 7' or greater below tailwater, tailwater permitting. At tailwater below elevation 539', entrance weirs should be on sill.

f. Powerhouse Collection System. Operate 4 floating orifices (numbers 1, 4, 6, and 10). **Note: All floating orifices will be closed for the 2000 operating season as part of an adult fish passage study.**

g. **South Shore Entrances (SSE 1 & 2).** Elevation of top of gates when on sill = 529'.

1. Operate both gates.

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

h. Transportation Velocity. 1.5' to 4' per second.

i. Tunnel Lights. The lights in the tunnel section under the spillway shall be on during fish passage period.

j. Head on Trashracks.

1. Maximum head of 0.5' on ladder exit.

2. Maximum head on picket leads shall be 0.3'.

k. Staff Gages and Water Level Indicators. Shall be readable at all water levels encountered during fish passage period.

l. Facility Inspections.

1. Powerhouse operators shall inspect facilities once per day.

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

3. Project personnel shall check calibration of fishway control system twice per month to ensure that it is kept within calibration.

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

5. Record all inspections.

2.3.3. Facility Monitoring and Reporting. Project biologists shall inspect fish passage facilities at the frequencies listed in the juvenile and adult fish facilities operating criteria sections. Project biologists shall prepare weekly reports, from March 1 through December 31, summarizing project operations. The weekly reports should provide an overview of how the project and the fish passage facilities operated during the week and an evaluation of resulting fish passage conditions. The reports shall include: any out of criteria situations observed and subsequent corrective actions taken; any equipment malfunctions, breakdowns, or damage along with a summary of resulting repair activities; adult fishway control calibrations; ESBS and VBS inspections; and any unusual activities which occurred at the project which may effect fish passage. The weekly reports shall cover a Friday through Thursday time period and shall be sent to CENWW-OD-TF by noon the following Monday via electronic mail. 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. Project biologists also inspect project facilities once per month and during dewaterings for the presence of zebra mussels. Biologists shall provide a report to CENWW-OD-TF on a monthly basis summarizing zebra mussel inspections.

3. Project Maintenance.

Project biologists should be present to provide technical guidance at all project activities that may involve fish handling. All dewaterings shall be accomplished in accordance with approved project dewatering plans. Dewatering and fish handling plans were reviewed and revised in 1997 to ensure that they comply with Appendix G, Guidelines for Dewatering and Fish Handling Plans.

3.1. Juvenile Fish Passage Facilities.

3.1.1. Scheduled Maintenance. Scheduled maintenance of the juvenile facilities is conducted during the entire year. Long-term maintenance or modification of facilities that requires them to be out of service for extended periods of time are conducted during the winter maintenance period from December 16 to 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 which will impact fish passage and survival. Maintenance of facilities such as ESBSs, which sometimes break down during the fish passage season, will be carried out according to procedures described below. In these cases, repairs will be made as prescribed and CENWW-OD-TF notified for further coordination. Unscheduled maintenance that will have a significant impact on juvenile fish passage shall be coordinated with the CBFWA and NMFS on a case-by-case basis by CENWW-OD-TF. CENWW-OD-TF will be notified as soon as possible after it becomes apparent that maintenance repairs are required. The Project Manager has the authority to initiate work prior to notifying CENWW-OD-TF when in his opinion delay of the work will result in an unsafe situation for people, property, or fish. Information required by CENWW-OD-TF includes:

a. Description of the problem.

b. Type of outage required.

c. Impact on facility operation.

d. Length of time for repairs.

e. Expected impacts on fish passage and proposed measures to mitigate them.

3.1.2.1. Extended-length Submersible Bar Screens. 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 affected ESBS can be removed and repaired or replaced.

During the spring runoff when river flows are at the level where taking a unit out of service and spilling will exceed the TDG limits allowed by state standards, project personnel may operate a turbine unit at <u>110 MWs or less</u> with a failed screen cleaner if there is evidence that the ESBS will not plug with debris. This will only happen if an ESBS screen cleaner fails after 1400 hours on a regular work day or any time on a weekend. Project personnel will pull and replace the screen the next morning, weekday or weekend inclusive. If the screen can not be pulled and repaired first thing the next morning, the turbine unit will be removed from service until the screen can be repaired. If there is evidence that fish are being injured under this operation, by either observing injured fish in the gatewells or injured fish appearing on the separator, the turbine unit will be removed from service immediately. This operation will not take place when daily average river flows are less than total powerhouse capacity and the turbine unit will not be operated during power peaking operations where turbine units are being turned on and off.

3.1.2.2. Gatewell Orifices. Each gatewell has two 12" orifices (gatewell slot 1A has one 14" test orifice) with air operated valves to allow fish to exit the gatewell. Under normal operation, at least one orifice per gatewell is operated. To minimize blockage from debris, orifices should be backflushed every day. If an air valve fails, the valve should be closed and the alternate orifice and air valve for that gatewell operated until repairs can be made. If both orifices are blocked with debris or damaged, 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 unwatered 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, at a minimum of every 2 hours, to allow juveniles to emigrate from all of the gatewells. During any orifice closure, gatewells shall be monitored hourly by project personnel for signs of fish problems or mortality. Orifices shall not be closed for longer than 5 hours in an operating turbine unit with ESBSs in place. During periods of high fish passage, orifice closure times may need to be less than 5 hours depending on fish numbers and condition. If orifices are closed, gatewells shall be monitored hourly. Spill may be used as an alternative avenue for fish passage during a collection channel outage.

3.1.2.4. Bypass Flume. The corrugated metal flume transports juveniles to either the transportation facilities or to the river below the project. If there is a problem with the flume that interferes with its operation, an emergency bypass system at the upper end of the flume can be opened and all of the fish in the bypass system diverted to the river below the project through a 30" pipe while repairs are made.

3.1.2.5. Transportation Facilities. The transportation facilities can be operated either to collect and hold juveniles for the transportation program or to bypass them back to the river. If part of the facility malfunctions or is damaged, efforts will first be made to bypass the fish around the damaged area. If this is not possible, the fish will be bypassed around the transportation facilities.

3.2. Adult Fish Passage Facilities.

3.2.1. Scheduled Maintenance. Scheduled maintenance of a facility that must be unwatered 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 not have a significant effect on fish passage may be conducted during the rest of the year. Fishway auxiliary water supply pumps require monthly, semi-annual, and annual maintenance. Monthly maintenance requires a one-day outage per pump, semi-annual maintenance requires a two-day outage per pump in July or August, and annual maintenance requires a two-week outage per pump during the winter maintenance period. When facilities are not being maintained during the winter maintenance period, they will be operated according to normal operating criteria unless otherwise coordinated with the fish agencies and tribes.

3.2.2. Unscheduled Maintenance. Unscheduled maintenance that will significantly affect the operation of a facility will be coordinated with the CBFWA and NMFS. Coordination procedures for unscheduled maintenance of adult facilities shall be the same as for juvenile facilities. 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 affects on fish passage, repairs may not be conducted until the winter maintenance period or until fewer numbers of fish are passing the project. If part of a facility is damaged or malfunctions that may significantly impact fish passage, it will be repaired as soon as possible.

3.2.2.1. Fish Ladder and Counting Station. The fish ladder contains fixed weirs, a counting station with picket leads, and a fish exit with trashrack. If any part of the ladder fails or is blocked with debris during the fish passage season, efforts will first be made to correct it without unwatering the ladder. Trash racks, picket leads, and counting stations can sometimes be repaired or maintained without unwatering the ladder. The decision to dewater the ladder and make repairs during the fish passage season or wait until the winter maintenance period will be made after coordination with the fish agencies and tribes.

3.2.2.2. Auxiliary Water Supply System. Three turbine-driven pumps on the south shore supply the auxiliary water for the fish ladder and the powerhouse collection system. All three pumps are required for normal operation. Approximately 150 to 180 cfs of excess water from the juvenile fish passage facilities is also added to the auxiliary water supply system. If one, two, or all three pumps fail, the fishway will be adjusted down in the following manner to get the best fish passage conditions possible until repairs can be made: first, NSE 2 and NPE 2 should be closed and NPE 1 operated 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, floating orifices OG-6 and OG-4 should be closed and SSE 1 and 2 should be raised at 1' increments until 6' below tailwater is reached. Note that all floating orifices will be closed for the 2000 operating season as part of an adult fish passage study. 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, OG-10 and OG-1 should be closed followed by NPE 1 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 are made up of main entrance weirs with hoists and automatic controls, and floating orifices which regulate themselves with tailwater level. 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 is damaged, it will be pulled out of the water and the entrance bulkheaded off until it is repaired.

3.2.2.4. Diffuser Gratings. Diffuser chambers for adding auxiliary water to fish ladders and collection channels are covered by gratings attached by several different methods. Diffuser gratings are normally checked during the winter maintenance period to make sure they are in place. These inspections are done either by dewatering the fish passage way and physically inspecting the diffuser gratings, or by 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. 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 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. Coordination of the problems should begin immediately through the established unscheduled maintenance coordination procedure (see paragraph 3.1.2). If possible, a video inspection should be made as soon as possible to determine the extent of the problem. If diffuser gratings are found to be missing or displaced, creating openings into the diffuser chambers, a method of repair shall be developed and coordinated with the fish agencies and tribes through the established coordination procedure. Repairs shall be made as quickly as possible unless coordinated differently.

4. Turbine Unit Operation and Maintenance.

4.1. Turbine Unit Operation. When in operation, turbine units will be operated to enhance adult and juvenile fish passage from March 1 through November 30. During this time period turbine units will be operated (as needed to meet generation requirements) in the priority order shown in Table LGS-4. Unit operating criteria may be coordinated differently to allow for fish research, construction, or project maintenance activities. To minimize mortality to juvenile fish passing through the turbine units from April 1 through October 31 (or as long as there is sufficient river flow and/or generation requests to operate turbine units 4, 5, and 6 within 1 percent of peak efficiency), operating priority during nighttime hours from 2000 to 0400 hours shall favor the north units as shown in Table LGS-4. If the project is spilling for juvenile fish passage nightly with no daytime spill, unit priorities shall change at 1800 and 0600 hours, when spill is started and ended, to minimize starting and stopping of turbine units. If the project is bypassing juvenile fish back to the river <u>through the main bypass flume</u>, nighttime unit operating priority shall be unit 1, then units 4 through 6 (Table LGS-4. If a turbine unit is taken out of service for maintenance or repair, the next unit in the priority list shall be operated.

Turbine units will be operated within 1% of best efficiency from March 15 through November 30 (or as specified in BPA's load shaping guidelines) unless operation outside of that range is necessary to: 1) meet the load requirements of the BPA Administrator whose load requests will be made in accordance with BPA's policy, statutory requirements, and load shaping guidelines (Appendix C); or 2) be in compliance with other coordinated fish measures. Project personnel shall record when turbine units are

Table LGS-4. Turbine unit operating priority for Little Goose Dam.

Season	Time of Day	Unit Priority
March 1 – November 30	24 hours	1, 2, 3, then 4-6 (any order)
April 1 – October 31 (Project IS Spilling)	Nighttime (0600 to 1800 hours)	1, 4-6 , 2, 3
April 1 – October 31 (During juvenile bypass through main flume and no spill)	Nighttime (2000 to 0400 hours)	1, 4-6 (in any order, then 2-3 (as needed)
December 1 – February 28	24 hours	Any Order

operated outside the 1% turbine efficiency range and shall provide the information to BPA on a weekly basis according to the load shaping guidelines. Between December 1 and March 14, turbine units will continue to be operated within the 1% turbine efficiency range except when BPA load requests require the units to be operated outside the 1% range.

Guidelines for operation of the turbine units within the 1% efficiency range at various heads are shown in Tables LGS-4 through LGS-7. The 1% efficiency ranges were calculated using results from 1994 index testing of turbine units 3 and 5 at Little Goose Dam. Maximum generation of units 1 through 6 at 115% overload is 155 MW.

4.2. Turbine Unit Outages During High River Flow Periods. During high spring flows, turbine unit outages for inspecting fish screens, repairing research equipment such as hydroacoustic or radio telemetry equipment, and other fish items may cause increased spill at a project in order to maintain reservoir levels within operating levels. This may result in TDG levels exceeding standards. It is important that this work be conducted when scheduled to ensure that facilities are working correctly and not injuring migrating fish, and that important fish research data is collected. To facilitate this work, reservoir storage may be utilized to minimize impacts from taking turbine units out

Table LGS-4. The 1% turbine operating range at Little Goose Dam for units 1-3 with extended-length submersible bar screens installed.

Head (ft)	Lower Generator Limits (MW)	Lower Generator Limits (CFS)	Upper Generator Limits (MW)	Upper Generator Limits (CFS)
85	69	11,204	128	20,769
86	70	11,256	130	20,866
87	72	11,308	133	20,963
88	73	11,360	135	21,058
89	74	11,424	137	21,177
90	75	11,462	140	21,247
91	77	11,525	142	21,364
92	78	11,575	144	21,457
93	79	11,611	147	21,523
94	80	11,673	149	21,638
95	82	11,708	151	21,703
96	83	11,742	154	21,767
97	84	11,803	155	21,724
98	86	11,850	155	21,478
99	87	11,897	155	21,237
100	88	11,957	155	21,024
101	89	12,017	155	20,816
102	91	12,062	155	20,588
103	92	12,107	155	20,365
104	93	12,152	155	20,146
105	95	12,210	155	19,954

NOTE: The turbine efficiency tables are being revised to reflect new information regarding extended-length submersible bar screens. These tables contain the best information currently available.

Table LGS-5. The 1% turbine operating range at Little Goose Dam for units 1-3 without extended-length submersible bar screens.

Head (ft)	Lower Generator Limits (MW)	Lower Generator Limits (CFS)	Upper Generator Limits (MW)	Upper Generator Limits (CFS)
85	75	12,168	137	22,317
86	76	12,168	140	22,441
87	76	12,010	141	22,331
88	77	12,009	142	22,238
89	78	12,006	144	22,151
90	79	12,003	145	22,067
91	79	11,872	146	21,982
92	80	11,874	149	22,106
93	81	11,878	150	22,023
94	82	11,887	151	21,943
95	83	11,897	152	21,866
96	83	11,790	154	21,792
97	84	11,803	155	21,724
98	85	11,813	155	21,478
99	86	11,814	155	21,237
100	86	11,713	155	21,024
101	87	11,717	155	20,816
102	88	11,720	155	20,588
103	89	11,723	155	20,365
104	89	11,628	155	20,146
105	90	11,733	155	19,954

NOTE: The turbine efficiency tables are being revised to reflect new information regarding extended-length submersible bar screens. These tables contain the best information currently available.

Table LGS-6. The 1% turbine operating range at Little Goose Dam for units 4-6 with extended-length submersible bar screens installed.

Head (ft)	Lower Generator Limits		Upper Generator Limits	
	(MW)	(CFS)	(MW)	(CFS)
85	83.3	13,505	105.8	17,152
86	84.3	13,488	107.3	17,167
87	85.2	13,470	108.7	17,182
88	86.2	13,453	110.2	17,195
89	87.2	13,435	111.7	17,208
90	88.1	13,418	113.1	17,220
91	89.3	13,437	114.8	17,274
92	90.4	13,455	116.5	17,328
93	91.6	13,473	118.1	17,379
94	92.7	13,490	119.8	17,430
95	93.9	13,507	121.5	17,479
96	94.9	13,504	122.9	17,490
97	95.9	13,501	124.3	17,500
98	96.9	13,498	125.7	17,510
99	97.9	13,495	127.1	17,520
100	98.9	13,492	128.5	17,529
101	100.1	13,510	129.2	17,431
102	101.3	13,527	129.8	17,335
103	102.5	13,544	130.5	17,240
104	103.7	13,560	131.1	17,147
105	104.9	13,576	131.8	17,056

NOTE: The turbine efficiency tables were revised to reflect new information using a 1995 index test and the 1975 model test and extended-length submersible bar screens. These tables are based on data from Lower Granite Dam.

Table LGS-7. The 1% turbine operating range at Little Goose Dam for units 4-6 without extended-length submersible bar screens.

Head (ft)	Lower Generator Limits (MW)	(CFS)	Upper Generator Limits MW)	(CFS)
85	85.1	13,532	113.0	17,972
86	86.1	13,515	114.6	17,988
87	87.1	13,497	115.6	17,914
88	88.1	13,480	116.6	17,842
89	89.1	13,463	117.6	17,771
90	90.0	13,446	120.8	18,045
91	91.2	13,465	122.6	18,102
92	92.4	13,483	124.4	18,158
93	93.6	13,501	126.2	18,212
94	94.7	13,519	128.0	18,265
95	95.9	13,535	129.8	18,317
96	96.9	13,533	131.3	18,329
97	98.0	13,530	132.8	18,340
98	99.0	13,527	134.3	18,350
99	100.0	13,524	135.8	18,360
100	101.1	13,521	137.3	18,370
101	102.3	13,539	138.0	18,268
102	103.5	13,557	138.7	18,167
103	104.7	13,574	139.4	18,068
104	105.9	13,590	140.1	17,971
105	107.1	13,606	140.8	17,876

NOTE: The turbine efficiency tables were revised to reflect new information using a 1995 index test and the 1975 model test and extended-length submersible bar screens. These tables are based on data from Lower Granite Dam.

of service and increasing spill. At Little Goose, this special operation shall take place when river flows are above 120 kcfs or when increasing spill levels will result in TDG levels exceeding standards. The activities covered under these operations will be coordinated with and approved by the TMT whenever possible.

For scheduled inspection or repair of research equipment, reservoirs shall be drafted to the bottom of MOP and allowed to fill to 1' above the MOP operating range as the work is accomplished. After the work, reservoirs will be drafted back to the MOP operating range. When inspection or repair work can be scheduled ahead of time, the following process will be followed:

a. Project personnel shall schedule turbine unit outages through the approved turbine outage scheduling procedure by noon of the Tuesday of the week prior to the outage.

b. Project personnel shall also contact CENWW-OD-TF and Reservoir Control Center (RCC) by the same time period and inform them of the intended work.

c. The RCC will coordinate the work activities with regional parties of the work at the TMT meeting on the following Wednesday.

d. After coordination with the TMT, RCC shall issue a teletype through the CBTT issuing instructions to project and BPA personnel for the scheduled work.

e. Spill will be increased by one spillbay stop setting (about 1.7 kcfs) above passing inflow to slowly lower the level of Little Goose pool to the bottom of the MOP range prior to the scheduled work taking place.

f. When the work takes place, additional spill will not be provided and the reservoir will be allowed to refill until the reservoir is 1' above the normal MOP range (a 2' pondage from where the pool was when the work started). At this point, screen inspections shall stop. (At Snake River projects, this should allow about one normal work day for the scheduled work.)

g. At the conclusion of the work, the reservoir shall be drafted back down to the MOP range utilizing a one spillbay stop increase in spill above passing inflow.

h. If work, such as screen inspections, is not finished, project personnel shall schedule another turbine unit outage for a date where it can be implemented again.

If the work that needs to be done is of an emergency type nature that does not normally require the turbine unit to be taken out of service (such as a failed hydroacoustic transducer versus a failed fish screen), and can not wait for the above process to be implemented, project personnel shall notify CENWW-OP-TF and RCC to get approval to do the work. If approval to do the work is given, the turbine unit shall be taken out of service and the reservoir level allowed to increase until it reaches 1' above the MOP operating range. At this point, the turbine unit must be returned to service and the reservoir will be drafted back to the MOP range using one spillbay stop setting above passing inflows.

4.3. Turbine Unit Maintenance. The project turbine unit maintenance schedule will be reviewed annually by project and Operations Division biologists for fish impacts. If possible, maintenance of priority units will be scheduled for non-fish passage periods, or when there are low numbers of fish passing the project. Each turbine unit requires annual maintenance that may take from several days to two weeks. Annual maintenance of all turbine units is normally scheduled during the mid-July to late November time frame. The maintenance of priority units for adult passage is normally conducted in mid-August, when fewer adults are migrating, to minimize impacts on migrating adults. Turbine units may occasionally require overhauls to repair major problems with the turbine or generator. Overhauls may take over one year to accomplish. Turbine units, governors, exciters, and control systems require periodic maintenance, calibration, and testing which may take them outside of the one percent best efficiency range. This work will be scheduled in compliance with BPA load shaping guidelines (Appendix C) to minimize impacts on juvenile fish. Transformers are Doble tested every 3 years. Testing may need to be more frequent if there is a known problem with a transformer. These tests normally take 2 to 3 work days. 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.

Unwatering turbine units should be accomplished in accordance with project dewatering plans. Prior to dewatering a turbine unit for maintenance, the turbine unit should be spun at speed-no-load, if possible, immediately before installing tailrace stoplogs and headgates to minimize the number of fish in the draft tube and scroll case. If a turbine unit is out of service for maintenance for an extended period of time without tailrace stoplogs in place, efforts should be made to not open the wicket gates if the scroll case must be dewatered at a later date without the unit being spun before hand.

5. Forebay Debris Removal. Debris at projects can impact fish passage conditions. Debris can plug or block trashracks, VBSs, gatewell orifices, dewatering screens, separators, and facility piping resulting in impingement, injuries, and descaling of fish. Removing debris at its source in the forebay is sometimes necessary to maintain safe and efficient fish passage conditions, navigation, and other project activities. Debris can be removed from the forebay by: physically encircling the debris with log booms and pulling it to shore with boats where it can be removed with a crane, removing the debris from the top of the dam using a crane and scoop, or passing the debris through the spillway with special powerhouse operations and spill. The preferred option is to remove debris at each project when possible to avoid passing debris on to the next project downstream. This is not always possible at each project as some projects do not have forebay debris removal capability. In this case, the only viable alternative is to spill to pass the debris.

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-TF at least two work days prior to the day they want the special project operations for spilling to pass debris. CENWW-OD-TF shall coordinate the special operations with RCC and NMFS. Project personnel shall provide CENWW-OD-TF the reason for the debris spill request including an explanation of project facilities being impacted by the debris, the date and time of the requested spill, and any special powerhouse or other operations required to move the debris to the spillway. When a debris spill is coordinated and approved, RCC shall issue a teletype detailing the specifics of the special operations.

Table LGS-8. Little Goose Dam spill pattern for adult fish passage and for minimizing total dissolved gas levels.

Spill Bay								Total Stops	Total Spill
1	2	3	4	5	6	7	8		
0	1						0	1	1.8
0	1	1					0	2	3.6
0	1	1	1				0	3	5.4
0	1	1	1	1			0	4	7.2
0	1	1	1	1	1		0	5	9.0
0	1	1	1	1	1	1	0	6	10.8
0	2	1	1	1	1	1	0	7	12.6
0	2	2	1	1	1	1	0	8	14.4
0	2	2	2	1	1	1	0	9	16.2
0	2	2	2	2	1	1	0	10	18.0
0	2	2	2	2	2	1	0	11	19.8
0	2	2	2	2	2	2	0	12	21.6
0	3	2	2	2	2	2	0	13	23.4
0	3	3	2	2	2	2	0	14	25.2
0	3	3	3	2	2	2	0	15	27.0
0	3	3	3	3	2	2	0	16	28.8
0	3	3	3	3	3	2	0	17	30.6
0	3	3	3	3	3	3	0	18	32.4
0	4	3	3	3	3	3	0	19	34.2
0	4	4	3	3	3	3	0	20	36.0
0	4	4	4	3	3	3	0	21	37.8
0	4	4	4	4	3	3	0	22	39.6
0	4	4	4	4	4	3	0	23	41.4
0	4	4	4	4	4	4	0	24	43.2
0	5	4	4	4	4	4	0	25	45.0
0	5	5	4	4	4	4	0	26	46.8
0	5	5	5	4	4	4	0	27	48.6
0	5	5	5	5	4	4	0	28	50.4
0	5	5	5	5	5	4	0	29	52.2
0	5	5	5	5	5	5	0	30	54.0
0	6	5	5	5	5	5	0	31	55.8
0	6	6	5	5	5	5	0	32	57.6
0	6	6	6	5	5	5	0	33	59.4
0	6	6	6	6	5	5	0	34	61.2
0	6	6	6	6	6	5	0	35	63.0
0	6	6	6	6	6	6	0	36	64.8
0	7	6	6	6	6	6	0	37	66.6
0	7	7	6	6	6	6	0	38	68.4
0	7	7	7	6	6	6	0	39	70.2

Table LGS-8. Little Goose Dam spill pattern for adult fish passage and for minimizing total dissolved gas levels (Continued).

Spill Bay								Total Stops	Total Spill
1	2	3	4	5	6	7	8		
0	7	7	7	7	6	6	0	40	72.0
0	7	7	7	7	7	6	0	41	73.8
0	7	7	7	7	7	7	0	42	75.6
0	8	7	7	7	7	7	0	43	77.4
0	8	8	7	7	7	7	0	44	79.2
0	8	8	8	7	7	7	0	45	81.0
0	8	8	8	8	7	7	0	46	82.8
0	8	8	8	8	8	7	0	47	84.6
0	8	8	8	8	8	8	0	48	86.4
0	9	8	8	8	8	8	0	49	88.2
0	9	9	8	8	8	8	0	50	90.0
0	9	9	9	8	8	8	0	51	91.8
0	9	9	9	9	8	8	0	52	93.6
0	9	9	9	9	9	8	0	53	95.4
0	9	9	9	9	9	9	0	54	97.2
0	10	9	9	9	9	9	0	55	99.0
0	10	10	9	9	9	9	0	56	100.8
0	10	10	10	9	9	9	0	57	102.6
0	10	10	10	10	9	9	0	58	104.4
0	10	10	10	10	9	9	0	58	104.4
0	10	10	10	10	10	9	0	59	106.2
0	10	10	10	10	10	10	0	60	108.0
0	11	10	10	10	10	10	0	61	109.8
0	11	11	10	10	10	10	0	62	111.6
0	11	11	11	10	10	10	0	63	113.4
0	11	11	11	11	10	10	0	64	115.2
0	11	11	11	11	11	10	0	65	117.0
0	11	11	11	11	11	11	0	66	118.8
0	12	11	11	11	11	11	0	67	120.6
0	12	12	11	11	11	11	0	68	122.4
0	12	12	12	11	11	11	0	69	124.2
0	12	12	12	12	11	11	0	70	126.0
0	12	12	12	12	12	11	0	71	127.8
0	12	12	12	12	12	12	0	72	129.6
0	13	12	12	12	12	12	0	73	131.4
0	13	13	12	12	12	12	0	74	133.2
0	13	13	13	12	12	12	0	75	135.0
0	13	13	13	13	12	12	0	76	136.8
0	13	13	13	13	13	12	0	77	138.6

Table LGS-8. Little Goose Dam spill pattern for adult fish

passage and for minimizing total dissolved gas levels (Continued).

Spill Bay								Total Stops	Total Spill
1	2	3	4	5	6	7	8		
0	13	13	13	13	13	13	0	78	140.4
0	14	13	13	13	13	13	0	79	142.2
0	14	14	13	13	13	13	0	80	144.0
0	14	14	14	13	13	13	0	81	145.8
0	14	14	14	14	13	13	0	82	147.6
0	14	14	14	14	14	13	0	83	149.4
0	14	14	14	14	14	14	0	84	151.2
0	15	14	14	14	14	14	0	85	153.0
0	15	15	14	14	14	14	0	86	154.8
0	15	15	15	14	14	14	0	87	156.6
0	15	15	15	15	14	14	0	88	158.4
0	15	15	15	15	15	14	0	89	160.2
0	15	15	15	15	15	15	0	90	162.0
0	16	15	15	15	15	15	0	91	163.8
0	16	16	15	15	15	15	0	92	165.6
0	16	16	16	15	15	15	0	93	167.4
0	16	16	16	16	15	15	0	94	169.2
0	16	16	16	16	16	15	0	95	171.0
0	16	16	16	16	16	16	0	96	172.8

SECTION 9

LOWER GRANITE DAM

Lower Granite Dam

1. Fish Passage Information. The locations of fish passage facilities at Lower Granite Lock and Dam are shown on Figure LWG-1. Dates for project operations for fish purposes and special operations are listed in Table LWG-1.

