US Army Corps of Engineers®
Northwestern Division

Fish Passage Plan
Corps of Engineers Projects

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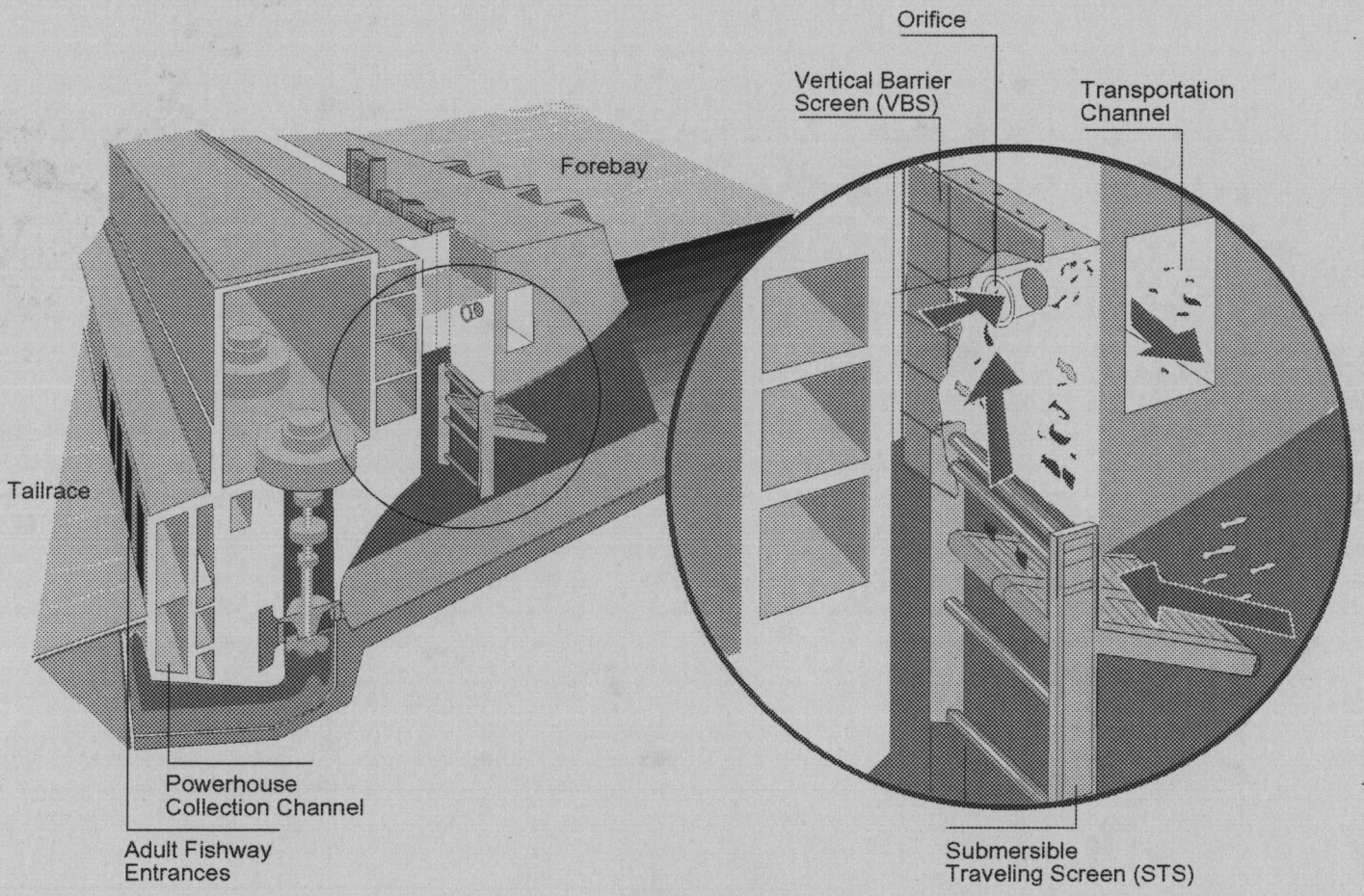

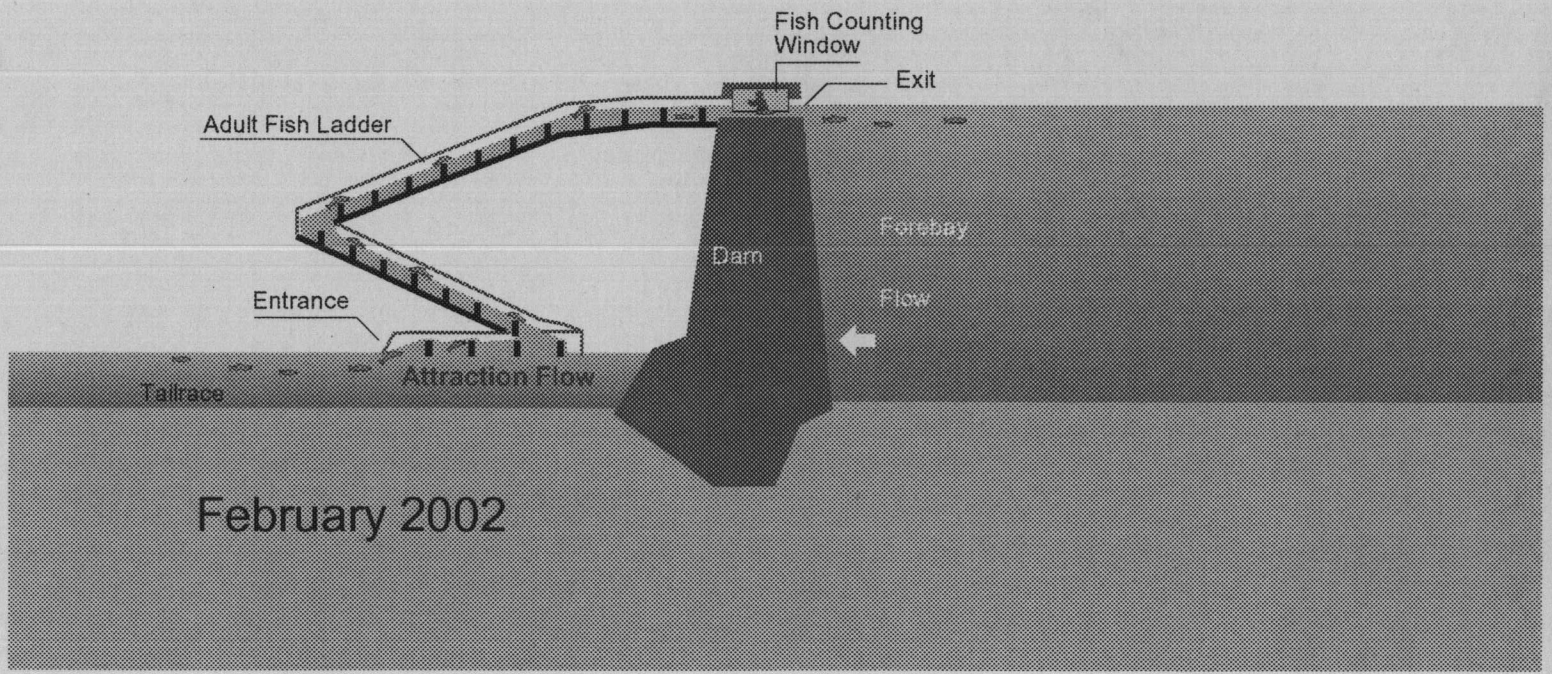

February 2002

FISH PASSAGE PLAN

FOR

CORPS OF ENGINEERS PROJECTS

U.S. ARMY CORPS OF ENGINEERS

NORTHWESTERN DIVISION

PORTLAND, OREGON

FEBRUARY 2002

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SECTION 1

OVERVIEW

1. Fish Passage Plan

1.1. Overview

The Fish Passage Plan (FPP) is developed by the U.S. Army Corps of Engineers (Corps) in coordination with the region's fisheries agencies, Indian tribes, Bonneville Power Administration (BPA), and other participants through the Corps' Fish Passage Operations and Maintenance Coordination Team (FPOM). The FPP describes year-round project operations necessary to protect and enhance anadromous and resident fish species listed as endangered or threatened under the Endangered Species Act (ESA), as well as other migratory fish species. The FPP guides Corps actions in regard to providing fish protection and passage at the eight Corps mainstem 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) and U.S. Fish and Wildlife Service (USFWS) as part of the ESA Section 7 consultation, Recovery Plan, or Section 10 permit processes, and through consideration of other regional input and plans. The current revisions reflect provisions contained in the NMFS Biological Opinion (BiOp), issued 21 December 2000 and titled "Reinitiation of Consultation on Operation of the Federal Columbia River Power System, Including the Juvenile Fish Transportation Program, and 19 Bureau of Reclamation Projects in the Columbia Basin", and the USFWS BiOp, issued 20 December 2000 and titled "Effects to Listed Species from Operations of the Federal Columbia River Power System". The Corps prepared a "Record of Consultation and Statement of Decision" relative to these BiOps in May 2001, stating how BiOp measures will be implemented to protect multiple ESA-listed fish species. Also, the Corps has prepared 1-year and 5-year Operations and Maintenance (O&M) implementation plans, as called for in the 2000 NMFS BiOp. Longer term project actions to increase capability and reliability of project fish passage are described in those Plans. 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 fisheries 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 fisheries agencies and tribes when they deviate from the FPP.

1.3. Technical Management Team. In-season decisions on river operations to achieve BiOp performance standards 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 Plan.

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, and nightly spill is provided at John Day Dam for spring and summer outmigrants to meet BiOp measures. Also, continuous spill

is normally provided in the spring at Lower Monumental Dam; however, in 2002 spill will be curtailed due to stilling basin erosion and scheduled repair work. Nightly spill is provided at McNary, Little Goose, and Lower Granite Dams for spring outmigrants. Spill may also be provided under special circumstances for non-listed fish species if recommended by the fisheries agencies and tribes and if the recommendations are consistent with regional operational agreements (i.e., Spring Creek National Fish Hatchery release in March). No spill will be allowed at Lower Monumental Dam in 2002 while the stilling basin is being repaired.

1.5. Total Dissolved Gas (TDG) Monitoring. 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 is to operate each mainstem project to meet state standards insofar as physically possible unless other overriding reasons cause temporary deviations. The Corps also recognizes that the NMFS 2000 Biological Opinion calls for fish spill to be provided at levels that create higher TDG levels (Appendix E). Also, implementation of fish spill requests from fisheries 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. The Corps will take those actions necessary to coordinate with the region and provide spill to protect ESA-listed fish in 2002. 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 Opinion 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 of this document (project specific sections). Additional

criteria may be developed as part of the ESA Section 10 permit process and/or in coordination with the TMT. Implementation of juvenile fish transportation, including deviation from the plan described in Appendix B, will be coordinated through the TMT and with NMFS (ESA).

1.8. Project Fish Passage Facilities Inspection and Reporting Criteria.

1.8.1. General. Sections 2 through 9 of this document (project specific sections) 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 in Portland, Oregon describing out-of-criteria situations, adjustments made to resolve problems, and a detailed account of how out-of-criteria situations affected project fish passage and survival. The weekly inspection reports also include summaries of equipment calibrations, adult fish collection channel velocity monitoring, and water temperature monitoring. Equipment which does not require 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 fisheries 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 fisheries agencies and tribes on other project-specific operations that do not have system impacts.

The RCC participates in meetings of the TMT throughout the year that recommends river operations to implement the BiOps and other recommendations from fish interests. These meetings are held in the Corps' Northwestern Division office in Portland, Oregon, and are open to the public. Corps representatives are available at these meetings to discuss the latest weather and runoff forecasts, as well as fish, hydrologic, water quality, and power information to assist in the planning of upcoming operations for fish passage. Fish operation recommendations are evaluated by the Corps to determine impact on overall system operations. The Corps also coordinates with NMFS and USFWS to meet ESA requirements for listed species.

1.9.1. Agency Responsibilities.

1.9.1.1. U.S. Army Corps of Engineers.

a. Coordinate with NMFS and USFWS 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 Consultation and Statement of Decision.

c. In cooperation with the fisheries 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 fisheries 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. Fisheries Agencies and Indian Tribes.

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

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

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

d. Provide status reports on the timing of the downstream migration, including pertinent marked fish release and recovery data, with weekly written reports estimating percentage of 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 ESA-listed species. Provide and update hatchery release schedules weekly.

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

g. Provide information on all proposed and scheduled studies or special operations designed to improve fish passage operations 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 fisheries 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 fisheries 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. Coordination Process. Actions that may impact fish system wide will be coordinated and documented through the TMT process. Actions that may impact fish at a specific project which are a result of actual operations, implementation of RPA actions, incidental take terms and conditions contained in the 2000 BiOps, or research projects, will follow the coordination process outlined below.

The party responsible for the action will prepare and e-mail a memo to the NMFS point of contact who is responsible for activities at that dam, which describes the action, BiOp measure addressed, how the action may impact fish, and how the action has been designed to minimize impacts. NMFS will provide concurrence or recommended

changes in an e-mail response. This coordination process is described in a letter to Brigadier General Carl A. Strock from Brian J. Brown, U.S. Dept. of Commerce, NOAA, NMFS, dated 5 June 2001. A copy of this letter is available from the District Biologist.

