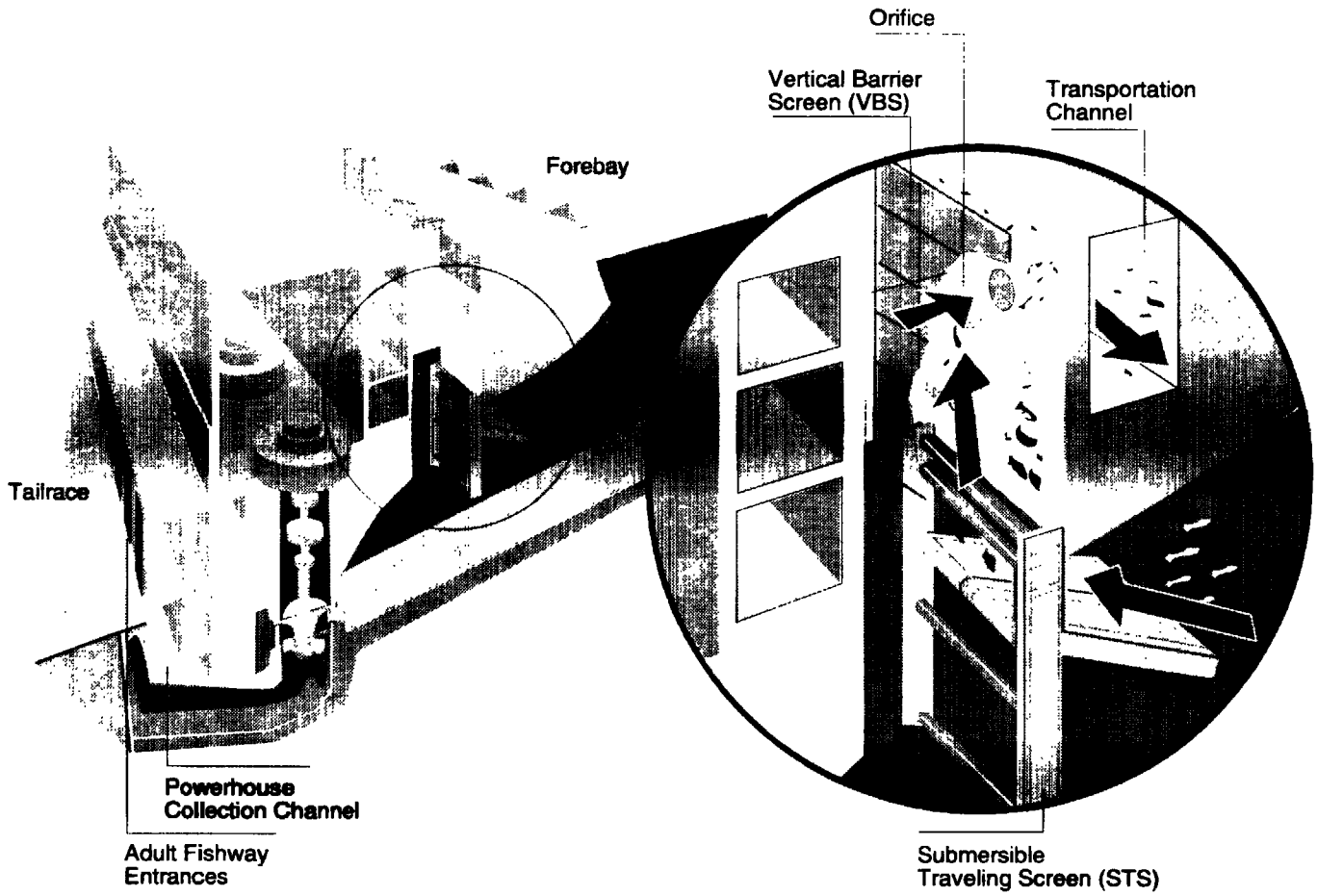
US Army Corps of Engineers

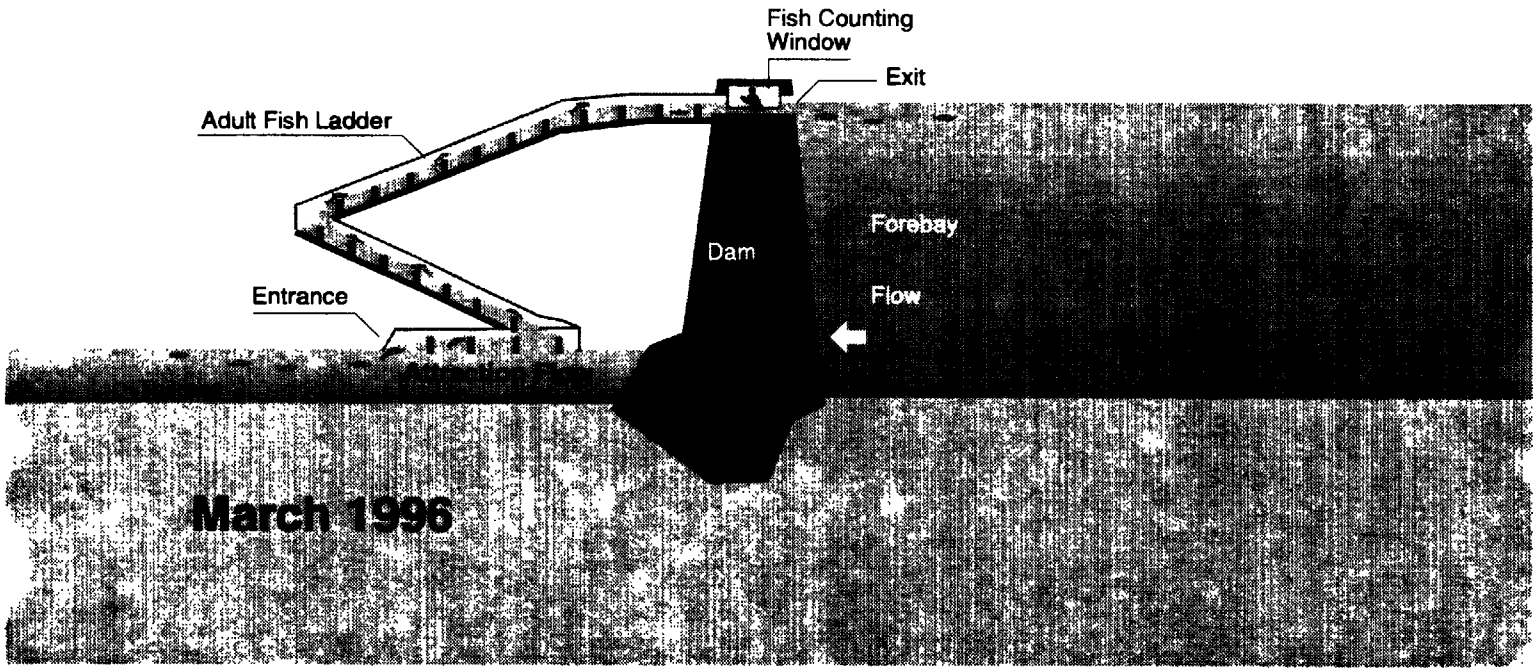
North Pacific Division

Fish Passage Plan

Corps of Engineers Projects

CENPD-ET-PR





March 1996

DEPARTMENT OF THE ARMY
NORTH PACIFIC DIVISION, CORPS OF ENGINEERS
P.O. BOX 2870
PORTLAND, OREGON 97208-2870

Reply to
Attention of:

Environmental Resources

27 March 1996

Dear Interested Party:

Enclosed for your use is the U.S. Army Corps of Engineers' Fish Passage Plan (FPP). It has been prepared under our project operating authorities to describe the manner in which the Corps' mainstem projects on the Columbia and lower Snake Rivers will operate in 1996 and future years to provide acceptable fish passage conditions. This document has been revised to incorporate recommendations arising from ongoing regional coordination consistent with the NMFS Biological Opinion on hydrosystem operation dated 2 March 1995, and decisions contained in the Corps' Record of Decision signed on 10 March 1995, to protect migratory fish species listed as endangered under the Endangered Species Act and their critical habitat. The FPP has been provided to NMFS, BPA, BOR, USFWS, NPPC, and other regional entities.