1.1. Juvenile Fish Passage.

1.1.1. Facilities Description. The Lower Granite juvenile facilities consist of a bypass system and juvenile transportation facilities. The bypass system contains extended length 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 the fish to the transportation facilities or to the river. The transportation facilities include an upwell and separator structure to separate the juveniles and adults from the excess water and adult fish, raceways for holding fish, a distribution system for distributing the fish among the raceways or to the barge or back to the river, a sampling and marking building, truck and barge loading facilities, and PIT tag detection and deflection systems.

1.1.2. Juvenile Fish Migration Timing. Juvenile migration timing at Lower Granite Dam is indicated in Table LWG-2. The dates in the table are based on juvenile fish collection numbers and do not reflect FGE or spill passage. Maintenance of juvenile fish passage facilities that may impact juvenile fish passage or facility operations should be conducted during the maintenance season.

1.2. Adult Fish Passage.

1.2.1. Facilities Description. The adult fish passage facilities at Lower Granite are made up of one fish ladder on the south shore, two south shore entrances, a powerhouse collection system, north shore entrances with a transportation channel underneath the spillway to the powerhouse collection system, and an auxiliary water supply system. The powerhouse collection system is comprised of ten floating orifices, two downstream entrances and one side entrance into the spillway basin on the north end of the powerhouse, and a common transportation channel. Four of the floating orifices and the two downstream entrances at the north end of the collection system are operated. The north shore entrances are made up of two downstream entrances and a side entrance into the spillway basin with the two downstream

Insert Figure LWG-1 Here

Table LWG-1. Dates of project operations for fish purposes at Lower Granite Dam, 2000.

Reserved for page 2 of Table LWG-1.

Table LWG-2. Juvenile migration timing at Lower Granite Dam based on juvenile fish collection numbers.

% Collection	1995	1996	1997	1998	1999
Yearling Hatchery Chinook					
10%	4/21	4/24	4/21	4/20	4/23
90%	5/15	5/19	5/19	5/10	5/22
Yearling Wild Chinook					
10%	4/15	4/11	4/12	4/12	4/17
90%	6/3	5/19	5/15	5/17	6/2
Subyearling Chinook					
10%	7/8	6/27	6/27	6/24	6/10
90%	9/21	8/29	8/27	8/30	8/23
Hatchery Steelhead					
10%	4/28	4/24	4/7	4/27	4/24
90%	5/21	5/19	5/22	5/20	5/27
Wild Steelhead					
10%	4/24	4/17	4/16	4/25	4/22
90%	5/23	5/20	5/18	5/23	5/30

entrances normally used. The auxiliary water is supplied by three electric pumps that pump water from the tailrace. Two pumps are normally used to provide the required flows.

1.2.2. Adult Migration Timing. Upstream migrants are present at Lower Granite throughout the year. Maintenance of adult facilities is scheduled for January and February to minimize the impact on upstream migrants. Table LWG-3 lists primary passage periods by species and shows the earliest and latest date of peak passage that have been recorded from compilation of fish counts by the Corps. Adult fish are normally counted from March 1 through December 15. Fish counters count adult fish by direct observation for 16-hours per day (0400 to 2000 Pacific Standard Time) from April 1 through October 31. Adult fish are counted in March for 8-hours per day (0800 to 1600 Pacific Standard Time) and in November and December for 24-hours per day by video taping of fish passage and later interrogation of the videotapes. Nighttime adult fish passage (2000 to 0400 hours) from April 1 through October is also video taped and interrogated by fish counters for endangered species concerns.

2. Project Operation.

2.1. Spill Management. Involuntary spill at Lower Granite is the result of river flow exceeding powerhouse capacity, insufficient generation loads to pass the river flow, turbine

Table LWG-3. Adult migration timing at Lower Granite Dam from 1975-1998 based on adult fish counts.

Species	Counting Period	Date of Peak Passage	
		Earliest	Latest
Spring Chinook	3/1 - 6/17	5/3	5/27
Summer Chinook	6/18 - 8/17	6/18	7/17
Fall Chinook	8/18 - 12/15	9/5	10/6
Steelhead	3/1 - 12/15	9/3	10/16
Sockeye	3/1 - 12/15	7/1	7/19

unit outages (forced or scheduled), or the failure of a key component of the juvenile fish passage facility which forces the project to spill to provide juvenile fish passage. Spill at Lower Granite shall be distributed in accordance with the spill pattern included at the end of this section, Table LWG-9. Special spills for juvenile fish passage and surface collector operation may be provided as detailed in Appendix A (Special Project Operations and Research). Spills for juvenile fish passage normally take place during the spring, from April 3 through June 20.

2.2. Dissolved Gas Management and Control. Total dissolved gas (TDG) levels at Lower Granite are monitored in accordance with the Dissolved Gas Monitoring Program, Appendix D. The TDG levels will be monitored at the Lower Granite forebay and tailrace automated stations year-round. Data will be collected every half-hour and transmitted via computer every hour. Data on spill volume and total project flow will be reported at the same time. Implementation of spill management requests will be based in part upon TDG monitoring data and the observed condition of migrant juveniles and adults, along with juvenile migration monitoring data. Requests for spill will be coordinated through the Technical Management Team (TMT).

2.3. Operating Criteria.

2.3.1. Juvenile Fish Passage Facilities. Operate from March 25 through October 31 for juvenile fish bypass, collection, and transportation and from November 1 through December 15 for bypassing adult fallbacks. Operate the juvenile facilities according to the criteria listed below and in Appendix B (Corps' Juvenile Fish Transportation Program Operating Criteria) for the bypassing, collection, and transportation of juvenile salmonids. The transportation program may be revised in accordance with the ESA Section 10 permit and the NMFS biological opinion.

2.3.1.1. Winter Maintenance Period (December 16 through March 25). Check and perform maintenance as required on the items listed below.

a. Forebay Area and Intakes.

1. Remove debris from forebay and gatewell slots.

2. Rake trash racks just prior to the operating season.

3. Measure drawdown in gatewell slots after cleaning trashracks and with ESBSs in place.

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

1. Maintenance completed on all screens.

2. Inspect ESBSs prior to installation and operate debris cleaner (dogged off on deck) to ensure proper operation.

3. Log results of trial run.

4. Inspect all VBSs at least once per year. Repair as needed.

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

6. ESBSs installed in at least 4 turbine units by March 24 (all 6 turbine units if possible). Remaining ESBSs installed prior to April 1.

c. Collection Gallery.

1. Makeup water valves and float control equipment maintained and ready for operation.

2. Orifice lights are operational.

3. Orifices clean and valves operating correctly.

4. Automatic orifice cycling and backflush system maintained and operating correctly.

d. Transportation Facilities.

1. 42" and 72" sluice gates maintained and operating correctly.

2. Inclined screen clean and in good condition with no holes in or damage to screen mesh, gaps around screen, or missing silicone.

3. Perforated plate smooth with no rough edges.

4. Wet separator and fish distribution system maintained and ready for operation as designed.

5. Brushes and screens on crowders in good condition with no holes in screens or rough edges.

6. Crowders maintained, tested, and operating correctly.

7. All valves, slide gates, and switch gates maintained and in good operating condition.

8. Retainer screens in place with no holes in screens or sharp wires protruding.

9. Barge and truck loading pipes should be free of debris, cracks, or blockages and barge loading boom maintained and tested.

10. All sampling equipment should be maintained and in good operating condition prior to watering up the facilities.

e. Barges.

1. All pumps maintained and in good operating condition.

2. Fish release openings and related equipment in good operating condition.

3. No rough edges or support beams protruding into compartments.

4. No brass or galvanized fittings in circulation lines.

5. All loading hoses properly installed so fish will not hit sides of compartments or support beams when loading.

6. Loading hoses in good shape with rubber gaskets in cam lock fittings.

7. Inside edges of cam lock joints should be beveled to

avoid sharp edges.

8. Warning systems tested and operational.

9. Provide net and/or deck covers.

f. Maintenance Records. Record all maintenance and inspections.

g. Avian Predation Areas (Forebay and Tailrace). Inspect bird wires and replace as needed. Where possible, add additional bird wires or other deterrent devices to cover areas of known avian predation activity.

2.3.1.2. Fish Passage Period (March 25 through December 15).

a. Forebay Area and Intakes.

1. Remove debris from forebay.

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

3. If a visible accumulation of contaminating substances (such as oil) is detected in a gatewell and it cannot removed within 24 hours, the gatewell orifices shall be closed and the turbine unit shut down until the material has been removed and any problems corrected. Action should be taken as soon as possible to remove the oil from the gatewell so the orifice can be reopened to allow the fish to exit the gatewell. Orifices shall not be closed for longer than 48 hours.

4. Log drawdown differentials in bulkhead slots at least once per week.

5. Remove debris from forebay and trashracks as required to maintain less than 1' of additional drawdown in gate slots. Additional raking may be required when heavy debris loads are present in the river or if fish condition requires it.

6. Coordinate cleaning effort with personnel operating juvenile collection facilities.

7. Dip bulkhead gatewell slots to remove fish prior to installing bulkhead for unwatering bulkhead slot.

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

1. ESBSs and flow vanes installed in at least 4 turbine units by March 24 and all operating units prior to April 1. Between March 25 and March 31, turbine units without ESBSs installed may be operated on a last on/first off basis only if the daily average river flow is above the generating capacity of the four screened units.

2. Operate ESBSs with flow vanes attached to screen.

3. Operate ESBSs with debris cleaners in automatic mode. Set cleaning frequency as required to maintain clean screens and good fish condition. Change cleaning frequency as needed.

4. Inspect each ESBS once per month.

5. If an ESBS is damaged or fails during the juvenile fish passage season, follow procedures detailed under unscheduled maintenance of ESBSs (paragraph 3.1.2.1). In no case should a turbine unit be operated with a missing or a known non-operating or damaged ESBS, except as noted.

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

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

8. Measure head differentials across VBSs at least once per week from April 1 through June 30 (more frequently if required) and biweekly for the remainder of the operating season. Clean VBS when head differentials reach 1.5'. When a head differential of 1.5' is reached, the respective turbine unit should be operated at a reduced loading, not more than 110 MW, to minimize loading on the VBS and potential fish impingement. Clean VBSs as soon as possible after a 1.5' head differential is reached.

9. Inspect at least 2 VBSs at random across the powerhouse between the spring and summer migration periods. If a debris accumulation is noted, inspect other VBSs and clean debris as necessary.

c. Collection Gallery Checks.

1. Orifices clean and operating. Operate at least one orifice per bulkhead slot (preferably the north orifice)(18 open). 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. Monitor fish condition in gatewells hourly during orifice closure period.

2. Orifice lights operational and operating on open orifices.

3. Orifice jets not hitting back wall, bypass gallery full.

4. Rotate orifices in fish screens slots (6 open).

5. Backflush orifices at least once per day, and more frequently if required. During periods of high debris, orifices should be inspected and backflushed several times per day, as determined by the project biologist, to keep orifices clean.

6. If utilizing the automatic orifice backflush system, inspect as determined by the project biologist (but at least once per shift unless coordinated differently) to ensure that the orifices are opening and closing correctly and are clear of debris. The project biologist will determine the frequency of automatic orifice cycling and backflushing to maintain clear orifices.

7. Makeup water valves and associated float controls operational and maintaining stable channel flow.

d. Transportation Facilities.

1. 42" and 48" sluice gates operational.

2. Maintain stable water conditions in upwell and separator. No holes, broken wires, or gaps in inclined screen. Operate separator and fish distribution system as designed.

3. Crowder screen brushes should be maintained in good operating condition, with no holes or sharp edges on crowder screens. Crowders in good operating condition.

4. All valves, slide gates, and switch gates in and around separator and raceways operational.

6. Inspect raceway and tank retainer screens to make sure they are clean with no holes or protruding wire.

7. 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. Avian Predation Areas (Forebay and Tailrace).

1. Bird wires and other avian deterrent devices should be monitored to assure they are in good condition. Any broken wires or devices should be replaced as soon as possible.

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

3. Project biologists shall routinely monitor project areas to determine areas of active avian predation and, if possible, adjust harassment program to cover these areas or install bird wires or other deterrent devices to discourage avian predation activities.

f. Inspection and Record Keeping.

1. Inspect fish facilities once each shift. Inspect facilities according to fish facilities monitoring program.

2. Record all maintenance and inspections.

2.3.2. Adult Fish Passage Facilities. Operate the adult fish passage facilities according to the following criteria:

2.3.2.1. Winter Maintenance Period (January 1 through February 28).

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

b. Dewater 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. Inspect all diffuser gratings and chambers annually by dewatering and physically inspecting the gratings and chambers or by using divers or video inspection techniques. All diffuser gratings and chambers are to be dewatered and physically inspected at least every 3 years. Repair deficiencies.

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

d. Calibrate all mechanical and electronic water level measuring devices, as necessary, for proper facility operations.

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

f. Fish pumps maintained and ready for operation.

2.3.2.2. Fish Passage Period (March 1 through December 31).

Note: Lower Granite pool may be operated at minimum operating pool (MOP), between elevations 733' and 734' msl, as part of the Corps' efforts to improve migration conditions for juvenile salmonids. This will result in some of the adult fishway entrances at Lower Granite bottoming out on their sills prior to reaching criteria depths. Continuous operation at MOP may also result in increased pumping head on the auxiliary water supply pumps, decreasing the amount of water by the pumps.

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

b. Counting Window Widths. Counting windows should be operated as far out as possible while maintaining adequate counting conditions. When possible, the minimum counting slot width should be 18". All equipment should be maintained and in good condition.

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

d. North Shore Entrances (NSE 1 & 2). Elevation of top of gates when on sill = 625'.

1. Operate both downstream gates.

2. Weir depth: 7' or greater below tailwater.

e. North Powerhouse Entrances (NPE 1 & 2). Elevation of top of gates when on sill = 628'.

1. Operate both downstream gates.

2. Weir depth: 8' or greater below tailwater. At tailwaters below elevation 636', weirs should be on sill.

f. Powerhouse Collection System. Operate 4 floating orifices (numbers 1, 4, 7, and 10).

g. South Shore Entrances (SSE 1 & 2). Elevation of top of gates when on sill = 625'.

1. Operate both gates.

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

h. Transportation Velocity. 1.5' to 4' per second.

i. Tunnel Lights. Lights in the tunnel section under the spillway shall be on during fish passage period.

j. Head on Trashracks.

1. Maximum head of 0.5' on ladder exits.

2. Maximum head on picket leads shall be 0.3'.

k. 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 throughout the passage season.

l. Facility Inspections.

1. Powerhouse operators shall inspect facilities once per day.

2. Project biologist shall inspect facilities three times per week. Facilities should be according to fish facilities monitoring program.

3. Project personnel shall check calibration of fishway control system twice per month to ensure that it is kept within calibration. The control system should be calibrated as required to maintain proper readings at all control point locations.

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

5. Record all inspections.

2.3.3. Facility monitoring and reporting. Project biologists shall inspect fish passage facilities at the frequencies listed in the juvenile and adult fish facilities operating criteria sections. Project biologists shall prepare weekly reports, from March 1 through December 31, summarizing project operations. The weekly reports should provide an overview of how the project and the fish passage facilities operated during the week and an evaluation of resulting fish passage conditions. The reports shall include: any out of criteria situations observed and subsequent corrective actions taken; any equipment malfunctions, breakdowns, or damage along with a summary of resulting repair activities; adult fishway control calibrations; ESBS and VBS inspections; and any unusual activities which occurred at the project which may effect fish passage. The weekly reports shall cover a Friday through Thursday time period and shall be sent to CENWW-OD-TF by noon the following Monday via electronic mail. 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. Project biologists also inspect project facilities once per month and during dewaterings for the presence of zebra mussels. Biologists shall provide a report to CENWW-OD-TF on a monthly basis summarizing zebra mussel inspections.

3. Project Maintenance.

Project biologists shall 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 plans. Dewatering and fish handling plans were reviewed and revised in 1997 to ensure that they comply with Appendix G, Guidelines for Dewatering and Fish Handling Plans.

3.1. Juvenile Fish Passage Facilities.

3.1.1. Scheduled Maintenance. Scheduled maintenance of the juvenile facilities is conducted during the entire year. Long-term maintenance or modifications of facilities that require them to be out of service for extended periods of time are conducted during the winter maintenance period from December 16 to March 25. 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 and survival. Maintenance of facilities such as ESBSs, which sometimes break down during the fish passage season, will be carried out according to procedures described below. In these cases, repairs will be made as prescribed and CENWW-OD-TF notified for further coordination. Unscheduled maintenance, that will have a significant impact on juvenile fish passage, shall be coordinated with the CBFWA (via the FPC) and NMFS on a case-by-case basis by CENWW-OD-TF. CENWW-OD-TF will be notified as soon as possible after it becomes apparent that maintenance repairs are required. The Project Manager has the authority to initiate work prior to notifying CENWW-OD-TF when in his opinion delay of the work will result in an unsafe situation for people, property, or fish. Information required by CENWW-OD-TF includes:

a. Description of the problem.

b. Type of outage required.

c. Impact on facility operation.

4. Length of time for repairs.

5. Expected impacts on fish passage and proposed measures to mitigate them.

3.1.2.1. Extended-length Submersible Bar Screens. All 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 affected ESBS can be removed and repaired or replaced.

During the spring runoff when river flows are at the level where taking a unit out of service and spilling will exceed the TDG limits allowed by state standards, project personnel may operate a turbine unit at <u>110 MWs or less</u> with a failed screen cleaner if there is evidence that the ESBS will not plug with debris. 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 can not 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 4 orifices, two 10" orifices with air operated valves in the bulkhead slot and two 8" orifices with manually operated slide gates in the fish screen slot, for allowing the fish to exit the slots. Under normal operation, a total of 24 orifices are operated with 18 being bulkhead slot orifices and 6 being fish screen slot orifices. At least 1 orifice is open in each bulkhead slot with the fish screen slot orifices rotated. 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 or damaged, the turbine unit will be taken out of service until repairs can be made. If repairs are to take longer than 48 hours, juvenile fish will be dipped from the gatewell with a gatewell dip basket.

3.1.2.3. Bypass Pipe. The bypass pipe goes from the end of the powerhouse bypass channel to the transportation facilities downstream of the dam. All juvenile fish in the bypass system must pass through this to the transportation facilities or to the tailrace. If any part of the bypass pipe is damaged, the gatewell orifices will be closed and the bypass system unwatered until repairs can be made. Turbine units will not be operated for longer than 5 hours with ESBSs in place and orifices closed. 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 less than 5 hours depending on fish numbers and condition.

3.1.2.4. Transportation Facilities. The transportation facilities can be operated to either collect and hold juveniles for the transportation program, 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 unwatered until repairs are made. Spill may be used as an alternative avenue for fish passage during a bypass system outage.

3.2. Adult Fish Passage Facilities.

3.2.1. Scheduled Maintenance. Scheduled maintenance of a facility that must be unwatered 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 not have a significant effect on fish passage may be conducted during the rest of the year. When facilities are not being maintained during the winter maintenance period, they will be operated according to normal operating criteria unless otherwise coordinated with the fish agencies and tribes.

3.2.2. Unscheduled Maintenance. Unscheduled maintenance that will significantly affect the operation of a facility will be coordinated with the fish agencies and tribes. Coordination procedures for unscheduled maintenance of the adult facilities are the same as for juvenile facilities. 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 located in an offshoot from the ladder, 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 it without unwatering the ladder. Trash racks, picket leads, and counting stations can sometimes be repaired or maintained without unwatering the ladder. If the fish trap malfunctions or is damaged, fish may be passed around it until repairs are made. The decision to dewater the ladder and make repairs during the fish passage season or wait until the winter maintenance period will be made after coordination with the fish agencies and tribes.

3.2.2.2. Auxiliary Water Supply System. Three electric pumps supply the auxiliary water for the fish ladder and the powerhouse collection system. During normal operations and most flow conditions, two pumps are capable of providing the required flows. If a pump fails during the two-pump operation, the pump on standby will be operated to make up the flows. If two pumps fail, NSE 2 and NPE 2 will be closed and NPE 1 raised in 1' increments to provide the required 1' to 2' head differential. If the head cannot be maintained by the time the top of the weir reaches 5', the floating orifices should be closed in the following order: OG-4, OG-7, OG-10, and OG-1. If the head in the system still cannot be maintained at this point, SSE 1 and SSE 2 should be raised in 1' increments until 5' below tailwater is reached. If all three pumps fail, NSE 1 and NPE 1 should be closed, the powerhouse collection channel bulkheaded off at the junction pool, and SSE 1 and SSE 2 operated at 6' below tailwater regardless of the head.

3.2.2.3. Fishway Entrances. The fishway entrances consist of main entrance weirs with hoists and automatic controls, and floating orifices which regulate themselves with tailwater level. 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 is damaged, it will be pulled out of the water and the entrance bulkheaded off until it 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 the fish passage way and physically inspecting the diffuser gratings, or by 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. 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 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. Coordination of the problems should begin immediately through the established unscheduled maintenance coordination procedure (see paragraph 3.1.2). If possible, a video inspection should be made as soon as possible to determine the extent of the problem. If diffuser gratings are found to be missing or displaced, creating openings into the diffuser chambers, a method of repair shall be developed and coordinated with the fish agencies and tribes through the established coordination procedure. Repairs shall be made as quickly as possible unless coordinated differently.

4. Turbine Unit Operation and Maintenance.

4.1. Turbine Unit Operation. When in operation, turbine units will be operated to enhance adult and juvenile fish passage from March 1 through December 15. During this time period, turbine units will be operated (as needed to meet generation requirements) in the priority order shown in Table LWG-4. Unit operating priority may be coordinated differently to allow for fish research, construction, or project maintenance activities. To minimize mortality to juvenile fish passing through the turbine units from April 1 through October 31 (or as long as there is sufficient river flow and/or generation requests to operate turbine units 4, 5, or 6 within 1% of best turbine efficiency), operating priority during nighttime hours from 2000 to 0400 hours shall be units 4, 5, and 6 (in any order) and then units 1, 2, and 3 as needed (Table LWG-4). If a turbine unit is taken out of service for maintenance or repair, the next unit in the priority list shall be operated.

Table LGS-4. Turbine unit operating priority for Lower Granite Dam.

Season	Time of Day	Unit Priority
March 1 – December 15	24 hours	1, 2, 3, then 4-6 (any order)
April 1 – October 31 (If there is enough flow to run priority units)	Nighttime (2000 to 0400 hours)	4-6 (in any order, then 1-3 (as needed)
December 16 – February 28	24 hours	Any Order

Turbine units will be operated within the 1% turbine efficiency range from March 15 through November 30 (or as specified in the BPA load shaping guidelines) unless operation outside of that range is necessary to: 1) meet the load requirements of the BPA Administrator whose load requirements will be made in accordance with BPA's policy, statutory requirements, and load shaping guidelines (Appendix C); or 2) be in compliance with other coordinated fish measures. Project personnel shall record when turbine units are operated outside the 1% efficiency range and shall provide the information to BPA on a weekly basis according to the load shaping guidelines.

Between December 1 and March 15, turbine units will continue to be operated within the 1% turbine efficiency range except when BPA load requests require the units to be operated outside the 1% range.

Guidelines for operation of the turbine units within the 1% efficiency range at various heads are shown in Tables LWG-5 through LWG-8. The 1% efficiency ranges were calculated using results from 1994 index testing of turbine unit 3 at Little Goose Dam. Maximum generation of units 1 through 6 at 115% overload is 155 MW.

4.2. Turbine Unit Outages During High River Flow Periods. During high spring flows, turbine unit outages for inspecting fish screens, repairing research equipment such as hydroacoustic or radio telemetry equipment, and other fish items may cause increased spill at a project in order to maintain reservoir levels within operating levels. This may result in TDG levels exceeding standards. It is important that 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 Granite, this special operation shall take place when river flows are above 120 kcfs or when increasing spill levels will result in TDG levels exceeding standards. The activities covered under these operations will be coordinated with and approved by the TMT whenever possible.

For scheduled inspection or repair of research equipment, reservoirs shall be drafted to the bottom of MOP and allowed to fill to 1' above the MOP operating range as the work is accomplished. After the work, reservoirs will be drafted back to the MOP operating range. When inspection or repair work can be scheduled ahead of time, the following process will be followed:

a. Project personnel shall schedule turbine unit outages through the approved turbine outage scheduling procedure by noon of the Tuesday of the week prior to the outage.

b. Project personnel shall also contact CENWW-OD-TF and Reservoir Control Center (RCC) by the same time period and inform them of the intended work.

c. The RCC will coordinate the work activities with regional parties of the work at the TMT meeting on the following Wednesday.

d. After coordination with the TMT RCC shall issue a teletype through the CBTT issuing instructions to project and BPA personnel for the scheduled work.

Table LWG-5. The 1% turbine operating range at Lower Granite Dam for units 1-3 with extended-length submersible bar screens installed.

Head (ft)	Lower Generator Limits		Upper Generator Limits	
	(MW)	(CFS)	(MW)	(CFS)
85	69	11,204	128	20,769
86	70	11,256	130	20,866
87	72	11,308	133	20,963
88	73	11,360	135	21,058
89	74	11,424	137	21,177
90	75	11,462	140	21,247
91	77	11,525	142	21,364
92	78	11,575	144	21,457
93	79	11,611	147	21,523
94	80	11,673	149	21,638
95	82	11,708	151	21,703
96	83	11,742	154	21,767
97	84	11,803	155	21,724
98	86	11,850	155	21,478
99	87	11,897	155	21,237
100	88	11,957	155	21,024
101	89	12,017	155	20,816
102	91	12,062	155	20,588
103	92	12,107	155	20,365
104	93	12,152	155	20,146
105	95	12,210	155	19,954

NOTE: The turbine efficiency tables are being revised to reflect new information regarding extended-length submersible bar screens. These tables are based on data from Little Goose Dam.

Table LWG-6. The 1% turbine operating range at Lower Granite Dam for units 1-3 without extended-length submersible bar screens installed.

Head (ft)	Lower Generator Limits (MW)	(CFS)	Upper Generator Limits (MW)	(CFS)
85	75	12,168	137	22,317
86	76	12,168	140	22,441
87	76	12,010	141	22,331
88	77	12,009	142	22,238
89	78	12,006	144	22,151
90	79	12,003	145	22,067
91	79	11,872	146	21,982
92	80	11,874	149	22,106
93	81	11,878	150	22,023
94	82	11,887	151	21,943
95	83	11,897	152	21,866
96	83	11,790	154	21,792
97	84	11,803	155	21,724
98	85	11,813	155	21,478
99	86	11,814	155	21,237
100	86	11,713	155	21,024
101	87	11,717	155	20,816
102	88	11,720	155	20,588
103	89	11,723	155	20,365
104	89	11,628	155	20,146
105	90	11,733	155	19,954

NOTE: The turbine efficiency tables are being revised to reflect new information regarding extended-length submersible bar screens. These tables are based on data from Little Goose Dam.

Table LWG-7. The 1% turbine operating range at Lower Granite Dam for units 4-6 with extended-length submersible bar screens installed.

Head (ft)	Lower Generator Limits		Upper Generator Limits	
	(MW)	(CFS)	(MW)	(CFS)
85	83.3	13,505	105.8	17,152
86	84.3	13,488	107.3	17,167
87	85.2	13,470	108.7	17,182
88	86.2	13,453	110.2	17,195
89	87.2	13,435	111.7	17,208
90	88.1	13,418	113.1	17,220
91	89.3	13,437	114.8	17,274
92	90.4	13,455	116.5	17,328
93	91.6	13,473	118.1	17,379
94	92.7	13,490	119.8	17,430
95	93.9	13,507	121.5	17,479
96	94.9	13,504	122.9	17,490
97	95.9	13,501	124.3	17,500
98	96.9	13,498	125.7	17,510
99	97.9	13,495	127.1	17,520
100	98.9	13,492	128.5	17,529
101	100.1	13,510	129.2	17,431
102	101.3	13,527	129.8	17,335
103	102.5	13,544	130.5	17,240
104	103.7	13,560	131.1	17,147
105	104.9	13,576	131.8	17,056

NOTE: The turbine efficiency tables were revised to reflect new information using a 1995 index test and the 1975 model test and extended-length submersible bar screens. These tables are based on data from Lower Granite Dam.