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

a. Flow Augmentation and Reservoir Operations Recommendations. Procedures described in the Water Management Plan will be used for fish operations. Coordination for system and project operations will occur through TMT. This will include 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 BiOp fish spill provisions described in Appendix E, including special TDG conditions for juvenile fish passage. The TDG and gas bubble trauma signs in fish will be monitored and evaluated during the spill season by the Corps, NMFS, other fisheries agencies, tribes, and water quality agencies. Project spill levels will be adjusted as needed, based on daily physical and biological monitoring results, and coordinated with the TMT and tribes.

c. Special Operations Recommendations (Fish-related and for Project O&M Activities). Recommendations for special fish operations outside the Water Management Plan may be made to RCC. Coordination of these recommendations will be made through the TMT. Recommendations related to project O&M activities requiring special operations will be evaluated for impacts on fish migration. Sufficient lead time will be given on a planned operation, whenever practical, to allow coordination with the TMT, NMFS, and USFWS (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, USFWS, other fisheries agencies, and tribes will occur through the TMT. Except as necessary for emergency actions, adequate time will be allowed for evaluation of all project and fish impacts prior to implementation. Coordination of emergencies, as identified in the Emergency Protocols adopted by the TMT (Water Management Plan, Appendix 2), will be followed.

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

Bonneville Dam

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

1.1. Juvenile Fish Passage.

1.1.1. Facilities Description, 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 0) 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 12.5" orifices per gatewell in units 11-14 and fish unit 2, and one 12.5" orifice in all other gatewells flowing into a fish bypass channel, an excess water elimination facility, and a 48" fish transport pipe which connects the bypass channel to the tailrace. A 48" and 42" transport pipe at the high and low outfalls respectively, transport fish to the tailrace at the 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.

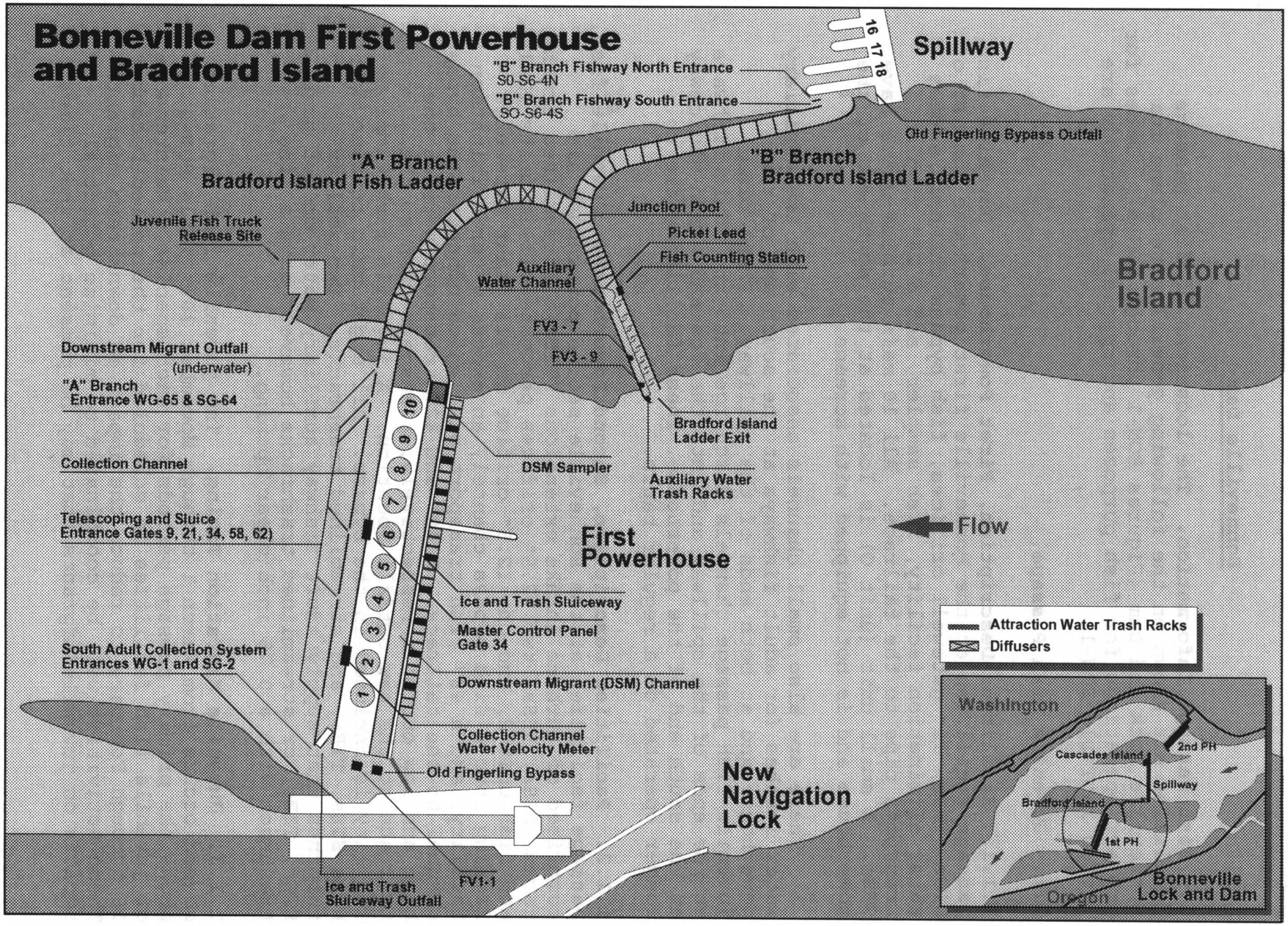

Figure BON-1 Bonneville Dam first powerhouse and Bradford Island fish ladder.

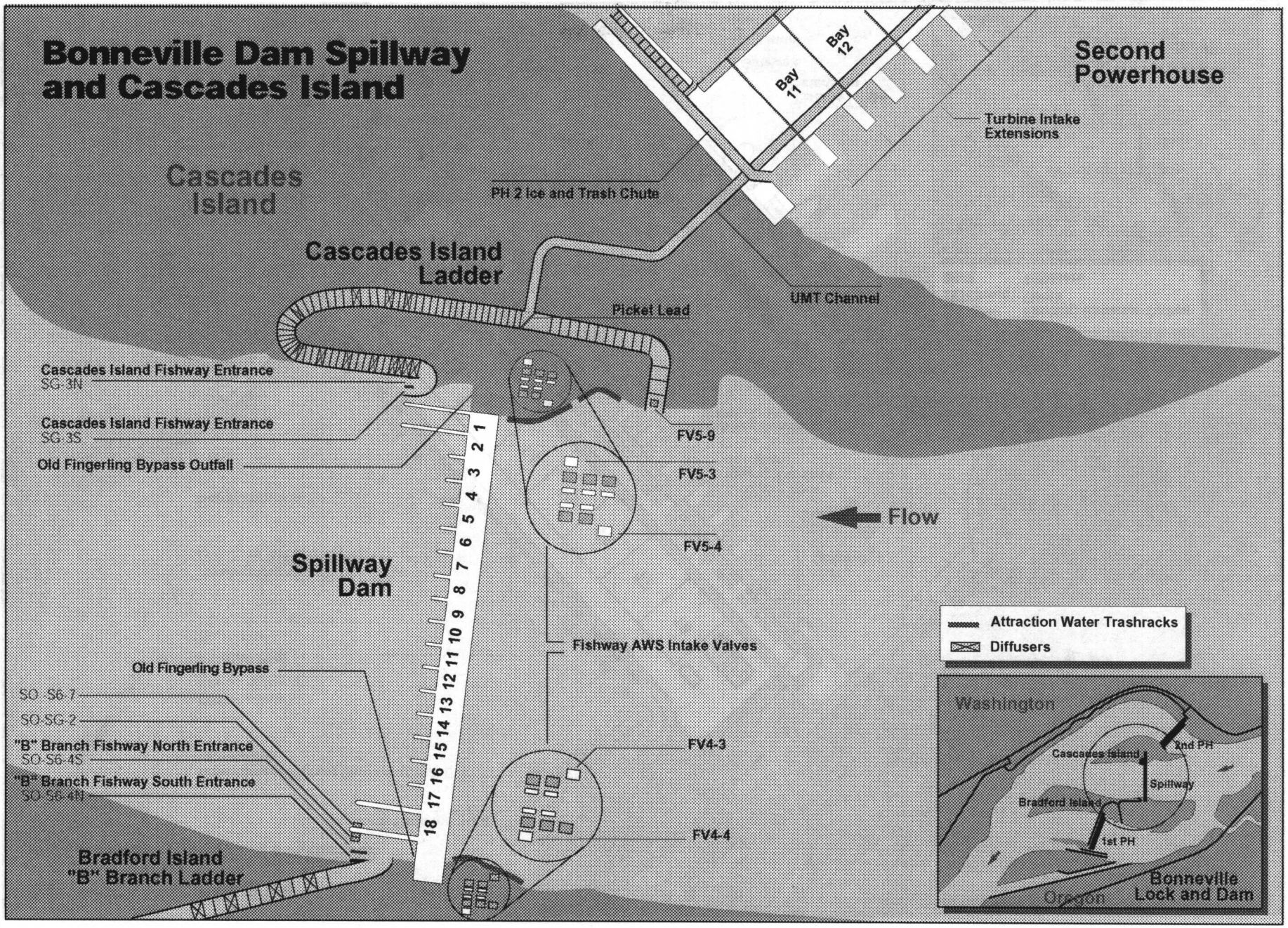

Figure BON-2 Bonneville Dam spillway, Cascades Island fish ladder and upstream migrant transportation channel (UMT).

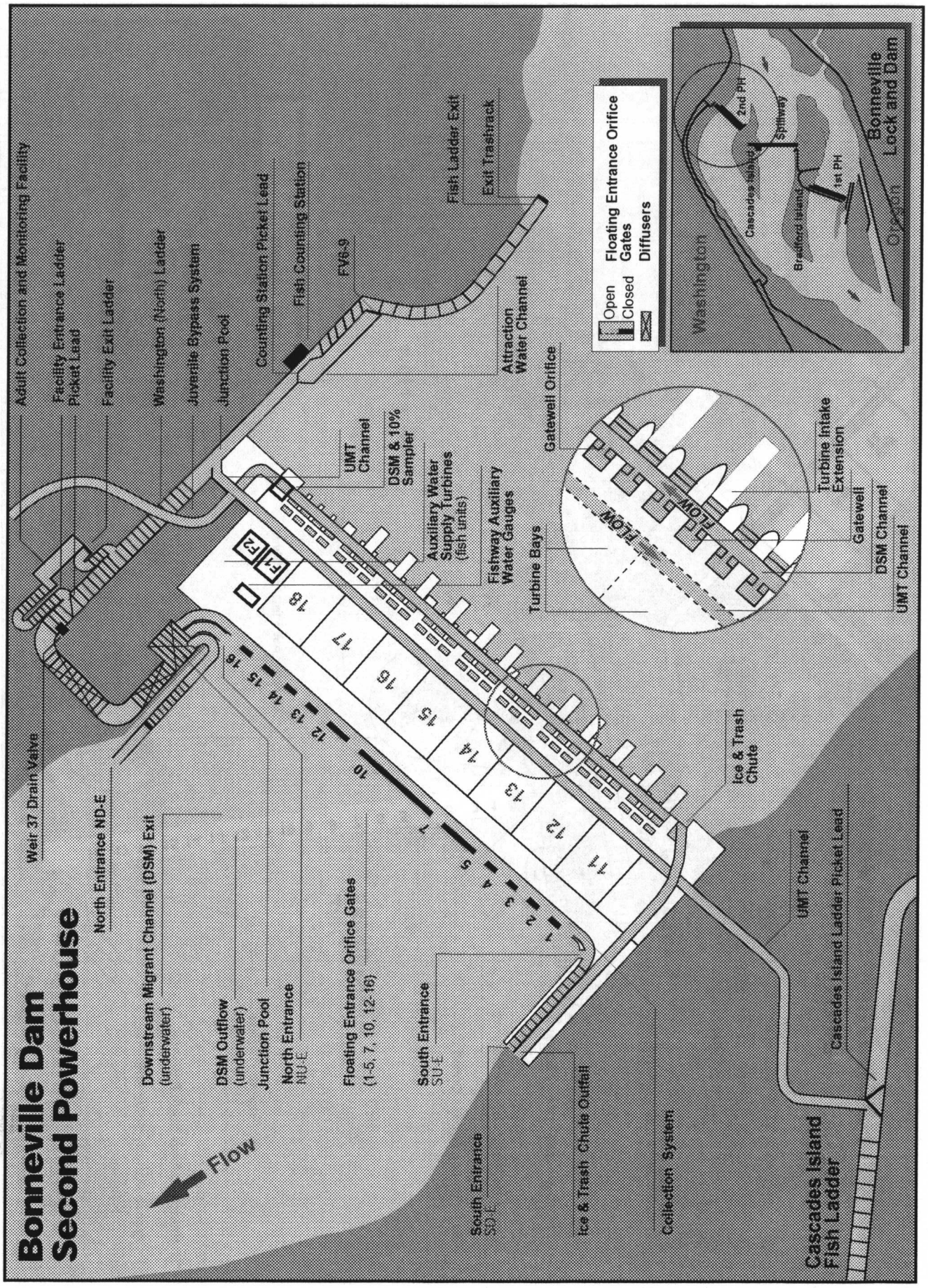

Figure BON-3 Bonneville Dam second powerhouse and Washington (north) fish ladder.