The FPP is revised when necessary to incorporate changes to project operations and maintenance as a result of either new facilities or recommendations on operational procedures. Draft FPP revisions will be provided to the Corps' Fish Passage O&M Coordination Team for regional review. Revisions will be published two weeks after the close of the regional review period. Recommendations may come from NMFS, other fisheries agencies, Indian tribes, other Federal and state agencies, the Northwest Power Planning Council, and interested parties. Snake River Salmon Recovery Plan features will be considered for incorporation when that Plan becomes final. All FPP revisions will be consistent with the 1995 Biological Opinion.

The FPP represents the Corps' commitment to the region in restoring Columbia River basin salmon populations, with emphasis on protection of depleted wild and naturally-spawning fish stocks and their critical habitat. Please contact Rudd Turner of this office at 503/326-6586 if you have questions or comments.

Owen J. Mason
Chief, Environmental Resources

Encl.

FISH PASSAGE PLAN

FOR

CORPS OF ENGINEERS PROJECTS

U.S. ARMY CORPS OF ENGINEERS

NORTH PACIFIC DIVISION

PORTLAND, OREGON

MARCH 1996

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FISH PASSAGE PLAN

1. **General**. The Corps' Fish Passage Plan (FPP) is developed in coordination with the region's fisheries agencies, Indian tribes, the Bonneville Power Administration (BPA), and other participants through the Corps' Fish Passage O&M Coordination Team. It is revised as necessary to incorporate changes to project operations and maintenance as a result of new facilities or changes in operational procedures.

FPP revisions will incorporate changes adopted through coordination with the National Marine Fisheries Service (NMFS) as part of the Endangered Species Act (ESA) Section 7 consultation, Recovery Plan, or Section 10 permit processes, and through consideration of other regional input and plans. The current revisions reflect provisions contained in the NMFS' Biological Opinion issued 2 March 1995 (Reinitiation of Consultation on 1994 - 1998 Operation of the Federal Columbia River Power System and Juvenile Transportation Program in 1995 and Future Years) and in the Corps' Record of Decision signed 10 March 1995 (U.S. Army Corps of Engineers North Pacific Division Record of Decision, Reservoir Regulation and Project Operations, 1995 and Future Years).

FPP revisions are provided to the Northwest Power Planning Council (NPPC) for use by the Fish Operations Executive Committee (FOEC) as part of the overall river operation plan. When revising the FPP, the Corps considers the amended NPPC Columbia River Basin Fish and Wildlife Program to the fullest extent practicable.

The FPP describes year-round project operations necessary to protect and enhance ESA-listed salmon species as well as other anadromous fish species. The FPP guides Corps actions in regard to providing fish protection and passage at the Corps' eight mainstem Columbia and Snake River projects. Other Corps documents and agreements related to fish passage at these projects are consistent with the 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.

Decisions on river operations to achieve interim fish passage efficiency (FPE) or survival goals for spring and summer outmigrants will be made in coordination with the Technical Management Team (TMT). FPE goals will apply until either project or system survival goals are developed. The Corps considers the following factors in implementing FPE and survival goals:

1. Spill provisions contained in the NMFS Biological Opinion on hydrosystem operations (Appendix F) and the Corps' Juvenile Fish Transportation Plan (JFTP) (Appendix C), which are implemented where they apply;

2. Endangered, threatened, or depleted natural and wild stocks, which take priority for protection over hatchery stocks;

3. Potential for adverse impacts on other project uses; and,

4. Risk of adverse environmental and physical impacts.

Corps mainstem projects will provide spill for juvenile fish passage according to the NMFS Biological Opinion (specifications in Appendix F) to protect ESA-listed salmon species. These spill levels were developed through consultation with NMFS and may be changed during the fish migration season as recommended by the TMT. Continuous spill is provided at Bonneville, The Dalles, and Ice Harbor Dams for spring and summer outmigrants to meet Biological Opinion requirements. Nightly spill is also provided at John Day and McNary Dams (spring season only at McNary), and may be provided in the spring at the Snake River collector dams, Lower Monumental, Little Goose, and Lower Granite, under certain conditions of higher flow (see Appendix F). Spill also may be provided under special circumstances for nonlisted fish species, if recommended by the fisheries agencies and tribes and if the recommendations are consistent with regional operational agreements (i.e., Spring Creek Hatchery release).

Total dissolved gas (TDG) saturation levels are monitored at the forebay and tailrace of each mainstem project during the fish passage season. The water quality standard and criterion developed by the states and EPA is 110% of saturation at ambient temperature and pressure. Adherence to this standard is a goal of spill management by the Corps. However, the NMFS Biological Opinion calls for fish spill to be provided up until higher TDG levels are exceeded (Appendix F). Also, implementation of fish spill requests in the past has resulted in TDG levels of 120% or greater. Therefore, fish spill implementation will be subject to further coordination with appropriate entities if excessive TDG levels occur or if evidence of

gas bubble disease is observed in fish. Any spill requests that will cause exceedence of the state TDG standard must include appropriate coordination with state water quality agencies, including waivers of state water quality standards if necessary, previously obtained by the requester (see Appendix G, the Division Engineer's spill policy letter).

BPA guidelines on system load shaping to consider fish impacts are included in Appendix D. The guidelines describe procedures BPA follows to make hydropower load requests that enable the Corps to operate turbine units within 1% of peak efficiency.

Comments on the FPP are welcome. They may be directed either to the Fish Passage O&M Coordination Team or the Corps' North Pacific Division, Environmental Resources office in Portland, Oregon.

2. **Project Operation and Maintenance**. Appendix A contains the detailed criteria for operation and maintenance of fish passage facilities and project operation procedures for fish passage at the Corps projects on the lower Snake and lower Columbia Rivers. Unresolved differences between FPP criteria and prior recommendations of the fisheries agencies and tribes are highlighted within Appendix A.

3. **Juvenile Fish Transportation Plan**. Juvenile fish will be transported in accordance with the plan laid out in the NMFS Biological Opinion. Transportation criteria are contained in the JFTP, Appendix C. The JFTP covers the collection, holding, and transport of juvenile fish. Other project criteria on the operation of the

juvenile fish bypass systems are contained in Appendix A. Additional criteria may be developed as part of the NMFS ESA Section 10 permit process.

4. **Project Fish Passage Facilities Inspection and Reporting Criteria.**

a. **General.** Appendix A contains the detailed criteria for inspection and reporting criteria for fish passage facilities at the Corps projects on the lower Snake and lower Columbia Rivers. The Corps provides weekly written inspection reports to NMFS Environmental and Technical Division describing any 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 facilities inspections and monitoring.

b. **Criteria for Reporting Excursions Outside the 1% Peak Turbine Efficiency Operating Range.** Reporting excursions outside the 1% peak turbine efficiency operating range will be performed by BPA on a semi-monthly basis with a monthly synopsis. These reports will record instances where lower Columbia (LCOL) and lower Snake river (LSN) turbines were operated outside 1% peak efficiency ranges for significant periods as defined under the guidelines in Appendix D. BPA will prepare the reports by consolidating data provided by Corps project operators at LCOL and LSN projects. Reports will be sent to NMFS by BPA. The intent of excursion reporting is to provide a means for quality assurance during the fish

passage season when projects operate within the 1% peak turbine efficiency guidelines, as specified in Appendix D.