Table LWG-8. The 1% turbine operating range at Lower Granite Dam for units 4-6 without extended-length submersible bar screens installed.

Head (ft)	Lower Generator Limits (MW)	(CFS)	Upper Generator Limits (MW)	(CFS)
85	85.1	13,532	113.0	17,972
86	86.1	13,515	114.6	17,988
87	87.1	13,497	115.6	17,914
88	88.1	13,480	116.6	17,842
89	89.1	13,463	117.6	17,771
90	90.0	13,446	120.8	18,045
91	91.2	13,465	122.6	18,102
92	92.4	13,483	124.4	18,158
93	93.6	13,501	126.2	18,212
94	94.7	13,519	128.0	18,265
95	95.9	13,535	129.8	18,317
96	96.9	13,533	131.3	18,329
97	98.0	13,530	132.8	18,340
98	99.0	13,527	134.3	18,350
99	100.0	13,524	135.8	18,360
100	101.1	13,521	137.3	18,370
101	102.3	13,539	138.0	18,268
102	103.5	13,557	138.7	18,167
103	104.7	13,574	139.4	18,068
104	105.9	13,590	140.1	17,971
105	107.1	13,606	140.8	17,876

NOTE: The turbine efficiency tables were revised to reflect new information using a 1995 index test and the 1975 model test. These tables are based on data from Lower Granite Dam.

e. Spill will be increased by one spillbay stop setting (about 1.7 kcfs) above passing inflow to lower the level of Little Goose pool to the bottom of the MOP range prior to the scheduled work taking place.

f. When the work takes place, additional spill will not be provided and the reservoir will be allowed to refill until the reservoir is 1' above the normal MOP range (a 2' pondage from where the pool was when the work started). At this point, screen inspections shall stop. (At Snake River projects, this should allow about one normal work day for the scheduled work.)

g. At the conclusion of the work, the reservoir shall be drafted back down to the MOP range utilizing a one spillbay stop increase in spill above passing inflow.

h. If work, such as screen inspections, is not finished, project personnel shall schedule another turbine unit outage for a date where it can be implemented again.

If the work that needs to be done is of an emergency type nature that does not normally require the turbine unit to be taken out of service (such as a failed hydroacoustic transducer versus a failed fish screen), and can not wait for the above process to be implemented, project personnel shall notify CENWW-OP-TF and RCC to get approval to do the work. If approval to do the work is given, the turbine unit shall be taken out of service and the reservoir level allowed to increase until it reaches 1' above the MOP operating range. At this point, the turbine unit must be returned to service and the reservoir will be drafted back to the MOP range using one spillbay stop setting above passing inflows.

4.3. Turbine Unit Maintenance. The project turbine unit maintenance schedule will be reviewed annually by project and Operations Division biologists for fish impacts. If possible, maintenance of priority units will be scheduled for non-fish passage periods, or when there are low numbers of fish passing the project. Each turbine unit requires annual maintenance that may take from several days to two weeks. Annual maintenance of all turbine units is normally scheduled during the mid-July to late November time frame. The maintenance of priority units for adult passage is normally conducted during mid-August, when fewer adults are migrating, to minimize impacts on migrating adults. Turbine units may occasionally require overhauls to repair major problems with the turbine or generator. Overhauls may take over one year to accomplish. Turbine units, governors, exciters, and control systems require periodic maintenance, calibration, and testing which may take them outside of the 1% turbine efficiency range. This work will be scheduled in compliance with BPA load shaping guidelines (Appendix C) to minimize impacts on juvenile fish. Transformers are Doble tested every 3 years. Testing may need to be more frequent if there is a known problem with a transformer. These tests normally take 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.

Unwatering turbine units should be accomplished in accordance with project dewatering plans. Prior to dewatering a turbine unit for maintenance, the turbine unit should be spun at speed-no-load, if possible, immediately before installing tailrace stoplogs and headgates to minimize the number of fish in the draft tube and scroll case. If a turbine unit is out of service for maintenance for an extended period of time without tailrace stoplogs in place, efforts should be made to not open the wicket gates if the scroll case must be dewatered at a later date without the unit being spun before hand.

5. Forebay Debris Removal. Debris at projects can impact fish passage conditions. Debris can plug or block trashracks, VBSs, gatewell orifices, dewatering screens, separators, and facility piping resulting in impingement, injuries, and descaling of fish. Removing debris at its source in the forebay is sometimes necessary to maintain safe and efficient fish passage conditions, navigation, and other project activities. Debris can be removed from the forebay by: physically encircling the debris with log booms and pulling it to shore with boats where it can be removed with a crane, removing the debris from the top of the dam using a crane and scoop, or passing the debris through the spillway with special powerhouse operations and spill. The preferred option is to remove debris at each project when possible to avoid passing a debris problem on to the next project downstream. This is not always possible at each project, as some projects do not have forebay debris removal capability. In this case, the only viable alternative is to spill to pass the debris.

All special spills (other than normal spill patterns for ongoing spill operations) and project operations for passing debris will be coordinated prior to the operations taking place. Each project shall contact CENWW-OD-TF at least two work days prior to the day they want the special project operations for spilling to pass debris. CENWW-OD-TF shall coordinate the special operations with RCC and NMFS. Project personnel shall provide CENWW-OD-TF the reason for the debris spill request including an explanation of project facilities being impacted by the debris, the date and time of the requested spill, and any special powerhouse or other operations required to move the debris to the spillway. When a debris spill is coordinated and approved, RCC shall issue a teletype detailing the specifics of the special operations.

Table LWG-9. Lower Granite spillway pattern for adult fish passage.

Spill Bay								Total Stops	Total Spill
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**		
1	1	1			1	1	1	6	10.50
1	2	1			1	1	1	7	12.37
1	2	1			1	2	1	8	14.25
1	2	1	1		1	2	1	9	15.99
1	2	2	1		1	2	1	10	17.86
1	2	2	1	1	1	2	1	11	19.61
1	2	2	2	1	1	2	1	12	21.48
1	2	2	2	2	1	2	1	13	23.35
1	2	2	3	2	1	2	1	14	25.27
2	2	2	3	2	1	2	1	15	27.14
2	2	2	3	3	1	2	1	16	29.06
2	2	2	3	3	2	2	1	17	30.93
2	2	3	3	3	2	2	1	18	32.85
2	3	3	3	3	2	2	1	19	34.77
2	3	3	4	3	2	2	1	20	36.67
3	3	3	4	3	2	2	1	21	38.61
3	3	4	4	3	2	2	1	22	40.53
3	3	4	4	3	3	2	1	23	42.45
3	4	4	4	3	3	2	1	24	44.37
3	4	4	4	4	3	2	1	25	46.29
3	4	4	5	4	3	2	1	26	48.21
3	4	5	5	4	3	2	1	27	50.13
4	4	5	5	4	3	2	1	28	52.05
4	5	5	5	4	3	2	1	29	53.97
4	5	5	5	4	4	2	1	30	55.89
4	5	5	5	5	4	2	1	31	57.81
4	5	5	6	5	4	2	1	32	59.73
4	5	6	6	5	4	2	1	33	61.65
4	6	6	6	5	4	2	1	34	63.57

NOTE: Spills over 64,000 should be employed only at night if possible. Schedule is based on model studies and needs to be verified.

APPENDIX A

SPECIAL PROJECT OPERATIONS AND STUDIES

APPENDIX A: BONNEVILLE

Bonneville Dam

1. Special Project Operations.

1.1. Spring Creek Hatchery Release. The first hatchery release is expected to occur on March 9, followed by 24-hour spill for juvenile fish passage until such time as passage rates drop back to low levels. Powerhouse operating priority, spill levels, and duration of special operations will be determined in coordination with fish agencies through TMT. Project operations for fish passage will be defined by RCC teletype prior to the release.

1.2. Spill. Spill will be provided continuously from April 20 through August 31 for spring and summer migrants as required in the National Marine Fisheries Service (NMFS) 1995 Biological Opinion, Section VIII.A.2, and 1998 Supplement. Daytime spill (see Section 2, Table BON-6 for spill hours) for juvenile fish passage will be 75,000 cfs and nighttime spill will be up to the 120% TDG cap (approximately 100,000 to 150,000 cfs). Discussions are ongoing concerning the daytime spill cap that was established to minimize adult fish fallback. In preparation for a regional decision that may change the daytime spill, COE and regional fish managers have developed study objectives and proposals that evaluate daytime spill to the 120% TDG cap. These objectives include: evaluate adult salmon and steelhead fallback rates, entrance use and project passage times; determine adult salmon and steelhead migration routes and depth distribution in response to dissolved gas in the tailrace; and estimate fish passage efficiency.

2. Studies.

2.1. Prototype Testing of ESBS at Bonneville First Powerhouse. In 2000, prototype testing of ESBS, streamlined trash racks, and new VBS will be continued at Bonneville I in MU8. Installation of ESBS and VBS will occur prior to the fish passage season.

FGE testing (NMFS) will begin approximately April 15 and conclude approximately July 15, depending on the number of fish collected. FGE tests will be conducted at night and will require the unit to be shut down for short periods nightly for removal and placement of fyke nets in the emergency bulkhead slot. This outage will be approximately one hour to place the fyke net, and one hour to remove the net nightly.

In addition to the fyke net test above, hydroacoustics will be used to estimate FGE (WES and PNNL). For the WES deployment, transducers will be installed both on the ESBS and on the trash racks prior to the test start date of 24 April. Testing will be completed on 14 July. Installation on both the trash racks and ESBS will be concurrent with their delivery and will require a one-day outage. As always, several outages should be expected throughout the testing season to repair equipment.

The PNNL deployment will require a one-day unit outage to install 3 upward looking transducers to the lowest trash rack of slot 8B with a diver. In addition to the 3 upward looking transducers, a traversing split beam transducer will be mounted on a frame that will be lowered into the trash rack guides of 8B. This will allow the multiplexing split beam system to measure juvenile salmonid behavior in the near field regions upstream of the streamlined trash racks.

It is expected that Unit 8 will be available for normal operation during non-testing periods as a last on operation to meet project/regional needs.

There will also be additional outages required to remove and inspect the ESBS. The timing of these outages has not been determined, but may be as frequent as weekly during the testing period. These outages are expected to be short duration (2 - 3 hours) and limited to the time required to remove, inspect, and replace the ESBS.

2.2. Bonneville Rehab Biological Testing (also testing under the Turbine Survival Program). A repeat of the biological testing of the minimum gap runner installed in unit 6 is scheduled for fall of 2000. In addition to the biological testing, there will need to be commission testing in both units 4 and 10. The units will undergo a series of pre-startup tests that will require each unit’s STSs to be removed. A normal pre-start scenario is to mechanically roll the unit for 1 day. After the unit has been deemed structurally sound, the unit will be HIPOT tested for 2-3 days. After this test series is complete the unit is subjected to several load rejection tests that require the STSs to be removed (2 days). The unit’s STSs will be reinstalled and then be advanced to a 72 hour run test, followed by the 100 day commissioning test.

2.3. Lower Columbia River Adult Study. Adult salmon, steelhead and lamprey will be captured at the adult fish monitoring facility and tagged with radio transmitters from April through September 2000. For adult salmon and steelhead evaluations, two tests are proposed in addition to general migration monitoring. These two tests are still under discussion in regional forums. They include evaluating fallback under two spill levels and assessing the effects of closing the First Powerhouse collection channel orifice and sluice gates. If the regional discussions regarding increasing daytime spill (see section 1.2 above) result in removal of the 75 kcfs daytime spill cap, fallback rates will be compared between 75 kcfs spill and spill to the 120% TDG cap. The spill test will utilize a randomized block design, with 2-day treatments within 4-day blocks, from early April to early June. In addition to testing fallback under two spill conditions, project and powerhouse passage times will be compared under two first powerhouse adult fishway conditions: collection channel orifice/sluice gates open versus closed.

Adult Pacific lamprey passage will be evaluated using radio telemetry. Nighttime passage into the Cascades and Bradford Island fishways will be tested under two entrance heads. Entrance head will be lowered to 0.5 ft. between 2200 hours and 0430 hours on even days from April 4 to September 30 at Bradford Island. This operation will occur between 2200 hours and 0430 hours on odd days from April 4 to September 30 at Cascades Island. Entrance head will remain within FPP criteria (1.0-2.0 ft.) during all other days and times.

2.4. Fish Passage Efficiency. FPE will be evaluated at Bonneville Dam using hydroacoustic and radio telemetry techniques. At the spillway, gates 2, 4, 6, 7, 8, 10, 12, 14, 15, and 17 will each be sampled with one down-looking transducer per bay. Transducers will be mounted 26.5′ below the top of spill gates and aimed 5 degrees upstream. Transducers will be at elevation 56.5′ when the gate is closed and at elevation 69 ft when the gate is opened 12.5′ (7 dogs). At the second powerhouse, one of three intakes at every turbine unit will be randomly selected for sampling. A pair of transducers will be mounted on the downstream side of trash racks 1 and 5. One transducer of each pair will be mounted at the vertical center of the uppermost trash rack and aimed downward to sample unguided juvenile salmon passing below the tip of the traveling screen. The second transducer of each pair will be mounted on the bottom of the fifth trash rack from the top and aimed upward to sample fish passing above the tip of the screen. At the first powerhouse, one of three intakes at turbines 7, 9, and 10 will be randomly selected for sampling. A pair of transducers will be mounted on the downstream side of trash racks 1 and 5. One transducer of each pair will be mounted at the top center of the uppermost trash rack and aimed downward to sample unguided juvenile salmon passing below the tip of the STS. The second transducer of each pair will be mounted at the bottom of the fifth trash rack from the top and aimed upward to sample fish passing above the tip of the screen. Hydroacoustic transducer installation will take approximately two weeks in late February and early March. Approximately three main turbine units must be out of service at a time to allow for diver access and outages will occur between 0800 and 2000 hours. This work will be planned to occur before the spill season. For equipment removal in August, three turbine units will again be required out of service at a time from 0500 to 2000 hrs. Typically, we can expect approximately 12 transducer failures over a 3-month period. Each failure will require a turbine unit outage of approximately four hours. If a dive is required to repair the problem, the two adjacent units must be out of service as well.

2.5. Bonneville Second Powerhouse Vertical Distribution. Vertical distribution of spring and summer juvenile migrants will be evaluated using hydroacoustic techniques at the second powerhouse. We are planning to monitor vertical distribution 1-3 and 10-15 meters upstream of trash racks on Units 14 and 17. Vertical distribution in the 1-3 meter range will only be measured for summer migrants, because TIEs will need to be removed for this element. TIEs create vortices that prohibit hydroacoustic monitoring near the face of the second powerhouse. Therefore, to monitor vertical distribution near the face of the powerhouse, TIE removal should start June 15 and be completed by June 20. Mounts for split beam transducers will be installed on pier noses adjacent to Units 14 and 17 during the February 28 – March 3 timeframe. It may be necessary for divers to install these mounts, and as such would require three main turbine units out of service for approximately 4 hours per unit. Two single-beam transducers on gimbal mounts will be deployed on the forebay floor approximately 10 meters upstream of Units 14 and 17. These transducers and mount will be deployed using a small tugboat. From April 1 to August 31, unit priority will be 11, 18, 17, 14, 12, 13, 15, and 16. The selection of Units 14 and 17 as test units is tentative and could change following assessment of second powerhouse forebay hydraulics at WES.

2.6. Prototype Surface Collector (PSC) at the First Powerhouse. The PSC will extend across units 1-6 and extend 20' into the forebay beyond the piers. Deep vertical slots will be in front of the center intake (B) of units 1-6. The slots will be configured to be 20' wide and extend from the surface to elevation 32.5' msl. The goals for surface flow bypass research and development at the first powerhouse in 2000 are to (1) confirm the proof-of-concept for surface flow bypass at B1 that was established in 1998 and 1999; (2) maximize PSC efficiency; and (3) understand behavioral processes and mechanisms that affect performance and to aid future surface flow bypass designs. This will be a “process” study, not a “treatment” study. Fixed-aspect hydroacoustics will be used to estimate the number of juvenile salmon passing into the PSC, as well the number passing under the PSC and into each of the three intakes of the turbine units. Multi-beam and split-beam hydroacoustics will be used to monitor three-dimensional behavior of fish entering or passing under the PSC. Radio telemetry will also be used to estimate PSC performance, and provide two-dimensional behavior of fish in the forebay in front of the PSC. Three-dimensional behavioral for species specific behavioral will be monitored with 3D sonic transmitters and tracking equipment.

The new PSC modules in front of units 1 and 2 were constructed and installed between December 1999 and February 2000. All units (1-6) will be configured by the end of March. Frequent unit outages will be required throughout this period because divers, boats, and barges will be working in the forebay. Additionally, it is expected that divers will be needed to make modifications and repairs to the PSC throughout March. The number or timing of outages for construction and repair can not be accurately estimated.

Units 1-6 will be operated as priority units for the study period, which is expected to last from mid-April to the end of July. Turbine units will be blocked loaded, with schedule and table to be supplied as planning process and schedule are confirmed, to attempt to keep the flows through the turbine units, and PSC in a steady state. The project forebay will need to have a soft constraint elevation with fluctuations at the first powerhouse not to exceed +/- 1.5 feet, with more narrow ranges during periods of peak inriver migration and test fish releases. Specific dates will be developed in coordination with RCC and BPA prior to the start of the study. The B slot sluice gate in each unit will be opened to assure positive flow into the sluiceway (elevation to be determined by Hydraulic Design; it may be necessary to change sluice gate elevations throughout the season depending on forebay elevations). The trash racks for the PSC will not be installed; thus, trash raking within the PSC will be necessary throughout the testing season. It is assumed that the units will need to be off-line during trash raking, and that each raking event will take approximately one to two hours.

Units 1–6 will generate at various project heads as shown in Table SPO-BON-1. This turbine operation will ensure a reasonable approximation of the flows experienced through the turbine and PSC during the 1998 fish passage season. This operational range is intended to keep the flow through the

Table SPO-BON-1. Bonneville first powerhouse unit 1 – 6 megawatt outputs at 40 – 62 ft. project head differentials.

Range of Project Heads (ft.)	Required MW Output for Units 1, 2, 3, and 5 (MW)	Required MW Output for Units 4 and 6 (MW)
40	26.7	28.2
41-42	27.8	29.4
43-45	29.7	31.7
46-49	32.4	34.7
50-53	35.4	38.0
54-58	38.6	41.6
59-62	42.0	45.2

turbine units with PSC structures within +/- 500 cfs of 10,100 cfs. The MW output requested falls within the 1% efficiency range of first powerhouse operations with STSs in place. Units 4 and 6 have different MW output requirements because they are minimum gap runner units and have a different MW vs. discharge relationship than the older units.

Hydroacoustic, radio telemetry, and 3D monitoring equipment will be installed prior to testing in April 2000. Divers will be used to installed some of the hydroacoustic equipment, which will require unit outages during the winter and spring of 2000.

The researchers will operate multi-beam hydroacoustic equipment to evaluate swimming direction and speed of smolts within 50' of the PSC entrance. The behavioral sonar systems will be deployed on a small barge in the forebay upstream of each PSC entrance. The barge needs to be anchored 120' to 150' upstream of the PSC at unit 5 or 6. In addition to two upstream float and anchor lines, the barge also needs to be securely tied on the downstream end by lines to the forebay deck or PSC. Personnel from WES will run one electric power cable and several signal cables from the acoustic equipment on the barge along one of the downstream lines (above water) to the forebay deck. The powerhouse may need to be shut down during the anchoring activities.

2.7. Movement, Distribution, and Passage Behavior of Radio-Tagged Juvenile Salmonids at Bonneville Dam Associated with the

Surface Bypass Program. Access to the project Boat Restricted Zone (BRZ) will be required for conducting this study. Besides this, no specific operational requirements are expected.

2.8. Flat Plate PIT Tag Detection of Juvenile Salmonids at the First Powerhouse Smolt Monitoring DSM. The installation and testing of this equipment is not expected to require any special project operations. However, since this program is in the developmental phase, and water control within the DSM is questionable, possible problems with the operation may arise. In the case of needed repairs to the system, one or two occasions of one or two-hour reversal of flow through this system may be required to adjust the equipment. No serious effects to fish passage are expected.

2.9. All dates shown are approximate and could be advanced or delayed by a week or so depending on various factors such as river flows, contractor schedules, equipment failures, etc. Some of the evaluations may not proceed. Therefore, a final description of studies and outages being conducted will be coordinated with the region (FFDRWG, SRWG) prior to April 1. All special operation requests or schedule changes will be coordinated with the fish agencies and tribes through the AFEP (FFDRWG) and with RCC and BPA.

APPENDIX A: THE DALLES

The Dalles Dam

1. Special Project Operations - Spill. Spill will be provided continuously from April 20 through August 31 for spring and summer migrants as required in the National Marine Fisheries Service Biological Opinions or as modified to meet test conditions described in paragraph 2. Actual spill levels are being developed as part of ESA Section 7 consultations on hydrosystem operations to protect multiple listed species. They will be provided in a manner consistent with TDG management to avoid excessive gas supersaturation conditions.

2. Studies.

At the time of FPP publication, regional coordination for spill and survival studies at The Dalles Dam was ongoing. Although the studies, as described below, represent the current proposal, they may be modified upon completion of the regional coordination. Currently, we anticipate estimating passage and survival through the spillway and sluiceway operated under one condition that would be expected to result in relatively high survival. Spillway discharge will be fixed at a percentage of total river flow, and only the juvenile spill pattern will be used during the study. The ice and trash sluiceway forebay gates 1-1, 1-2, and 1-3 also will be open continuously throughout the study period. Additionally, intake occlusions will be evaluated for their ability to decrease turbine entrainment. The occlusion structures will be placed in front of both fish units and main units 1-5. All structures will be kept in place or removed above the water according to a random block design. Each treatment will last three days, a block will last six days. One full day will likely be required to move the occlusions in or out to set up for the next treatment. The turbine unit at an intake occlusion will need to be shut down each time the structure is moved.

2.1. Spillway and Sluiceway Survival Studies. Survival studies will be conducted at The Dalles Dam spillway and ice and trash sluiceway. PIT-tagged juvenile chinook and coho salmon will be released at three locations (north, middle, and south) 200m upstream of the spillway and directly into the ice and trash sluiceway. Control fish will be released in the tailrace near the highway bridge in the main channel. Recaptures will occur at the Bonneville Dam PIT tag detectors.

Radio tagged fish will also be released with the PIT tag study. These fish will yield data on tailrace movements, retention, and holding locations. Extensive tailrace equipment and boating will be required.

2.2. FPE Evaluation. Hydroacoustic and radio telemetry techniques will be used to document salmonid behavioral responses to particular hydraulic flow fields. The hydroacoustic and radio telemetry FPE evaluations will also occur from April through August with the same schedule as that described above for survival studies. Therefore, the significance of this test will also be based on three-day treatments. Radio tagged juvenile salmonids will be released from the John Day Dam JBS for this evaluation. Test fish utilized for the John Day Dam evaluations will also be monitored at The Dalles Dam. Repairs to monitoring equipment can be expected and periodic turbine and spillbay outages may be requested to ensure proper data collection.

2.3. Behavioral studies. Two studies will be conduced to address detailed behavior in support the intake occlusion study and also to gather data on fish behavior relative to specific hydraulic conditions. These data will be analyzed with data generated by a computational fluid dynamics model.

Tracking split-beam sonar will be used to collect data within 15 m of the sluiceway. An acoustic Doppler current profiler will also be deployed near the sluiceway to monitor real time hydraulics.

Acoustic telemetry will be used to determine 3-dimensional positions of fish that are within 200 meters of the sluiceway and 2-dimensional positions for all sonic-tagged fish in the forebay.

2.4. Adult Salmon and Steelhead Passage Evaluations. Radio telemetry techniques will be used to evaluate adult salmon and steelhead passage through the project. The effects of special spillway operations for juvenile fish survival will be assessed for adult migrants by monitoring adult salmon and steelhead fallback rates, entrance use, and passage times at the project. Contingent on a hydraulic evaluation of the adult fish collection system, all floating orifices will be closed in 2000. Entrance use and passage times will be monitored and compared to previous years' data to ensure that adult migrants are not negatively affected.

2.5. Equipment Installation and Maintenance. Installation of hydroacoustic transducers, radio telemetry equipment, and the release mechanisms for the survival studies will begin in March at The Dalles Dam. Installation of spillway transducers will occur between mid-March and mid-April, spill gates will need to be closed for the installation. The gate in one bay at a time will be closed. Installation of hydroacoustic equipment at the powerhouse and sluiceway will require turbine unit outages to allow for diver access. It will take approximately two weeks, from March 16 through 27, to install and align all of the transducers at the powerhouse. Three turbine units will be out of service for approximately 8 hours each day beginning at 0800 hrs. The fish units will be taken out of service on March 16 and 17 between 2000 and 0500 hours. Typically, we can expect approximately 12 transducer failures over the three-month period. Each failure will require a turbine unit outage of approximately four hours. If a dive is required to repair the problem, the two adjacent units will be out of service as well. Equipment will be removed between August 1 and 7 with procedures and outages similar to the installation outages discussed above, if it can be accomplished without manipulating the spill schedule. Equipment removal will be delayed until after the spill season if necessary to prevent interruptions to the other ongoing evaluations. Release hoses will also be installed in the ice and trash sluiceway from March 30 through April 10.

Additional turbine outages will be needed to install the tracking split-beam system. Units 1-3 will likely be needed off for half a day to install this system.

Acoustic telemetry hydrophones will be installed throughout the project. A total spillway closure may be needed to place hydrophones on the bottom of the forebay. Individual spill bay and turbine outages may also be necessary to install this equipment.

The number of spillway and turbine outages will be minimized as much as possible. We will attempt to install all equipment at a given location in one outage. However, this may not always be possible.

All dates are approximate and could be advanced or delayed by a week or so depending on various factors such as river flows, contractor schedules, equipment failures, etc. Some of the evaluations may not proceed, therefore, a final description of studies and outages being conducted will be coordinated with the region prior to April 1. All special operation requests or schedule changes will be coordinated with the fish agencies and tribes through the AFEP (FFDRWG), and with BPA and RCC.

Installation of the intake occlusion extensions will require lengthy outages of fish units and MU 1 – 6 over a 9-week construction period (approximately 31 January through 31 March).

APPENDIX A: JOHN DAY

John Day Dam

1. Special Project Operations - Spill. Spill will be provided from April 20 through August 31 for spring and summer migrants as required in the National Marine Fisheries Service Biological Opinions or as modified to meet test conditions described in paragraph 2. Between May 15 and July 31, spill will occur from 1900 to 0600 hours (11 hours total). Before and after that time period, spill will be for 12 hours nightly from 1800 to 0600 hours. At project flows up to 300,000 cfs, spill discharges will be 60% of instantaneous project flow. Above 300,000 cfs project flow, spill discharges will be 180,000 cfs (up to the hydraulic limit of the powerhouse). Spill will be provided in a manner consistent with TDG management to avoid excessive gas supersaturation conditions.

2. Studies.

At the time of FPP publication, regional coordination for spill and survival studies at John Day Dam was ongoing. Although the studies, as described below, represent the current proposal, they may be modified upon completion of the regional coordination.

2.1. Fish Passage Efficiency Studies. Hydroacoustic and radio telemetry methodologies will be used to survey fish behavior. For FPE studies, two spill conditions will be compared, in response to the 1998 Supplemental Biological Opinion measure to study 24-hour spill at John Day Dam. The specific spill levels and duration for the FPE study have not yet been agreed upon in the regional forum. Special operations required to support the FPE studies will be conducted outside of the juvenile fish migration period to the extent practicable. However, there will be some modification to standard project operation. Hydroacoustic and radio telemetry FPE evaluations will occur from May 1 through July 31 with a one-week break about the first week of June.