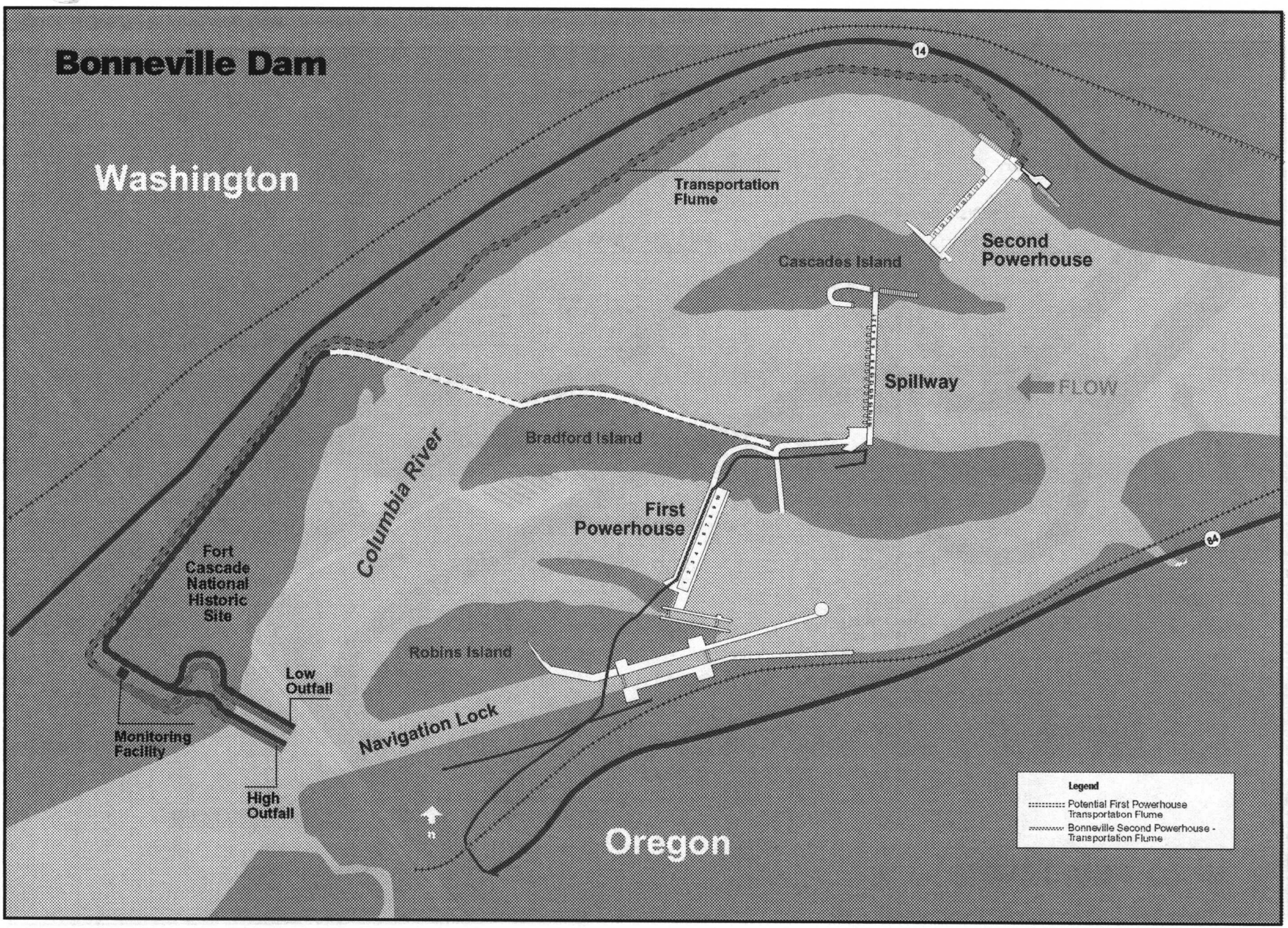

Figure BON-4 Bonnevillle juvenile fish passage system.

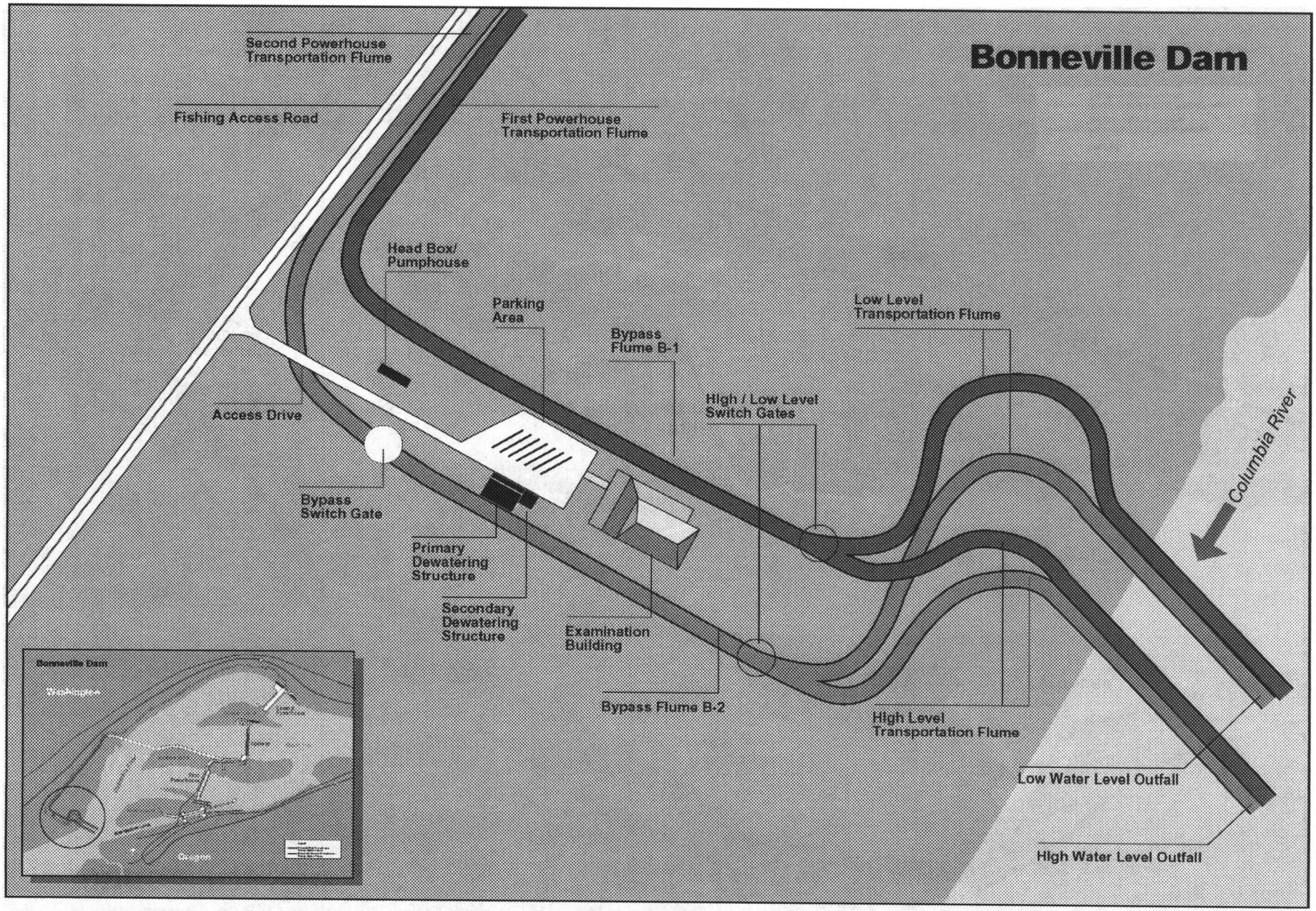

Figure BON-5 Bonnevillle Dam juvenile fish monitoring facility and outfall flumes.

Table BON-1. Dates of project operation for fish purposes at Bonneville Dam, 200

Table BON-1. Dates of project operations for fish purposes at Bonneville Dam, 2002

Task Name	Start	Finish	Reference
Weekly Reports	Fri 3/1/02	Fri 2/28/03	FPP Bon 2.6.3
Lower Columbia River study	**Fri 3/1/02**	**Thu 10/31/02**	**FPP App A Bon 2.2**
Sea Lion Predation	Fri 3/1/02	Wed 5/15/02	FPP App A Bon 2.2
Radio Tag Study	Mon 4/1/02	Thu 10/31/02	FPP App A Bon 2.2
Fall Back Study	Wed 4/10/02	Sat 8/31/02	FPP App A Bon 2.2
Juvenile Migration Timing	Fri 3/1/02	Sat 11/30/02	FPP Bon 1.1.3
Adult Fish Counting	**Fri 3/1/02**	**Fri 2/28/03**	**FPP Bon 1.2.2**
Video Only 24 Hours	Fri 3/1/02	Sun 3/31/02	FPP Bon 1.2.2
Visual Count 0400 - 2000	Mon 4/1/02	Thu 10/31/02	FPP Bon 1.2.2
Video Count 2000 - 0400	Mon 4/1/02	Thu 10/31/02	FPP Bon 1.2.2
Video Only 24 Hours	Fri 11/1/02	Fri 2/28/03	FPP Bon 1.2.2
TDG Monitoring	Fri 3/1/02	Fri 2/28/03	FPP App D Phase 2
Avian Abatement in Place	Fri 3/1/02	Fri 3/1/02	FPP Bon 2.4.1.1 g
Operate Avian Cannons	Fri 3/1/02	Sat 8/31/02	FPP Bon 2.4.1.1 g
Screens in Place	Fri 3/1/02	Sun 12/15/02	FPP Bon 2.4.1.2
Install TIES	Fri 3/1/02	Fri 3/1/02	FPP Bon 2.4.2.2 m
Adult Fish Passage Season	Fri 3/1/02	Sat 11/30/02	FPP Bon 2.5.1.2
Spill Gates 1 and 18 Open 4"	Fri 3/1/02	Sat 11/30/02	FPP Bon 2.5.1.2 b 1
1% limitations	**Fri 3/1/02**	**Fri 2/28/03**	**FPP Bon 4.3**
1% soft constraint	Fri 3/1/02	Thu 3/14/02	FPP Bon 4.3
1% hard constraint	Fri 3/15/02	Thu 10/31/02	FPP Bon 4.3
1% soft constraint	Fri 11/1/02	Fri 2/28/03	FPP Bon 4.3
Flat Pit Tag Detection PH1	Fri 3/1/02	Sat 11/30/02	FPP App A Bon 2.5
ESBS FGE Testing	Fri 3/1/02	Sat 11/30/02	FPP App A Bon 2.1
Juvenile Salmon Radio Tag Study	Fri 3/1/02	Sat 11/30/02	FPP App A Bon 2.4
Spring Creek Hatchery Release Approx.	Fri 3/15/02	Sun 3/24/02	FPP App A Bon 1.1
Fish Passage Efficiency Study	Mon 4/1/02	Wed 7/31/02	FPP App A Bon 2.3
Project Survival	Mon 4/1/02	Wed 7/31/02	FPP App A Bon 2.7