5. **Project Operation Criteria**. The following paragraphs summarize, by project, the operating criteria of the FPP. Special project operations, including spill, current research project summaries, and Project Improvements for Endangered Species (PIES) items are described in Appendix B. Operating schedules are provided in Appendix A and Appendix B, where applicable. Schedules may be adjusted for endangered species during certain conditions such as extended periods of additional flows, or to meet special fish needs.

a. **Bonneville Dam.**

The ten main generation units at the first powerhouse are screened. A small generation unit at the south end of the first powerhouse is not screened. The eight main generation units at the second powerhouse are screened. Two small generation units at the second powerhouse are not screened. Both powerhouses at Bonneville Dam have juvenile fish bypass systems.

(1) **Operation for Juvenile Passage**.

- Operate juvenile fish passage facilities in accordance with project operating criteria contained in Appendices A and B.

- Provide spill according to guidelines contained in Appendices B and F.

(2) **Operation for Adult Passage**.

• Operate the project throughout the year in accordance with project operating criteria as specified in Appendices A and B.

b. **The Dalles Dam**.

Turbine generation units at The Dalles are not screened. Approximately 3,600 to 4,000 cfs flow is routed through the ice and trash sluiceway during the juvenile passage season. This is an interim operation until a new juvenile bypass system becomes operational.

(1) **Operation for Juvenile Passage**.

• Operate juvenile fish passage facilities in accordance with project operation criteria contained in Appendices A and B.

• Provide spill according to guidelines contained in Appendices B and F.

(2) **Operation for Adult Passage**.

• Operate the project throughout the year in accordance with project operating criteria as specified in Appendices A and B.

c. **John Day Dam**.

All sixteen generation units are screened and the project has bypass facilities.

(1) **Operation for Juvenile Passage**.

• Operate juvenile fish passage facilities in accordance with operating criteria in Appendices A and B.

• Provide spill according to guidelines contained in Appendices B and F.

(2) **Operation for Adult Passage**.

• Operate the project throughout the year in accordance with operating criteria as specified in Appendices A and B.

d. **McNary Dam**.

All fourteen main generation units at McNary are screened. Two small station service units are not screened. Extended-length screens are being installed in 1996. The project has facilities to separate juveniles by size, then bypass them either directly to the tailrace or to raceways for transport by barge or truck to in-river release sites below Bonneville Dam. The collection and transportation facilities will operate during the summer/fall outmigration season.

(1) **Operation for Juvenile Passage**.

• Operate juvenile fish bypass and collection facilities in accordance with operating criteria in appendices A and B and the JFTP located in Appendix C.

• Provide spill according to guidelines in Appendices B and F.

(2) **Operation for Adult Passage**.

• Operate project facilities throughout the year in accordance with operating criteria as specified in Appendices A and B.

e. **Ice Harbor Dam**.

All six generation units are screened. Fish exit gatewells through 14-inch orifices. A new juvenile bypass system becomes fully operational in 1996.

(1) **Operation for Juvenile Passage**.

• Operate juvenile fish passage facilities in accordance with project operating criteria contained in Appendices A and B.

• Provide spill according to guidelines in Appendices B and F.

(2) **Operation for Adult Passage**.

• Operate project facilities throughout the year in accordance with operating criteria contained in Appendices A and B.

f. **Lower Monumental Dam**.

All six generation units are screened. The project has facilities to separate juveniles by size, then bypass them either directly to the tailrace near the north shore or to raceways for transport by barge or truck to in-river release sites below Bonneville Dam.

(1) **Operation for Juvenile Passage**.

• Operate juvenile fish passage facilities in accordance with project operation criteria contained in Appendices A and B and the JFTP located in Appendix C.

• Provide spill according to guidelines in Appendices B and F.

(2) **Operation for Adult Passage**.

• Operate project facilities throughout the year in accordance with operating criteria contained in Appendices A and B.

g. **Little Goose Dam**.

All six generation units at Little Goose have standard-length screens in place. Extended-length screens will be installed by late 1996. The project has facilities to separate juvenile fish by size, then bypass them either directly to the tailrace or to raceways for transport by barge or truck to in-river release sites below Bonneville Dam.

(1) **Operation for Juvenile Passage**.

• Operate juvenile fish passage facilities in accordance with operating criteria contained in Appendices A and B and the JFTP located in Appendix C.

• Provide spill according to guidelines in Appendices B and F.

(2) **Operation for Adult Passage**.

• Operate project facilities throughout the year in accordance with operating criteria as shown in Appendices A and B.

h. **Lower Granite Dam**.

All six generation units at Lower Granite are screened. Extended-length screens are being installed in 1996. The project has facilities to bypass juvenile fish either directly to the tailrace or to raceways for transport by barge or truck to below Bonneville Dam. In addition, a surface bypass prototype is being installed in March 1996 above the intakes of turbine units 4 - 6. Fish will be bypassed through spill bay 1 into the tailrace.

(1) **Operation for Juvenile Passage**.

• Operate juvenile fish passage facilities in accordance with operating criteria as shown in Appendices A and B and the JFTP located in Appendix C.

• Provide spill according to guidelines in Appendices B and F.

(2) **Operation for Adult Passage**.

• Operate project facilities throughout the year in accordance with operating criteria as shown in Appendices A and B.

6. 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 Indian tribes. The Corps' Reservoir Control Center (RCC) coordinates operations of Corps projects that affect system water management, spill, unit availability, or other project uses. District biologists may coordinate directly with the fisheries agencies and tribes on other project-specific operations that do not have system impacts.

RCC daily briefings are held at 1300 hours, Monday through Friday, in the U.S. Custom House, Portland, Oregon. RCC also participates in weekly meetings of the Federal interagency TMT which recommends a river operation for the following week. Corps representatives are available at these meetings to discuss the latest weather and runoff forecasts, as well as fish, hydrologic, water quality, and power information to assist in the planning of operations for fish passage for the next few days. Fish operations recommendations are evaluated by the Corps to determine impact on overall system operations. The Corps also coordinates with NMFS to meet ESA requirements for endangered species.

a. **Information and Coordination Needs**.

(1) **U.S. Army Corps of Engineers**.

(a) Coordinate with NMFS on operational actions that might impact threatened or endangered salmon species.

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

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

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

(e) Carry out routine and emergency fish passage operations and maintenance procedures in accordance with criteria in Appendices A and B.

(f) Conduct the Dissolved Gas Monitoring Program as described in Appendix E.

(2) **Fisheries agencies and Indian tribes**.

(a) Request spill for fish through NMFS to protect endangered species, or in accordance with the amended NPPC Fish and Wildlife Program.

(b) Through NMFS, provide RCC with a spill priority list and updates for discussion by the TMT.

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

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

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

(f) Provide appraisal to the operating agencies of the amount of flexibility available in fish operations while maintaining acceptable conditions for migrants. 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) Assure that all viable methods and procedures to reduce mortality to migrants are utilized. This may include such operations as collection and transportation of migrants, use of ice and trash sluiceways, and others.

(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's 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 1% of peak efficiency, as indicated in Appendix D.

(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.

b. **Coordination Procedures.**

(1) **Coordination of the FPP**.

The FPP is effective year-round. FPP revisions are coordinated with the Corps' Fish Passage O&M Coordination Team, which includes NMFS, other Federal and state fisheries agencies, Indian tribes, and other interested parties. Different pieces of the FPP may be revised at different times. Suggested revisions should be submitted to the Committee 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 forwarded to NPPC for use by FOEC as part of the overall river operation plan.

(2) **Day-to-day coordination of river system**.

(a) **Flow augmentation and reservoir operations recommendations.**

Procedures described in the Water Management Plan will be used for fish operations. These may include requirements and schedules for coordination

meetings, in-season briefings, water use accounting, providing information, and making and implementing fish-related recommendations.