Hydroacoustic transducer installation will take approximately two weeks from March 16 through 27. Approximately three main turbine units at a time must be out of service to allow for diver access and outages will occur between 0800 and 2000 hours. The spillway transducers will be redesigned for 2000; therefore, there is potential for requiring spillway outages for installation and spill for testing. This work will be planned to occur before the spill season. Equipment removal at John Day Dam will be coordinated with equipment removal at The Dalles Dam, and will occur from August 3 through 7, provided it does not interfere with the required spillway operations. Three turbine units will again be placed out of service at a time from 0500 to 2000 hrs. Typically, we can expect approximately 12 transducer failures over a 3-month period. Each failure will require a turbine unit outage of approximately four hours. If a dive is required to repair the problem, the two adjacent units must be out of service as well.

Release systems may need to be installed on three spillbays for the tailrace egress studies. Spillbays will need to be out of service. Again, this work will be schedule for before the spill season.

2.2. Adult Salmon and Steelhead Passage Evaluations. Radio telemetry techniques will be used to evaluate adult salmon and steelhead passage through the project. Adult salmon and steelhead fallback rates will be evaluated during 24-hour spill for juvenile passage studies. The specific spill levels and duration for these studies have not yet been agreed upon in the regional forum.

2.3. All dates shown are approximate and could be advanced or delayed, depending on factors such as river flow, contractor schedules, equipment failures, etc. Some evaluations may not proceed, therefore, a final description of studies and outages will be coordinated with the region (FFDRWG, SRWG) prior to April 1. All special operations requests or changes in the above schedules will be coordinated with the fish agencies and tribes through the AFEP (FFDRWG) and with BPA and the RCC.

APPENDIX A: MCNARY

McNary Dam

1. Special Project Operations.

1.1. Spill. Spill for fish passage will be provided during the spring outmigration season in accordance with spill specifications in the NMFS Biological Opinion on hydrosystem operation (Appendix E) as updated in 2000 through ESA consultation and the TMT Water Management Plan. Special daytime or nighttime spill patterns may be implemented to control dissolved gas levels to agreed upon levels, while attempting to achieve desired spillway discharges. Alternative spill patterns to reduce TDG levels or to change tailrace conditions for fish passage should be coordinated through the TMT.

1.2. Installation of Data Acquisition and Control System (DACS) on Turbine Units. McNary project personnel are installing a DACS system on all turbine units at McNary Dam. One turbine unit at a time will be taken out of service, throughout the year, for approximately five weeks for installation of the equipment. Occasionally 2 turbine units will be taken out of service at the same time for several days to tie the equipment together into the transformer bank for the turbine units. This will increase the amount of water being spilled if river flows are above the powerhouse hydraulic capacity. DACS installation should be complete by March 2000.

1.3. Doble Tests. Transformer banks 3, 4, and 5 will be taken out of service, one at a time, and doble tested in September and October 2000. The two corresponding turbine units (5 and 6, 7 and 8, and 9 and 10) for each transformer bank will be out of service during the testing. Testing will take approximately 3 days per transformer bank.

1.4. Inspection of the Upstream Face of the Dam and the Embankment Riprap. The upstream face of the dam's embankment riprap is to be inspected by boat on or around April 11, 2000. The forebay water level will need to be near elevation 337 for the inspection.

1.5. PIT Tag Modifications. The McNary juvenile fish facility PIT tag detection system will be modified prior to the 2000 juvenile bypass season. A new electrical power supply and communication system will be installed. New electronics and antenna coils will also be installed as part of the change to the 134.2 kHz ISO system.

1.6. Installation of Bulkheads in Juvenile Collection Channel. The ice and trash sluiceway gates along the McNary juvenile collection channel will be replaced with taller bulkheads between December 15, 1999 and February 29, 2000. The Contractor will start at turbine unit 14 and work towards turbine unit 1.

1.7. Cylindrical Dewatering Structure Construction. A prototype cylindrical dewatering structure will be constructed from January through June, 2000. The structure will be located on the north end of the powerhouse tailrace deck and will have a water supply system tied into the upper ice and trash sluiceway channel. The excess water from the juvenile collection channel primary dewatering structure that is routed to the north end of the ice and trash sluiceway will be used for the water supply for the test cylindrical dewatering structure. The Contractor will tap into existing, unused, pipes in the north end of the upper ice and trash sluiceway and route a 34-inch supply pipe to the tailrace deck. The water supply construction work should be completed by March 1, 2000. The rest of the prototype structure on the tailrace deck will be completed by June, 2000. Construction of the rest of the cylindrical dewatering structure work should not require any alterations to project operations. If construction of the water supply system is not completed by mid-March, when ESBS installation begins, excess water from the dewatering structure will be diverted through the south end of the sluiceway.

1.8. Gantry Crane Rail Replacement. A contractor will replace the rails for the gantry crane on the powerhouse intake deck during July and August 2000. The rails will be replaced in sections, 2 turbine units at a time, with each section taking approximately 8 days. When a rail section is being replaced, the gantry crane will be located on the larger usable section of crane rail, either north or south of ongoing work. The crane will be able to be used for normal crane activities, like pulling an ESBS or VBS, over the stretch of crane rail that it is sitting on. It will not be available for use on the section of the powerhouse that is on the other side of the ongoing crane rail replacement. Any work for that section of the powerhouse will have to wait until the section of crane rail being worked on is completed. If there is a problem with an ESBS or VBS that cannot be corrected without using the gantry crane, then the turbine unit will be taken out of service until work on the current section of crane rail is completed and the crane can be moved to correct the problem.

1.9. Installation of Beacon/Fish Release Pipes for Turbine Passage/Survival Tests. Turbine unit 5 or another turbine unit may be taken out of service for several days in February to install a beacon for monitoring sonic tagged fish passing through the turbine unit. The turbine unit may be taken out of service and dewatered in late summer of 2000 (for approximately 3 weeks) to install fish release pipes for a turbine survival study. If the test is conducted, the turbine unit will be taken out of service again during the fall for approximately 3 weeks to remove the pipes.

2. Studies.

2.1. Turbine Passage/Survival Studies. A scintillation frame will be installed in one of the intake bays of turbine unit 5 (or another unit) in May or June and for releasing sonic tagged fish into the turbine intake. In another study, juvenile salmonids may be tagged with balloon tags and released through a series of release pipes into turbine unit 5 (or another unit) to measure survival of fish passing through different areas of the turbine unit. The release pipes will go from the forebay deck, down the B-slot head gate slot, and attach to the stay rings in the turbine scroll case. The test may take place during daylight hours over a three-week period in early fall of 2000. Turbine unit 5 will be out of service for approximately 3 weeks prior to the beginning of the test for installation of the release pipes. Turbine unit 5 may be operated outside of the daytime test hours when needed. Adjacent turbine units (4 and 6) should be operated when possible during fish releases to make retrieval in the tailrace easier. If the study is conducted, another three week outage of turbine unit 5 will be required after the completion of the test for removal of the release pipes.

2.2. Juvenile Fish Separator Evaluations. NMFS will be conducting research on design parameters for juvenile fish separators utilizing their two test separators located in the juvenile fish collection channel. These two separators are connected to two orifices in turbine unit 6. During testing periods, fish exiting the orifices will be routed through the separators. During non-testing periods, the fish will be either diverted around the separators into the collection channel or alternate gatewell orifices will be used. This study will take place from mid April through August 2000.

2.3. Effects of Extended Length Screens on the Behavior of Pacific Lamprey. This study is to determine if ESBS's impact Pacific lamprey at McNary Dam. The contractor will use video equipment to monitor the surfaces of the test ESBS and will evaluate lamprey behavior if they come in contact with the extended length submerged bar screen (ESBS) and during operation of the cleaning brushes. This work will require the installation of video cameras on the screens. In order to access the screens for installation, a turbine unit outage will be required at least three times during the fish season. Camera installation may be coordinated with other screen work to reduce the impacts to project operation.

2.4. Biological Performance of Modified Porosity Control Plates of Extended Length Submerged Bar Screens. Hydroacoustic evaluation of fish guidance efficiency (FGE) of ESBSs with new beveled perforated plates is tentatively planned for the summer of 2000. This research will require at least one but not more than three ESBS's to be modified with the new perforated plates. Screen modification, transducer installation, and evaluation will impact the operation of up to three turbine units. Test units will need to be operated continuously within the 1% peak efficiency curve. The experimental design may be similar to the testing proposed for Little Goose (refer to the Little Goose section 2.1 of this appendix) with one or more in-season screen switches or the design may be modified depending on the results of the Little Goose evaluation.

2.5. Prototype Testing of a Cylindrical Dewatering Screen. NMFS will evaluate the biological and debris handling performance of the new prototype cylindrical dewatering screen during the summer of 2000. Test fish will be obtained by gatewell dipping. Operation of the prototype cylindrical dewatering screen requires using excess water from the juvenile collection channel primary dewatering structure. The cylindrical dewatering screen will not be completed prior to the water-up of the juvenile bypass facility. This study will not impact project operations.

APPENDIX A: ICE HARBOR

Ice Harbor Dam

1. Special Project Operations.

1.1. Spill. Spill for fish passage will be provided during spring and summer outmigration seasons, in accordance with spill specifications in the NMFS Biological Opinion on hydrosystem operations (Appendix E as updated in 2000 through ESA consultation and the TMT Water Management Plan. Special daytime and nighttime spill patterns may be implemented to control dissolved gas levels to agreed upon levels or to reduce tailrace eddying conditions, while attempting to achieve desired spillway discharges. Alternative spill patterns to reduce TDG levels or to change tailrace conditions for fish passage should be coordinated through the TMT.

1.2. Spillway Tainter Gate Inspection. A Contractor will inspect all the Ice Harbor spillway tainter gates during October through December 2000, outside of the spill season. Each spill gate will be taken out of service one at a time and inspected. A clearance tag will be issued and stop logs installed to unwater each spill gate for inspection. All wells, beams, and welds will be inspected.

2. Studies.

2.1. Spillway Survival Study. A combination of radio tags and PIT tags will be used to evaluate spillway survival at Ice Harbor and to partition relative survival between Ice Harbor and McNary dams. Two different spill levels may be evaluated as part of this study. Fish will be tagged at Lower Monumental Dam and released into the spillway and tailrace at Ice Harbor Dam. Fish will be monitored with radio receivers through the McNary reservoir and the PIT tag detection system at McNary Dam. Release hoses and support equipment will be installed in the spillway and tailrace at Ice Harbor Dam by April 1 and will remain in place until August. Stable flow conditions will be required for one hour prior to and after fish releases.

2.2. High Velocity Prototype Separator Study. The new prototype high velocity fish separator will be evaluated during 2000. Juvenile fish passing through the juvenile bypass system will be periodically diverted through the test facility as part of the evaluation. During non-test periods, juvenile fish will be bypassed through the main juvenile bypass flume. The study may require early operation of the prototype separator to test hydraulic conditions and new modifications prior to the juvenile fish bypass season. During flow evaluations, all fish passing through the facilities will be bypassed directly back to the river with no additional handling.

2.3. Evaluation of Adult Salmon and Steelhead Migration Past the Snake and Columbia River Dams. Idaho Cooperative Fisheries Research Unit will monitor the passage of adult salmonids through the hydrosystem. Two spill levels may be evaluated at Ice Harbor Dam, 45 kcfs and 110 kcfs, to determine passage effectiveness with the newly completed spillway deflectors and training wall. Holding of adult fallbacks within the juvenile collection channel will also be evaluated. The study requires the installation of radio receivers and data loggers throughout the fishways and various locations on the dam. Equipment installation will occur prior to the fish season and is not expected to require special project operations. During March through November 2000, access needs to be provided at the tailrace and fishways for regular downloading of radio receivers.

2.4. Evaluation of Homing of Transported Fish and of Adult Fish Migration Characteristics. If there are an insufficient amount of tagged adult fish which enter the Snake River, supplemental tagging of adult fish is proposed for the evaluation of homing of transported fish and the evaluation of adult fish migration characteristics (depth and temperature monitoring tags). This will require the operation of the adult trap located in the Ice Harbor south shore fish ladder.

APPENDIX A: LOWER MONUMENTAL

Lower Monumental Dam

1. Special Project Operations.

1.1. Spill. Spill for fish passage will be provided during the spring outmigration season under certain conditions of higher flow, according to specifications in the NMFS Biological Opinion on hydrosystem operation (Appendix E) as updated in 2000 through ESA consultation and the TMT Water Management Plan. Special nighttime spill patterns may be implemented to control dissolved gas levels to agreed upon levels, while attempting to achieve desired spillway discharges. Alternative spill patterns to reduce TDG levels or to change tailrace conditions for fish passage should be coordinated through the TMT. Nighttime spill levels may be reduced or curtailed for short periods of time on a daily or every other day basis in order to provide safe conditions for the towboat and fish barge to travel to and from the juvenile fish facilities and for loading the fish barge. Depending on flow levels, Lower Monumental pool may also need to be manipulated above MOP in order to control spill while the fish barge is loading.

1.2 Rewedging Generator Coils. The generator coils for turbine units 4, 5, and 6 at Lower Monumental will be rewedged beginning July 1, 2000, with completion expected around the end of December 2000. This work requires partially disassembling the generators. More than one turbine unit at a time may be taken out of service for this work.

1.3. Stilling Basin Survey. A hydrographic survey of the Lower Monumental stilling basin will take place during August or September 2000. This work should take approximately 1 day (6 to 8 hours). Acoustic mapping techniques will be used to map areas of erosion within and around the stilling basin. The survey will be conducted at night and special operations will be required to minimize flow through the stilling basin area. No spill will be allowed and turbine units on the north end of the powerhouse will be operated. Fishway auxiliary water may need to be curtailed for short periods of time while areas near the fishway entrances are being surveyed.

1.4. PIT Tag Modifications. The Lower Monumental juvenile fish facility PIT tag detection system will be modified prior to the 2000 juvenile bypass season (during the winter maintenance period). A new electrical power supply and communication system will be installed. Also, new electronics and antenna coils will also be installed as part of the change to the 134.2 kHz ISO system.

2. Studies.

2.1. Evaluation of Adult Salmon and Steelhead Migration Past the Snake and Columbia River Dams. Idaho Cooperative Fisheries Research Unit will continue to monitor the passage of adult salmonids through the hydrosystem. The 5 floating orifices (1,3, 5, 7, and 9 numbered from north to south) will be closed prior to the 2000 fish passage season. Once the orifices are closed, there will be no impact to project operations. The study requires the installation of radio receivers and data loggers throughout the fishway and various locations on the dam. The installation of equipment will take place prior to the fish passage season and is not anticipated to require special project operations. During March through November 2000, access needs to be provided at the tailrace and fishways for regular downloading of radio receivers.

2.2. Ice Harbor Spillway Survival Study. Juvenile fish will be removed from the Lower Monumental Dam daily sample and tagged with radio tags and PIT tags for a spillway survival study at Ice Harbor Dam.

APPENDIX A: LITTLE GOOSE

Little Goose Dam

1. Special Project Operations.

1.1. Spill. Spill for fish passage will be provided during the spring outmigration season under certain conditions of higher flow, according to specifications in the NMFS Biological Opinion on hydrosystem operation (Appendix E) as updated in 2000 through ESA consultation and the TMT Water Management Plan. Special nighttime spill patterns may be implemented to control dissolved gas levels to agreed upon levels, while attempting to achieve desired spillway discharges. Alternative spill patterns to reduce TDG levels or to change tailrace conditions for fish passage should be coordinated through the TMT.

1.2. Repair of Powerhouse Transformers. The two banks of powerhouse transformers (T1 and T2) at Little Goose Dam require maintenance in 2000. The work includes replacing the seals on the transformer bushings, fixing oil leaks, and purifying the oil in the transformers. Warm, dry weather is required for this work as the transformers will be open and exposed to the weather. The maintenance work on each transformer is expected to take approximately 6 weeks to complete. T2 is scheduled to be maintained first, from approximately August 1 through September 15, and will require the outage of turbine units 5 and 6. During this work period, turbine units 1 through 4 will remain in operation and should be capable of passing river flows. Turbine units 1 through 4 will be out of service when T1 is maintained, between approximately September 15 and October 31. During the work period, turbine units 5 and 6 will remain in operation and should be capable of passing river flows.

1.3. Spillway Tainter Gate Inspection. A contractor will inspect all the Little Goose spillway tainter gates during January and February 2000, outside of the spill season. A clearance tag will be issued and stop logs installed prior to dewatering and inspecting each spillway tainter gate. Each spill gate will be taken out of service one at a time and inspected. All wells, beams, and welds will be inspected.

1.4. Installation of Forebay Debris Boom. A new forebay debris boom will be installed at Little Goose Dam between January and February 2000.

1.5. PIT Tag Modifications. The Little Goose Juvenile Fish Facility PIT tag detection system will be modified prior to the 2000 juvenile bypass season (during the winter maintenance period). A new electrical power supply and communication system will be installed. New electronics and antenna coils will also be installed as part of the change to the 134.2 kHz ISO system.

2. Studies.

2.1 Fish Guidance Efficiency Testing. The perforated plate panel for the ESBSs have been redesigned to minimize vibration and bolt shearing. During 2000, 3 ESBSs will be outfitted with new perforated plate panels and their fish guidance efficiency (FGE) will be compared to 3 ESBSs with standard perforated plate panels. FGE tests will be in the B slots only. There will be a test screen in the B slot for turbine unit 1 and a control screen in the B slot for turbine unit 2. Turbine units 3-4 and 5-6 will have test screens and control screen paired in the same manner. Transducers will be installed on the ESBS frames with the ESBSs at deck level or in the screen repair pit prior to the fish passage season. Three screen swaps are planned during the test. Test and control screens will be swapped within the pairs. This will require turbine unit outages, most likely two at a time for 8 to 10 hours. Malfunctioning transducers may need to be repaired or replaced. This will require a turbine unit outage. The project will attempt to operate the turbines in pairs when possible.

2.2. Evaluation of Adult Salmon and Steelhead Migration Past the Snake and Columbia River Dams. Idaho Cooperative Fisheries Research Unit will continue to monitor the passage of adult salmonids through the hydrosystem. The 4 floating orifices (1, 4, 6, and 10 numbered from south to north end) will be closed prior to the 2000 fish passage season. The study requires the installation of radio receivers and data loggers throughout the fishway and various locations on the dam. The installation of equipment will take place prior to the fish season and are not anticipated to require special project operations. During March through November 2000, access needs to be provided at the tailrace and fishways for regular downloading of radio receivers.

APPENDIX A: LOWER GRANITE

Lower Granite Dam

1. Special Project Operations.

1.1. Spill. Spill for fish passage will be provided during the spring outmigration season under certain conditions of higher flow, according to specifications in the NMFS Biological Opinion on hydrosystem operation (Appendix E) as updated in 2000 through ESA consultation and the TMT Water Management Plan. Special nighttime spill patterns may be implemented to control dissolved gas levels to agreed upon levels, while attempting to achieve desired spillway discharges. Alternative spill patterns to reduce TDG levels or to change tailrace conditions for fish passage should be coordinated through the TMT. During periods of high river flow, spill volumes and the elevation of Lower Granite reservoir may need to be manipulated on a daily or every other day basis to provide safe conditions for loading the fish barge at the juvenile fish facilities below the dam.

1.2. Surface Bypass Collector Operation. The surface bypass collector constructed in 1996 along with the simulated Wells intakes and the behavioral guidance structure will be tested during the spring of 2000. Anticipated operation of the surface bypass collector (SBC) includes passing 4,000 cfs through the structure and spillbay 1 along with approximately 2,000 cfs through spillbay 2 as training flow. During the spring juvenile fish spill period (paragraph 1.1 above), 20% of the instantaneous flow daily average flow will be spilled, including surface collector flow. The SBC will be tested with high and low turbine operation (turbine units 4 and 5) as a test variable. During testing, project operators will be requested to stay as close to the upper and lower ends of the 1% efficiency curve as possible. Turbine unit priority during the SBC test will be 4, 5, 1-3, 6. Four test conditions are proposed for 2000: 1) high turbine load and single entrance; 2) high turbine load and double entrance; 3) low turbine load and single entrance; and 4) low turbine load and double entrance. SBC operation will be continuous, except for entrance configuration changes, between about April 10 and May 27, 2000. These operations reflect options as included in an approved monitoring plan for 2000.

1.3. Rewedge Generator Coils. The Lower Granite generator coils for turbine unit 1 will be rewedged after July 1, 2000, and work completed before December 31, 2000. A four-month outage is required for rewedging. This work requires partially disassembling the generator.

1.4. Spillway Tainter Gate Inspection. A Contractor will inspect all of the Lower Granite spillway tainter gates from approximately July 1 through the end of September 2000, outside of the spill season. A clearance tag will be issued and stop logs installed prior to dewatering and inspecting each gate. Spillway gates will be taken out of service one at a time and inspected. All wells, beams, and welds will be inspected.

1.5. PIT Tag Modifications. The Lower Granite juvenile fish facility PIT tag detection system will be modified prior to the 2000 juvenile bypass season (during the winter maintenance period). A new electrical power supply and communication system will be installed. New electronics and antenna coils will also be installed as part of the change to the 134.2 kHz ISO system.

2. Studies.

2.1. Evaluation of Juvenile Fish Transportation Versus In-River Survival. Juvenile spring/summer chinook and steelhead will be PIT tagged at the juvenile fish collection facility and then released into the river below the project for either in-river migration or collection and transportation at Little Goose Dam. Most fish will be tagged out of the east bank of raceways in NMFS's temporary tagging facilities. Tagging of fish from the raceways will be independent of any other facility sampling operations and will reduce the number of fish direct loaded into fish barges. At the beginning and end of the tagging operation, when fish numbers are low, fish will be tagged in the facility sampling room. This will require increasing the normal facility sampling rate in order to get the required number of fish on marking days. The adult fish trap will also be operated in 2000 to monitor adult returns of study fish tagged in previous years.

2.2. Evaluation of Adult Salmon and Steelhead Migration Past the Snake and Columbia River Dams. Idaho Cooperative Fisheries Research Unit will continue to monitor the passage of adult salmonids through the hydrosystem. Prior to the fish passage season, the submerged weirs in the lower end of the adult fish ladder will be modified to decrease the amount of flow over the top of the weirs and to increase flows through the orifices. It is hoped that this modification will reduce the rate of adult turn-around in the transition pool. This modification will remain in place throughout the fish passage season unless it creates poor passage conditions. This modification will be evaluated as part of the study. The study requires the installation of radio receivers and data loggers throughout the fishway and various locations on the dam. The installation of equipment will take place prior to the fish season and are not anticipated to require special project operations. During March through November 2000, access needs to be provided at the tailrace and fishways for regular downloading of radio receivers.

APPENDIX B

CORPS OF ENGINEERS JUVENILE

FISH TRANSPORTATION PLAN

Corps of Engineers' Juvenile Fish Transportation Plan

1. Introduction:

a. The Juvenile Fish Transportation Plan describes operations and establishes criteria for the transportation of juvenile salmon and steelhead from Lower Granite, Little Goose, Lower Monumental, and McNary dams (collector dams) to release areas below Bonneville Dam. This work plan supplements normal operating criteria presented elsewhere in the Fish Passage Plan for the collector dams.

b. Collection and transportation is accomplished by the Walla District, Corps of Engineers (CENWW), under an Endangered Species Act (ESA) permit from the National Marine Fisheries Service (NMFS). On-site biological oversight is provided by fishery agencies through contracts with Washington Department of Fish and Wildlife (WDFW) and Oregon Department of Fish and Wildlife (ODFW). On-site quality control is provided by WDFW at Lower Granite, Lower Monumental, and McNary dams and ODFW at Little Goose Dam.

c. The transport program will be coordinated with other fishery monitoring, research, and management activities by CENWW. Coordination will be achieved with the fishery agencies and tribes through NMFS, the Fish Passage Center (FPC), the Technical Management Team (TMT), and other agencies as required.

2. Objective: The objective of CENWW and the transportation program is to maximize survival of juvenile fish collected and transported by:

a. Providing safe and efficient collection and barge or truck transport of juvenile salmon and steelhead from collector dams to release areas below Bonneville Dam;

b. Identifying and recommending programs or facility changes that would benefit fish collection and transportation or bypass operations;

c. Assuring that collection, transport, and release site facilities are ready for operation prior to the beginning of transport operations;

d. Assuring that collection, transport, and release site facilities are properly maintained throughout the transport season;

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

f. Coordinating changes needed to accommodate fluctuations in the outmigration with project, NMFS, FPC, and TMT personnel;

g. Coordinating transport evaluation and other research with the transportation program;

h. Providing the training of new personnel associated with collection and transport facilities and equipment;

i. Providing all parties involved a list of emergency points of contact and appropriate telephone numbers so that any emergency can be coordinated and corrected efficiently;

j. Preparing an annual report detailing transportation activities and results for the previous year, and identifying maintenance, replacement, or modifications needed for the next transport season.

3. Program Duration:

a. <u>Starting Operations</u>: Transport operations will start on March 25 at Lower Granite Dam. Collection of juvenile fish for transportation at Little Goose and Lower Monumental dams will begin on April 1. McNary Dam will begin sampling for PIT tags, monitoring facility operations, and the Smolt Monitoring Program on April 1. Transport operations at McNary Dam will not begin until conditions specified under paragraph 4.a.(2) are met.

b. <u>Summer Transport Operations</u>: At McNary Dam, summer operations will begin when the number of subyearling chinook exceeds the number of yearling chinook salmon in the daily sample for 3 consecutive days. At Lower Granite, Little Goose, and Lower Monumental dams, summer operations will begin on June 21. Fish collected during summer operations will be held in covered raceways or holding tanks. Sampling may convert to 100% when fish numbers at Snake River projects are below 500 fish per day (per FPC sampling guidelines) and mini-tankers may be used.

Steelhead, which state biologists determine are in poor condition or are reverting to the parr stage, may be bypassed to the river.

c. Ending Operations: Transport operations are anticipated to continue through approximately October 31 at Lower Granite, Little Goose, and Lower Monumental dams, and December 15 at McNary Dam.

d. Emergency Termination Criteria: Project Biologists will report to the CENWW Transportation Coordinator when high water temperatures or other factors increase collection mortality to 6 percent of daily collection for 3 consecutive days or if daily collection mortality exceeds 10,000 fish. The Transportation Coordinator will evaluate the situation and shall notify NMFS and may arrange a conference call, if needed, with FPC and/or TMT to discuss the options of continuing collection and transportation or to bypass fish. In the event of a fish loss exceeding conditions set forth in the ESA Section 10 Permit for the transportation program, the Corps shall notify NMFS 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 Manager. Emergency termination will be coordinated by the CENWW Transportation Coordinator with NMFS and FPC.

4. Operating Criteria:

a. Collection and Transportation: Juvenile fish shall be transported in accordance with the ESA Section 10 permit, the Biological Opinion prepared under ESA Section 7 consultation with NMFS, and transportation program criteria. During transport operations, collected juvenile fish will be bypassed back to the river if the number of collected fish exceeds facility and barge holding capacities. Holding for transportation will resume when adequate capacities are available to hold and transport fish according to transportation program criteria. Maximum holding time and loading criteria will not be exceeded without CENWW review and approval. Marked or PIT tagged fish will be released to the river if they are part of an approved research study or smolt monitoring program travel time evaluation. Specifics of the transportation program may be altered during the transportation season based on recommendations from the TMT.

(1) At Lower Granite, Little Goose, and Lower Monumental dams, all juvenile fish collected shall be transported. Barging operations will begin on April 9 and continue through June 24.