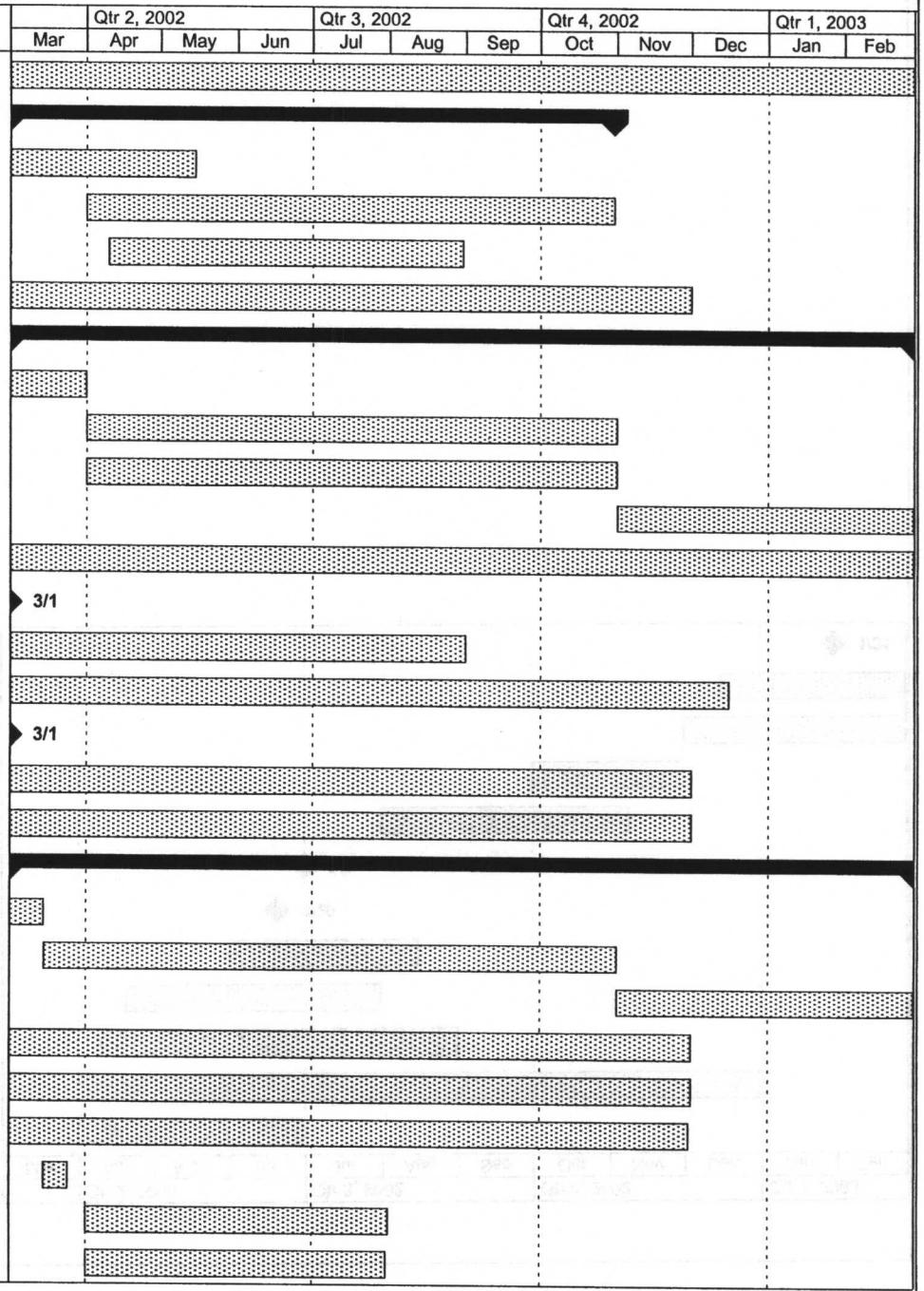

Table BON-1. Dates of project operations for fish purposes at Bonneville Dam, 2002

Task Name	Start	Finish	Reference
More Back Flushing Recommended	Mon 4/1/02	Sun 6/30/02	FPP Bon 2.4.1.2.d
Yearly Chinook Delayed Mortality	Mon 4/1/02	Tue 12/31/02	FPP App A Bon 2.6
Spill for Juvenile Fish	Wed 4/10/02	Sat 8/31/02	FPP App A Bon 1.2
Prototype FGE Testing PH2	Sat 4/20/02	Wed 7/31/02	FPP App A Bon 2.8
Special Spill Time for Sockeye	Sat 6/1/02	Thu 8/15/02	FPP Bon 2.2.3
Possible remove screens from ph1	Thu 6/20/02	Thu 6/20/02	FPP Bon 2.4.1.2.o
Remove TIES	Mon 7/1/02	Mon 7/1/02	FPP Bon 2.4.2.2 m
Rehab Testing Unit 5	Thu 8/1/02	Sat 11/9/02	FPP App A Bon 2.1
Possible operation of Ice and Trash Chute	Tue 10/1/02	Sat 11/30/02	FPP Bon 2.4.1.2 m
Maintenance of Adult Fish Facilities	Sun 12/1/02	Fri 2/28/03	FPP Bon 1.2.2
Maintenance of Juvenile Fish Facilities	Mon 12/16/02	Fri 2/28/03	FPP Bon 1.1.3
Annual Report	Fri 1/31/03	Fri 1/31/03	FPP Bon 2.6.3

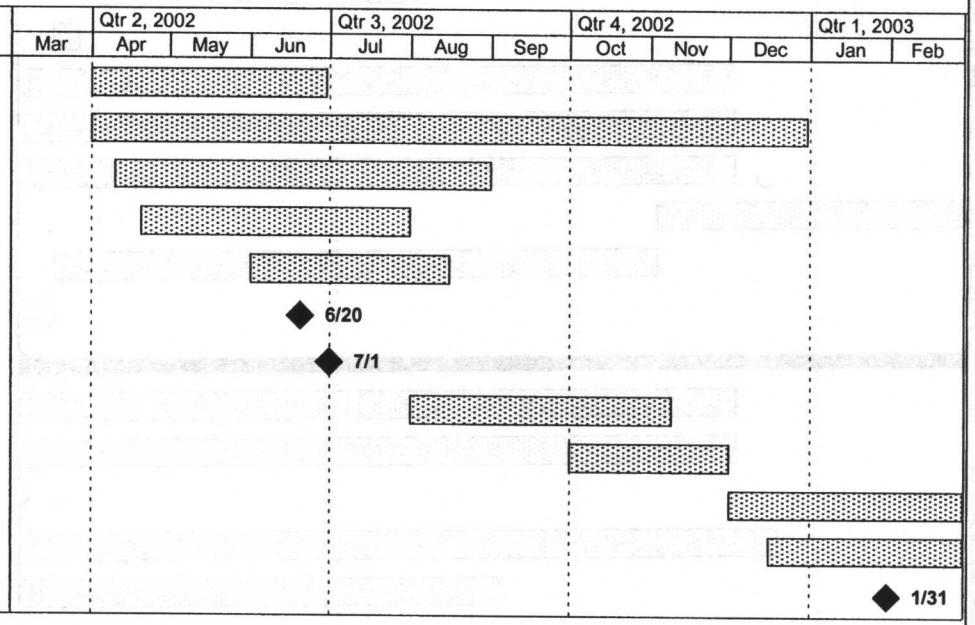

Table BON-2. PH1 10%, 50%, and 90% passage dates for 1988-1999

Yearling Chinook				
	10 %	50%	90 %	# of Days
1995	17-Apr	09-May	26-May	40
1996	19-Apr	02-May	27-May	39
1997	20-Apr	4-May	26-May	37
1998	23-Apr	5-May	23-May	31
1999	21-Apr	9-May	30-May	40
MEDIAN	20-Apr	05-May	26-May	39
MIN	17-Apr	02-May	23-May	31
MAX	23-Apr	09-May	30-May	40

Subyearling Chinook - "Brights" Only				
	10 %	50%	90 %	# of Days
1995	6-Jun	23-Jun	15-Jul	40
1996	9-Jun	29-Jun	18-Jul	40
1997	7-Jun	26-Jun	29-Jul	53
1998	3-Jun	16-Jun	20-Jul	48
1999	11-Jun	30-Jun	25-Jul	45
MEDIAN	07-Jun	26-Jun	20-Jul	45
MIN	03-Jun	16-Jun	15-Jul	40
MAX	11-Jun	30-Jun	29-Jul	53

Unclipped Steelhead				
	10 %	50%	90 %	# of Days
1995	28-Apr	12-May	27-May	30
1996	24-Apr	6-May	26-May	33
1997	23-Apr	8-May	25-May	33
1998	27-Apr	12-May	31-May	35
1999	24-Apr	13-May	1-Jun	39
MEDIAN	24-Apr	12-May	27-May	33
MIN	23-Apr	06-May	25-May	30
MAX	28-Apr	13-May	01-Jun	39

Clipped Steelhead				
	10 %	50%	90 %	# of Days
1995	04-May	17-May	29-May	26
1996	27-Apr	16-May	29-May	33
1997	29-Apr	13-May	28-May	30
1998	2-May	15-May	1-Jun	31
1999	27-Apr	19-May	5-Jun	40
MEDIAN	29-Apr	16-May	29-May	31
MIN	27-Apr	13-May	28-May	26
MAX	04-May	19-May	05-Jun	40

Coho				
	10 %	50%	90 %	# of Days
1995	28-Apr	13-May	29-May	32
1996	23-Apr	14-May	28-May	36
1997	29-Apr	18-May	4-Jun	37
1998	3-May	20-May	4-Jun	33
1999	28-Apr	23-May	7-Jun	41
MEDIAN	28-Apr	18-May	04-Jun	36
MIN	23-Apr	13-May	28-May	32
MAX	03-May	23-May	07-Jun	41

Sockeye (Wild + Hatchery)				
	10 %	50%	90 %	# of Days
1995	10-May	19-May	27-May	18
1996	4-May	18-May	2-Jun	30
1997	6-May	21-May	22-Jun	48
1998	10-May	15-May	29-May	20
1999	10-May	17-May	1-Jun	23
MEDIAN	10-May	18-May	01-Jun	23
MIN	04-May	15-May	27-May	18
MAX	10-May	21-May	22-Jun	48

Table BON-2a. PH2 10%, 50%, and 90% passage dates for 2000-2001.

Yearling Chinook				
	10 %	50%	90 %	# of Days
2000	23-Apr	17-May	1-Jun	40
2001	26-Apr	11-May	6-Jun	42

Subyearling Chinook[1]				
	10 %	50%	90 %	# of Days
2000	6-Jun	22-Jun	19-Jul	44
2001	7-Jun	9-Jul	15-Aug	70

Unclipped Steelhead				
	10 %	50%	90 %	# of Days
2000	23-Apr	16-May	1-Jun	40
2001	2-May	18-May	9-Jun	39

Clipped Steelhead				
	10 %	50%	90 %	# of Days
2000	28-Apr	18-May	4-Jun	38
2001	7-May	20-May	12-Jun	37

Coho				
	10 %	50%	90 %	# of Days
2000	6-May	22-May	3-Jun	29
2001	15-May	24-May	3-Jun	20

Sockeye				
	10 %	50%	90 %	# of Days
2000	5-May	25-May	7-Jun	34
2001	3-Jun	10-Jun	25-Jun	23

[1] Only includes upriver Brights, to exclude the influence of Spring Creek hatchery fish (Tules).

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 2001. 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). Winter steelhead are counted by video at Bonneville Dam from November 1 through March 31 as described in Table BON-3. Peak winter steelhead migration timing for the year 1999 appears in Table BON-4.

Table BON-4. Adult migration timing from fish counts, 1938-2001.

Species	Count Period	Earliest Peak	Latest Peak
Spring chinook	3/14 - 5/31	4/15	5/27
Summer Chinook	6/1 - 7/31	6/3	7/31
Fall Chinook	8/1 - 11/15	8/31	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	6/20	7/13
Winter steelhead	11/1 - 3/31	2/24	2/24

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 were completed in 2000 so that the second powerhouse can now operate to meet local as well as system power needs independently of the first powerhouse.

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

PERIOD	PRIORITY
0001 March 10 through **2400 September 15**	**18,11,17,12-16, 4,5,6,3,7,8,2,9,1,10**
0001 September 16 through **2400 March 9**	**18,11,17,12-16,10,9, 1,2,8,3,7,4,6,5**
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**

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). 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. (Decisions regarding spill level changes will be made through regional agreement at TMT). 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 10 and end August 31. These are planning dates and are flexible according to specific requirements relating to fish abundance. The daytime spill amount is 75 kcfs in order to reduce adult fallback (see section 2.2.3). The NMFS 2000 BiOp sets a minimum spill level of 50 kcfs. 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. In 2002, the Ice-Trash Chute will be operated for the March Spring Creek NFH fall Chinook release unless erosion at the outfall becomes a problem. The Ice-Trash Chute will not be operated for additional auxiliary water in the event of PH2 Fish Unit 1 or 2

out-of-service status as decided through regional agreement at FPOM (See also 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. The NMFS 2000 BiOp sets a minimum spill level of 50 kcfs. 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	0500	1730
Mar 18 - Mar 31	0500	1800
Apr 1 - 21[1]	0500	1915
Apr 22 - May 10	0500	1945
May 11 - 31	0400	2015
Jun 1 - Jul 22[2]	0400	2145
Jul 23 - 31	0500	2145
Aug 1 - 15	0500	2130
Aug 16 - 31	0500	1930

[1] Times after April 7 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 the Spring Creek National Fish Hatchery (NFH) fish release, but not later than March 10 for all stations at Bonneville. Spill volume and total project flow will be reported at the same time. 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 Abatement Measures. 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. Operate the outfall avian cannons from March 1 through August 31. During August, avian cannons may be shut off if project observes no predatory birds at the outfall, and coordinates through FPOM. If birds reappear at the outfall, cannon operation will resume and FPOM will be informed. If only

one outfall is used during the season, use either avian cannon, whichever is the most effective avian deterrent. The cannons will be operated from sunrise to sunset unless otherwise coordinated through FPOM.

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 (submersible traveling screens (STS), extended length bar screens (ESBS), etc.) will be in place prior to the beginning of the juvenile fish passage season. (In the rare event that juvenile fish are released from Spring Creek NFH prior to March, the screens will be installed before the release occurs. The release is typically scheduled for mid-March.) Screens (STS, ESBS) will remain in operation through December 15 to prevent adult salmonids from falling back through turbine units, even though the juvenile passage season officially ends November 30.

a. 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 that 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 FPOM by the February meeting.

d. Operate all gatewell orifice systems. Inspect each orifice three times 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 at least 0.7' (preferred), +/-0.2'. of depth over the end of the DSM inclined dewatering screen. (If this level cannot be achieved, follow-on rationale will be provided in a FPP addendum, and PSMFC smolt monitoring personnel will be notified of changes.)