(b) **Fish spill management.**

The Corps will implement fish spill provisions contained in Section VIII.A.2. of the NMFS Biological Opinion , consistent with state water quality standards including applicable TDG waivers which are in effect at the time. 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, BPA, and water quality agencies. Recommendations on adjusting spill levels based on physical and biological monitoring results will be forwarded to the TMT for discussion at their weekly meetings.

(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. Prior coordination of these recommendations with RCC is strongly encouraged. RCC will consider degree of fish-related needs along with the extent of impacts on power and nonpower project uses, and project O&M requirements, in making its decision. Modifications to recommendations will be coordinated prior to implementation with NMFS, BPA, U.S. Bureau of Reclamation (BOR), U.S. Fish and Wildlife Service, state fisheries agencies, Indian tribes, and the entity recommending the change.

Recommendations related to project O&M activities will be evaluated for impacts on fish migration, including coordination with the fisheries agencies and tribes and coordination with NMFS. Sufficient lead time will be given on a planned operation, whenever practical, to allow ample consideration of fish impacts in RCC's decision. As much lead time as possible will be provided for immediate actions. 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, including coordination with NMFS, other fisheries agencies and tribes. Except as necessary for emergency actions, adequate time will be allowed for evaluation of all project impacts, including fish, prior to implementation.

(e) **Dispute resolution.**

Unresolved disputes may be brought before the TMT or other appropriate forum for the particular issue, for discussion and resolution. If the TMT is unable to resolve an issue, it will be forwarded, with alternative solutions proposed, to the regional directors of the operating agencies (Corps and BOR) for decision. Input from regional forums such as the Implementation Team (IT) or FOEC will be considered by the Corps in making its final decision.

APPENDIX A

OPERATION AND MAINTENANCE CRITERIA FOR FISH PASSAGE FACILITIES AT CORPS OF ENGINEERS PROJECTS

Bonneville Dam

I. BONNEVILLE DAM

A. Fish Passage Information. The locations of fish passage facilities are shown on the following general site plans for Bonneville Lock and Dam (p. BON-2 through BON-4).

1. Juvenile Fish Passage

a. Facilities Description

(1) First Powerhouse

(a) Facilities Description. Juvenile fish passage facilities at the Bonneville first powerhouse consist of STSs, VBSs, 12" gatewell orifices, fish bypass channel, excess water elimination facility, fish sampler, and a 24" fish transport pipe to the tailrace. All 10 main turbine units have STSs. A small unit (unit "O") is located at the south end of the powerhouse and is not equipped with screens. It is used for back-up station service and does not currently operate often.

There are also small channels associated with the auxilliary 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 & trash sluiceway at the south end of the powerhouse. These facilities are no longer operated on a regular basis.

(2) Second Powerhouse

(a) Facilities Description. Juvenile fish passage facilities at the Bonneville second powerhouse comprise turbine intake extensions (TIEs), streamlined trash racks, STSs (recently lowered for more effectiveness), VBSs, two 12" orifices per gatewell (with only one operating per gatewell) flowing into a fish bypass channel, an excess water elimination facility, and a 36" fish transport pipe which connects the bypass channel to the tailrace. 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.

b. Juvenile Migration Timing. Maintenance of juvenile fish facilities is scheduled for the period of approximately 1 December through February to reduce the impact on downstream migrants. Maintenance activities will be coordinated to minimize potential impacts on juvenile migrants that may be present during this time period.