(2) At McNary Dam, fish collected during the spring shall be bypassed through the transportation facilities back to the river until subyearling chinook predominate the daily total chinook collection for 3 consecutive days. When this occurs, fish will be collected and held for transportation with all fish collected being transported. During the spring, juvenile fish may be sampled for the Smolt Monitoring Program and for monitoring facility operations.

b. Peak Migration Periods: For the purpose of transport operations, the peak migration period is defined as beginning when total collection at an individual project reaches 20,000 fish per day (actual peak days may range from 250,000 to 830,000 fish per day). Normally, truck transportation will be used before and after the peak, and barge transportation will be used during the peak. Peak migration generally occurs between April 15 and May 31 at Lower Granite, Little Goose, Lower Monumental, and McNary Dams. At McNary Dam, a summer peak also occurs from late June through August.

c. Collection Facility Operations:

(1) Once transport operations begin, collection facilities will be staffed 24 hours per day until operations cease.

(2) Flows at the juvenile fish separator will be monitored at least every 15 minutes throughout separator operations.

(3) When collection systems are not providing safe fish passage or meeting operating criteria, project managers and biologists will make operational changes that are in the best interests of the fish, then notify CENWW as soon as possible. The CENWW Transport Coordinator will coordinate changes with NMFS, FPC, and TMT.

d. Sampling Procedures:

(1) Sampling will be accomplished in accordance with sampling guidelines recommended by the FPC.

(2) Fish that are sampled will be counted by electronic counting tunnels and the counts verified and adjusted by hand counts. All fish number estimates, raceway, truck, and barge loading densities and rates will be based on a sample of fish collected. Samples will be taken hourly 24 hours per day. Sample rates will be coordinated with smolt monitoring program personnel and set by project biologists.

(3) Species composition and weight samples will be taken to determine loading densities for raceways, barges, and trucks. Project personnel will keep a running total of hourly estimates of fish numbers, raceway totals, and direct loading totals for barges based on these estimates. Daily samples for monitoring descaling will include a minimum of 100 fish of the dominant group(s) for which descaling information is recorded. During periods of low fish passage, descaling will be monitored daily for facility operations. During extended transport operations (after August 1 at Snake River projects), samples may be evaluated every other day to minimize handling stress and to allow all collected fish to be held in the sample holding tanks.

(4) Where smolt monitoring activities are conducted at collector dams, project biologists may utilize daily total information gathered by those personnel.

e. Loading Criteria:

(1) Raceways: Maximum raceway holding capacity will be 0.5 lbs. of fish per gallon of water. Inflow to raceways is approximately 1,200 gallons per minute (gpm) at Lower Granite and Little Goose dams, and 2,600 gpm at Lower Monumental and McNary dams. Individual raceway volume is approximately 12,000 gallons of water at Lower Granite and Little Goose, and 24,000 gallons at Lower Monumental and McNary.

(2) The 0.5 pounds per gallon criterion is not to be exceeded without CENWW review and approval. Such decisions will be coordinated with NMFS, FPC, and TMT and a joint decision whether to exceed criteria or bypass fish to the river will be made based on: (1) species composition; (2) total anticipated collection during the critical holding period; (3) in-river fish passage conditions; and (4) fish condition. Project biologists will provide information to the CENWW Transport Coordinator upon which to base these decisions.

(3) Distribution Among Raceways: Collected fish should be spread among raceways to minimize crowding and stress, and to reduce the risk of disease transmission. Additional groups should be added to each raceway at the discretion of the project biologist until holding capacity is reached. Whenever possible, small fish will be held in raceways separate from large fish.

(4) Holding Time: Maximum holding time in raceways will be 2 days.

(5) Truck and Barge Capacities: Loading criteria are 5 pounds of fish per gpm inflow for barges and 0.5 pounds of fish per gallon of water for trucks. Capacities per vehicle are shown in Table B-1.

f. Summer (Extended) Transport Operations:

(1) During the extended season, all fish collected at Lower Granite and Little Goose dams will be routed to the sample holding tanks, which are shaded. All collected fish will be handled for Smolt Monitoring Program requirements, and for loading from the sample holding tanks into trucks. To minimize handling stress, facility samples may be processed every other day.

Table B-1. Capacities for fish transport vehicles.

Barge	**Capacity (gal)**	**Inflow (gpm)**	**Fish Capacity (lbs)**
Sockeye (2127)	85,000	4,600	23,000
Blueback (2817)	85,000	4,600	23,000
Steelhead (4382)	100,000	10,000	50,000
Coho (4394)	100,000	10,000	50,000
Chinook (8105)	150,000	15,000	75,000
King Salmon (8106)	150,000	15,000	75,000
8107	150,000	15,000	75,000
8108	150,000	15,000	75,000
Truck	3,500		1,750
Mini-tank	150		75

(2) At Lower Monumental Dam, all collected fish will be routed to the sample tanks when fish numbers drop to an acceptable handling level. At that time all fish collected will be handled as part of the daily sample. To minimize handling

stress, facility samples may be processed every other day. When large trucks are used, fish will be loaded from the raceways. When mini-tankers are used, Corps and agency project biologists will select the best method of transferring fish from the lab to the mini-tanker.

(3) During summer months at McNary Dam, from June 15 through August 31, water temperatures will be measured along the face of the powerhouse, in B-slot gatewells, and within the collection channel on a daily basis. These temperature measurements will be used for management of north powerhouse loading criteria contained in Appendix A of the Fish Passage Plan. During warm water periods, collected fish may be transported by truck or barge on a daily basis to minimize stress and mortality from warm water conditions. Other special operations may be required at McNary Dam during summer months to minimize impacts of project operations on juvenile fish collection during warm water temperature periods.

(4) When water temperatues are above 68^{0} F, all personnel handling fish shall take extra care to minimize stress and other impacts on fish.

g. Facility and Equipment Logbooks and Records: To document collection and transportation activities, the following items will be logged at each dam by either project personnel or state biologists:

(1) Juvenile Fish Facilities: Records will be maintained recording fish counts by hour, by day, and by species, numbers and species of fish trucked or barged, number and species of fish sampled, descaling rates, and mortality rates. Records will be transmitted daily to CENPW for consolidation and transmittal to CENPD. Facility personnel will follow standard operating procedures (SOPs), and will note in facility logbooks accomplishment of SOPs at various stations at the collection facilities. General observations of fish condition and juvenile fish passage will be documented in facility logbooks by state biologists.

(2) Truck and Barge Logbooks: Each truck and barge shall have a logbook for recording fish loading rates, fish condition, estimated mortalities, area of release, equipment malfunctions, and accomplishment of scheduled work under the SOPs. When consecutive loading of trucks or barges occurs at downstream projects, truck drivers or barge riders will record

numbers and condition of fish loaded. Towboat captains will keep logbooks on towboat activities. Barge riders will be authorized as inspectors by the COR to initial entries noting towboat passage, loading, or fish release activities, and comments on barging operations. State biologists will report truck and barge mortality information in their weekly reports.

(3) Weekly Reports: State biologists shall prepare weekly reports documenting daily and weekly collection and transportation numbers, sampling information, facility and sampling mortality, descaling rates, and adult fallbacks. The weekly reports will be used by CENWW for any weekly reports required in the ESA Section 10 permit issued by NMFS.

5. Transport Operations:

a. Truck Operations: Seven fish transport trailers and four tractors, and three mini-tanks are available for hauling fish. One mini-tank will be provided at each Snake River project. Mini-tanks are small units that can be mounted onto pickup trucks. Normally trailers will be distributed two at Lower Granite Dam, one at Little Goose Dam, one at Lower Monumental Dam, and two at McNary Dam. A spare trailer will be kept at McNary Dam. Trucks may be redistributed to meet transport demands.

(1) Truck/Mini-tank Release Sites: The normal early spring release site for trucked fish will be at Dalton Point. From June 26 through the end of the transport season, trucks and mini-tanks will be transported by barge from a boat ramp located several miles below Bonneville dam to a mid-river release area. Mid-river releasing of trucked fish will continue as long as river levels allow safe loading of trucks onto the barge.

(2) Operation of Truck Life Support Systems: Truck drivers will be trained by project biologists and maintenance personnel on the operation of truck life support systems, the requirements of fish to be met, and signs of stress for which to watch. Routine checks will be made on support systems and fish condition at check points identified by project biologists. Life support system data and information on fish condition will be entered into the truck driver's logbook at each check point and at the release point. The truck driver's logbook will be reviewed by the project biologist upon the truck driver's return after each trip.

(3) If required to maintain transport schedules,

transport trucks 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.

b. Barge Operations: Eight fish barges will be available for use.

(1) Barge Scheduling: Barges with 75,000 pound capacity will operate from Lower Granite Dam. It takes approximately 79 hours to make a trip from Lower Granite Dam to the release area near the Skamania light buoy below Bonneville Dam and return. One barge will leave Lower Granite Dam every-other-day beginning on April 9. 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 June 24. During spring operations, barges will take on additional fish at Little Goose, and Lower Monumental dams as barge capacity allows or the two medium and two small barges will be used for direct loading of fish at Little Goose Dam. When daily collection exceeds barge capacity, juvenile fish will be bypassed to the river until collection numbers drop to where juvenile fish can be barged within barge carrying capacity criteria. During the summer, two barges will be used from McNary Dam. A round trip from McNary Dam to the release area takes less than 48 hours. One barge will leave McNary Dam every two days when numbers allow, and every day during higher fish collection days. Summer barge operations will continue while collection at McNary exceeds 3,500 pounds of fish per day (the capacity of two trucks) or trends indicate numbers will exceed the 3,500 pound trigger number. The number of barges used will be governed by fish collection rates, with the second towboat and barge used on an intermittent basis shifting from one to two barge operation as authorized by CENWW.

(2) Barge Loading: Whenever possible, small and large fish will be loaded in separate compartments in barges.

(3) Barge Riders: Project barge riders will accompany each barge trip, supervising all loading and release operations, and barge operations en-route. Barge riders will be trained on barge operation, maintenance, and emergency procedures by project biologists and maintenance personnel. Barge riders will also be cross-trained in facility operations, and may rotate with

facility operators as decided by project management. Barge riders shall be responsible for monitoring fish condition, barge equipment operations, and water quality (temperature and dissolved oxygen levels) at regular intervals during downriver trips. Barge riders shall maintain logbooks recording loading activities and times, loading densities by barge compartment, information on equipment operations, and release locations. Standard operating 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. The barge rider shall also serve as an inspector for the towboat contract, and record information required by the Contracting Officer's Representative (COR), and shall initial the towboat captain's logbook confirming operational information and lockage times. Any unresolved differences between barge riders and towboat crews shall immediately be reported to the COR.

(4) Barge Release Area: The barge schedule is based on release at the Skamania light buoy (approximately RM 140) with arrival at that point pre-determined to occur during night-time hours to minimize predation impacts. Barge travel time is affected by weather and river flows. As allowed by arrival time at Bonneville Dam, barge riders will randomly select barge release sites from Skamania light buoy upstream to Warrendale (approximately RM 141) to further decrease the ability of predators to prey on fish released from the barge. Project biologists will provide maps designating specific release sights to ensure that fish will not be released in the same area on consecutive trips.

6. Emergency Procedures:

a. Emergency procedures will be followed at any time an emergency occurs, 24 hours per day, 7 days per week during the transport season. Emergencies will be reported to the CENWW Transport Coordinator as soon as possible.

b. In the event of an emergency (equipment failure at a facility or on a truck or barge, emergency lock outage, chemical spill in the river, etc.), facility workers, truck drivers, and barge riders will be expected to take immediate appropriate actions to protect fish. If time allows, the worker, driver, or rider should consult with his/her supervisor by phone or radio to jointly make emergency decisions. If time does not allow consultation, the worker, driver, or rider must take appropriate action on his/her own initiative, then report to his/her supervisor as soon as possible after the action has been completed.

c. A complete listing of persons to be notified in case of emergencies and their business and home telephone numbers will be provided to each person involved in the transport program. Facility operators, truck drivers, and barge riders will be trained on emergency notification procedures by project biologists and CENWW. For the purpose of reporting an emergency, the person involved will immediately notify his/her supervisor, or the next person up the line until the emergency has been properly reported and corrective action has been initiated. In addition to telephone reporting, barge riders will report emergencies by the towboat radio to the nearest Corps dam. The operator on duty will relay the message to the person or persons identified by the barge rider.

7. Fishery Agency Roles:

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

b. Contracts specify that state agency personnel at collector dams accomplish specific tasks for the Project Manager including:

(1) Supervising or conducting handling, inspection, and recording of data from fish sampled at the collection facility;

(2) Evaluating and recording fish condition, and recommending operational changes or inspection of facilities if fish condition indicates a problem;

(3) Providing hand counts of sampled fish, assisting the project biologist in adjusting electronic fish counts, checking hourly and daily fish counts for accuracy, and coordinating facility counts with counts of FPC smolt monitoring program personnel where appropriate;

(4) Conducting quality control inspections of collection facilities and transport equipment including visits to other collection facilities when work schedules can be so

arranged;

(5) Monitoring the effects of smolt monitoring and research projects on fish condition and transportation activities and reporting impacts, including numbers of fish handled for research purposes and the disposition of those fish, to the project biologist;

(6) Participating in gatewell dipping as required to monitor fish condition;

(7) Preparing weekly reports summarizing fish numbers and transport activities, and;

(8) Preparing text and tabular information in the correct format for project annual reports.

8. Dissemination of Information:

a. Project biologists or agency biologists at each collector dam will be responsible for entering all pertinent information into the computer database and for transmitting daily reports to CENWW. Weekday information will be transmitted by 1500 hours on the day collected. Weekend information will be transmitted to CENWW by 1200 hours on the following Monday.

b. Agency biologists will provide weekly reports detailing fish collection and transportation numbers, descaling estimates, and facility and transportation mortality estimates. The reports will also contain a narrative on project activities and compliance with operating criteria. If research or smolt monitoring activities are occurring at the project, the weekly reports will include information on the number of fish sampled and sacrificed also. Agency biologists shall provide the reports to interested parties within the region.

9. Project Requirements for Fishery Agency Activities and Research:

a. Coordination: Agencies and tribes expecting to work at Corps dams will provide early coordination including work proposals, evidence of approval by CBFWA, copies of ESA permits, and project needs and requirements through written correspondence to the Chief, Operations Division, of CENWW, and shall not start work until written approval has been received;

b. Protocol: To maintain good working relationships and safe working conditions, fishery agencies, tribes, and research organizations will be required to follow courtesy and safety protocols as follows.

(1) Check in with the Project 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;

(2) 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;

(3) Adhere to project clearance, safety, and work procedures;

(4) Notify the Project Manager or his/her representative of unscheduled or non-routine work and activities, and;

(5) 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

LOAD SHAPING GUIDELINES TO ENABLE

OPERATING TURBINES AT BEST EFFICIENCY

Bonneville Power Administration's System Load Shaping Guidelines to Enable Operating Turbines at Peak Efficiency

1. Background: Outmigrating juvenile salmonids have several potential routes of passage past hydroelectric dams on the mainstem Columbia and Snake Rivers, including turbines, mechanical bypass, sluiceways, and spillways. Fish passage survival varies depending on the route of passage. As a result of reported high mortality rates for fish passage through turbines (Long 1968; Schoeneman et al. 1961), regional efforts have been focused on providing non-turbine passage routes for juvenile fish as a means to improve fish survival through the FCRPS. Nevertheless, substantial numbers of juvenile fish will continue to pass through turbines; therefore, effort to minimize turbine-related mortality is a priority of the fishery agencies and Indian Tribes, National Marine Fisheries Service (NMFS), U.S. Army Corps of Engineers (Corps), and Bonneville Power Administration (BPA).

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 efficiency tables provided by the Corps for each project in the Fish Passage Plan (FPP). The Corps shall ensure that these efficiency ranges are based on the best available information, and that updates are coordinated with BPA, and the Fish Facility Operation and Maintenance Committee and operating agencies. The tables will be distributed to all operating agencies prior to implementation, allowing at least two working days after receipt of the tables for implementation.

Operating efficiency of turbines is a result of wicket gate opening and blade angle for a given head (Bell 1981). As a result, there is a family of turbine efficiency curves for each project (or turbine design) for various head differentials. Operational decisions affecting turbine operations are based on efficiency curves for incremental changes in head, as provided by turbine manufacturers or empirical testing.

3. Guidelines:

a. Objective: To reduce the mortality of outmigrating 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 one percent of peak efficiency, or as otherwise specified, during the Peak Efficiency Operating Period, within the guidelines outlined below.

b. Peak Efficiency Operating Period: This period is defined as 24 hours per day from March 15 through October 31 for the LCOL river projects and March 15 through November 30 for the LSN river projects. BPA will maintain generation requests that allow turbines to operate within 1 percent of peak efficiency in accordance with these guidelines however, operation may occur outside 1 percent of peak efficiency subject to the limitations listed in paragraphs 4 and 5.

Reporting generation requests outside the 1 percent peak efficiency range relative to the applicable peak efficiency limitations during the Peak Efficiency Operating Period will be provided as outlined in paragraph 6.

c. Unit Priorities: The Corps should make every effort to adhere to unit priorities. 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. Likewise, the Corps will also indicate the priority for operating units outside the one percent peak efficiency minimum or maximum ranges. The list will be based on the best available fish passage and turbine efficiency information, developed by the Corps and will be included in the FPP.

d. Project Priorities: If units must be operated out of the 1 percent peak efficiency range, then BPA will make every effort to assure that generation requests to the Corps projects adhere to project priorities. Project priority may be developed weekly, based on in-season fish passage information, by the Technical Management Team (TMT).

e. Coordination: Coordination processes should facilitate implementation by taking advantage of pre-existing interagency coordinating mechanisms (such as the COE, BOR, BPA and NMFS in-season management process, as described in the 1995

Biological Opinion on Operation of the Federal Columbia River Power System (FCRPS).

Coordination is also intended to minimize frequent disruption of FCRPS by allowing the action agencies sufficient lead time to include system operational changes in their planning activities. Sufficient time is defined as a minimum of two working days before implementation, unless an emergency situation exists. In the event of an emergency, implementation will begin as soon as practical given concurrent operations, hydraulic situations and loads.

Reasonable and prudent operation outside of peak efficiency for limitations listed in paragraphs 4.a and 4.b is at the discretion of the BPA and Corps. BPA and the Corps will coordinate with NMFS when operation of turbines outside of the peak efficiency range may be appropriate under provisions in paragraphs 4.c through 4.i. Coordination will occur during the weekly TMT meetings, as described in the 1995 Biological Opinion on Operation of the FCRPS.

Emergency situations, described in paragraphs 4.a and 4.b, that require an immediate change in FCRPS operation to avoid excessive take of listed salmonids may be directly coordinated at any time between NMFS and the action agencies. Coordination of an emergency change in FCRPS operation shall normally be completed immediately, with information supplied to the TMT described above as soon as practical. Implementation of the change(s) will occur as soon as practical given operational, hydraulic and load conditions. The action agencies shall provide points of contact to allow such emergency coordination to occur.

4. Limitations for the period March 15 through October 31 for the LCOL river projects and through November 30 for the LSN river projects: Conditions that may affect BPA's ability to operate in such a manner include:

a. System Reliability: BPA's ability to operate the power system in a manner that enables the Corps to maximize operation of turbines within peak 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 System Coordinating Council (WSCC), and the

North American Electric Reliability Council (NERC) reliability requirements.

BPA's Reliability Criteria for Operations[1], the Northwest Power Pool Operating Manual[2], the Western Systems Coordinating Council Operations Committee Handbook[3], and the North American Electric Reliability Council Operating Manual[4] define system response criteria and margin of resource generation.

Predictable instances of deviation from within the peak range as a consequence of prudent utility operation for control of short term system dynamics include:

1) Routine responses to loss of generation, load or transmission within the interconnection including delivery of Operating Reserve Obligation to NWPP members upon request. The duration of these deviations is minimal, but dependent upon recovery by the interconnection member with the problem.

2) Routine starting and stopping of generation units. These deviations are unavoidable, but very short in duration.

3) Deliberate dropping of generation, i.e., instantaneous interruption of output, to preserve system integrity. This dropping could cause a brief excursion.

b. Firm and Direct Service Industry (DSI) Load: The LCOL and LSN projects will be operated within one percent of peak efficiency to the extent that the ability to meet firm loads is not jeopardized. According to the Regional Act, the Power Sales Contract[5] with the DSIs and House Report 96-976[6] dated September 16, 1980," the total DSI load will be considered firm for purposes of resource operation."

c. Total Dissolved Gas Supersaturation (TDG): The TDG levels will be monitored at each project during the fish passage season. Signs of gas bubble disease will be monitored at all Smolt Monitoring Program sampling sites and selected in-river sites. Peak turbine efficiency operation may be modified if

[1]Section 4.
[2]Minimum Operating Reliability Criteria Sections I and II. 1.-3. and 8.
[3]Minimum Operating Reliability Criteria Section II 1.-4. and 8., and Section III 1.1 and 1.2.
[4]The entire manual has relevance. However, particularly concise portions are - Guide II.A. and the Reliability Criteria for Interconnected Systems Operation, especially the Preamble, Section I.A., B., and C., Section II.A. and B., and Section III.A.
[5]Section 8.(a).(1)
[6]Part II, page 48

representative monitoring data indicate that TDG is affecting fish survival. Necessary operational modifications will be coordinated through the process outlined in paragraph 3.e.

d. Coordinated Fishery Operations: In the event that coordinated fishery operations and approved fishery research are not in accord with operating turbines at peak efficiency, operational modifications will be coordinated through the process outlined in paragraph 3.e.

e. 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 peak efficiency range.

f. Flow Augmentation Operations: Flow augmentation requests for LCOL flows at McNary (MCN) are primarily met by water releases from GCL. The decision on whether to use GCL flexibility to provide inflows to MCN at the level necessary to meet the week's LCOL flow request when fish collection is maximized for transport during the flow augmentation period shall be made through the coordination process outlined in paragraph 3.e.

The TMT flow augmentation requests may exceed the one percent peak efficient operation range at LCOL/LSN projects. Meeting this flow request will take precedent over peak efficient operations. Coordination of the implementation of the flow requests will occur through the process outlined in paragraph 3.e.

g. Transport Projects: Resolution of the conflict between spill management and turbine operation within one percent of peak efficiency at transport projects during the transport season shall be determined through the coordination process outlined in B.4, and in accordance with fish transportation guidelines, based on in-season flow and fish passage information. Care should be taken during transition periods close to the upper flow boundary to avoid frequent switching of priorities between spill and generation

h. Routine Maintenance and Testing: All units at all projects must undergo maintenance and associated testing. The testing necessitates deviation from the 1 percent peak efficiency band for periods of from 15 minutes to 8 hours. Scheduling of maintenance testing will be coordinated through the process outlined in B.4, to ensure that it is conducted during times of low fish passage within a day to minimize impacts on fish.

i. Flood Control: The FCRPS provides multiple benefits to the region. Flood control is the primary function of many of the projects on the Columbia River. In the event that river flow conditions require flood control operations, operation of turbines within the 1% peak efficiency range may be modified or suspended based on the Corps' direction. Allowing excursions from 1% peak efficiency for flood control operations would facilitate transportation, reduce excessive dissolved gas levels, and lower the risk of gas bubble disease in fish. Coordination of flood control operations will occur as outlined in paragraph 3.e. See also paragraphs 4.c and 4.e.

During flood control operation, compliance reporting will follow procedures outlined in paragraph E.

j. Other: In the event that the excursion was not explainable or caused by human error.

5. Limitations for the period March 15 through March 31, and September 1 through October 31 for the lower Columbia River projects and through November 30 for the lower Snake River projects: Conditions that may affect BPA's ability to operate in such a manner include all limitations in C.1 through C.10, plus the requirement for prudent use of the FCRPS storage capability necessary to import energy into the FCRPS for fish storage and firm load requirements.

6. Quality Control: Significant deviations from 1% will be reported to the TMT. Data on unit status will be kept by BPA during the 1% operating season. Documentation as to why the excursions occurred will be kept in project logs at each dam.

Upon request of the TMT, a case by case brief explanation of the reason(s) for unit operation outside the peak efficiency range, the date, and the associated period of time will be provided by the appropriate parties.

A brief explanation of the reason(s) for unit operation outside the peak efficiency range, the date, and the associated period of time will also be provided for documented excursions. Other excursions (e.g., excursions for unknown reasons) will also be reported.

APPENDIX D

DISSOLVED GAS MONITORING PROGRAM

PLAN OF ACTION FOR 2000

APPENDIX D

CORPS OF ENGINEERS PLAN OF ACTION FOR DISSOLVED GAS MONITORING IN 2000

INTRODUCTION

This Plan of Action for 2000 summarizes the role and responsibilities of the Corps of Engineers as they relate to dissolved gas monitoring, and identifies channels of communication with other cooperating agencies and interested parties. The Plan summarizes what to measure, how, where, and when to take the measurements and how to analyze and interpret the resulting data. It also provides for periodic review and alteration or redirection of efforts when monitoring results and/or new information from other sources justifies a change. Some information on the complementary activities of other participating agencies is provided at the end of this document.

GENERAL APPROACH

The total dissolved gas (TDG) monitoring program consists of a range of activities designed to provide management information about dissolved gas and spill conditions. These activities include time-series measurements, data analysis, synthesis and interpretation, and calibration of numerical models. Four broad categories of objectives are involved:

1) data acquisition, to provide decision-makers with synthesized and relevant information to control dissolved gas supersaturation on a real-time basis,
2) real-time monitoring, to ascertain where project release water quality stands relative to existing state dissolved gas standards and federal criteria;
3) trend monitoring, to identify long-term changes in basin wide dissolved gas saturation levels resulting from water management decisions; and
4) model refinement, to enhance predictive capability of existing models used to evaluate management objectives.

Portland, Seattle and Walla Walla Districts will continue to assume direct responsibilities for TDG monitoring at their respective projects, including data collection, transmission, and analysis and reporting. The Division's Reservoir Control Center (RCC) will coordinate this activity with the Districts and other State and Federal agencies and private parties as needed to insure the information received meet all real-time operational and regulatory requirements. Districts and Division roles and functions are described in more detail in later sections of this document.

The Corps considers TDG monitoring a high priority activity with considerable potential for adversely affecting reservoir operations and ongoing regional efforts to protect aquatic biota. It will make all reasonable efforts toward achieving at least a data quality and reliability level comparable to that provided in 1999.

Furthermore, the Corps believes it is important to maintain a two-way communication between those conducting the monitoring and the users of monitoring information. These interactions give decision-makers and managers an understanding of the limitations of monitoring and, at the same time, provide the technical staff with an understanding of what questions should be answered. Therefore, comments and recommendations received from users were and continue to be very useful in establishing monitoring program priorities and defining areas requiring special attention.

DISTRICTS/DIVISION RESPONSIBILITIES

Portland, Seattle and Walla Walla Districts Functions. Portland, Seattle and Walla Walla Districts will perform all the activities required at their TDG monitoring sites. Data will be collected and transmitted from those sites systematically and without interruption to the Columbia River Operational Hydromet Management System (CROHMS) (or any alternate database as may be specified). Normal monitoring season will be from 1 April through 15 September for all stations except Bonneville and the stations below Bonneville. Because of the Spring Creek hatchery release, monitoring for Bonneville and stations below Bonneville will be from 10 March through 15 September. Winter monitoring, where applicable, will be at least from 15 December through 15 March.

District responsibilities include but are not limited the following tasks:

- preparing annual monitoring plan of action and schedule
- procuring data collection/transmission instruments
- preparing and awarding equipment and service contracts
- performing initial instrument installation and testing
- setting up permanent monitoring installations, if requested
- relocating existing stations, if warranted
- collecting and transmitting TDG data to CROHMS
- reviewing data for early detection of instrument malfunction
- making periodic service and maintenance calls once every 2-3 weeks
- providing emergency service calls as needed and/or when so notified
- performing special TDG measurements, if needed
- keeping records of instrument calibration and/or adjustments
- retrieving, servicing, and storing instruments at the end of the season
- making final data correction and posting in separate data base
- performing data analysis to establish/strengthen spill vs. TDG relationship
- preparing an annual activity report
- document and report QA/QC performance

All three Districts will also be responsible for (1) preparing an annual report on instrument performances, and (2) providing the necessary material including test and data analyses, charts, maps, etc. for incorporation in the Corps' Annual TDG Report, which will be finalized by the Division. Additional monitoring at selected locations may be required on an as needed basis and as possible based on available funding. Dissemination of data to outside users will remain a Division responsibility to avoid duplication and uncoordinated service.