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 6 hour intervals until such time as the screen sweep is redesigned and reliable throughout the fish passage season. (Note: this was coordinated with NMFS in 2001 to prevent emergency outages of DSM1 during fish passage season). This interval between operations may be increased to one revolution every 60 minutes when monitoring personnel are not present depending on the amount of debris passing. During high debris periods, fishway inspectors, including project operators will visually inspect debris accumulation in the forebay and in gatewells to determine when to increase the frequency of the screen sweep to 20 minute intervals, then report their recommendations to DSM monitors. If gatewells are at least ½ covered with debris prior to gatewell dipping, the screen sweep interval shall be increased and remain until debris passing the DSM inclined screen subsides. (This system will be upgraded in 2002 to meet the NMFS criteria of one revolution every 20 minutes as agreed through FPOM, Jan/Feb. 2002.)

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. This system is planned for automation in the future, but will be operated as outlined above until such automation takes place, as agreed through FPOM, Jan/Feb., 2002. (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 three times per day. Project fish biologist and fish biological staff will conduct at least three inspections per week.

o. The STSs will be removed from the five highest priority units (units 3, 4, 5, 6,and 7) at the first powerhouse as soon as possible after June 20 on years when the river flow is forecast not to exceed the capacity of the second powerhouse plus the capacity of spill program plus the capacity of five first powerhouse units (during the day, this is about 270 Kcfs) The STSs in unit 1,2,8,9, and 10 will be left in place to operate as necessary after September 15.

2.4.1.3. Winter Maintenance Season (December 1 through February). Screens (STS, ESBS) will remain in place until December 15 to prevent adult salmonids from falling back through turbine units, thereby shortening some aspects of the winter maintenance period by two weeks.

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, protrusions, and proper seating (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.

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 (submersible traveling screens (STS), etc.) will be in place prior to the beginning of the juvenile fish passage season. (In the rare event that juvenile fish are released from Spring Creek NFH prior to March, the screens will be installed before the release occurs. The release is typically scheduled for mid-March.) Screens (STS) will remain in operation through December 15 to prevent adult salmonids from falling back through turbine units, even though the juvenile passage season officially ends November 30.

a. Main unit gatewell drawdown will be measured a minimum of once per week and reported in the weekly report. 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 workday or by turning the unit off at night and letting the debris float off the racks. However, if the head exceeds 3' or if the adult fishway head is reduced, the unit's racks will be raked immediately, even if it is early in the day. When debris accumulation is persistent, unit 18 may be operated while the fish unit is off at night to help draw loosened debris away. An FPOM task group is developing operational guidelines with the goal of increasing measurement frequency.

c. Operate STSs at angle of 60° 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 FPOM by the February meeting, upon request.

e. Operate all gatewell orifice systems. Inspect each orifice three times 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 manually during the inspection. Manually flush orifices known to have recurring plugging or other problems, especially at the north end. Orifice jets will be observed through the light tubes during the inspection. Light tubes and orifice tube lenses shall be replaced and kept clean as required so that visual observations of orifice jets are possible during fishway inspections. 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 three times 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 be 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. In 2001, VBSs were found to be properly seated and fish were still found on the add-in water perf plate. As a result, add-in water system use was discontinued and coordinated with FPOM. The perf. plate problem is being addressed in the follow-on contract work for 2002.

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 6 hours or as determined by debris presence. If debris increases in the system, the frequency of revolutions will be increased. (This system will be upgraded in 2002 to meet the NMFS criteria of one revolution every 20 minutes as agreed through FPOM, Jan/Feb 2002.)

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 August 31. During August, avian cannons may be shut off if project observes no predatory birds at the outfall, and coordinates through FPOM. If birds reappear at the outfall, cannon operation will resume and FPOM will be informed. If only one outfall is used during the season, use either avian cannon, whichever is the most effective avian deterrent. 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. The FPOM coordination team will be kept informed of progress and changes throughout the 2002 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 (except the 2-mile transport flume) every two hours to ensure safe fish passage conditions. Observe video monitors at least every half hour or continually, and inspect manually every two hours or more frequently according to trash sweep operation or other debris potential. Project Fisheries will make longer and more frequent trips to the adult separator during the kelt passage season to monitor kelt passage over the separator. (Adult separator monitoring frequency is being addressed by COE to provide BPA funding to employ PSMFC monitors to meet NMFS monitoring frequency criteria to protect

steelhead kelt downstream migrants, as agreed by FPOM, Jan/Feb, 2002.)

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. Begin fish salvage operations immediately at the monitoring facility.

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 1 through February). Screens (STS) will remain in place until December 15 to prevent adult salmonids from falling back through turbine units, thereby shortening some aspects of the winter maintenance period by two weeks. STSs in priority units will be left in place during this period (Dec. 1 - 15). 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 1 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 that 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° 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 three times 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 and coordinated through the FPOM.

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. When spilling exclusively for adult attraction, spill only during the daylight hours (see Table BON-6).

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. (COE is investigating gate operational potential and will provide appropriate FPP language in a FPP Addendum in 2002.)

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 (see Table BON-14) for both day and night. See section 2.2. Spill Management for guidance.

2.5.2. Winter Maintenance 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 three times 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 three times 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. However, (Project Maintenance states): "Experience has shown that cleaning of the fish unit brush rigging is necessary throughout the season. In the past, as carbon dust on the exciter slip rings flashes over, this causes unscheduled machine downtime to clean

and repair the collector system. Through trial and error, it has been determined that the rigging should be cleaned two times during the passage season. One cleaning operation is performed in conjunction with the mid-year collection channel diffuser grating dive inspection, and the second stands alone on the outage schedule." (This has been agreed to at FPOM, Jan/Feb., 2002).

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 and clean trashracks if necessary.

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 (three times per day during high debris periods), 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, damaged, or not properly seated. In these cases, the associated unit will be taken out of service as if unscreened and repairs will be made before returning the unit to normal service. If screens are pulled and replaced, the underwater video

inspection camera will be deployed to check the screens for proper seating.

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 that may indicate problems with diffuser gratings. If a diffuser grating is known to or suspected of having moved, creating an opening into a diffuser chamber, efforts must immediately be taken to correct the situation and minimize impacts on adult fish in the fishway. If possible, a video inspection should be made as soon as possible to determine the extent of the problem. If diffusers gratings are found to be missing or displaced, creating openings into the diffuser chambers, a method of repair shall be developed and coordinated with the fish agencies and tribes through the established FPOM coordination procedure. Repairs shall be made as quickly as possible unless coordinated differently.

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, usually mid to late afternoon. Fish count station windows, light panels, and crowder panels will be cleaned as needed to achieve accurate counts and, when practicable, during the time of day when fish passage is least affected, usually mid to late afternoon.

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 8' 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, the Ice-Trash Chute will not be operated for additional auxiliary water out of concern for entrainment of adult salmonids (through regional agreement at

FPOM, Jan/Feb., 2002, this applies to the ITC during the entire year).

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.

a. 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 that may indicate problems with diffuser gratings. If a diffuser grating is known to or suspected of having moved, creating an opening into a diffuser chamber, efforts must immediately be taken to correct the situation and minimize impacts on adult fish in the fishway. If possible, a video inspection should be made as soon as possible to determine the extent of the problem. If diffuser gratings are found to be missing or displaced, creating openings into the diffuser chambers, a method of repair shall be developed and coordinated with the fish agencies and tribes through the established FPOM coordination procedure. Repairs shall be made as quickly as possible unless coordinated differently.

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. New, separate 1% operating criteria are provided for MGR units 4 and 6 (Table BON-12).

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 that 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: (4-8), 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	5,528	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.

Head (feet)	First Powerhouse (units 4 and 6)							
	STS				Without STS			
	Lower Limit (MW)	Lower Limit (cfs)	Upper Limit (MW)	Upper Limit (cfs)	Lower Limit (MW)	Lower Limit (cfs)	Upper Limit (MW)	Upper Limit (cfs)
35	17.6	6,757	24.0	9,200	18.9	7,203	23.6	9,019
36	18.2	6,771	24.6	9,181	19.5	7,205	24.3	8,985
37	18.7	6,783	25.3	9,163	20.1	7,205	25.0	8,951
38	19.3	6,794	26.0	9,145	20.7	7,2040	25.6	8,918
39	19.8	6,804	26.6	9,128	21.3	7,2023	26.3	8,886
40	20.4	6,753	27.3	9,031	21.9	7,199	26.9	8,854
41	21.0	6,754	28.4	9,148	22.5	7,201	28.0	8,969
42	21.5	6,755	29.5	9,259	23.1	7,202	29.1	9,077
43	22.0	6,756	30.5	9,363	23.6	7,203	30.1	9,180
44	22.6	6,756	31.6	9,463	24.2	7,203	31.2	9,278
45	23.1	6,756	32.7	9,557	24.8	7,203	32.3	9,370
46	23.7	6,763	33.6	9,603	25.4	7,210	33.2	9,416
47	24.3	6,769	34.6	9,648	26.0	7,217	34.1	9,459
48	24.8	6,775	35.5	9,689	26.6	7,223	35.0	9,500
49	25.4	6,780	36.5	9,729	27.3	7,229	36.0	9,539
50	26.0	6,785	37.4	9,776	27.9	7,2349	36.9	9,575
51	26.5	6,792	38.3	9,809	28.5	7,2413	37.8	9,618
52	27.1	6,798	39.3	9,850	29.1	7,2486	38.4	9,577
53	27.7	6,804	40.2	9,889	29.7	7,2547	39.0	9,537
54	28.3	6,810	41.2	9,927	30.3	7,260	39.7	9,499
55	28.8	6,815	42.1	9,962	30.9	7,266	41.6	9,768
56	29.4	6,817	43.1	10,003	31.5	7,269	42.5	9,808
57	29.9	6,820	44.0	10,042	32.1	7,272	43.4	9,846
58	30.4	6,823	45.0	10,079	32.7	7,274	44.4	9,883
59	31.0	6,825	45.9	10,115	33.3	7,277	45.3	9,918
60	31.5	6,827	46.9	10,150	33.8	7,2793	46.3	9,952
61	32.1	6,842	47.6	10,128	34.5	7,296	46.9	9,930
62	32.8	6,857	48.3	10,106	35.1	7,311	47.6	9,909
63	33.4	6,871	49.0	10,085	35.8	7,326	48.3	9,889
64	34.0	6,884	49.7	10,064	36.5	7,340	49.0	9,868
65	34.6	6,897	50.4	10,044	37.1	7,354	49.7	9,849
66	35.0	6,885	51.2	10,072	37.6	7,341	50.6	9,876
67	35.5	6,873	52.1	10,099	38.1	7,329	51.4	9,902
68	35.9	6,862	53.0	10,126	38.6	7,317	52.3	9,928
69	36.4	6,851	53.9	10,152	39.0	7,305	53.2	9,954
70	36.8	6,841	54.8	10,177	39.6	7,294	54.1	9,979

Table BON-13. Turbine operating ranges within the 1% turbine efficiency range for Bonneville second powerhouse (units 11-18), with or without STSs in place.

	Second Powerhouse (units 11-18)							
	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	26.7	10,619	41.9	16,628	26.2	10,330	39.9	15,746
36	27.6	10,630	43.3	16,657	27.0	10,341	41.2	15,773
37	28.5	10,639	44.7	16,680	27.9	10,350	42.6	15,795
38	29.4	10,645	46.1	16,699	28.8	10,356	43.9	15,813
39	30.3	10,649	47.6	16,713	29.7	10,360	45.3	15,827
40	31.2	10,651	49.0	16,724	30.5	10,362	46.7	15,837
41	32.0	10,624	50.4	16,756	31.3	10,336	48.0	15,869
42	32.8	10,597	51.9	16,786	32.1	10,310	49.4	15,897
43	33.5	10,571	53.3	16,812	32.8	10,285	50.8	15,922
44	34.3	10,544	54.8	16,834	33.6	10,259	52.2	15,943
45	35.1	10,518	56.2	16,854	34.3	10,234	53.5	15,962
46	35.9	10,514	57.7	16,917	35.1	10,230	55.0	16,021
47	36.7	10,510	58.5	16,770	35.9	10,226	55.8	15,888
48	37.5	10,505	59.3	16,629	36.7	10,222	56.6	15,761
49	38.3	10,500	60.1	16,493	37.5	10,217	57.3	15,637
50	39.1	10,495	63.8	17,133	38.3	10,212	60.8	16,226
51	40.0	10,529	66.0	17,365	39.2	10,245	62.9	16,446
52	41.0	10,561	68.2	17,588	40.1	10,276	65.0	16,657
53	41.9	10,591	70.4	17,801	41.0	10,305	67.1	16,860
54	42.8	10,620	72.6	18,006	41.9	10,333	96.2	17,054
55	43.8	10,647	74.8	18,203	42.8	10,360	71.3	17,240
56	45.2	10,766	75.2	17,925	44.2	10,476	71.6	16,977
57	46.6	10,880	75.6	17,656	45.6	10,586	72.0	16,723
58	48.0	10,987	76.0	17,397	46.9	10,691	72.4	16,478
59	49.4	11,090	76.4	17,146	48.3	10,792	72.7	16,240
60	50.8	11,188	76.7	16,903	49.7	10,887	73.1	16,010
61	51.2	11,099	80.1	17,375	50.1	10,800	76.3	16,458
62	51.6	11,012	83.5	17,834	50.5	10,715	79.5	16,892
63	52.0	10,928	86.9	18,279	50.8	10,634	82.8	17,313
64	52.3	10,847	90.3	18,711	51.2	10,555	86.0	17,723
65	52.7	10,769	93.7	19,132	51.6	10,479	89.2	18,121
66	53.7	10,810	95.1	19,138	52.6	10,519	90.6	18,127
67	54.8	10,850	96.6	19,145	53.6	10,558	92.0	18,133
68	55.8	10,889	98.1	19,151	54.6	10,595	93.4	18,139
69	56.8	10,926	99.6	19,157	55.6	10,632	94.8	18,145
70	57.8	10,963	101.0	19,163	56.6	10,668	96.2	18,150

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, 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. Actual runtime will be the minimum amount needed to keep the unit in good working condition. This may be performed at night, daytime, or whenever unit cycling will have the least effect on fish passage as determined by the project biologist.