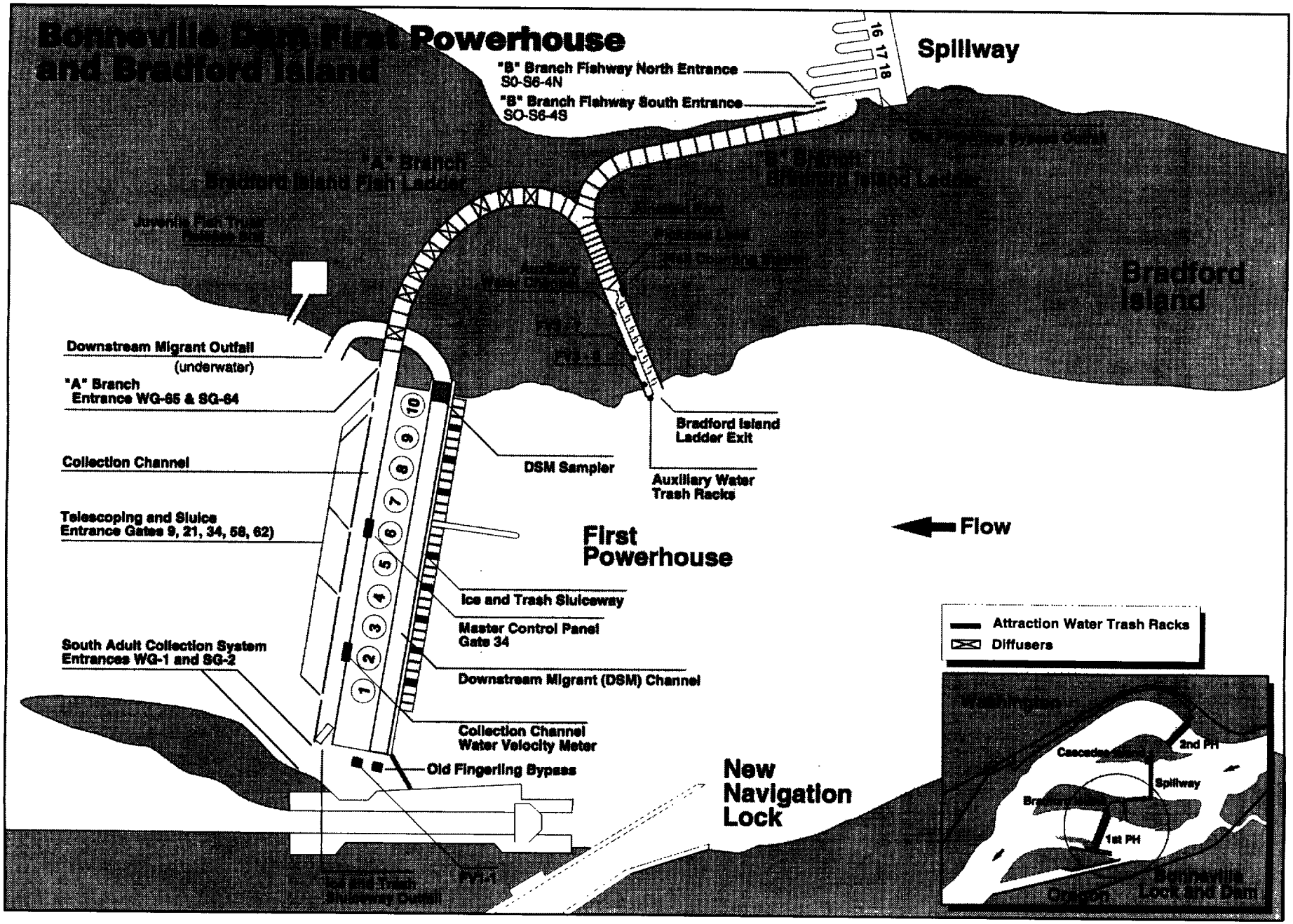

Figure 1 Bonneville Dam First Powerhouse and Bradford Island Fish Ladder

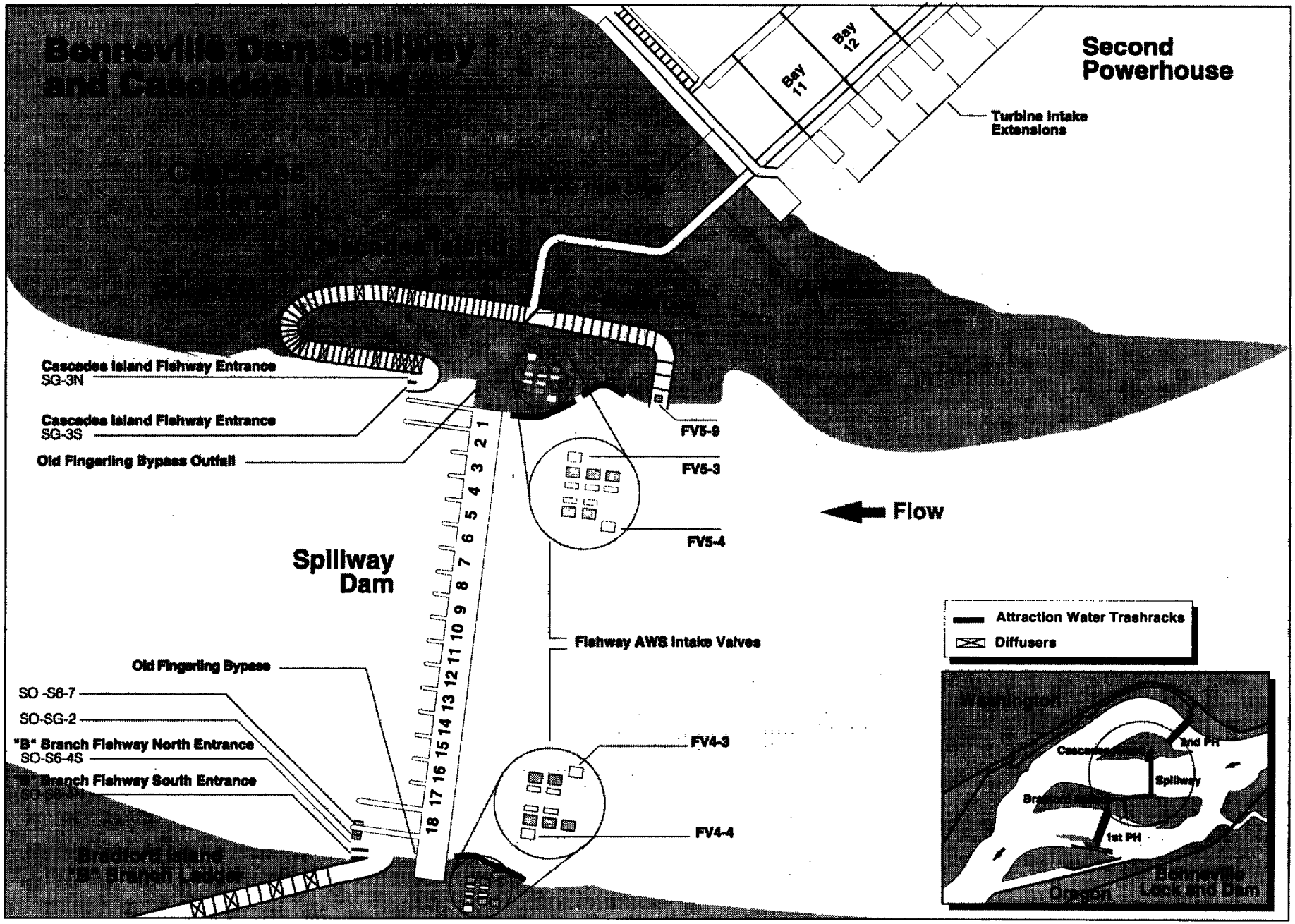

Figure 2 Bonneville Dam Spillway, Cascades Island Fish Ladder and Upstream Migrant Transportation Channel (UMT)

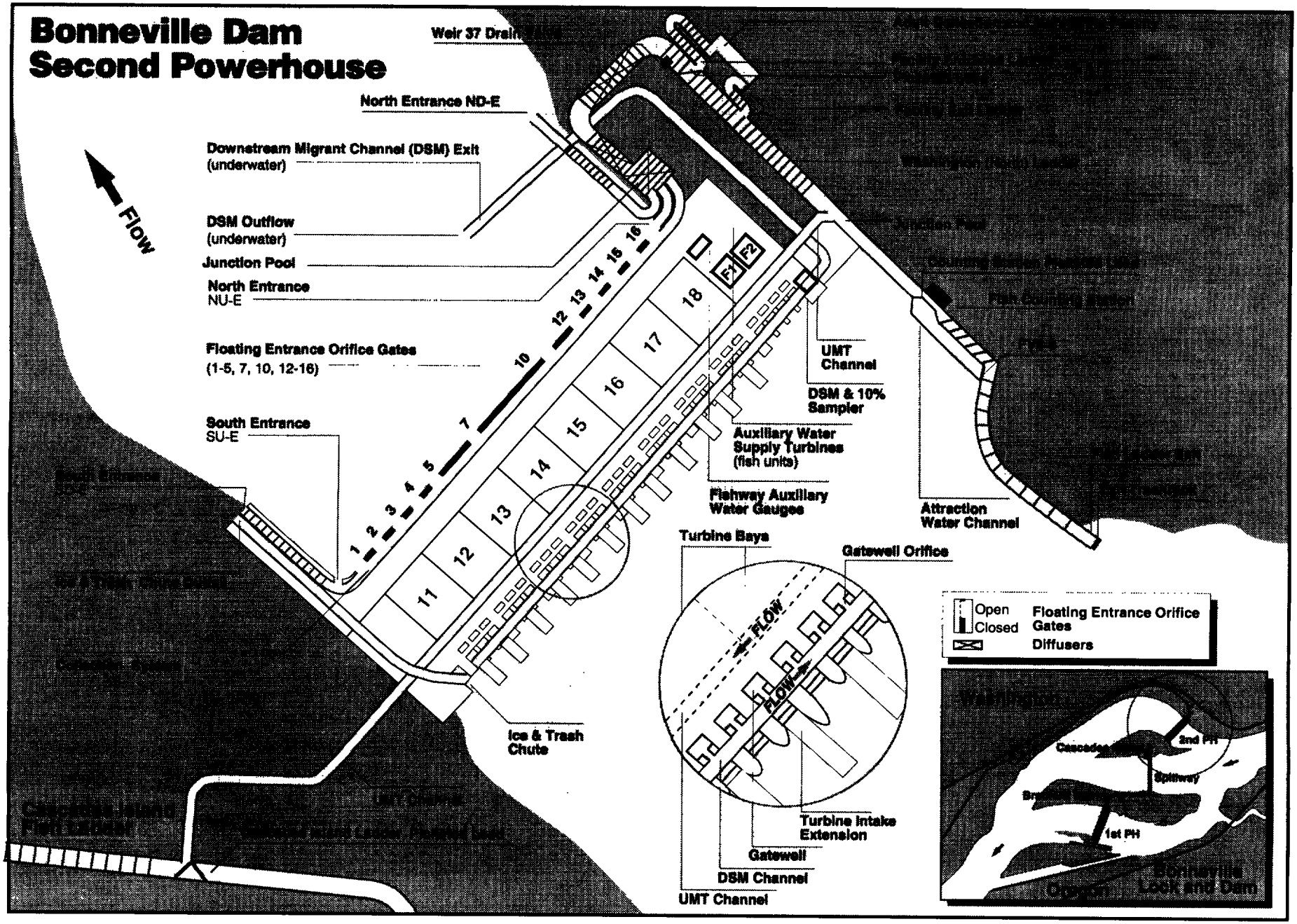

Figure 3 Bonneville Dam Second Powerhouse and Washington (North) Fish Ladder.

a. Low FGE at the second powerhouse has been improved by implementation of three measures: 1) full installation of turbine intake extensions (TIEs) in front of alternate intake slots; 2) replacing the top three standard trash racks in each intake slot with streamlined trash racks; and 3) lowering the STSs. These improvements were first fully installed at the beginning of the 1993 fish passage season. Guidance for spring and summer general flow distribution between powerhouses and spill is provided in the main text of the Fish Passage Plan and in appendix B.

b. Summer operation: 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 will change (see description in the main text of this plan and in appendix B).

c. Research, non-routine maintenance, and other fishery related activities will not be conducted within 100' of any fishway entrance or exit, or directly in, above, of adjacent to any fishway, unless concurred with by regional fisheries managers through ESA and other fish passage issues. Alternate actions will be considered by district and project biologists in conjunction with the fishery 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.