Division's Functions. The Division will be responsible for overall coordination of the TDG monitoring program with the Districts, other State and Federal agencies and cooperating parties. The Chief of the Water Quality Section, CENWD-NP-ET-WR, is the designated TDG Division Program Coordinator. S/he will report through the chain of command through Chief, Reservoir Control Center and Chief, Water Management Division to Director, Engineering & Technical Services Directorate. S/he will consult as needed with interested staff in Planning Division, Pacific Salmon Coordination Office, Construction-Operations Division, and others.

The Division TDG Program Coordinator will provide overall guidance to his District counterparts to ensure that the monitoring program is carried out in accordance with the plan outlined in this document, including close adherence to a general schedule and operating QA/QC protocols. S/he will be the main point of contact for all technical issues related to the TDG monitoring at Corps projects. S/he will refer problems of common regional interest to relevant forums such as the EPA/NMFS Water Quality Team (WQT) for peer review and open discussion. S/he will facilitate final decision-making on technical issues based on all relevant input from interested parties.

The Division TDG Program Coordinator will meet with his District counterparts in January to discuss and firm up detailed implementation plan and schedule for the current year. Discussion will cover monitoring sites, equipment, data collection and transmission procedures, service and maintenance, budget, etc. A set of specific performance standards will be jointly prepared as a basis for reviewing and monitoring District performances. A post-season review meeting will be held annually to provide a critique of the operations and identify areas needing changes and/or improvements.

2000 ACTION PLAN

The 2000 Action Plan consists of the usual seven phases observed in previous years, plus winter monitoring. These phases are as follows:

(1) Program start-up;
(2) Instrument Installation;
(3) In-season Monitoring and Problem Fixing;
(4) Instrument Removal and Storage;
(5) Winter Monitoring
(6) Data Compilation, Analysis and Storage;
(7) Program Evaluation and Report; and
(8) Special Field Studies

The Plan of Action for all three Districts is essentially the same as in 1999, with the exception some QA/QC modifications.

Portland District will continue to use the USGS to conduct their TDG monitoring. Walla Walla District water quality staff may contract out some of the routine instrument calibration responsibilities in 2000. They will continue to operate much of their system by themselves. Seattle District will continue to contract with Common Sensing, Inc. to conduct their routine calibration of TDG equipment. In general the 1999 plan is as follows.

Phase 1: Program Start-Up

Responsible parties (See Table 1) will be invited for a follow-up coordination meeting some time in January for final discussions on the plan of action. This will ensure a good mutual understanding of the most current objectives of the dissolved gas monitoring program, including data to be collected, instrument location, procedures to be used, special requirements, etc. The draft plan will be presented for peer review at a January meeting of the WQT.

All three Districts will ensure that adequate funding is available for 2000 monitoring activities. Portland District, having decided to continue to use the service of the USGS in 2000, will prepare the necessary MIPRs to secure those services and provide for rental and associated maintenance of the USGS's Sutron data collection platforms. Walla Walla District will review their equipment inventory and proceed with the necessary orders for new TDG instruments and DCPs, if applicable. Seattle will renew their contractual arrangements as needed for the operation of the Chief Joseph and Libby stations.

All maintenance and service contracts should be completed at least two weeks before the instruments are installed in the field. Where applicable, the Districts will ensure that real estate agreements and right of entry are finalized between the landowners and the Corps. All paper work for outside contracting will be completed no later than 31 January.

To date, the districts have been initiating the MIPR processes to continue contracts through the 1999-2000 winter monitoring season and the 2000-monitoring season. Districts and division have been updating the QA/QC protocols. Walla Walla District is planning to install temperature loggers in several Lower Snake reservoirs. Temperature loggers have already been placed in Dworshak Reservoir. Walla Walla may be changing their current transmission systems from LAN connection-based transmission to GOES satellite transmission

Discussions between districts, division and contractors are expected to continue through January, at which time a final plan of action will be produced. It is also understood that the following entities will continue to operate their monitoring instruments in 2000:

- U.S. Bureau of Reclamation, below Hungry Horse, at the International Boundary and above and below Grand Coulee Dam;
- Mid-Columbia PUDs (Douglas, Chelan and Grant Counties), above and below all five PUD dams on the Columbia River; and
- Idaho Power Company, in the Hells Canyon area (as part of its Federal Energy Regulatory Commission's license renewal requirement).

Phase 2: Instrument Installation

Instruments to be installed and their assigned locations are listed in Table 2 and shown in Figure 1. Some of them are already in place for the 1999-2000 winter monitoring. The Corps network will essentially remain the same as in 1999, except for the following. Walla Walla District has installed temperature monitors in the upper portions of the Dworshak pool and is considering the installation of temperature monitors in the forebays of McNary, Ice Harbor and Lower Granite project. These stations would consist of eight sensors in ten-foot vertical increments collecting data every two hours. The district is discussing the cost feasibility of real-time transmission of this information versus manual downloading. Walla Walla may keep the Anatone and Pasco sites in operation over the winter measuring temperature only. Portland District has removed the Kalama and Wauna Mills sites (as of winter 1998-9).

As before, the station below Libby Dam will only be activated if spill for flood control at the project becomes likely.

All instruments are scheduled to have been in place and duly connected to their Sutron or Zeno DCP's no later than 10 March at Bonneville and downstream stations, and no later than 1 April at all other stations. If needed, the station below Libby will be reactivated in May or at least two weeks before the start of flow releases for white sturgeon. Monitoring stations below Bonneville are scheduled to be in place first, prior to the release of Spring Creek Hatchery fish.

Corps stations that remain in service during the 1999-2000 winter will continue their operation with minimum interruption into the spring, following the necessary instrument service and maintenance check-up. These stations include the following: Dworshak tailwater, Lower Granite forebay and tailwater, Ice Harbor forebay and tailwater, McNary forebay (Oregon and Washington sides) and tailwater, Bonneville forebay, and Warrendale. An assessment of monitoring site integrity will be conducted; any damages that may have occurred over the winter will be fixed before proceeding on to calibration and testing. Selected project personnel may be requested to assist on this task as needed.

Phase 3: In-season Monitoring and Problem Fixing

Actual data collection and transmission will start prior to the first Spring Creek Hatchery release, but no later than 15 March for stations below Bonneville, and no later than 1 April for the remainder of the monitoring network. Exact starting dates will be coordinated with the Corps' Reservoir Control Center (CENWD-NP-ET-WR), project biologists and cooperating agencies, based on run-off, spill, and fish migration conditions.

The following data will be collected approximately every hour:

WC, Water Temperature (^{o}C)
BH, Barometric Pressure (mm of Hg)
NT, Total Dissolved Gas Pressure (mm of Hg)

Oxygen pressure and calculated nitrogen pressure parameters are currently collected at Walla Walla stations and at one Seattle District station.

OP, Dissolved Oxygen Pressure (mm of Hg)
NP, Nitrogen + Argon Pressure (mm of Hg)

Data will be collected at least hourly and transmitted at least every four hours. If feasible, the previous 12 hours of data will also be sent to improve the capability of retrieving any data that may have been lost during the preceding transmission. For Portland and Seattle Districts, data transmission will be done via the GOES Satellite, to the Corps' ground-receive station in Portland. After decoding, all data will be stored in the CROHMS database. Per their contract with Portland District, the USGS is planning to have the satellite data going into CROHMS and ADAPS (internal to the USGS) simultaneously to allow for some pre-screening. The Walla Walla District will transmit their data hourly to CROHMS and the Walla Walla District's Home page on the Internet. Transmission will be through routes other than the GOES satellite.

Given their direct relevance to fish mortality, the first three parameters (WC, BH and NT) will be collected on a first priority basis. At the 1998 annual post-season review, a suggestion was made to extend high monitoring priority to Dissolved Oxygen in known oxygen-deficient areas. During the 1999 annual post-season review, attendants were not convinced that oxygen should only be measured at oxygen limited locations because oxygen pressure data answers questions about nitrogen content of saturated waters. No resolution was reached, however if oxygen is measured, managers are encouraged to follow adequate QA/QC measures to ensure that the data gathered is valid.

Given the problems with calibration at the John Day tailwater station in 1999, and given the uncertainties of the deflector performance as it relates to TDG production, a second or "redundant" instrument will be placed in the same monitoring pipe as the first instrument during the 2000-monitoring season. Both instruments will transmit to CROHMS real-time.

Daily reports summarizing TDG and related information will be posted on the Technical Management Team's home page. To the extent feasible, the measured TDG data will be compared with model predicted values so that suspicious values can be flagged and/or discarded before they are released. Data filtering through other methods will also be made. Information provided on the homepage will include the following data:

- Station Identifier
- Date and Time of the Probe Readings
- Water Temperature, °C
- Barometric Pressure, mm of Hg
- TDG Pressure, mm of Hg
- Calculated TDG Saturation Percent (%)
- Project Hourly Spill, Kcfs (QS)
- Project Total Hourly Outflow, Kcfs (QR)
- Number of Spillway Gates Open

Stop settings, if different from the numbers provided in the Fish Passage Plan, will also be given.

Reconciliation between data received to CROHMS will be made by the Reservoir Control Center staff based on the input from the field before the data are permanently stored in the Corps' Water Quality Data Base. Additional data posting in the Technical Management Team or Portland, Seattle and Walla Walla Districts' home page will continue.

Instrument reliability and accuracy will be monitored through the following basic QA/QC procedures, as discussed through the WQT technical workgroup.

- Calibrations of instruments will occur every two weeks
- Competent personnel (Corps or contractor) will visit monitoring site to check for and if necessary, fix site problems (probes clogging, leaking membranes, instruments out of calibration, etc.) and recalibrate the faulty instrument(s).
- Calibration will be accomplished using a primary standard (pressure gauge, hand-held barometer, etc). A secondary standard, such as a portable lab-calibrated instrument, will be used as needed to limit sampling precision uncertainty.
- TDG membranes will be changed every two weeks with a dry, functioning membrane.
- If an emergency visit is conducted, a redundant monitor will be placed in river during emergency visit to serve as a temporary back-up to field monitor.

If data recorded by the fixed sensors are different from those recorded during calibration procedure, appropriate corrections will be made to current as well as past data already stored in CROHMS as soon as possible. Significant and/or unusually large changes will be reported immediately to all customary users, including the Fish Passage Center.

Adequate inventory of spare instruments will be maintained to ensure that at least one backup monitor will be made available for deployment as necessary in each Corps District. A malfunctioning instrument will be repaired within 24 to 48 hours, depending on the remoteness of the instrument location and TDG conditions (weekends may require a longer response time). High priority will be placed on fixing a faulty instrument when TDG are or expected to be in excess of the current state standards.

Contractor and/or Corps staff will maintain TDG instruments. Instruments needing repairs that are beyond the staff's capability will be shipped to the manufacturer. In-house water quality and information management will do repairs of communication network staff. USGS Stennis Center (MS) staff will handle Service and repairs of the Sutron DCPs. Service and repairs of the Zeno DCPs will be performed by a contractor.

To better understand the physical process of dissolved gas distribution across the reservoirs and its dissipation along the various pools, selected transects studies will continue to be conducted on an as-time-permits basis. An additional objective for this activity is to be able to define how representative readings from current monitoring sites really are with respect to the entire river reach. Model runs using GASSPILL and other acceptable tools such as a Neural Network model or regression-based equations developed by the Waterway Experimental Station for the Gas Abatement Study will be performed as needed to define the range of expected/acceptable TDG levels under various spill conditions.

To help reduce response time in determining whether an emergency field visit is needed, the following decision-making model was developed by the WQT:

1) No emergency trips are made for the parameter of temperature or oxygen.

2) For gas and barometric pressure, if more than 25% of the hourly values are missing, then an emergency trip is needed.

3) If the difference in values between two consecutive stations is larger than 20 mm Hg for gas pressure, or 14 mm Hg for barometric pressure, then an emergency trip is triggered. Criterion 3 does not apply if:

a) there is a transient “spike” for a parameter.
b) if the higher-than-expected gas pressure value is associated with spill operations.

4) If gas parameters at a station do not fall within any of the WES generated/RCC generated gas production curves, are not caused from operational or structural changes, and these data persist for over 48 hours, then an emergency visit is triggered.

5) If there is uncertainty with an abnormal reading at a gas monitoring station that persists for more than 48 hours, the COE will notify TMT and WQT members as soon as possible via email. If the COE plans to change fish passage actions because of the uncertainty, it should notify both the TMT & WQT members of the proposed change. TMT members will determine whether or not a meeting or conference call is needed and advise the COE of this need. The COE will then convene a TMT meeting. Each state's fishery and water quality agencies will work together prior to any TMT meeting on this issue to balance and assure consistency of the proposed actions with fishery management requirements and state water quality standards.

Phase 4: Instrument Removal and Storage

Water quality monitors will be removed shortly after the end of the monitoring season (15 September) by Corps staff or the USGS, except for those that are slated for continued winter monitoring. Those removed will be serviced by the maintenance and service contractors and stored at a convenient location until the beginning of the next monitoring season. A selected number of monitors and spare DCPs will be available for off-season special monitoring activities upon request. Seattle District owns its Sutron DCPs, and maintains and stores them as needed.

Phase 5: Winter Monitoring.

The same few stations that were selected for winter operation in 1998-1999 will be retained for compliance monitoring in the following 1999-2000 winter. These included, at a minimum, stations located at International Boundary, Dworshak tailwater, Lower Granite forebay and tailwater, Ice Harbor forebay and tailwater, McNary forebay (Oregon and Washington) and tailwater, Bonneville forebay, and Warrendale. Anatone and Pasco stations will continue to monitor temperature over the winter season.

Phase 6: Data Compilation, Analysis and Storage

Time and resource permitting, Corps staff and contractors will fill data gaps, perform statistical analyses, and develop trends and relationships between spill and TDG saturation. Efforts will continue to be expanded on the calibration and application of GASSPILL (Dissolved Gas) and COLTEMP (Water Temperature) models, and finding ways to facilitate and/or improve user access to the TDG and TDG-related database. The GASSPILL model will be periodically modified to incorporate the latest findings brought about by the Gas Abatement Study. Regression-based models assembled by the University of Washington will also be used as appropriate. Possibly, the SYSTDG model (being developed by WES) will be available for in-season gas production predictions and screening. Data collected at and transmitted from all network stations will be ultimately stored at CENWD-NP-ET-WR, where they can be accessed through a data management system such as HEC-DSS.

Phase 7: Program Evaluation and Summary Report

An annual report will be prepared after the end of the normal (spring and summer) monitoring season to summarize the yearly highlights of the TDG monitoring program. It will include a general program evaluation of the adequacy and timeliness of the information received from the field, and how that information is used to help control TDG supersaturation and high water temperature in the Columbia River basin. Information on the performance of the instruments (including accuracy, precision and bias associated with each parameter) and the nature and extent of instrument failures will be documented. This summary should include statistics on data confidence limits. Division staff will prepare the Annual TDG Monitoring Report based on field input and other material provided by each District. This report will also contain suggestions and recommendations to improve the quality of the data during the FY2000 monitoring program.

The WQT has discussed the possibility of developing an independent peer review process to confirm data quality in-season and to summarize data quality post-season. This review process would likely be costly, so the group is currently compiling a firm outline of what the process would provide and how much it would cost. This action may be incorporated into the 2000-monitoring season.

Phase 8: Special Field Studies

As provided for in Phase 3, additional monitoring of dissolved gas saturation will be conducted on an as-needed basis. The current plan for additional monitoring includes transect measurements below selected dams to: 1) establish the relationship between various spill amounts and TDG saturation, and 2) plot TDG variations within a given cross-section of the river, especially a cross-section that includes a fixed monitoring station. Special consideration will continue to be made at evaluating improvements (or any other changes) to TDG levels brought about by the new flip-lips at John Day Dam. Efforts will also be expanded in learning more about dissolved gas supersaturation dissipation along the fish migration route, possibly using monitoring made from moving fish barges and deployment of self-contained wireless probes. These on-going efforts are expected to continue for several years.

COOPERATION WITH PARTICIPATING AGENCIES

The Bureau of Reclamation, Douglas County PUD, Chelan County PUD, and Grant County PUDs currently monitor for total dissolved gases at their mainstem projects. Until recently, these groups were not directly influenced by the listings of salmon and steelhead under the Endangered Species Act. Nonetheless, they have maintained a cooperative effort with the Corps in collecting and reporting total dissolved gas and related water quality parameters and in making this information available to the Corps for storage in their CROHMS database. Idaho Power Company is believed to have been collecting some TDG information in the Hells Canyon Complex, however, this information has not been as widely disseminated as the data from the rest of the TDG monitoring network. Following are the action plans for the cooperating agencies.

Bureau of Reclamation. Bureau of Reclamation TDG monitoring will continue at International Boundary and the Grand Coulee forebay and tailrace, and the Hungry Horse sites in 2000. Hourly data transmission to CROHMS will continue via the GOES satellite. In May 1998, the Grand Coulee forebay sensor was lowered to elevation 1193', 15' below minimum operating pool. This change was done to provide more representative water quality data of the impounded water released downstream via turbine intakes or spill outlets.

Douglas County PUD. TDG monitoring will continue at the forebay and tailrace of Wells Dam in 2000. Hourly data from both of these stations will continue to be sent to the Corps. Douglas Co. may be conducting their station calibrations on a more frequent basis in 2000, and are considering contracting this work out.

Chelan County PUD. The physical monitoring of TDG to be conducted in 2000 will be very similar to the monitoring conducted in 1999. Chelan will continue to monitor TDG in the forebay and tailrace of both Rocky Reach and Rock Island Dams. The PUD will continue to use Common Sensing monitors in the forebay and Hydrolab Datasonde 4s in the tailrace. Data will continue to arrive to the Corps hourly, and efforts will be made to repair malfunctioning probes within 48 hours. Monitoring instruments will be calibrated every three to four weeks or as necessary. Chelan will also continue to conduct weekly transects in the tailraces of both projects to validate the locations of the tailrace monitors and may institute some forebay transects to verify that forebay readings are representative of the conditions in the river at large.

Grant County PUD. TDG will continue to be monitored in the forebays and tailraces of both Wanapum and Priest Rapids Dams. Fixed site locations will not be changed and all probes will be calibrated before the season and every three to four weeks following. Hourly data will continue to be posted on the Grant Co. PUD website. The PUD will also continue weekly cross sectional monitoring at the four fixed monitoring stations in the forebay and tailraces of both projects. Calibration of the instruments was contracted out in 1999.

Table 1. List of Contact Persons in 2000

Project	Name	Position	Phone #	E-Mail
Internat'l Bndry., Hungry Horse, Grand Coulee	Dave Zimmer	Biologist/ Coordinator	(208) 378-5088	dzimmer@ pn.usbr.gov
	Norbert Cannon	Oversight	(208) 334-1540	ncannon@ pn.usbr.gov
	Jim Doty	Transmission	(208) 378-5272	jdoty@ pn.usbr.gov
Chief Joseph, Libby	Marian Valentine	Hydraulic Eng./ Coordinator	(206) 764-3543	marian.valentine @usace.army.mil
	Dave VanRijn	Oversight	(206) 764-6926	david.p.vanrijn@ usace.army.mil
	Ray Strode	Trouble-shooting	(206) 764-3529	ray.strode@ usace.army.mil
Wells (Douglas)	Rick Klinge	Biologist/ Coordinator	(509) 884-7191	rklinge@ televar.com
Rocky Reach, Rock Isl.(Chelan)	Robert MacDonald	Biologist/ Coordinator	(509) 663-8121	robertm@ televar.com
Wanapum, Priest Rapids (Grant)	Chris Carlson	Biologist/ Coordinator	(509) 754-3541 x2154	ccarlso@ gcpud.org
	Dee Chandler	Oversight/Data Management	(509) 754-3541	dchandl@ gcpud.org
Dworshak, Low. Granite, Little Goose, Low. Monumental, Ice Harbor, McNary, Pasco, Anatone	Dave Reese	Biologist/ Coordinator	(509) 527-7279	david.l.reese@ usace.army.mil
	Gary Slack	Oversight.	(509) 527-7636	gary.m.slack@ usace.army.mil
	Russ Heaton	Oversight	(509) 527-7282	russ.d.heaton@ usace.army.mil
John Day, The Dalles, Bonne-ville, Warrendale, Skamania,Camas /Washougal, Kalama, Wauna Mills	Jim Britton	Biologist/ Coordinator	(503) 808-4888	james.l.britton@ usace.army.mil
	Joe Rinella	USGS/Contract Coordinator	(503) 251-3278	jrinella@ usgs.gov
	Dwight Tanner	USGS/Oversight	(503) 251-3289	dqtanner@ usgs.gov
Division Pgm. Coordination	Dick Cassidy	Program Coordinator	(503) 808-3938	richard.a.cassidy @usace.army.mil
	Mary Todd Haight	Program Oversight	(503) 808-3939	mary.todd.haight @usace.army.mil

Table 2. 2000 Dissolved Gas Monitoring Network

STATION CODE	STATION NAME	OWNERS
CIBW*	US/Can Boundary	USBR
HGHW	Below HGH	USBR
FDRW	GCL Forebay	USBR
GCGW	GCL Tailwater	USBR
LIBM (#)	LIB Tailwater	NWS
CHJ	CHJ Forebay	NWS
CHQW	CHJ Tailwater	NWS
WEL	WEL Forebay	DOUGLAS CO.
WELW	WEL Tailwater	DOUGLAS CO
RRH	RRH Forebay	CHELAN CO.
RRDW	RRH Tailwater	CHELAN CO.
RIS	RIS Forebay	CHELAN CO.
RIGW	RIS Tailwater	CHELAN CO.
WAN	WAN Forebay	GRANT CO.
WANW	WAN Tailwater	GRANT CO.
PRD	PRD Forebay	GRANT CO.
PRXW	PRD Tailwater	GRANT CO.
PAQW	Col. Above Snake	NWW
DWQI*	DWR Tailwater	NWW
PEKI	Peck/Clearwater	NWW
LEWI	Lewiston/Clearwater	NWW
ANQW	Upper Snake at Anatone	NWW
LWG*	LWG Forebay	NWW
LGNW*	LWG TW	NWW
LGS	LGS Forebay	NWW
LGSW	LGS Tailwater	NWW
LMN	LMN Forebay	NWW
LMNW	LMN Tailwater	NWW
IHR*	IHR Forebay	NWW
IDSW*	IHR Tailwater	NWW
MCQW*	MCN FB/Wa	NWW
MCQO*	MCN FB/Or	NWW
MCPW*	MCN Tailwater	NWW
JDA	JDA Forebay	NWP
JHAW	JDA Tailwater	NWP
TDA	TDA Forebay	NWP
TDDO	TDA Tailwater	NWP
BON*	BON Forebay	NWP
WRNO*	Warrendale	NWP
SKAW	Skamania	NWP
CWMW	Camas	NWP

(#) during spill only (*) winter monitoring station USBR= U.S. Bureau of Reclamation NPP= Portland District NPS= Seattle District NPW = Walla Walla District LB=Left bank RB=Right bank MC=mid-channel

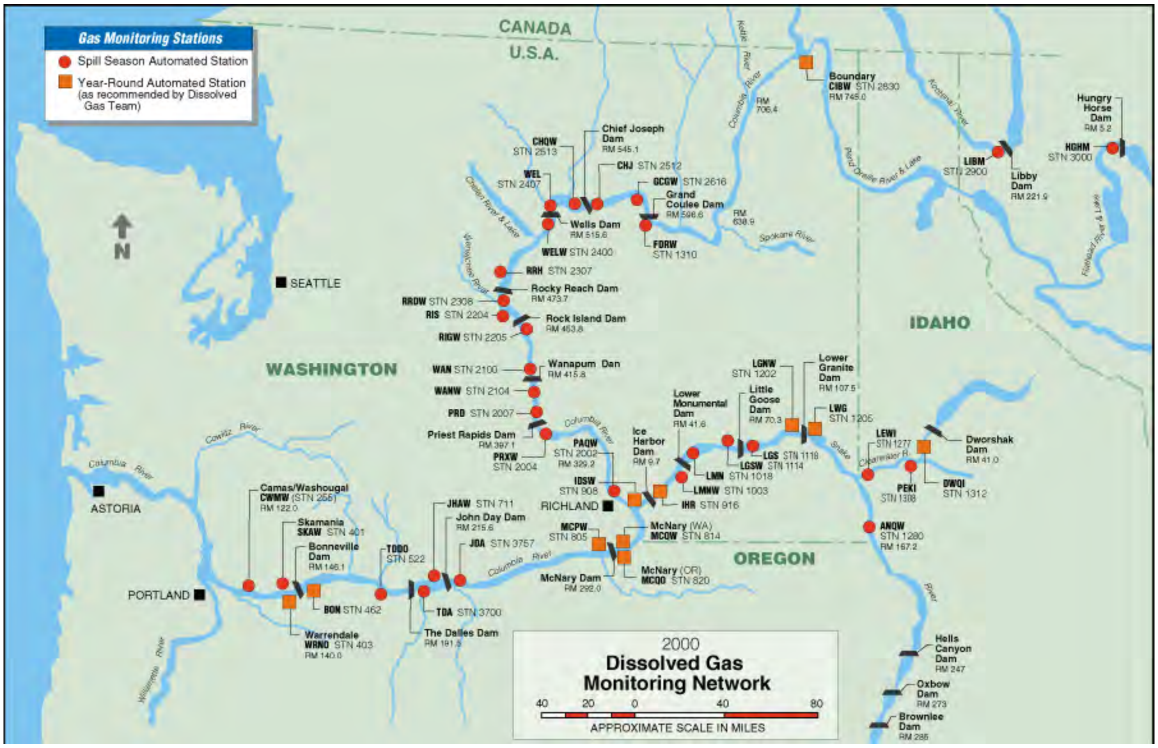

Figure 1. 2000 Dissolved Gas Monitoring Network

APPENDIX E

SECTION III. OF THE NMFS 1998 SUPPLEMENT

TO THE BIOLOGICAL OPINION ON FCRPS OPERATION

SYSTEM SPILL

Operation of the Federal Columbia River Power System Including the Smolt monitoring Program and the Juvenile Fish Transportation Program: A Supplement to the Biological Opinion Signed on March 2, 1995 for the Same Projects

May 14, 1998

Excerpt from Section III. Proposed Action:

3. System Spill

The Action Agencies had proposed in their Biological Assessment to modify spill levels from those specified in 1995 RPA Measure 2. The NMFS undertook a comprehensive review of the new information regarding the effects of spill (Appendix C) including revised project-specific estimates of:

- Estimates of fish guidance efficiency (the proportion of juveniles approaching turbine intakes which are guided into bypasses);
- Total dissolved gas levels associated with spill levels at each project; and
- New spill efficiency estimates for some projects (i.e., the proportion of fish approaching a project that pass via the spillway, divided by the proportion of total flow that is spilled).

The 1995 RPA defined an 80% fish passage efficiency goal for spill but recognized that some projects would achieve a lower fish passage efficiency due to dissolved gas limits (1995 RPA Measure 2). The NMFS review indicated that, while some projects were meeting the 80% fish passage efficiency goal (i.e., proportion of fish passing by non-turbine routes), others were not. Although the levels of spill provided during 1995 through 1997 were consistent with the spill recommended in the 1995 RPA, NMFS supports additional spill on a system wide basis to provide further benefits to steelhead while also increasing the survival of Snake River spring/summer and fall chinook and sockeye. The additional spill should be provided as described below pending review of performance (i.e., spill effectiveness and efficiency) and consideration of biologically-based performance standards for project passage. The Action Agencies anticipate development of such a standard by the end of 1999 and have agreed to provide this additional spill during the interim period. To the extent that FPE at some projects will exceed 80%, this additional spill supplements 1995 RPA Measure 2 for the interim period pending decisions on long-term actions.