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

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 supplies at least 24 hours, but no more than 96 hours, prior to dewatering. This operation shall not be initiated until 1800 hours on November 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 according to specifications in the Dewatering Plans. The project biologist will invite fish agency and/or tribal biologists to participate in the dewatering. 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 that are placed in the lower-most weirs to prevent fish from re-ascending the dewatered portion of the adult fishway shall have ropes placed on them to be tied to fishway railings. The orifice blocks shall be removed just before the fishway is returned to service. The ropes will help identify and prevent the orifice blocks from being accidentally left in place after fishway water-up. The orifice blocking devices will appear on the pre-water-up checklist maintained by the project biologist.

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 the entire 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) that 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 that 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 workdays 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.

Spillway Bay Number																		Stops	FB=74.
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	ft.	Kcfs
vertical gate opening (ft.)																			
0.5																	0.5	2	3.6
0.5	0.5																0.5	3	5.4
0.5	0.5															0.5	0.5	4	7.2
0.5	0.5														0.5	0.5	0.5	5	9.0
0.5	0.5		0.5												0.5	0.5	0.5	6	10.7
0.5	0.5		0.5	0.5											0.5	0.5	0.5	7	12.5
0.5	0.5		0.5	0.5									0.5		0.5	0.5	0.5	8	14.3
0.5	0.5		0.5	0.5							0.5		0.5		0.5	0.5	0.5	9	16.1
0.5	0.5		0.5	0.5					0.5		0.5		0.5		0.5	0.5	0.5	10	17.9
0.5	0.5		0.5	0.5			0.5		0.5		0.5		0.5		0.5	0.5	0.5	11	19.7
0.5	0.5	0.5	0.5	0.5			0.5		0.5		0.5		0.5		0.5	0.5	0.5	12	21.5
0.5	0.5	0.5	0.5	0.5			0.5		0.5		0.5		0.5		0.5	1	0.5	13	22.8
0.5	1	0.5	0.5	0.5			0.5		0.5		0.5		0.5		0.5	1	0.5	14	24.0
0.5	1	0.5	0.5	0.5	0.5		0.5		0.5		0.5		0.5		0.5	1	0.5	15	25.8
0.5	1	0.5	0.5	0.5	0.5		0.5		0.5		0.5		0.5	0.5	0.5	1	0.5	16	27.6
0.5	1	0.5	0.5	0.5	0.5	0.5	0.5		0.5		0.5		0.5	0.5	0.5	1	0.5	17	29.4
0.5	1	0.5	0.5	0.5	0.5	0.5	0.5		0.5		0.5	0.5	0.5	0.5	0.5	1	0.5	18	31.2
0.5	1	0.5	0.5	0.5	0.5	0.5	0.5		0.5	0.5	0.5	0.5	0.5	0.5	0.5	1	0.5	19	33.0
0.5	1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	1	0.5	20	34.8
0.5	1	1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	1	0.5	21	36.0
0.5	1	1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	1	1	22	37.3
1	1	1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	1	1	23	38.6
1	1	1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	1	1	1	24	39.8
1	1	1	1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	1	1	1	25	41.1
1	1	1	1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	1	1	1	1	26	42.3
1	1	1	1	0.5	0.5	0.5	0.5	1	0.5	0.5	0.5	0.5	0.5	1	1	1	1	27	43.6
1	1	1	1	0.5	0.5	1	0.5	1	0.5	0.5	0.5	0.5	0.5	1	1	1	1	28	44.9
1	1	1	1	0.5	0.5	1	0.5	1	0.5	0.5	1	0.5	0.5	1	1	1	1	29	46.1
1	1	1	1	0.5	1	1	0.5	1	0.5	0.5	1	0.5	0.5	1	1	1	1	30	47.4
1	1	1	1	0.5	1	1	0.5	1	0.5	0.5	1	1	0.5	1	1	1	1	31	48.7
1	1	1	1	0.5	1	1	0.5	1	1	0.5	1	1	0.5	1	1	1	1	32	49.9
1	1	1	1	1	1	1	0.5	1	1	0.5	1	1	0.5	1	1	1	1	33	51.2
1	1	1	1	1	1	1	1	1	1	0.5	1	1	0.5	1	1	1	1	34	52.5
1	1	1	1	1	1	1	1	1	1	0.5	1	1	1	1	1	1	1	35	53.7
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	36	55.0
1	1.5	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	37	56.1
1	1.5	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1.5	1	38	57.2
1	1.5	1	1	1	1	1	1	1	1	1	1	1	1	1	1.5	1.5	1	39	58.3
1	1.5	1.5	1	1	1	1	1	1	1	1	1	1	1	1	1.5	1.5	1	40	59.5
1.5	1.5	1.5	1	1	1	1	1	1	1	1	1	1	1	1	1.5	1.5	1	41	60.6
1.5	1.5	1.5	1	1	1	1	1	1	1	1	1	1	1	1	1.5	1.5	1.5	42	61.7
1.5	1.5	1.5	1	1	1	1	1	1	1	1	1	1	1	1	1.5	2	1.5	43	62.7
1.5	2	1.5	1	1	1	1	1	1	1	1	1	1	1	1	1.5	2	1.5	44	63.8
1.5	2	1.5	1	1	1	1	1	1	1	1	1	1	1	1	2	2	1.5	45	64.8
1.5	2	1.5	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	46	65.9
2	2	1.5	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	47	66.9
2	2	1.5	1	1	1	1	1	1.5	1	1	1	1	1	1	2	2	2	48	68.0

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

Spillway Bay Number																		stops	FB=74.0
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	ft.	Kcfs
vertical gate opening (ft.)																			
2	2	2	1	1	1	1	1	1.5	1	1	1	1	1	1	2	2	2	49	69.0
2	2	2	1	1.5	1	1	1	1.5	1	1	1	1	1	1	2	2	2	50	70.2
2	2	2	1.5	1.5	1	1	1	1.5	1	1	1	1	1	1	2	2	2	51	71.3
2	2	2	1.5	1.5	1	1	1	1.5	1	1	1.5	1	1	1	2	2	2	52	72.4
2	2	2	1.5	1.5	1	1	1	1.5	1	1	1.5	1	1.5	1	2	2	2	53	73.5
2	2	2	1.5	1.5	1	1.5	1	1.5	1	1	1.5	1	1.5	1	2	2	2	54	74.6
2	2	2	1.5	1.5	1	1.5	1	1.5	1	1	1.5	1	1.5	1	2	2.5	2	55	75.6
2	2.5	2	1.5	1.5	1	1.5	1	1.5	1	1	1.5	1	1.5	1	2	2.5	2	56	76.6
2	2.5	2	1.5	1.5	1.5	1.5	1	1.5	1	1	1.5	1	1.5	1	2	2.5	2	57	77.7
2	2.5	2	1.5	1.5	1.5	1.5	1	1.5	1	1	1.5	1	1.5	1.5	2	2.5	2	58	78.8
2	2.5	2	1.5	1.5	1.5	1.5	1	1.5	1.5	1	1.5	1	1.5	1.5	2	2.5	2	59	80.0
2	2.5	2	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1	1.5	1	1.5	1.5	2	2.5	2	60	81.1
2	2.5	2	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1	1.5	1.5	1.5	1.5	2	2.5	2	61	82.2
2	2.5	2	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	2	2.5	2	62	83.3
2	2.5	2	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	2.5	2.5	2	63	84.3
2	2.5	2	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	2.5	3	2	64	85.2
2	2.5	2	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	2.5	3	2.5	65	86.2
2	3	2	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	2.5	3	2.5	66	87.1
2	3	2	1.5	2	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	2.5	3	2.5	67	88.2
2	3	2	1.5	2	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	2	2.5	3	2.5	68	89.2
2	3	2	2	2	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	2	2.5	3	2.5	69	90.2
2	3	2	2	2	1.5	1.5	1.5	1.5	1.5	1.5	1.5	2	1.5	2	2.5	3	2.5	70	91.3
2	3	2	2	2	1.5	1.5	2	1.5	1.5	1.5	1.5	2	1.5	2	2.5	3	2.5	71	92.3
2.5	3	2	2	2	1.5	1.5	2	1.5	1.5	1.5	1.5	2	1.5	2	2.5	3	2.5	72	93.3
2.5	3	2	2	2	1.5	1.5	2	1.5	2	1.5	1.5	2	1.5	2	2.5	3	2.5	73	94.3
2.5	3	2	2	2	1.5	1.5	2	1.5	2	1.5	1.5	2	1.5	2	3	3	2.5	74	95.3
2.5	3	2	2	2	2	1.5	2	1.5	2	1.5	1.5	2	1.5	2	3	3	2.5	75	96.3
2.5	3	2	2	2	2	1.5	2	1.5	2	1.5	1.5	2	2	2	3	3	2.5	76	97.3
2.5	3	2	2	2	2	1.5	2	1.5	2	1.5	1.5	2	2	2	3	3	3	77	98.3
2.5	3	2	2	2	2	1.5	2	1.5	2	1.5	2	2	2	2	3	3	3	78	99.3
3	3	2	2	2	2	1.5	2	1.5	2	1.5	2	2	2	2	3	3	3	79	100.2
3	3	2.5	2	2	2	1.5	2	1.5	2	1.5	2	2	2	2	3	3	3	80	101.2
3	3	2.5	2	2	2	2	2	1.5	2	1.5	2	2	2	2	3	3	3	81	102.3
3	3	2.5	2	2	2	2	2	2	2	1.5	2	2	2	2	3	3	3	82	103.3
3	3	2.5	2	2	2	2	2	2	2	2	2	2	2	2	3	3	3	83	104.3
3	3	2.5	2	2.5	2	2	2	2	2	2	2	2	2	2	3	3	3	84	105.3
3	3	2.5	2.5	2.5	2	2	2	2	2	2	2	2	2	2	3	3	3	85	106.3
3	3	2.5	2.5	2.5	2	2	2	2	2	2	2	2	2.5	2	3	3	3	86	107.3
3	3	2.5	2.5	2.5	2	2	2	2	2	2	2	2	2.5	2.5	3	3	3	87	108.2
3	3.5	2.5	2.5	2.5	2	2	2	2	2	2	2	2	2.5	2.5	3	3	3	88	109.1
3	3.5	3	2.5	2.5	2	2	2	2	2	2	2	2	2.5	2.5	3	3	3	89	110.1
3	3.5	3	2.5	2.5	2	2	2	2	2	2	2	2	2.5	2.5	3	3.5	3	90	111.0
3	3.5	3	2.5	2.5	2.5	2	2	2	2	2	2	2	2.5	2.5	3	3.5	3	91	111.9
3	3.5	3	2.5	2.5	2.5	2	2	2	2	2	2	2	2.5	2.5	3.5	3.5	3	92	112.8
3	3.5	3	2.5	2.5	2.5	2.5	2	2	2	2	2	2	2.5	2.5	3.5	3.5	3	93	113.8
3	3.5	3	2.5	2.5	2.5	2.5	2	2	2	2	2	2	2.5	3	3.5	3.5	3	94	114.8
3	3.5	3	2.5	3	2.5	2.5	2	2	2	2	2	2	2.5	3	3.5	3.5	3	95	115.7