2. Spill Management

a. General.

(1) Regardless of time of day, only one spill schedule will be used at Bonneville Dam (See Spill Schedule, p. BON-8 through BON-10).

(2) Nighttime spill is limited as necessary to control gas supersaturation. Adjustments of the nighttime spill level may be granted on a case-by-case basis by the Reservoir Control Center, dependent upon dissolved gas saturation readings at stations downstream of the dam, and upon fish movement. The hours of nighttime spill are the daily complements of the periods of daytime spill (see I.B.2.c. (1), below). However, changing spill gate positions takes some time, particularly for the gates which can't yet be operated remotely. So, the transition to the daytime cap should begin early enough in the day to minimize violating the defined daytime spill maximum and should not start until after the daytime cap period is over.

b. Juvenile Fish.

(1) Spill will be provided according to guidance described in appendices B and F.

(2) The second powerhouse ice and trash chute will be operated for ice and trash removal and for emergency auxiliary adult transportation channel water supply only as outlined under Operating Standards for Adult Passage Facilities.

c. Adult Fish.

(1) During the adult fish passage period, daytime spill will be limited to 75 kcfs whenever possible. Normally, this restriction will be from one hour before sunrise to one half hour before sunset. However, during the sockeye passage season, 1 June through 15 August, the cap will apply until one hour after sunset.

SPILL SCHEDULE FOR BONNEVILLE DAM

updated 8 June 1993

BAY NUMBER																		DOGS	KCFS
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18		
4"	1																4"	1	
4"	1															1	4"	2	
4"	1	1														1	4"	3	
4"	1	1													1	1	4"	4	
4"	1	1	1												1	1	4"	5	
4"	1	1	1											1	1	1	4"	6	
4"	1	1	1	1										1	1	1	4"	7	
4"	1	1	1	1									1	1	1	1	4"	8	
4"	1	2	1	1									1	1	1	1	4"	9	
4"	3	2									2				1	2	4"	10	33.6
4"	3	2									2				2	2	4"	11	37.2
4"	3	2			1						2				2	2	4"	12	40.3
4"	3	2			2						2				2	2	4"	13	43.9
4"	3	2	1		2						2				2	2	4"	14	47.0
4"	3	2	1		2						2			1	2	2	4"	15	50.1
4"	3	2	1		2				1		2			1	2	2	4"	16	53.8
4"	3	2	1		2				2		2			1	2	2	4"	17	56.9
4"	3	2	2		2				2		2			1	2	2	4"	18	60.5
4"	3	2	2		2		1		2		2			1	2	2	4"	19	63.6
4"	3	2	2		2		2		2		2			1	2	2	4"	20	67.2
4"	3	2	2		2		2		2		2		1	1	2	2	4"	21	70.3
4"	3	2	2		2		2		2		2		2	1	2	2	4"	22	74.0
4"	3	2	2		2		2		2		2		2	1	2	3	4"	23	77.5
4"	3	2	2		2		2		2		2		2	2	2	3	4"	24	81.1
4"	3	3	2		2		2		2		2		2	2	2	3	4"	25	84.6
4"	3	3	2		2		2	1	2		2		2	2	2	3	4"	26	87.7
4"	3	3	2		2		2	2	2		2		2	2	2	3	4"	27	91.3
4"	4	3	2		2		2	2	2		2		2	2	2	3	4"	28	94.8
4"	4	3	2		2		2	2	2		2		2	2	3	3	4"	29	98.4
4"	4	3	2		2		2	2	2		2		2	2	3	4	4"	30	102
4"	4	3	3		2		2	2	2		2		2	2	3	4	4"	31	105
4"	4	3	3	1	2		2	2	2		2		2	2	3	4	4"	32	109
4"	4	3	3	2	2		2	2	2		2		2	2	3	4	4"	33	112
4"	4	3	3	2	2		2	2	2		2	1	2	2	3	4	4"	34	115

SPILL SCHEDULE FOR BONNEVILLE DAM

updated 8 June 1993

BAY NUMBER																		DOGS	KCFS
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18		
4"	4	3	3	2	2		2	2	2		2	2	2	2	3	4	4"	35	119
4"	4	3	3	2	2	1	2	2	2		2	2	2	2	3	4	4"	36	122
4"	4	3	3	2	2	2	2	2	2		2	2	2	2	3	4	4"	37	126
4"	4	3	3	2	2	2	2	2	2	1	2	2	2	2	3	4	4"	38	129
4"	4	3	3	2	2	2	2	2	2	2	2	2	2	2	3	4	4"	39	133
4"	4	4	3	2	2	2	2	2	2	2	2	2	2	2	3	4	4"	40	135
4"	4	4	3	2	2	2	2	2	2	2	2	2	2	3	3	4	4"	41	139
4"	4	4	3	2	2	2	2	2	2	2	2	2	2	3	4	4	4"	42	143
4"	4	4	3	3	2	2	2	2	2	2	2	2	2	3	4	4	4"	43	146
4"	4	4	3	3	2	2	2	2	2	2	3	2	2	3	4	4	4"	44	150
4"	4	4	3	3	2	2	2	2	2	2	3	2	3	3	4	4	4"	45	153
4"	4	4	3	3	2	3	2	2	2	2	3	2	3	3	4	4	4"	46	157
4"	4	4	3	3	2	3	2	2	3	2	3	2	3	3	4	4	4"	47	160
4"	4	4	3	3	2	3	2	3	3	2	3	2	3	3	4	4	4"	48	164
4"	5	4	3	3	2	3	2	3	3	2	3	2	3	3	4	4	4"	49	167
4"	5	4	3	3	2	3	2	3	3	2	3	2	3	3	4	5	4"	50	171
4"	5	4	4	3	2	3	2	3	3	2	3	2	3	3	4	5	4"	51	174
4"	5	5	4	3	2	3	2	3	3	2	3	2	3	3	4	5	4"	52	178
4"	5	5	4	3	2	3	2	3	3	2	3	2	3	3	5	5	4"	53	181
4"	5	5	4	3	2	3	2	3	3	3	3	2	3	3	5	5	4"	54	185
4"	5	5	4	3	2	3	3	3	3	3	3	2	3	3	5	5	4"	55	188
4"	5	5	4	3	2	3	3	3	3	3	3	2	3	4	5	5	4"	56	192
4"	5	5	4	4	2	3	3	3	3	3	3	2	3	4	5	5	4"	57	195
4"	6	5	4	4	2	3	3	3	3	3	3	2	3	4	5	5	4"	58	199
4"	6	5	4	4	3	3	3	3	3	3	3	2	3	4	5	5	4"	59	203
4"	6	5	4	4	3	3	3	3	3	3	3	3	3	4	5	5	4"	60	206
4"	6	5	4	4	3	3	3	3	3	3	3	3	3	4	5	6	4"	61	210
4"	6	5	5	4	3	3	3	3	3	3	3	3	3	4	5	6	4"	62	213
4"	6	6	5	4	3	3	3	3	3	3	3	3	3	4	5	6	4"	63	217
4"	7	6	5	4	3	3	3	3	3	3	3	3	3	4	5	6	4"	64	220
4"	7	6	5	4	3	3	3	3	3	3	3	3	4	4	5	6	4"	65	223
4"	7	6	5	4	3	4	3	3	3	3	3	3	4	4	5	6	4"	66	227
4"	7	6	5	4	3	4	3	3	3	3	3	3	4	4	6	6	4"	67	230
4"	7	6	5	4	3	4	3	3	3	3	3	3	4	5	6	6	4"	68	234