The Action Agencies proposed that the actual dates of spill and flow augmentation be determined annually by the TMT based on inseason monitoring information. However, the planning dates are April 3 (modified from the April 10 planning date specified in 1995 RPA Measure 2) to June 20 and June 21 to August 31 for spring and summer, respectively, in the Snake River; April 10 to June 30 in the mid-Columbia River; and April 20[1] to June 30 and July 1 to August 31 for spring and summer, respectively, in the lower Columbia River. Initial estimates of spill levels, and the basis for each estimate, are shown below (Table III-2). The specific spill volumes listed in Table III-2 must be viewed as approximate because the total dissolved gas levels measured at the monitoring site below each project, at a given spill level, can vary with such factors as forebay dissolved gas level, spill patterns and water temperature changes. Also, there are many project-specific limitations on spill levels for reasons other than dissolved gas. These include adult passage, navigation, and research activities. These limitations are typically of

[1] Review of steelhead passage information at McNary Dam indicated that the planning date of April 20 for chinook salmon is applicable to steelhead (Smolt Index Report, PIT-tag data, Fish Passage Center, Portland, Oregon). In some years, steelhead smolts reached McNary before April 20; in some years, after April 20.

short duration but they do reduce spill for fish passage to a limited degree. Dissolved gas and biological monitoring information, and the results of research on spill effectiveness and survival, should be reviewed annually so that specific spill levels can be developed for each project.

Table III-2. Estimated spill caps for the operations specified in this Supplemental FCRPS Biological Opinion.

Project	Estimated Spill Level [2]	Hours	Limiting Factor
Lower Granite	45 kcfs	6 pm - 6 am	gas cap
Little Goose	60 kcfs	6 pm - 6 am	gas cap
Lower Monumental	40 kcfs	6 pm - 6 am	gas cap
Ice Harbor	75 kcfs (night) 45 kcfs (day)	24 hours	nighttime - gas cap daytime - adult passage
McNary	150 kcfs	6 pm - 6 am	gas cap
John Day	180 kcfs/60%[3]	1 hour before sunset to 1 hour after sunrise	gas cap/percentage
The Dalles	64%	24 hours	tailrace flow pattern and survival concerns (study planned in 1998)
Bonneville	120 kcfs (night) 75 kcfs (day)	24 hours	nighttime - gas cap daytime - adult fallback

Comparison of these new spill objectives with those set out in the 1995 FCRPS Biological Opinion is difficult. Whereas the previous spill objectives were defined as a spill percentage, the proposed objectives (which, in most cases, are based on the spillway flows at which gas caps are reached) are described in terms of "kcfs over the spillway." These changes are described in detail in Appendix C ("Basis for NMFS Determinations Concerning the Use of Spill as Mitigation for Operation of the Federal Columbia River Power System") and are briefly outlined for each project below.

Lower Granite: The 1995 FCRPS Biological Opinion set a spill level at Lower Granite of 80% instantaneous spill for 12 hours per day. However, under most conditions, this level of spill could not be implemented because the gas cap was reached at spillway flows of 40 kcfs. The Action Agencies now

[2] The estimates of fish passage efficiency used to derive these spill levels are conservative in that they are based on the guidance efficiencies of hatchery spring/summer chinook instead of those estimated for wild or hatchery steelhead. Estimates for hatchery spring/summer chinook were used because the spill levels set in this Supplemental FCRPS Biological Opinion must be equally protective of the weakest listed stock present in the river during the steelhead outmigration period.

[3] The total dissolved gas cap at John Day Dam is estimated at 180 kcfs and the spill cap for tailrace hydraulics is 60%. At project flows up to 300 kcfs, spill discharges will be 60% of instantaneous project flow. Above 300 kcfs project flow, spill discharges will be 180 kcfs (up to the hydraulic limit of the powerhouse).

estimate that the gas cap will be reached at 45 kcfs and propose this level as the spill limit. Based on radio-tracking studies with adult chinook, performed at Lower Granite Dam during 1996 and 1997, a spill level of 45 kcfs should not adversely affect adult passage (T. Bjornn, fax to R. Kalamasz, S. Pettit, and J. Ceballos, dated April 4, 1998). At a river flow 100 kcfs, the new standard will provide an instantaneous spill level of 45 kcfs and an estimated fish passage efficiency (FPE) of 85%.

It may be necessary to consider a lower spill limit to accommodate safety concerns when juveniles are being loaded directly onto barges and the barges must be docked for extended periods. Spill operations must also consider research needs critical to the proposed evaluation of the prototype surface bypass/collector (i.e., project operations are modified to spill for 24-hours per day instead of only at night and powerhouse operations are modified to provide the required hydraulic conditions in the immediate forebay). Data from this research are critical to the long-term regional decision due by the end of 1999.

The BPA has specified 11.5 kcfs as a minimum powerhouse flow for system reliability. Because this minimum is dependent on the status of generation at other projects, it may not be necessary at all times.

Little Goose: The 1995 FCRPS Biological Opinion described a spill level for Little Goose Dam of 80% instantaneous spill for 12 hours per day. As at Lower Granite Dam, the Action Agencies could not usually implement this level because the gas cap was reached at spillway flows of approximately 35 kcfs. The Action Agencies now estimate that the gas cap will be reached at 60 kcfs at this dam and propose this limit. Based on radio-tracking studies with adult chinook, performed during 1997, a spill level of 60 kcfs should not adversely affect adult passage (C. Perry, Idaho Cooperative Fish and Wildlife Research Unit [ICFWRU] fax to J. Ceballos, NMFS, dated April 9, 1998).

The BPA has specified 11.5 kcfs as a minimum powerhouse flow for system reliability. Because this minimum is dependent on the status of generation at other projects, it may not be necessary at all times.

At a river flow of 100 kcfs, the new standard will provide an instantaneous spill level of 60 kcfs and an estimated of FPE of 86%.

Lower Monumental: The 1995 FCRPS Biological Opinion set a spill level at Lower Monumental Dam of 81% of instantaneous spill for 12 hours per day. Again, this level of spill was not provided voluntarily because the gas cap was reached at spillway flows of approximately 40 kcfs. The Action Agencies have not changed this estimate of spill at the gas cap. Therefore, spill levels at this dam are not expected to change during 1998. Based on radio-tracking studies with adult chinook, performed during 1997, a spill level of 40 kcfs should not adversely affect adult passage (C. Perry, ICFWRU, fax to J. Ceballos, NMFS, dated April 9, 1998). Because the gas cap is currently reached at approximately 40 kcfs, no reduction in spill is necessary between 0500 to 0600 hours. Because spill is limited, the maximum achievable FPE is limited to approximately 61%.

The BPA has specified 11.5 kcfs as a minimum powerhouse flow for system reliability. Because this minimum is dependent on the status of generation at other projects, it may not be necessary at all times.

Ice Harbor: The 1995 FCRPS Biological Opinion described spill levels at Ice Harbor Dam of 27% in the spring and 70% in the summer, each for 24 hours per day. The 27% spring objective was often reached, even though the gas cap limited voluntary spill to flows of 25 kcfs. The summer target of 70% was also reached at the lower flow levels. Due to the installation of spillway flow deflectors, the Action Agencies now estimate that the gas cap will be reached at 75 kcfs. Based on research performed during the early 1980's, concerns for adult passage would limit daytime (0500 to 1800) spill to 45 kcfs. However, in view of preliminary information from radio-tracking studies performed during 1996, wherein a spill level higher than 45 kcfs did not adversely impact adult passage (C. Perry, ICFWRU, fax to J. Ceballos, NMFS, dated April 9, 1998), may require that the 45 kcfs adult passage daytime cap may need to be reconsidered once the final results are available. However, no change is proposed at this time. Additional short-term limits may need to be imposed to address safety concerns when barges are exiting the lock in the downstream direction. Temporary modifications to FPP spill patterns to improve navigation conditions will not be necessary once coffer cell construction below the spillway is completed this coming winter. At a river flow of 100 kcfs, the new standard will provide an instantaneous spill level of 75 kcfs and an estimated spring chinook FPE of 84%.

The BPA has specified 7.5 to 9.5 kcfs as minimum powerhouse flows for system reliability. Because this minimum is dependent on the status of generation at other projects, it may not be necessary at all times.

McNary: The 1995 FCRPS Biological Opinion set a spill level at McNary Dam of 50% for 12 hours per day. Due to limited powerhouse capacity and because the gas cap was reached at spillway flows 120 kcfs, these spill levels were reached under most conditions. The Action Agencies now estimate that the gas cap will be reached at 150 kcfs and proposed this level of spill as the limit. At a river flow of 240 kcfs, the new standard will provide an instantaneous spill level of 150 kcfs and an estimated FPE of 89%. BPA has specified a minimum powerhouse flow of 50 kcfs to maintain power transmission system stability.

John Day: The 1995 FCRPS Biological Opinion set spill levels of 33% during spring and 86% during summer, 12 hours per day. The gas cap was reached at spillway flows of 20 to 50 kcfs (depending on the spill pattern), prohibiting voluntary spill under most river flow conditions. Because of spill flow deflectors have been installed at this project, the Action Agencies now estimate that the gas cap will be reached at spillway flows of approximately 180 kcfs. The Action Agencies therefore propose a spill limit of 180 kcfs except when river flows are less than approximately 250 to 300 kcfs. At these low flows, poor tailrace conditions at the bypass outfall will limit spill to 60% of the total river flow.

BPA has specified a minimum powerhouse flow of 50 kcfs to maintain power transmission system stability.

A change in hours to one hour before sunset to one hour after sunrise is also proposed to partially offset the high cost of the increased spill levels at John Day. At a river flow of 240 kcfs, the new standard will provide an instantaneous spill level of 60% and an estimated spring chinook FPE of 79%, from one hour before sunset to one hour after sunrise

The Action Agencies also propose to investigate 24-hour spill at John Day Dam beginning in 1999. The cost and transmission system effects of 24-hour spill at John Day are a concern. However, high spillway effectiveness and high daytime passage were noted during 24-hour spill in 1997 (Corps Memorandum for the Record from Bob Dach, February 3, 1998). This observation, together with the need to evaluate the slight change in spill hours, warrants further investigation. Spill effectiveness was highest during the summer but daytime passage was much higher than expected during both spring and summer, indicating a potential decrease in forebay residence time (and subsequent predator exposure) in this area. The framework for the proposed study is as follows: (1) the study will not exceed two years; (2) the scope of the study will include both spring and summer spill; (3) the test condition will not necessarily involve 24 hour spill seven days per week (i.e., 24-hour spill will be limited temporally in season so as to generate the necessary information with minimal effects on generation and transmission capacity); (4) the study plan will be approved through the Regional Forum process.

Commenters suggested that the 24-hour spill test should be conducted at John Day during 1998. However, it would not be reasonable to implement this test during 1998 because the necessary planning cannot be completed.

The Dalles: The 1995 FCRPS Biological Opinion set a spill level at The Dalles Dam of 64% for 24 hours. Because the gas cap was reached at spillway flows of 230 kcfs, the Opinion spill level was met most of the time. Whereas spill could be increased further before the gas cap was reached, poor tailrace conditions and recent poor survival estimates at high spill volumes are a concern. No change is proposed until planned survival and spill effectiveness studies, planned for 1998, can be completed. However, changes in spill operations at The Dalles may be proposed once this research is completed. Any resulting changes in the annual operation will be coordinated through the Regional Forum process and memorialized through the 1995 RPA Measure 26 consultation Framework or some similar process. At a river flow of 240 kcfs, 64% spill will provide an estimated FPE of 79%.

The BPA has specified a minimum powerhouse flow of 50 kcfs to maintain power transmission system stability.

Bonneville: The 1995 FCRPS Biological Opinion did not recommend specific spill percentages at Bonneville Dam because spill was limited severely by the need for measures to prevent adult fallback. In addition, the gas cap was reached at 120 kcfs spillway flow. Research is to address these issues is needed and no change in spill is proposed at this time. At a river flow of 240 kcfs, the limited spill capability will provide an estimated FPE of 59%.

The BPA has specified a minimum powerhouse flow of 30 kcfs.

Excerpt From: Basis for NMFS Determinations Concerning The Use of Spill as Mitigation for Operation of the Federal Columbia River Power System

Spill and Spill Related Recommendations

For the above-mentioned reasons, NMFS has reconsidered the spill volumes and scenarios contained in RPA Measure 2 of the 1995 FCRPS Biological Opinion. The NMFS has determined that it is reasonable to increase spill volumes beyond the 80%-FPE level at projects where this can be accomplished without exceeding the current TDG cap (or other project-specific limitations) during 1998 and future fish passage seasons. Table C-3 illustrates the differences in FPE and spill amounts (under a given flow scenario) between the recommended spill approach and an 80%-FPE spill approach. The estimated average FPE over the eight FCRPS dams is less than 80% under both strategies. However, the gas cap-limited spill approach results in a somewhat higher overall average FPE.

Table C-3. Estimates of fish passage efficiencies and spill volumes obtainable in 1998 under a 1995 FCRPS Biological Opinion-type spill program (i.e., 80% FPE limit) versus those obtainable with a gas cap-limited spill program (i.e., capped 120% TDG). Unless otherwise specified, 12-hour (i.e., 1800 to 0600) spill is prescribed. (Calculations assume 100 kcfs total flow at LGR and 240 kcfs total flow at MCN.)

	1995 BiOp (80% FPE) Approach			**Gas Cap Limited Spill Approach**		
Project	**Spill Volume (kcfs)**	**Instant Spill (%)**	**FPE**[4]	**Spill Volume (kcfs)**	**Instant Spill (%)**	**FPE**[5]
LGR	20 (12 hrs)	20	80	45 (12 hrs)	45	85
LGS	25 "	25	80	60 "	60	86
LMN	40 "	40	61	40 "	40	61
IHR	55 (night)	55	80	75 (night)	75	84
	45 (day)	45		45 (day)	45	
MCN	0	0	81	150 (12 hrs)	63	89
JDA	148 (12 hrs)	65	80	180[7] (12 hrs)	60	79
TDA[6]	156 (24 hrs)	64	79	156 (24 hrs)	64	79
BON	120 (night)	50	59	120 (night)	50	59
	75 (day)	31		75 (day)	31	
Ave. FPE			75			78

The specific spill volumes shown in Table C-3 must be viewed as approximate because the total dissolved gas levels measured at the monitoring site below each project, at a given spill level, can vary with such

[4] These FPE's are calculated with the same equation used in Table C-1, however, current FGE and TDG estimates are used. 80% FPE was used to cap spill.

[5] These FPE estimates are based on the same FGE and TDG data but the 120% gas cap and other project specific limitations were used to cap spill (limitations are described in the text below).

[6] Spill will be capped at 64% at this project, see project specific discussion in the text.

[7] The spill level at John Day Dam is capped at 180 kcfs for gas or 60% total flow due to tailrace conditions (see text below).

factors as forebay dissolved gas level, spill patterns, and water temperature changes. Also, there are many project-specific limitations on spill levels other than dissolved gas. These include adult passage, navigation, and research activities. These limitations are typically of short duration but they do reduce spill for fish passage to some degree. The NMFS recommendations for system spill and limits to spill duration for each project are discussed below:

Planning Dates

The actual dates of spill and flow augmentation should be determined annually by the TMT based on inseason monitoring information. Planning dates are April 3 to June 20 and June 21 to August 31 for spring and summer, respectively, in the Snake River; April 10 to June 30 in the mid-Columbia River; and April 20 to June 30 and July 1 to August 31 for spring and summer, respectively, in the lower Columbia River.

Spill Trigger for Lower Snake River Collector Dams

Voluntary spill should occur at Lower Granite, Little Goose, and Lower Monumental Dams when the April 1 volume-of-runoff forecast indicates that seasonal average forecasted flows at Lower Granite Dam are projected to exceed 85 kcfs during the spring migration period (early April to June 20). The NMFS recognizes that, early in the season, voluntary spill may occur when river flows are substantially less than 85 kcfs. It is intended that voluntary spill be maintained to provide equitable spread-the-risk conditions throughout the migration season for the population as a whole.

System Wide Issues

Gas bubble disease monitoring of juvenile and adult salmonids should continue at all the current sites as defined in the NMFS 1998 Gas Bubble Disease Monitoring Plan. It is the determination of the NMFS Dissolved Gas Team (DGT) that the juvenile portion of the monitoring program has been reasonably well validated through the annual research and monitoring that has been conducted since 1994 (Mark Schneider, DGT cochair, pers. comm., March 2, 1998). However, two important research needs remain for the monitoring program: (1) a better understanding of the effects of extremely high near-field TDG levels on all species of salmonid and (2) verification of the adult salmon monitoring program.

Gas abatement studies should continue for all FCRPS dams including Chief Joseph and Grand Coulee Dam (including reducing high Boundary TDG levels). Even though there is no intentional fish passage in this reach, TDG generated by these two dams contributes to system TDG downstream and reduces the ability to provide fish-protective levels of spill at downstream dams.

Tailrace hydraulic conditions should be evaluated through general model studies to determine optimum spill patterns for minimizing the retention time of juveniles in spill basins and tailraces and for minimizing adverse conditions for adult passage at all dams where this has not already been accomplished. These evaluations have been completed for existing conditions at Bonneville, The Dalles and John Day Dams and have been partially completed for Ice Harbor Dam. Very little detailed information exists for McNary, Lower Monumental, Little Goose and Lower Granite Dams, particularly under the potential high spill levels called for in this Supplemental FCRPS Biological Opinion. Scale model studies will allow a timely assessment of tailrace conditions in a stepwise manner through a full range of spill and total flow levels and varied turbine unit operations. After implementation, the final patterns should be verified to the extent possible through field observations.

Information on spill efficiency (flow per fish) and effectiveness (percent of total project passage) is also needed at most FCRPS dams under a variety of spill and flow conditions. Limited information from radio-tagged juveniles passing several dams under very high flow conditions during 1996 and 1997 indicate that the spill scenarios which are effective for passing juvenile migrants may be different from those effective for passing adults. Information collected at John Day Dam in 1997 indicates that 24-hour spill may be much more effective than 12-hour spill in reducing residence time in the forebay (by allowing juvenile fish to pass as soon as they approach the dam). This study also indicated that, for some species, daytime spill may be more effective than nighttime spill. If spill is limited to 12 hours for adult concerns, these studies can help identify which 12 hours are best. It is likely that the John Day Dam example would hold true for other FCRPS dams.

Studies of spill effectiveness would also allow more accurate estimates of the smolt-to-adult return (SAR) rates of PIT-tagged fish released in the hydrosystem. Computation of SARs requires that the total number of smolts passing each project be estimated from rates of detection in the juvenile bypass system. This requires an accurate estimate of the percent of total project passage via the spillway versus the powerhouse. Spill effectiveness studies would provide the needed information.

Spillway survival estimates are needed for all dams under a variety of total flow and spill conditions. Currently, spill patterns and volume limitations are developed with physical models of the dams at the Corps' Waterways Experiment Station based on general and somewhat subjective estimates of the stilling basin retention time of juveniles, predation risk to juveniles, and adult-passage concerns. The current studies are set up to assess adult passage through the tailraces of FCRPS dams but very little effort has been made to estimate the effects these management options would have on juvenile survival.

Lower Granite Dam

The 100 kcfs spill trigger specified in the 1995 FCRPS Biological Opinion has been reduced to 85 kcfs. Spill operations for fish passage must also consider critical research data needs relating to the proposed evaluation of the prototype surface bypass/collector during spring 1998, and potentially, 1999. The federal parties have reached agreement on voluntary spill hours, spill volume, and powerhouse turbine operations during spring 1998. Specifically, during the spring SBC evaluation, spill will occur 24 hours per day with a minimum flow of 5.8 kcfs and a preferred maximum of 35 kcfs. Turbine unit operating priority will be units 1, 4,5,3 and 6. Unit 6 will not be operated unless necessary to control total dissolved gas saturation. In the absence of special operations for research, 12-hour nighttime spill to the 45-kcfs TDG cap will occur. The Action Agencies' preferred operation during the spring of 1998 is to maintain a constant powerhouse load (unit 1 @19.9 kcfs, and units 3,4,5 @15.5 kcfs).

Dissolved gas limitations - Depending on ambient forebay gas levels, spill to 120% TDG saturation will limit spillway flows to about 45 kcfs.

Powerhouse flow limitations - Powerhouse hydraulic capacity within one percent of peak efficiency is normally about 123 kcfs. However, in 1998, unit 2 will be out of operation and powerhouse capacity will be reached at flows of approximately 103 kcfs. Total river flows above this volume will cause involuntary spill. The BPA has specified 11.5 kcfs as a minimum powerhouse flow for system reliability. Because this minimum depends on the status of generation at other projects, it may not be necessary at all times. The Corps' Fish Passage Plan (FPP) specifies that units 1, 2, and 3, be given operating priority for fish passage during the daytime and the larger units (4, 5, and 6) be given priority at night.

Tailrace limitations - It may be necessary to limit spill in order to limit the occurrence of adverse hydraulic conditions in the tailrace. Poor hydraulic conditions resulting in large tailrace eddies can reduce adult passage efficiency and increase predation on juveniles passing through the spillway and bypass system. Based on radio-tracking studies with adult chinook, performed at Lower Granite Dam during 1996 and 1997, a spill level of 45 kcfs should not adversely affect adult passage (T. Bjornn fax to R. Kalamasz, S. Pettit, and J. Ceballos, dated April 4, 1998). It may be necessary to consider a lower limit to accommodate safety concerns when the project is direct-loading. The Corps has not conducted the specific modeling studies of tailrace spill patterns at Lower Granite that might identify other limits to spill. However, it is known that a large eddy forms below the powerhouse as spill levels increase. The formation and the size and shape of the eddy vary with spill level and turbine unit operations. Until modeling studies can be performed, the need for spill limitations to minimize this eddy will be assessed inseason by the TMT.

Little Goose Dam

Continue 12-hour nighttime spill at this project. PIT-tagged fish will be returned to the river after detection whereas other collected fish will be transported. Barge loading, which normally occurs in the late afternoon, can be hampered when two barges are in tow. A new secondary bypass system was installed for the 1997 season which releases bypassed smolts into positive downstream flow conditions.

Dissolved gas limitations - Depending on ambient forebay gas concentrations, spill to 120% TDG saturation will limit spillway flows to about 60 kcfs.

Powerhouse flow limitations - Powerhouse hydraulic capacity with unit operation within one percent of peak efficiency is approximately 123 kcfs. The BPA has specified 11.5 kcfs as a minimum powerhouse flow for system reliability. Because this minimum depends on the status of generation at other projects, it may not be necessary at all times. The FPP specifies that units 1, 2, and 3, be given operating priority for fish passage during the daytime and that the larger units (4, 5, and 6) be given priority at night.

Tailrace limitations - It may be necessary to limit spill in order to limit the occurrence of adverse hydraulic conditions in the tailrace. Poor hydraulic conditions resulting in large tailrace eddies can reduce adult passage efficiency and increase predation on juveniles passing through the spillway and bypass system. Based on radio-tracking studies with adult chinook, performed during 1997, a spill level of 60 kcfs should not adversely affect adult passage (C. Perry, Idaho Cooperative Fish and Wildlife Research Unit [ICFWRU] fax to J. Ceballos, NMFS, dated April 9, 1998). Specific modeling studies of tailrace spill patterns, for the purpose of identifying other limitations to spill at Little Goose, have not been conducted. However, inseason observations indicate that an eddy forms below the powerhouse at spill levels as low as 35%. The need for spill limitations to minimize this eddy will be assessed inseason by the TMT.

Lower Monumental Dam

Continue 12-hour nighttime spill at this project. PIT-tagged fish will be returned to the river after detection whereas other collected fish will be transported.

Dissolved gas limitations - Depending on ambient forebay gas levels, spill to the 120% TDG saturation will be limited to spillway flows of about 40 kcfs.

Powerhouse flow limitations - Powerhouse hydraulic capacity with unit operation within one percent of peak efficiency is approximately 123 kcfs. The BPA has specified 11.5 kcfs as a minimum powerhouse flow for system reliability. Because this minimum depends on the status of generation at other projects, it may not be necessary at all times. The FPP specifies that units 1, 2, and 3, be given operating priority for fish passage.

Tailrace limitations - Adverse hydraulic conditions (eddy at JBS outfall) during periods of high spill (spillway flows of 60 to 70 kcfs) have been observed at this project but have not yet been calibrated. Inseason observations indicate that spill levels of 50% or less may be necessary to minimize the eddy below the powerhouse. Due to the lack of specific data, the need for spill limitations to minimize this eddy will be assessed inseason by the TMT. Based on radio-tracking studies with adult chinook, performed during 1997, a spill level of 40 kcfs should not adversely affect adult passage (C. Perry, ICFWRU, fax to J. Ceballos, NMFS, dated April 9, 1998).

Navigation limitations - Barge loading for the juvenile transportation program normally occurs in the evening hours and has in the past been hampered by voluntary spill. A new mooring dolphin has been installed and is expected to allow spill to continue during barge loading in 1998 and future years. However, spill it may be necessary to temporarily reduce spill to accommodate the loading process.

Ice Harbor Dam

Hydroacoustic studies conducted by BioSonics, Inc., for the Corps have indicated a relatively flat diel passage distribution for juvenile migrants through this spillway. This passage pattern supports continued 24-hour spill this project.

Dissolved gas limitations - Spillway flows at Ice Harbor Dam will increase due to the additional spill deflectors installed during 1997. Spillway flows resulting in 120% TDG saturation (with eight of ten spillbays equipped with deflectors) is anticipated to be approximately 75 kcfs.

Powerhouse flow limitations - Powerhouse hydraulic capacity with unit operation within one percent of peak efficiency is approximately 94 kcfs. The BPA has specified 7.5 to 9.5 kcfs as the range of minimum powerhouse flows for system reliability. Because this range of minimum flows is related to the status of generation at other projects, it may not be necessary at all times. The FPP specifies that units 1,3, 4, and 2, be given operating priority for fish passage.

Tailrace limitations - It may be necessary to reduce spill levels as spill levels approach total river flow levels in order to maintain good hydraulic conditions in the tailrace. Poor hydraulic conditions resulting in large tailrace eddies can reduce adult passage efficiency and increase predation on juveniles passing through the spillway and bypass system. Preliminary modeling studies of tailrace spill patterns have been conducted for the purpose of optimizing spill patterns, however, specific spill volume limitations (other than for barge traffic) have not been determined. Past radio-tracking studies on adult passage indicate that a daytime spill cap of approximately 45 kcfs is necessary to maintain good adult passage (Turner et al. 1984). This daytime cap should be in effect from 0500 to 1800 hours. Preliminary data indicate that a spill level higher than 45 kcfs appears not to adversely impact adult passage (C. Perry, ICFWRU, fax to J. Ceballos, NMFS, dated April 9, 1998). However, no change is proposed for the 1998 season.

Navigation limitations - Under current conditions, spill flow presently causes problems for barge traffic exiting the navigation lock when river flows exceed 100 kcfs. The Corps has indicated that they will reduce spill as long as is necessary to pass navigation traffic. An alternative spill schedule for this purpose is included in the Corps' Fish Passage Plan. Temporary modifications to FPP spill patterns to improve navigation conditions will not be necessary once coffer-cell construction below the spillway is completed during the winter of 1998-99.

McNary Dam

Continue 12-hour nighttime spill and the secondary bypass of juvenile salmonids back to the river.

Dissolved gas limitations - Depending on ambient forebay gas levels, spillway flows at which the 120% TDG cap is reached may range between 120 and 160 kcfs.

Powerhouse flow limitations - Powerhouse hydraulic capacity with unit operation within one percent of peak efficiency is approximately 170 to 175 kcfs. This low capacity will cause involuntary spill to occur at normal spring flow levels. The BPA has specified a minimum powerhouse flow of 50 kcfs to maintain power transmission system stability. The FPP specifies that units 1,2, and 3 be given operating priority for fish passage.