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

Spillway Bay Number																		stops	FB=74.
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	ft.	Kcfs
vertical gate opening (ft.)																			
3	3.5	3	3	3	2.5	2.5	2	2	2	2	2	2	2.5	3	3.5	3.5	3	96	116.6
3	3.5	3	3	3	2.5	2.5	2.5	2	2	2	2	2	2.5	3	3.5	3.5	3	97	117.6
3	3.5	3	3	3	2.5	2.5	2.5	2	2	2	2	2.5	2.5	3	3.5	3.5	3	98	118.6
3	3.5	3	3	3	2.5	2.5	2.5	2	2	2	2.5	2.5	2.5	3	3.5	3.5	3	99	119.5
3	3.5	3	3	3	2.5	2.5	2.5	2	2.5	2	2.5	2.5	2.5	3	3.5	3.5	3	100	120.5
3	3.5	3.5	3	3	2.5	2.5	2.5	2	2.5	2	2.5	2.5	2.5	3	3.5	3.5	3	101	121.4
3	3.5	3.5	3	3	2.5	2.5	2.5	2	2.5	2.5	2.5	2.5	2.5	3	3.5	3.5	3	102	122.4
3	3.5	3.5	3	3	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	3	3.5	3.5	3	103	123.4
3	3.5	3.5	3	3	3	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	3	3.5	3.5	3	104	124.3
3	3.5	3.5	3	3	3	3	2.5	2.5	2.5	2.5	2.5	2.5	2.5	3	3.5	3.5	3	105	125.2
3	3.5	3.5	3	3	3	3	2.5	2.5	2.5	2.5	2.5	2.5	2.5	3	3.5	3.5	3.5	106	126.1
3	3.5	3.5	3	3	3	3	2.5	2.5	2.5	2.5	2.5	2.5	2.5	3	3.5	4	3.5	107	127.0
3	3.5	3.5	3	3	3	3	3	2.5	2.5	2.5	2.5	2.5	2.5	3	3.5	4	3.5	108	127.9
3	3.5	3.5	3	3	3	3	3	2.5	2.5	2.5	2.5	2.5	3	3	3.5	4	3.5	109	128.9
3	3.5	3.5	3	3	3	3	3	2.5	2.5	2.5	2.5	3	3	3	3.5	4	3.5	110	129.8
3	3.5	3.5	3	3	3	3	3	2.5	2.5	3	2.5	3	3	3	3.5	4	3.5	111	130.7
3	3.5	3.5	3	3	3	3	3	2.5	2.5	3	3	3	3	3	3.5	4	3.5	112	131.7
3.5	3.5	3.5	3	3	3	3	3	2.5	2.5	3	3	3	3	3	3.5	4	3.5	113	132.6
3.5	3.5	3.5	3.5	3	3	3	3	2.5	2.5	3	3	3	3	3	3.5	4	3.5	114	133.5
3.5	3.5	3.5	3.5	3	3	3	3	2.5	2.5	3	3	3	3	3	3.5	4	4	115	134.3
3.5	3.5	3.5	3.5	3	3	3	3	2.5	2.5	3	3	3	3	3.5	3.5	4	4	116	135.2
3.5	3.5	3.5	3.5	3	3	3	3	2.5	2.5	3	3	3	3	3.5	4	4	4	117	136.1
3.5	3.5	3.5	3.5	3	3	3	3	2.5	3	3	3	3	3	3.5	4	4	4	118	137.0
3.5	3.5	3.5	3.5	3	3	3	3	3	3	3	3	3	3	3.5	4	4	4	119	138.0
3.5	4	3.5	3.5	3	3	3	3	3	3	3	3	3	3	3.5	4	4	4	120	138.8
3.5	4	4	3.5	3	3	3	3	3	3	3	3	3	3	3.5	4	4	4	121	139.7
4	4	4	3.5	3	3	3	3	3	3	3	3	3	3	3.5	4	4	4	122	140.6
4	4	4	4	3	3	3	3	3	3	3	3	3	3	3.5	4	4	4	123	141.5
4	4	4	4	3	3	3	3	3	3	3	3	3	3	4	4	4	4	124	142.3
4	4	4	4	3	3.5	3	3	3	3	3	3	3	3	4	4	4	4	125	143.2
4	4	4	4	3.5	3.5	3	3	3	3	3	3	3	3	4	4	4	4	126	144.1
4	4	4	4	3.5	3.5	3	3	3	3	3	3	3.5	3	4	4	4	4	127	145.0
4	4	4	4	3.5	3.5	3	3	3	3	3	3	3.5	3.5	4	4	4	4	128	145.9
4	4	4	4	3.5	3.5	3	3	3	3	3	3	3.5	3.5	4	4	4.5	4	129	146.8
4	4	4	4	3.5	3.5	3.5	3	3	3	3	3	3.5	3.5	4	4	4.5	4	130	147.7
4	4	4	4	3.5	3.5	3.5	3	3	3	3	3.5	3.5	3.5	4	4	4.5	4	131	148.6
4	4	4	4	3.5	3.5	3.5	3	3	3	3	3.5	3.5	3.5	4	4.5	4.5	4	132	149.4
4	4.5	4	4	3.5	3.5	3.5	3	3	3	3	3.5	3.5	3.5	4	4.5	4.5	4	133	150.2
4	4.5	4.5	4	3.5	3.5	3.5	3	3	3	3	3.5	3.5	3.5	4	4.5	4.5	4	134	151.1
4	4.5	4.5	4	3.5	3.5	3.5	3	3	3.5	3	3.5	3.5	3.5	4	4.5	4.5	4	135	152.0
4	4.5	4.5	4	3.5	3.5	3.5	3.5	3	3.5	3	3.5	3.5	3.5	4	4.5	4.5	4	136	152.9
4	4.5	4.5	4	3.5	3.5	3.5	3.5	3	3.5	3.5	3.5	3.5	3.5	4	4.5	4.5	4	137	153.8
4	4.5	4.5	4	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	4	4.5	4.5	4	138	154.7
4	4.5	4.5	4	4	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	4	4.5	4.5	4	139	155.5
4	4.5	4.5	4	4	4	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	4	4.5	4.5	4	140	156.4
4	4.5	4.5	4	4	4	3.5	3.5	3.5	3.5	3.5	3.5	3.5	4	4	4.5	4.5	4	141	157.3
4	4.5	4.5	4	4	4	4	3.5	3.5	3.5	3.5	3.5	3.5	4	4	4.5	4.5	4	142	158.2

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

Spillway Bay Number																		stops	FB=74.0
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	ft.	Kcfs
vertical gate opening (ft.)																			
4	4.5	4.5	4	4	4	4	3.5	3.5	3.5	3.5	3.5	4	4	4	4.5	4.5	4	143	159.0
4	4.5	4.5	4	4	4	4	3.5	3.5	3.5	3.5	4	4	4	4	4.5	4.5	4	144	159.9
4	4.5	4.5	4	4	4	4	4	3.5	3.5	3.5	4	4	4	4	4.5	4.5	4	145	160.8
4	4.5	4.5	4	4	4	4	4	3.5	3.5	4	4	4	4	4	4.5	4.5	4	146	161.6
4	4.5	4.5	4	4	4	4	4	4	3.5	4	4	4	4	4	4.5	4.5	4	147	162.5
4	4.5	4.5	4	4	4	4	4	4	4	4	4	4	4	4	4.5	4.5	4	148	163.4
4	4.5	4.5	4.5	4	4	4	4	4	4	4	4	4	4	4	4.5	4.5	4	149	164.2
4	4.5	4.5	4.5	4	4	4	4	4	4	4	4	4	4	4.5	4.5	4.5	4	150	165.1
4	4.5	4.5	4.5	4.5	4	4	4	4	4	4	4	4	4	4.5	4.5	4.5	4	151	165.9
4	4.5	4.5	4.5	4.5	4	4	4	4	4	4	4	4	4.5	4.5	4.5	4.5	4	152	166.7
4	4.5	4.5	4.5	4.5	4.5	4	4	4	4	4	4	4	4.5	4.5	4.5	4.5	4	153	167.6
4	4.5	4.5	4.5	4.5	4.5	4	4	4	4	4	4	4.5	4.5	4.5	4.5	4.5	4	154	168.4
4	4.5	4.5	4.5	4.5	4.5	4	4	4	4	4	4	4.5	4.5	4.5	4.5	5	4	155	169.2
4	5	4.5	4.5	4.5	4.5	4	4	4	4	4	4	4.5	4.5	4.5	4.5	5	4	156	170.1
4	5	4.5	4.5	4.5	4.5	4	4	4	4	4	4.5	4.5	4.5	4.5	4.5	5	4	157	170.9
4	5	4.5	4.5	4.5	4.5	4.5	4	4	4	4	4.5	4.5	4.5	4.5	4.5	5	4	158	171.7
4	5	4.5	4.5	4.5	4.5	4.5	4	4	4	4	4.5	4.5	4.5	4.5	5	5	4	159	172.5
4	5	4.5	4.5	4.5	4.5	4.5	4	4	4	4.5	4.5	4.5	4.5	4.5	5	5	4	160	173.4
4	5	5	4.5	4.5	4.5	4.5	4	4	4	4.5	4.5	4.5	4.5	4.5	5	5	4	161	174.2
4	5	5	4.5	4.5	4.5	4.5	4	4	4	4.5	4.5	4.5	4.5	5	5	5	4	162	175.0
4	5	5	5	4.5	4.5	4.5	4	4	4	4.5	4.5	4.5	4.5	5	5	5	4	163	175.8
4	5	5	5	4.5	4.5	4.5	4	4.5	4	4.5	4.5	4.5	4.5	5	5	5	4	164	176.7
4	5	5	5	4.5	4.5	4.5	4	4.5	4	4.5	4.5	4.5	5	5	5	5	4	165	177.5
4	5	5	5	4.5	4.5	4.5	4.5	4.5	4	4.5	4.5	4.5	5	5	5	5	4	166	178.3
4	5	5	5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	5	5	5	5	4	167	179.2
4	5	5	5	4.5	5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	5	5	5	5	4	168	180.0
4	5	5	5	4.5	5	4.5	4.5	4.5	4.5	4.5	5	4.5	5	5	5	5	4	169	180.8
4	5	5	5	4.5	5	4.5	4.5	4.5	4.5	4.5	5	5	5	5	5	5	4	170	181.6
4	5	5	5	5	5	4.5	4.5	4.5	4.5	4.5	5	5	5	5	5	5	4	171	182.4
4	5	5	5	5	5	4.5	5	4.5	4.5	4.5	5	5	5	5	5	5	4	172	183.2
4	5	5	5	5	5	4.5	5	4.5	5	4.5	5	5	5	5	5	5	4	173	184.0
4	5	5	5	5	5	4.5	5	5	5	4.5	5	5	5	5	5	5	4	174	184.8
4	5	5	5	5	5	5	5	5	5	4.5	5	5	5	5	5	5	4	175	185.6
4	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	4	176	186.4
4	5.5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	4	177	187.4
4	5.5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5.5	4	178	188.4
4	5.5	5	5	5	5	5	5	5	5	5	5	5	5	5	5.5	5.5	4	179	189.3
4	5.5	5.5	5	5	5	5	5	5	5	5	5	5	5	5	5.5	5.5	4	180	190.3
4	5.5	5.5	5	5.5	5	5	5	5	5	5	5	5	5	5	5.5	5.5	4	181	191.3
4	5.5	5.5	5	5.5	5	5	5	5	5	5	5	5	5	5.5	5.5	5.5	4	182	192.2
4	5.5	5.5	5.5	5.5	5	5	5	5	5	5	5	5	5	5.5	5.5	5.5	4	183	193.2
4	5.5	5.5	5.5	5.5	5	5	5	5	5.5	5	5	5	5	5.5	5.5	5.5	4	184	194.2
4	5.5	5.5	5.5	5.5	5	5	5.5	5	5.5	5	5	5	5	5.5	5.5	5.5	4	185	195.1
4	5.5	5.5	5.5	5.5	5	5	5.5	5	5.5	5	5	5.5	5	5.5	5.5	5.5	4	186	196.1
4	5.5	5.5	5.5	5.5	5	5	5.5	5.5	5.5	5	5	5.5	5	5.5	5.5	5.5	4	187	197.0
4	5.5	5.5	5.5	5.5	5.5	5	5.5	5.5	5.5	5	5	5.5	5	5.5	5.5	5.5	4	188	198.0
4	5.5	5.5	5.5	5.5	5.5	5	5.5	5.5	5.5	5	5.5	5.5	5	5.5	5.5	5.5	4	189	199.0