SPILL SCHEDULE FOR BONNEVILLE DAM

updated 8 June 1993

BAY NUMBER																		DOGS	KCFS
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18		
4"	7	6	5	4	3	4	3	3	3	3	3	3	4	5	6	7	4"	69	237
4"	7	6	5	5	3	4	3	3	3	3	3	3	4	5	6	7	4"	70	240
4"	7	6	5	5	3	4	3	3	3	3	4	3	4	5	6	7	4"	71	244
4"	7	6	5	5	3	4	3	4	3	3	4	3	4	5	6	7	4"	72	247
4"	7	6	5	5	4	4	3	4	3	3	4	3	4	5	6	7	4"	73	251
4"	7	6	6	5	4	4	3	4	3	3	4	3	4	5	6	7	4"	74	254
4"	7	7	6	5	4	4	3	4	3	3	4	3	4	5	6	7	4"	75	258
4"	7	7	6	5	4	4	3	4	4	3	4	3	4	5	6	7	4"	76	261
4"	7	7	6	5	4	4	4	4	4	3	4	3	4	5	6	7	4"	77	265
4"	7	7	6	5	4	4	4	4	4	4	4	3	4	5	6	7	4"	78	268
4"	8	7	6	5	4	4	4	4	4	4	4	3	4	5	6	7	4"	79	272
4"	8	7	6	5	4	4	4	4	4	4	4	4	4	5	6	7	4"	80	275
4"	8	7	6	5	4	4	4	4	4	4	4	4	4	5	7	7	4"	81	279
4"	8	7	6	5	4	4	4	4	4	4	4	4	4	6	7	7	4"	82	282
4"	8	7	6	5	5	4	4	4	4	4	4	4	4	6	7	7	4"	83	285
4"	8	7	6	5	5	4	4	4	4	4	4	4	4	6	7	8	4"	84	289
4"	8	7	6	6	5	4	4	4	4	4	4	4	4	6	7	8	4"	85	292
4"	8	7	7	6	5	4	4	4	4	4	4	4	4	6	7	8	4"	86	296
4"	8	8	7	6	5	4	4	4	4	4	4	4	4	6	7	8	4"	87	299
																		0	

Gate settings, or "dogs", create the following openings.

1 = 1.0'; 2 = 2.9'; 3 = 4.9'; 4 = 6.8'; 5 = 8.7';
6 = 10.6'; 7 = 12.6'; 8 = 14.5'; 9 = 16.4'; 10 = 18.3';
11 = 20.2'; 12 = 22.1'; 13 = 24.1"; 14 = 26.0'

i) Main unit gatewell drawdown will be measured a minimum of once per week. Remove debris from forebay and trash racks as required to maintain less than 1.5 feet of drawdown in gatewell or as indicated by fish condition (eg., higher than expected descaling) or as determined by the project biologist. STSs in units being raked will be run in continuous operating mode during raking operation. Gatewell orifices of the unit being raked must be closed during the procedure.

ii) Measure fish unit gatewell drawdown at least once per week. Remove debris as described above for main units, when necessary. However, to reduce the number of times the fish units have to be shut down during the daytime adult fish passage period, the fish units may be shut down between 2400 and 0300 hours as required to control drawdown. Also, main unit 18 may be operated during this time period, even at times when it otherwise would not be high enough on the priority list, to help draw debris away from the fish unit trash racks when the fish units are shut down.

iii) Operate STSs at angle of 60 degrees from vertical.

iv) Inspect each STS once per month and each VBS a minimum of once every two months (video is acceptable). Frequency of monthly inspections may be based on individual turbine unit run time. 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 1 May, mid-July, and 1 September. 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: 1) deterioration of fish conditions; 2) increased debris load in bypass system; and 3) other indications of STS or VBS malfunctions or failure. Prior to pulling VBSs for inspections, shut off units and dip gatewells.

CBFWA recommends that VBS inspections be conducted once per month through the fish passage season.

If STS or VBS damage or plugging is detected, follow procedures in Fish Facilities Manitenance Plan. Records of inspections or summary of such records will be made available to the FPC by 1 January upon request.

v) Operate all gatewell orifice systems. Inspect each daily to assure that the orifice valves and lights are operating correctly. Orifices with less than a clear flow jet will be cleaned at least once per day. Replace all burned out orifice lights within 24 hours. Electrical modifications were made in 1995 which allow central, automatic lighting control in the PH2-DSM. The DSM is now darkened on a scheduled as determined through coordination with the Corps' Fish Passage O&M Coordination Team in 1994. The PH2-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.

vi) Inspect each STS amp gauge at least once each shift and record reading once per day. If an STS failure occurs, then follow procedures in Fish Facilities Maintenance Plan (p. BON-19).

vii) Inspect all STS gatewells daily. The project will clean before gatewell 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 fishery measures, and then only on a last on/first off basis. After debarking a gatewell, inspect and if necessary, clean the orifice in that gatewell. Check gatewell drawdown.

CBFWA recommends the gatewells be cleaned before they become half covered.

The Corps is currently attempting to resolve this conflict through an element of the Project Improvements for Endangered Species (PIEs) program. A gatewell orifice sluice to remove debris and reduce fish handling is being developed for implementation in 1996.

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viii) 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 consultation with FPC and NMFS. Regardless of unit operating status, oil accumulations will be dealt with promptly.

ix) Coordinate gatewell cleaning with personnel operating downstream migrant sampling facilities.

x) 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.

xi) Turbine units without full compliments of STSs may not operate except to be in compliance with other coordinated fishery measures.

CBFWA recommends no operation of partially or fully unscreened turbines unless otherwise agreed.

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xii) Maintain DSM water surface between elevations 64.7 - 65.2 as measured at the south end of the channel.

xiii) Maintain water surface on dewatering screen between elevations 60.8 - 61.2.

xiv) Maintain water surface in downwell as close as possible to 57.5' +/- 0.5' under the automatic control system.

xv) Inspect facilities twice per day.

xvi) Operation of the Emergency Relief Gate (ERG) may strand juvenile fish that are near the dewatering screen when the water recedes. Training and maintenance operation of the ERG during the juvenile fish passage season should be minimized. As much as practical, all operation of the ERG should be coordinated through the project biologist. To ensure that the ERG is operable when needed, operation should be tested at the beginning of the juvenile fish passage season and once mid-season. Tests will be done at such a time as to create the least impact to migrating fish.

(c) **Winter Maintenance Season.** The winter maintenance season begins on the Monday closest to November 30 and ends on the last work day of a work week closest to 1 March. However, the end of the season may be shortened for an early fish release from Spring Creek National Fish Hatchery.

i) To reduce adult fallback mortality, the juvenile bypass system, or DSM channel will operate from 30 November to 15 December. STSs from priority units will be left in place during this period to the extent practicable. Screens from non-priority units may be removed beginning 27 November, but only if scheduled for maintenance. In all units, screens that are not being serviced shall be left in place during this period. Following 15 December, all remaining STSs may be removed. DSM may be dewatered (see Dewatering Plans) only when required for maintenance. The period of maintenance 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.

ii) Turbine intake extensions (TIEs) will be removed following the spring juvenile yearling chinook outmigration period, usually in early July. TIEs will be re-installed just prior to the start of the juvenile fish passage season, including, when practicable, prior to early hatchery releases from Spring Creek National Fish Hatchery.