Tailrace limitations - A reduction in spill levels may be required at high spill percentages to maintain good hydraulic conditions for juvenile and adult passage in the tailrace. However, observations in the tailrace during high spillway flows have not indicated a problem. This may be due to the bathymetric and shoreline configuration of this tailrace which tends to force powerhouse flow in a northwesterly direction (i.e., toward the spillway side of the river) as it moves downstream.

Nevertheless, because specific modeling of tailrace spill patterns for the purpose of identifying limitations to spillway flow under a variety of flow and unit operation conditions, the need for limitations should be assessed inseason by the TMT.

John Day Dam

Spill at John Day Dam will increase during 1998 due to completion of spillway flow deflectors during late 1997. Twenty-four hour spill should be investigated during 1999. High spillway effectiveness and high daytime passage were noted during 24-hour spill studies performed during 1997 (Memo for the Record from B. Dach, U.S. Army Corps of Engineers, February 3, 1998). Effectiveness was highest during the summer but daytime passage was much higher than expected during both spring and summer indicating a potential decrease in forebay residence time and subsequent predator exposure in this area.

Dissolved gas limitations - Nearfield TDG tests conducted during early 1998 indicate that spill volumes generating 120% TDG may be as high as 180 kcfs. Actual spill volumes will have to be determined in season because forebay gas level will probably affect this estimate.

Powerhouse flow limitations - The BPA has specified a minimum powerhouse flow of 50 kcfs to maintain power transmission system stability.

Tailrace limitations - Spill volume at this project will be limited by tailrace conditions under high spill percentages and medium-to-low total river volume. In the gas cap-limited spill scenario illustrated in Table C-3 (above), 144 kcfs out of 240 kcfs total flow (i.e., 60%) was spilled. Based on modeling studies at the Corps' Waterways Experiment Station, under a variety of simulated flow levels, this percentage of spill is the maximum that does not cause the formation of a large eddy below the powerhouse, particularly in the vicinity of the juvenile outfall. These modeling studies also indicated that at least 25-percent spill was needed to create acceptable tailrace conditions below the spillway. Additional modeling studies, scheduled prior to the start of the 1998 spill season, will help refine these limits.

The Dalles Dam

No change is recommended to the current spill scenario at The Dalles Dam (other than those necessary for research) until the ongoing spill studies are completed. Research completed to date indicates that this spillway is not a benign passage route although it may be very efficient in passing fish. After one year of research, the survival study has indicated that, under very high spill levels (greater than 250 kcfs), the survival of the test fish (coho and subyearling chinook) was lower than anticipated (86% to 93%) (Dawley et al. 1998 - Draft Report). The survival of subyearling chinook was higher. These fish were passed through the system under lower spill levels, indicating a possible connection between spill volume and survival. Also, percentages of spill greater than about 40% send increasing amounts of water and fish over shallow rocky shelves just downstream of the spillway. Fish swept into these areas are more likely to fall victim to predation than fish that stay in the main channel. It is unknown if this predation reduces spill survival to something less than turbine survival. However, increasing spill above the 40% level is likely to move in the direction of increased harm. More information is needed before any management changes are warranted. Any spill management changes indicated by the results of survival and spill effectiveness studies at The Dalles Dam will be implemented in a timely manner through the Regional Forum process.

Dissolved gas limitation - Depending on ambient dissolved gas levels in the forebay, the 120% TDG cap can be as high as 230 kcfs at this project.

Powerhouse flow limitations - The BPA has specified a minimum powerhouse flow of 50 kcfs to maintain power transmission system stability.

Tailrace limitations - Because of NMFS concern for juvenile survival through the spillway at high spill percentages and volumes, it is recommended that spill be limited to the 1995 FCRPS Biological Opinion level of 64% (rather than spilling to the TDG gas cap). The ongoing studies on passage survival and spill efficiency and effectiveness must be completed. In addition, and pending results of another year of survival studies, scoping should begin on methods to improve spillway survival at this dam (e.g., reconfigure the hydraulic characteristics of the stilling basin to reduce juvenile residence time).

Research limitations - Limited hydroacoustic data from 1996 studies indicate that 30% spill may be as effective at passing fish as the 64% required in 1995 RPA Measure 2 (BioSonics, Inc. 1997). Unfortunately, only three days of valid tests were completed at the 30% spill level. Additional tests during 1998 will help define this issue. Spill will be limited to 30% for approximately 50% of the 1998 fish passage season.

Bonneville Dam

No change is recommended to the Bonneville Dam spill scenario at this time. Spill, and therefore FPE, is limited by a relatively low TDG cap and by concerns for adult fallback during the daylight hours. These two issues should be the focus of continued research. Specifically, the Action Agencies should continue the ongoing project-specific gas abatement program for Bonneville Dam with focus on evaluating endbay flow deflectors and eliminating deep holes in the near tailrace. This work must also consider the effects that the implementation of gas abatement measures may have on passage and the safety of adult and juvenile salmonids. The ongoing study to reduce fallback of adults through the spillway should be expedited.

Dissolved gas limitation - Depending on ambient forebay dissolved gas levels, the 120% TDG cap is in the 100 to 150 kcfs range and averages about 120 kcfs at this project.

Powerhouse flow limitations - The BPA has specified a minimum powerhouse flow of 30 kcfs.

Tailrace limitations - The current spill pattern for Bonneville Dam was determined in modeling studies conducted in the early 1990's. These same studies indicated that a minimum spill level of 50 kcfs was necessary for adequate tailrace hydraulic conditions. There is no maximum spillway flow cap for fish passage. Because of the unique configuration of Bonneville Dam, flow from the spillway does not directly affect tailrace patterns below either of the two powerhouses.

Adult fallback limitation - Adult fallback through the spillway is known to be correlated to spill flow (Monan and Liscom 1975). The current spill cap for daylight hours is 75 kcfs.

APPENDIX F

NORTHWESTERN DIVISION POLICY ON SPILL AND TOTAL DISSOLVED GAS

Water Management Division
Environmental Resources Division
Operations and Construction Division

21 November 1996

North Pacific Division Policy
on Spill and Total Dissolved Gas

IMPLEMENTATION GUIDELINES

1. Instances that could lead to spill and potential high levels of TDG include but are not limited to the following:

- special reservoir operations associated with endangered species or water quality elements
- scheduled and unscheduled unit outages
- flood control or dam safety operations
- pre-approved research studies
- special operational constraints allowed/required for construction or maintenance
- contract work.

In those instances, types of remedial and/or preventive actions that may be considered include the following:

- storing excess runoff at upstream reservoir(s);
- minimizing the number of nonfunctioning turbine units;
- distributing the spill over longer hours;
- spreading spill to other projects;
- operating turbines outside the 1% peak efficiency flow range;
- changing spillway gate settings and/or spill patterns;
- avoiding spill that produces excess TDG during fish passage periods;
- revising or rescheduling activities to occur during low flow periods.

2. When there is a voluntary or planned spill operation that is likely to cause high TDG levels, the states and other affected parties will be kept informed in a timely manner directly or through existing management processes (such as Technical Management Team). Information to be provided will include:

- spill location(s) and amount(s);
- time duration and area coverage;
- predicted dissolved gas levels;

- monitoring plan(s); and
- preventive measure(s) planned or already in place.

If the spill operation mentioned earlier has also the potential for impacting ESA-listed fish species, information will be provided to the National Marine Fisheries Service and/or the U.S. Fish and Wildlife Service (depending on which agency has jurisdiction), and other interested federal and regional agencies or offices via direct communication or existing mechanism (such as the Technical Management Team). This information will be updated periodically as long as conditions warrant. Coordination through established forums (e.g. Technical Management Team) will be extended to all other state, tribal, Federal and regional agencies that are interested in the effects of spill on aquatic resources, including but not limited to ESA-listed stocks.

3. During periods of high runoff or other circumstances that require spilling over several or all projects in the hydropower system, a spill priority list will be developed in coordination with the Technical Management Team and other entities and implemented. The spill priority list will specify the order in which the projects should spill and the spill caps at each of those projects. The overall objective is to avoid creating localized detrimental dissolved gas concentrations where ESA-listed species and other resident species are present.

4. To minimize the cumulative effects of dissolved gas supersaturation, consideration will be given to spilling at the lower Columbia River projects before spilling at the upper Columbia and lower Snake Rivers projects. Projects that show the least propensity to create high TDG levels will be given first consideration. All projects in the Columbia River Basin, including appropriate Willamette River projects, may be placed on the spill priority.

5. Although water quality monitoring is a year-round responsibility, it is recognized that currently dissolved gas monitoring instruments are usually not in operation in the winter and that not all sites are monitored on a continuous basis. To carry out this water quality policy, both short and long-term actions will be implemented as explained below.

a. For the short-term, the Corps plans to respond quickly to meet data collection, analysis and additional monitoring requirements. Adequate inventory of data collection and transmission equipment will be maintained to allow for rapid installation at critical points along the river. The necessary predictive modeling capability will also be developed and maintained to evaluate operational scenarios. Data from short-term sampling stations will be correlated with the data from the regular network to fill in data gaps.

b. For the long-term, a small skeleton network will be established for year-round monitoring of dissolved gas at projects where spill is most likely to occur and where conditions exist for controlling spill. The Corps will also continue to evaluate and monitor various aspects of water quality management and its effects on the ecosystem in the framework of overall water resources management, and ensure that the results are shared with all interested parties.

6. Functional elements responsible for carrying out this policy and their respective roles are as follows:

North Pacific Division

Reservoir Control Center**:**

- develop and update the spill priority list to reflect fish movement or input received from the Districts;
- coordinate field monitoring with the districts;
- perform data analysis and model prediction;
- coordinate with Division and District Environmental Resources staff on biological constraints and requirements and any potential ESA implications;
- plan and coordinate real-time operation with BPA, the districts and the projects and other project owners;
- assure implementation of the Fish Passage Plan or coordinate necessary deviations;
- issue operational instructions to the projects;
- monitor actual implementation of these instructions and make adjustments as needed; and
- provide status reports to other Division and District elements and outside agencies.

Environmental Resources:

- coordinate necessary deviations of the Fish Passage Plan as needed;
- in consultation with District elements, provide biological support, including determination if an action has the potential for affecting an ESA-listed stock or result in adverse modification of critical habitat;
- coordinate or participate in coordination with NMFS and/or U.S. Fish and Wildlife Service and District staff as needed on ESA issues involving listed stocks;
- make recommendations on biological constraints (e.g. in-water work windows) and requirements, in consultation with the Districts

Operations and Construction:

- coordinate planned actions (e.g. maintenance) developed by the districts with appropriate Division elements;
- assure that any operations that may impact ESA-listed stocks have been coordinated prior to implementation; and
- provide an after-the-fact documentation for emergency actions.

Pacific Salmon Coordination Office:

- provide guidance on policy decisions; and
- provide regional interface on spill-related issues at the policy level

Office of Counsel:
- provide legal advice and support as needed.

Alaska, Portland, Seattle and Walla Walla Districts

Districts Water Quality/Water Management Elements:
- install, operate and maintain dissolved gas monitoring stations;
- collect and transmit total dissolved gas and other data to the Reservoir Control Center;
- conduct TDG abatement studies;
- evaluate station accuracy in representing TDG conditions in the river/reservoir;
- advise and recommend operations to minimize high dissolved gas levels to the RCC, and
- coordinate planning and scheduling of special reservoir operations with the Reservoir Control Center and other District elements.

District Operations and Construction Division:
- develop schedules for maintenance and service of project facilities and equipment that potentially require spill;
- coordinate planning and scheduling of special reservoir operations required by maintenance and schedule and construction activities with the Reservoir Control Center, other District elements; and contractors; and
- advise and recommend operations to minimize high dissolved gas levels.

District Environmental Resources Section
- in consultation with Division's Environmental Resources staffs, provide biological support, including determination if an action has the potential for affecting an ESA-listed stock or result in adverse modification of critical habitat;
- in coordination with Division Environmental Resources, assure implementation of the Fish Passage Plan or coordinate necessary deviations;
- coordinate or participate in coordination with NMFS and/or U.S. Fish and Wildlife Service and Division Environmental Resources staff as needed on ESA issues involving listed stocks;
- make recommendations on biological constraints (e.g. in-water work windows) and requirements, in consultation with the Division Environmental Resources staff, and.
- in cooperation with the Projects, provide reports on emergency operations that may have impacted aquatic resources (particularly ESA-listed stocks) and estimated duration and extent of effects.

District Office of Counsel:

- provide legal advice and support as needed, especially for ESA/NEPA issues, and
- provide litigation support.

Projects:

- identify maintenance requirements as far in advance as possible to enable proper advance coordination;
- carry out reservoir operations as instructed by the Reservoir Control Center;
- report back on operational and other problems needing attention, including fish conditions affected by TDG;
- advise and recommend operations to minimize high TDG levels;
- identify and recognize ESA requirements in implementing reservoir operations; and
- provide reports on emergency operations that may have impacted aquatic resources (particularly ESA-listed stocks) and estimated duration and extent of effects.

APPENDIX G

GUIDELINES FOR DEWATERING AND FISH HANDLING PLANS

Guidelines for Dewatering and Fish Handling (Salvage) Plans

Each Corps of Engineers mainstem project on the Columbia and Snake rivers have dewatering and fish handling plans which cover the dewatering of various project facilities which may contain fish at the time of dewatering. The plans contain procedures for any handling or salvaging of fish within a facility or project area when it is dewatered. All dewatering and fish handling plans should be reviewed and revised where appropriate to reflect any new information and guidelines listed below. The plans shall be reviewed by the Fish Passage O&M Coordination Team.

Coordination: The dewatering and fish handling (salvage) plan for each project shall include coordination procedures for planned and emergency fish salvage activities. The project fishery biologist shall coordinate all fish salvage activities with project and District personnel.

Fish Salvage Briefing: The plans shall include a requirement that a fish salvage briefing for <u>all participants</u> involved in a dewatering activity be held prior to each dewatering activity. The briefings should lay out responsibilities for each participant in the dewatering activity. All emergency fish salvage operations will be coordinated and overseen by the project fishery biologist or fisheries staff if possible.

Personnel: The dewatering plans shall specify the number and specialization of personnel required for each type of dewatering activity. Personnel for fish salvage include the project fishery biologist, fisheries staff, crane operators, riggers, winch operators, forklift operators, and maintenance workers. To minimize fish stress and mortality, adequate personnel must be available for fish salvage activities.

Facilities and Dewatering Procedures: The salvage plans shall be project specific and shall contain step by step dewatering and fish salvaging procedures for all facilities and project features which may contain fish. The most common areas include adult fish ladders and collection channels, juvenile bypass systems, juvenile fish sampling facilities, turbines scroll cases and draft tubes, gatewell slots, and navigation locks. Individual projects may have other facilities or features that contain fish. The plans shall specify how the facility is to be dewatered and where and how fish are to be salvaged. Each project shall have designated release sites for the various types of fish expected to be encountered during each dewatering activity.

Fish Handling Equipment: The plans shall specify all fish handling equipment required for handling fish during each type of dewatering activity. Typical fish salvage equipment includes gloves, hand held fish nets, seines, fish buckets, gatewell dip baskets, and fish transportation tanks and vehicles. All equipment should be in good condition and pre-positioned before dewatering begins.

Support Equipment: The plans shall include a detailed listing of all support equipment required for each dewatering activity. This should include items such as hard-hats, boots, safety harnesses, flashlights, portable radios, ladders, cranes, man-baskets, pumps, forklifts, and any other equipment required for a dewatering activity. The plans shall specify where equipment is required for use during a dewatering, where certain equipment should be pre-positioned before work begins, and the heavy equipment needed for fish salvage activities.

Fish Safety Pools: The fish salvage plans shall identify the areas in each facility which pond enough water to hold fish temporarily. The plan shall specify whether the safety pools are usually maintained by leakage or a controlled water flow. The plans shall specify how long and under what conditions each safety pool can be used to hold fish safely. If the there is the potential for the safety pools to freeze over or loose their water source, the fish should be evacuated as soon as possible.

Fish Handling Procedures/Practices: The plans shall include procedures to minimize fish mortality and stress. The primary fish handling objective will be to collect and transport fish to release sites with minimal stress and without injury or mortality to any fish. Plans shall specify the details of all fish handling activities including how to crown and handle fish within each facility, specifics on the number of fish which can be hauled or transported in containers or transport tanks at varying water temperatures, and how and where to release fish at each project.

Fish Handling Guidelines: General fish handling guidelines which should be reflected in fish handling/salvage plans are detailed here. Adult salmonids and other large adult fish should be salvaged first. Netting of fish should be minimized whenever possible. Fish should not be crowded in the holding containers. Fish will be less stressed in larger containers (300 gallons or larger preferred), in colder water, and with supplemental oxygen or aeration. If fish are transported in warmer water (>65^{o} F), fewer fish should be transported in a container and holding times should be shorter. All fish will be returned to the river as soon as possible at specified, predetermined release sites. Fish should not be held in holding tanks or containers for more than two hours under any circumstances. Fish should be released from the holding tanks into the river as soon as the fish salvage operation stops for any reason. Fish should be carefully released into the tailwater or forebay with a short vertical drop to the river. Fish release slides are desirable. The water temperature in the transport tank should be monitored. The water temperature in the transport or holding tanks will not be more than 2^{o} F different from the river water. Fish should be removed prior to debris removal if possible.

Fish Salvage Report: The fish salvage plan should include a report form for the fish salvage operations. These forms should be completed for all fish salvage activities and kept permanently on file at each project.

APPENDIX H

FISH SAMPLING PROTOCOLS FOR TRAPPING OPERATIONS IN THE BONNEVILLE DAM ADULT FISH COLLECTION AND MONITORING FACILITY

Fish Sampling Protocols for Trapping Operations in the Bonneville Dam Adult Fish Collection and Monitoring Facility (AFC&MF)

1. **General.** The following protocols will be implemented by agencies conducting research in the AFC&MF. Trapping will not occur when fish ladder water temperatures exceed 74°F as measured at the top of the return ladder. These protocols were coordinated and adopted through the Fish Passage Operation and Maintenance (FPOM) Coordination team and the Fish Passage Advisory Committee (FPAC).

2. **General requirements for AFC&MF users.** All personnel conducting research in the AFC&MF will implement the following requirements.
   - **a.** Users must have appropriate documentation for conducting research at the dam. (See Guide for Researchers at Bonneville Dam).
   - **b.** Users must have a valid ESA Section 10 Permit that covers all listed species passing the project during the trapping period and users shall comply with all fish handling conditions in the permit. **Note: If Section 10 conditions are more restrictive than the following protocols, users must follow Section 10 conditions.**
   - **c.** Hard hats are to be worn at all times. A headpiece with magnifying glass for monitoring GBT is also acceptable.
   - **d.** Long pants or raingear are to be worn at all times. Shorts or sweats will not be permitted in the lab.
   - **e.** Steel-toed shoes or steel-toed rubber boots are to be worn at all times. No tennis shoes or sandals will be permitted.
   - **f.** Users will notify project biologists when they arrive on site and when they depart (x3551, x3375, or x3552). If users supply the project biologists with a season schedule, it will not be necessary to notify project biologists upon arrival and departure. If users are on site during non-business hours (1700-0630), Monday through Friday or anytime on the weekends, they are required to contact the control room (x221 or x222) when they arrive and when they depart.
   - **g.** Users will lower the main ladder picket leads and downstream exit bulkhead when they arrive, if necessary, and raise the picket leads and downstream exit bulkhead when they are completed for the day unless other arrangements are made.
   - **h.** Users will be permitted to operate valves 9 and 10 to control flow down the flumes at their discretion and the raw water booster pump. It is recommended that valves 9 and 10 remain open 55% and 40%, respectively. Users will not be permitted to operate any other valves or the overhead crane unless permitted to do so through the project biologists.
   - **i.** Users will record the times picket leads are lowered and raised, which agency they are representing and water temperatures when they arrive, at 1200 and 1500 hours, each day they are using the AFC&MF. Temperatures will be recorded from the temperature probe at the top of the return ladder. A spreadsheet will be provided by project biologists and located by valves 9 and 10.
   - **j.** Users must use a cotton mesh net, which is large enough to safely handle the largest fish passing the project during the trapping period.

3. **Trapping protocols during the fish passage season (from 15 March through 30 November) when fish ladder water temperatures are <70°F.** Personnel conducting research during this time are required to be present in the AFC&MF to divert desired fish into the anesthetic tank using the flume swing gates. Undesired fish will be bypassed to the return pool. No diversion into or holding of fish in the braille pool will be allowed. The purpose of these protocols is to provide precautionary measures to limit delayed mortality resulting from stress when handling fish.
   - **a.** There will be no time restriction for trapping operations.
   - **b.** There will be no more than 4 chinook, or 6 steelhead, or 6 sockeye, or a combination of 6 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.
   - **c.** There will be no more than 6 adult salmonids allowed in the recovery tank at any one time.
   - **d.** Water in the anesthetic tank will be replaced at least two times per day. Water temperatures in the anesthetic tank will be maintained within 1°C of the fish ladder water temperature. **Note: If anesthetic tank water temperature exceeds 70°F, criteria in section 4 will go into effect.**
   - **e.** Water in the recovery tank will be running continuously allowing a constant exchange of water through the tank.
   - **f.** Personnel shall ensure fish are sampled as quickly as possible. It is recommended that it takes 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.
   - **g.** Personnel shall ensure that fish are fully recovered from anesthetization prior to release into the return ladder.
   - **h.** When trapping is completed for the day, users will raise the main ladder picket leads and the downstream exit bulkhead.

4. **Trapping protocols during the fish passage season (from 15 March through 30 November) when fish ladder water temperatures are between 70 and 74°F.** Personnel conducting research during this time period are required to be present in the AFC&MF to divert desired fish into the anesthetic tank using the flume swing gates. Undesired fish will be bypassed to the return pool. No diversion of fish into or holding of fish in the braille pool will be allowed. The purpose of these protocols are to provide precautionary measures to limit delayed mortality resulting from stress when handling fish during warm water conditions. If ladder water temperatures exceed 74°F during any time of the day when the AFC&MF is operating, trapping will be suspended immediately. The Corps reserves the right to terminate trapping operations at any time.
   - **a.** Trapping will only be allowed between 0600-1200 hours each day. The morning operations are to take advantage of the water-cooling that occurs overnight.
   - **b.** 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.
   - **c.** There will be no more than 3 adult salmonids allowed in the recovery tank at any one time.
   - **d.** Assure oxygen levels are maintained at saturation in the anesthetic and recovery tanks. Provide aeration as necessary to maintain oxygen levels the same as in the fish ladder water. In other words, there will be no depression in oxygen levels in the anesthetic or recovery tanks regardless of numbers of fish in and through the tank. To assure this, water in the anesthetic tank will be replaced at least every three hours.

- **e.** Water in the recovery tank will be running continuously allowing a constant exchange of water through the tank.
- **f.** 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, at least, from an un-chlorinated water source. Do not exceed a 3°F difference between the anesthetic or recovery tank water and fish ladder water.
- **g.** Personnel shall ensure fish are sampled as quickly as possible. It is recommended that it takes 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.
- **h.** Personnel shall ensure fish are fully recovered from anesthetization prior to release into the return ladder.
- **i.** When trapping is completed for the day, users will raise the main ladder picket leads and the downstream exit bulkhead.

5. Winter trapping protocols, from 1 December through 14 March. Personnel conducting research during this time are not required to be present in the AFC&MF. Users are allowed to activate the flume swing gates to divert all fish into the braille pool. The purpose of these protocols is to provide precautionary measures to limit passage delay, and stress from overcrowding in the braille pool.

- **a.** Sampling will occur on a daily basis.
- **b.** Fish will not be permitted to remain in the braille 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, reducing delay.
- **c.** During sampling, the braille 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 braille pool into the anesthetic tank, the braille pool will be lowered back to its full depth.
- **d.** 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.
- **e.** There will be no more than 3 adult salmonids allowed in the recovery tank at any one time.
- **f.** Water in the recovery tank will be running continuously allowing a constant exchange of water through the tank.
- **g.** Personnel shall ensure fish are sampled as quickly as possible. It is recommended that it takes 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.
- **h.** Personnel shall ensure fish are fully recovered from anesthetization prior to release into the ladder.
- **i.** If daily sampling can not occur on weekends, the main ladder picket leads and downstream exit gate will be raised following completion of sampling on Friday. The flume swing gates are to be deactivated to allow fish to pass freely into the return pool.

APPENDIX I

LIST OF ACRONYMS

List of Acronyms

ADCP	Acoustic Doppler Current Profiler	MU	Main Unit
ADV	Acoustic Doppler Velocimeter	MW	Megawatts
AFC&MF	Adult Fish Collection & Monitoring Facility	N	North
AWS	Auxiliary Water Supply	NDE	North Downstream Entrance
BGS	Behavioral Guidance Structure	NE	North Entrance
BI	Bradford Island	NFE	North Fishway Entrance
BON	Bonneville	NFH	National Fish Hatchery
BPA	Bonneville Power Administration	NMFS	National Marine Fisheries Service
BRZ	Boat Restricted Zone	NPE	North Powerhouse Entrance
CBFWA	Columbia Basin Fish and Wildlife Authority	NSE	North Shore Entrance
CBTT	Columbia Basin Teletype	NUE	North Upstream Entrance
CENWP	Portland District	O&M	Operations and Maintenance
CENWW	Walla Walla District	OFC	Outlet Flow Control
CFS	Cubic Feet per Second	OG	Orifice Gate
CI	Cascades Island	OOS	Out of Service
COE	Corps of Engineers	OPE	Orifice Passage Efficiency
DSM	Downstream Migrant (channel)	PDS	Primary Dewatering Structure
E	East	PIES	Project Improvements for Endangered Species
EPA	Environmental Protection Agency	PIT	Passive Integrated Transponder
ERG	Emergency Relief Gate	PLC	Program Logic Controller
ESA	Endangered Species Act	PSMFC	Pacific States Marine Fisheries Commission
ESBS	Extended-Length Submersible Bar Screen	PST	Pacific Standard Time
EW	East Weir	PUD	Public Utility District
FDS	Fish/Debris Separator	RCC	Reservoir Control Center
FERL	Fish Engineering Research Laboratory	S	South
FFDRWG	Fish Facilities Design Review Work Group	SBC	Surface Bypass Collector
FFU	Fisheries Field Unit	SDE	South Downstream Entrance
FG	Fish Gate	SE	South Entrance
FGE	Fish Guidance Efficiency	SFE	South fishway Entrance
FPC	Fish Passage Center	SG	Sluice Gate
FPE	Fish Passage Efficiency	SMF	Smolt Monitoring Facility
FPOM	Fish Passage O & M (Coordination Team)	SO	Sluice Oregon
FPP	Fish Passage Plan	SPE	South Powerhouse Entrance
fps	Feet Per Second	SPO	Special Project Operations
FV	Fish Valve	SSE	South Shore Entrance
IHR	Ice Harbor	STS	Submersible Traveling Screen
ISO	International Standardization Organization	SUE	South Upstream Entrance
JBS	Juvenile Bypass System	SW	Sluice Washington
JDA	John Day	SWI	Simulated Wells Intake
JFTP	Juvenile Fish Transportation Plan	TDA	The Dalles
JMF	Juvenile Monitoring Facility	TDG	Total Dissolved Gas
JP	Junction Pool	TIE	Turbine Intake Extension
kcfs	Thousand cfs	TMT	Technical Management Team
LCRAS	Lower Columbia River Adult Study	UMT	Upstream Migrant Transportation (channel)
LGS	Little Goose	VBS	Vertical Barrier Screen
LGW	Lower Granite	W	West
LMN	Lower Monumental	WDFW	Washington Department of Fish and Wildlife
MCN	McNary	WES	Waterways Experiment Station
MOP	Minimum Operating Pool		