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

Spillway Bay Number																		stops	FB=74.
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	ft.	Kcfs
vertical gate opening (ft.)																			
4	5.5	5.5	5.5	5.5	5.5	5	5.5	5.5	5.5	5	5.5	5.5	5.5	5.5	5.5	5.5	4	190	199.9
4	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5	5.5	5.5	5.5	5.5	5.5	5.5	4	191	200.9
4	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	4	192	201.9
4	5.5	5.5	5.5	6	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	4	193	202.8
4	5.5	5.5	5.5	6	5.5	5.5	5.5	5.5	5.5	5.5	5.5	6	5.5	5.5	5.5	5.5	4	194	203.8
4	5.5	5.5	5.5	6	5.5	5.5	5.5	5.5	5.5	5.5	6	6	5.5	5.5	5.5	5.5	4	195	204.7
4	5.5	5.5	5.5	6	6	5.5	5.5	5.5	5.5	5.5	6	6	5.5	5.5	5.5	5.5	4	196	205.7
4	5.5	5.5	5.5	6	6	5.5	6	5.5	5.5	5.5	6	6	5.5	5.5	5.5	5.5	4	197	206.6
4	5.5	5.5	5.5	6	6	5.5	6	5.5	6	5.5	6	6	5.5	5.5	5.5	5.5	4	198	207.6
4	6	5.5	5.5	6	6	5.5	6	5.5	6	5.5	6	6	5.5	5.5	5.5	5.5	4	199	208.5
4	6	5.5	5.5	6	6	5.5	6	5.5	6	5.5	6	6	5.5	5.5	5.5	6	4	200	209.5
4	6	5.5	5.5	6	6	5.5	6	5.5	6	5.5	6	6	5.5	5.5	6	6	4	201	210.4
4	6	6	5.5	6	6	5.5	6	5.5	6	5.5	6	6	5.5	5.5	6	6	4	202	211.4
4	6	6	5.5	6	6	5.5	6	5.5	6	5.5	6	6	6	5.5	6	6	4	203	212.3
4	6	6	5.5	6	6	5.5	6	5.5	6	5.5	6	6	6	5.5	6	6	4.5	204	213.2
4.5	6	6	5.5	6	6	5.5	6	5.5	6	5.5	6	6	6	5.5	6	6	4.5	205	214.0
4.5	6	6	6	6	6	5.5	6	5.5	6	5.5	6	6	6	5.5	6	6	4.5	206	215.0
4.5	6	6	6	6	6	5.5	6	5.5	6	5.5	6	6	6	6	6	6	4.5	207	215.9
4.5	6	6	6	6	6	5.5	6	6	6	5.5	6	6	6	6	6	6	4.5	208	216.9
4.5	6	6	6	6	6	6	6	6	6	5.5	6	6	6	6	6	6	4.5	209	217.8
4.5	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	4.5	210	218.8
4.5	6	6	6	6.5	6	6	6	6	6	6	6	6	6	6	6	6	4.5	211	219.7
4.5	6	6	6	6.5	6	6	6	6	6	6	6	6.5	6	6	6	6	4.5	212	220.6
4.5	6	6	6	6.5	6	6	6	6	6	6	6.5	6.5	6	6	6	6	4.5	213	221.6
4.5	6	6	6	6.5	6.5	6	6	6	6	6	6.5	6.5	6	6	6	6	4.5	214	222.5
4.5	6	6	6	6.5	6.5	6	6.5	6	6	6	6.5	6.5	6	6	6	6	4.5	215	223.4
4.5	6	6	6	6.5	6.5	6	6.5	6	6	6	6.5	6.5	6	6	6	6.5	4.5	216	224.4
4.5	6.5	6	6	6.5	6.5	6	6.5	6	6	6	6.5	6.5	6	6	6	6.5	4.5	217	225.3
4.5	6.5	6	6	6.5	6.5	6	6.5	6	6	6	6.5	6.5	6	6	6.5	6.5	4.5	218	226.3
4.5	6.5	6.5	6	6.5	6.5	6	6.5	6	6	6	6.5	6.5	6	6	6.5	6.5	4.5	219	227.2
4.5	6.5	6.5	6	6.5	6.5	6	6.5	6	6.5	6	6.5	6.5	6	6	6.5	6.5	4.5	220	228.1
4.5	6.5	6.5	6	6.5	6.5	6	6.5	6	6.5	6	6.5	6.5	6	6.5	6.5	6.5	4.5	221	229.1
4.5	6.5	6.5	6.5	6.5	6.5	6	6.5	6	6.5	6	6.5	6.5	6	6.5	6.5	6.5	4.5	222	230.0
4.5	6.5	6.5	6.5	6.5	6.5	6	6.5	6	6.5	6	6.5	6.5	6.5	6.5	6.5	6.5	4.5	223	230.9
4.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6	6.5	6	6.5	6.5	6.5	6.5	6.5	6.5	4.5	224	231.9
4.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	4.5	225	232.8
4.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	4.5	226	233.8
4.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	5	227	234.6
5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	5	228	235.4
5	6.5	6.5	6.5	7	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	5	229	236.3
5	6.5	6.5	6.5	7	6.5	6.5	6.5	6.5	6.5	6.5	6.5	7	6.5	6.5	6.5	6.5	5	230	237.2
5	6.5	6.5	6.5	7	6.5	6.5	6.5	6.5	6.5	6.5	7	7	6.5	6.5	6.5	6.5	5	231	238.2
5	6.5	6.5	6.5	7	7	6.5	6.5	6.5	6.5	6.5	7	7	6.5	6.5	6.5	6.5	5	232	239.1
5	6.5	6.5	6.5	7	7	6.5	7	6.5	6.5	6.5	7	7	6.5	6.5	6.5	6.5	5	233	240.0
5	6.5	6.5	6.5	7	7	6.5	7	6.5	6.5	6.5	7	7	6.5	6.5	6.5	7	5	234	240.9
5	7	6.5	6.5	7	7	6.5	7	6.5	6.5	6.5	7	7	6.5	6.5	6.5	7	5	235	241.9
5	7	6.5	6.5	7	7	6.5	7	6.5	6.5	6.5	7	7	6.5	6.5	7	7	5	236	242.8

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

Spillway Bay Number																		stops	FB=74.0
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	ft.	Kcfs
vertical gate opening (ft.)																			
5	7	7	6.5	7	7	6.5	7	6.5	6.5	6.5	7	7	6.5	6.5	7	7	5	237	243.7
5	7	7	6.5	7	7	6.5	7	6.5	7	6.5	7	7	6.5	6.5	7	7	5	238	244.6
5	7	7	6.5	7	7	6.5	7	6.5	7	6.5	7	7	6.5	7	7	7	5	239	245.6
5	7	7	7	7	7	6.5	7	6.5	7	6.5	7	7	6.5	7	7	7	5	240	246.5
5	7	7	7	7	7	6.5	7	6.5	7	6.5	7	7	7	7	7	7	5	241	247.4
5	7	7	7	7	7	7	7	6.5	7	6.5	7	7	7	7	7	7	5	242	248.3
5	7	7	7	7	7	7	7	6.5	7	7	7	7	7	7	7	7	5	243	249.3
5	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	5	244	250.2
5	7	7	7	7.5	7	7	7	7	7	7	7	7	7	7	7	7	5	245	251.1
5	7	7	7	7.5	7	7	7	7	7	7	7	7.5	7	7	7	7	5	246	252.0
5	7	7	7	7.5	7	7	7	7	7	7	7.5	7.5	7	7	7	7	5	247	252.9
5	7	7	7	7.5	7.5	7	7	7	7	7	7.5	7.5	7	7	7	7	5	248	253.8
5	7	7	7	7.5	7.5	7	7.5	7	7	7	7.5	7.5	7	7	7	7	5	249	254.8
5	7	7	7	7.5	7.5	7	7.5	7	7	7	7.5	7.5	7	7	7.5	7	5	250	255.7
5	7	7.5	7	7.5	7.5	7	7.5	7	7	7	7.5	7.5	7	7	7.5	7	5	251	256.6
5	7	7.5	7	7.5	7.5	7	7.5	7	7.5	7	7.5	7.5	7	7	7.5	7	5	252	257.5
5	7	7.5	7	7.5	7.5	7	7.5	7	7.5	7	7.5	7.5	7	7.5	7.5	7	5	253	258.4
5	7	7.5	7.5	7.5	7.5	7	7.5	7	7.5	7	7.5	7.5	7	7.5	7.5	7	5	254	259.3
5	7	7.5	7.5	7.5	7.5	7	7.5	7	7.5	7	7.5	7.5	7.5	7.5	7.5	7	5	255	260.2
5	7	7.5	7.5	7.5	7.5	7.5	7.5	7	7.5	7	7.5	7.5	7.5	7.5	7.5	7	5	256	261.2
5	7	7.5	7.5	7.5	7.5	7.5	7.5	7	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7	5	257	262.1
5	7	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7	5	258	263.0
5	7	7.5	7.5	8	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7	5	259	263.9
5	7	7.5	7.5	8	7.5	7.5	7.5	7.5	7.5	7.5	7.5	8	7.5	7.5	7.5	7	5	260	264.8
5	7	7.5	7.5	8	7.5	7.5	7.5	7.5	7.5	7.5	8	8	7.5	7.5	7.5	7	5	261	265.7
5	7	7.5	7.5	8	8	7.5	7.5	7.5	7.5	7.5	8	8	7.5	7.5	7.5	7	5	262	266.6
5	7	7.5	7.5	8	8	7.5	8	7.5	7.5	7.5	8	8	7.5	7.5	7.5	7	5	263	267.5
5	7	7.5	7.5	8	8	7.5	8	7.5	7.5	7.5	8	8	7.5	7.5	7.5	7.5	5	264	268.4
5	7.5	7.5	7.5	8	8	7.5	8	7.5	7.5	7.5	8	8	7.5	7.5	7.5	7.5	5	265	269.3
5	7.5	7.5	7.5	8	8	7.5	8	7.5	7.5	7.5	8	8	7.5	7.5	8	7.5	5	266	270.2
5	7.5	8	7.5	8	8	7.5	8	7.5	7.5	7.5	8	8	7.5	7.5	8	7.5	5	267	271.1
5	7.5	8	7.5	8	8	7.5	8	7.5	8	7.5	8	8	7.5	7.5	8	7.5	5	268	272.0
5	7.5	8	7.5	8	8	7.5	8	7.5	8	7.5	8	8	7.5	8	8	7.5	5	269	273.0
5	7.5	8	8	8	8	7.5	8	7.5	8	7.5	8	8	7.5	8	8	7.5	5	270	273.9
5	7.5	8	8	8	8	7.5	8	7.5	8	7.5	8	8	8	8	8	7.5	5	271	274.8
5	7.5	8	8	8	8	8	8	7.5	8	7.5	8	8	8	8	8	7.5	5	272	275.7
5	7.5	8	8	8	8	8	8	7.5	8	8	8	8	8	8	8	7.5	5	273	276.6
5	7.5	8	8	8	8	8	8	8	8	8	8	8	8	8	8	7.5	5	274	277.5
5	7.5	8	8	8.5	8	8	8	8	8	8	8	8	8	8	8	7.5	5	275	278.4
5	7.5	8	8	8.5	8	8	8	8	8	8	8	8.5	8	8	8	7.5	5	276	279.3
5	7.5	8	8	8.5	8	8	8	8	8	8	8.5	8.5	8	8	8	7.5	5	277	280.2
5	7.5	8	8	8.5	8.5	8	8	8	8	8	8.5	8.5	8	8	8	7.5	5	278	281.0
5	7.5	8	8	8.5	8.5	8	8.5	8	8	8	8.5	8.5	8	8	8	7.5	5	279	281.9
5	7.5	8	8	8.5	8.5	8	8.5	8	8	8	8.5	8.5	8	8	8	8	5	280	282.8
5	8	8	8	8.5	8.5	8	8.5	8	8	8	8.5	8.5	8	8	8	8	5	281	283.7
5	8	8	8	8.5	8.5	8	8.5	8	8	8	8.5	8.5	8	8	8.5	8	5	282	284.6
5	8	8.5	8	8.5	8.5	8	8.5	8	8	8	8.5	8.5	8	8	8.5	8	5	283	285.5

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

Spillway Bay Number																		stops	FB=74.
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	ft.	Kcfs
vertical gate opening (ft.)																			
5	8	8.5	8	8.5	8.5	8	8.5	8	8.5	8	8.5	8.5	8	8	8.5	8	5	284	286.4
5	8	8.5	8	8.5	8.5	8	8.5	8	8.5	8	8.5	8.5	8	8.5	8.5	8	5	285	287.3
5	8	8.5	8.5	8.5	8.5	8	8.5	8	8.5	8	8.5	8.5	8	8.5	8.5	8	5	286	288.2
5	8	8.5	8.5	8.5	8.5	8	8.5	8	8.5	8	8.5	8.5	8.5	8.5	8.5	8	5	287	289.1
5	8	8.5	8.5	8.5	8.5	8.5	8.5	8	8.5	8	8.5	8.5	8.5	8.5	8.5	8	5	288	290.0
5	8	8.5	8.5	8.5	8.5	8.5	8.5	8	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8	5	289	290.9
5	8	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8	5	290	291.8
5	8	8.5	8.5	9	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8	5	291	292.7
5	8	8.5	8.5	9	8.5	8.5	8.5	8.5	8.5	8.5	8.5	9	8.5	8.5	8.5	8	5	292	293.6
5	8	8.5	8.5	9	8.5	8.5	8.5	8.5	8.5	8.5	9	9	8.5	8.5	8.5	8	5	293	294.4
5	8	8.5	8.5	9	9	8.5	8.5	8.5	8.5	8.5	9	9	8.5	8.5	8.5	8	5	294	295.3
5	8	8.5	8.5	9	9	8.5	9	8.5	8.5	8.5	9	9	8.5	8.5	8.5	8	5	295	296.2
5	8	8.5	8.5	9	9	8.5	9	8.5	8.5	8.5	9	9	8.5	8.5	8.5	8.5	5	296	297.1
5	8	8.5	8.5	9	9	8.5	9	8.5	8.5	8.5	9	9	8.5	8.5	9	8.5	5	297	298.0
5	8	9	8.5	9	9	8.5	9	8.5	8.5	8.5	9	9	8.5	8.5	9	8.5	5	298	298.9
5	8	9	8.5	9	9	8.5	9	8.5	9	8.5	9	9	8.5	8.5	9	8.5	5	299	299.8
5	8	9	8.5	9	9	8.5	9	8.5	9	8.5	9	9	8.5	9	9	8.5	5	300	300.7