5. Adult Fish Passage Facilities

a. Operating Criteria

(1) Prior to 1 March

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

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

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

(2) 1 March through 30 November. (Adult Fish Passage Period)

(a) All Adult Facilities

i) Water depth over fish ladder weirs: 1.0' +/- 0.1' during the non-shad passage season (1 August through 14 May).

ii) Measure water temperature within each ladder system and in associated forebay and tailwater locations daily to reveal if temperature variances exist between locations. Additional monitoring equipment will be installed in 1996. Summaries of water temperature measurements will be included in weekly operation monitoring reports.

iii) Head on all entrances: 1.0 to 2.0 feet (1.5 feet preferred). A head of approximately 1.0 to 2.0 feet at the NUE entrance is indicated by a 1.2 to 2.2 foot (1.7 feet preferred) entrance head calculated using the fishway and tailwater staff gauges closest to NUE. Refer to maintenance plan when unable to achieve head criterion.

iv) A transportation velocity of 1.5 to 4.0 feet per second (2.0 fps preferred) shall be maintained for the full length of the powerhouse collection channel, the

lower ends of the fish ladders which are below the tailwater, and the Upstream Migrant Transportation (UMT) channel .

v) Maximum of 6" head will be allowed on the first powerhouse attraction water intakes and trashracks at all the ladder exits, with a 4" maximum head on all picket leads. Debris shall be removed when significant amounts accumulate.

vi) Staff gauges and water level indicators will be readable at all water levels encountered during the fish passage period. 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.

vii) 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. If counting is temporarily discontinued due to unscheduled events, or the fishway is dewatered, the crowder shall be fully opened, except during the counters' hourly ten minute break period. Leave fish passage slot lighted overnight.

viii) Inspect facilities twice per day.

ix) Upstream light banks in both count stations shall remain off in an attempt to facilitate fish passage through the count slot, and help reduce the number of fish impacting the count window framework.

x) Inspect and ensure that optimum passage conditions are maintained at fishway entrances and exits.

(b) Spillway Ladders

i) Spill bay gates 1 and 18 shall be open 4" to attract adult migrating fish to the adjacent fishway entrances, throughout the adult fish passage season.

ii) 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 feet, 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 feet, the south sluice gate shall close. When the tailwater exceeds 17 feet, sluice gates SW-SG-3N, SW-SG-3S, SO-SG-4N, and SO-SG-4S shall be closed.

(c) First Powerhouse

i) Entrance gate 65 structure and operation is being modified during February and March, 1996 under the PIES program. The gate should be operable soon after the start of the adult fish passage season. Operation guidelines were not available at time of printing of the 1996 FPP, but may be requested from the project or district biologists.

ii) Entrance gate 64 structure and operation is being modified during February and March, 1996 under the PIES program. The gate should be operable soon after the start of the adult fish passage season. Operation guidelines were not available at time of printing of the 1996 FPP, but may be requested from the project or district biologists.

iii) Operate powerhouse entrance gates 9, 21, 34, 58, and 62.

Orifice A (lower sluice gate) operates (opens) from tailwater elevation 7.0' to 16.0' on a rising tailwater and elevation 15.0' to 7.0' on a falling tailwater.

Orifice B (upper telescoping gate) operates (opens) from tailwater elevation 16.0' to 38.0' on a rising tailwater and elevation 38.0' to 15.0' on a falling tailwater.

iv) Powerhouse entrance gates 1 and 2 structure and operation is being modified during February and March, 1996 under the PIES program. The gates should be operable soon after the start of the adult fish passage season. Operation guidelines were not available at time of printing of the 1996 FPP, but may be requested from the project or district biologists.

(d) Second Powerhouse

i) Operate all north (NUE and NDE) and south (SUE and SDE) entrances. Operate weir crests at elevation 1.0' (fully lowered) for tailwater elevations up to 14.0'. For tailwater elevations greater than 14.0', operate weir crest 13.0' or greater below tailwater.

ii) Operate all 12 powerhouse floating gate fishway entrances.

(e) Spillway Operations

i) Bonneville Dam uses a single spill schedule for use both day and night (See **Spill Schedule For Bonneville Dam**, p. BON-8 through BON-10).

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

(1) 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. Adult facilities will be inspected once per day to assure operation as per standards above. 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. The units in the powerhouse with the fully operating fish facility will be first on/last off to meet power demand, except when the powerhouse 1 collection facility is out of service, units 1, 2 and 10 will continue to operate. One of the two ladders servicing the spill channel will be in full operation at all times unless specially coordinated. Outage periods will be minimized to the extent practicable.

(2) Spill bays 1 and 18 may be on seal throughout the winter operating period.

(3) 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.

C. Fish Facilities Maintenance

1. General

a. Scheduled Maintenance

(1) Staff gauges will be installed, cleaned, and/or repaired as required.

(2) A zebra mussel monitoring program will continue. These organisms have become a serious problem elsewhere in the country and are expected to eventually become introduced to the Columbia.

(3) 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.

2. Juvenile Fish Passage Facilities

a. Scheduled Maintenance

(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.

(2) **Juvenile Bypass System.** The Bonneville juvenile bypass facilities will receive preventive maintenance at all times of 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 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 raking of trash racks may be necessary when a storm brings large quantities of debris downriver to the project. Gatewell orifices of the unit being raked will be closed during the procedure (applies only to the first powerhouse).

(3) **Turbines and Spillways.** The maintenance and routine repair of project turbines and spillways is a regular and recurring process which requires that units be shut down for up to two months (see Dewatering Plans). The maintenance schedules for these turbines and spillways will be coordinated with the fisheries agencies through the Corps' Fish Passage O&M Coordination Team. Certain turbine and spillway discharges at the projects are secondarily used to attract adult fish to the areas of fishway entrances, to keep predator fish from accumulation in the area of juvenile release sites, and to move juveniles downstream away from the project. The maintenance schedules for these turbines and spillways will reflect equal weighting given to fish, power, and water management and will be coordinated with the appropriate resource agencies.

Some types of maintenance on turbines will result in the requirement to operate the turbine throughout its full capability before returning the turbine to normal service. These operations will be coordinated.

b. Unscheduled Maintenance

(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.

(2) Juvenile Bypass System

(a) Bonneville Project's juvenile bypass systems are controlled by automatic systems. 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 cleaned out.

(b) Inspect all STS gatewells daily. 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 fishery measures. This is to maintain clean orifices and minimize fish injury. The first powerhouse gatewell orifices will be closed during the debarking operation. After debarking a gatewell, back-flush the orifice in that gatewell. Check gatewell drawdown.

CBFWA recommends the gatewells be cleaned before they become half covered by debris.

The Corps is currently attempting to resolve this conflict through an element of the Project Improvements for Endangered Species (PIES) program. A gatewell orifice sluice to remove debris and reduce fish handling is being developed.

(c) Bonneville First Powerhouse. If any part of the dewatering screen, downwell, or juvenile release conduit fails, making this porton 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 downstream migrant (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 a depth of 3.5 feet[2] (see Endnotes, p. BON-29), gate 10C to 2.5 feet below the minimum expected forebay, and the ice and trash sluiceway end gate is open to provide safe transportation flows for juveniles. Forebay elevation will be kept above 74.0' msl. to the extent practicable. The bypass will then continue operating while repairs are completed. In either operating mode, the orifices will be cleaned with the air pressure system at least once per day, when plugged orifices are indicated, or after trash rack raking and gatewell debarking.

(d) Bonneville Second Powerhouse. If the bypass system fails in the dewatering section, downwell, 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 consultation with CBFWA. During this emergency operating mode, power generation will be minimized at the second powerhouse. Repairs will receive high priority.

(e) During fishway inspection the VBSs may be found to be plugged or damaged. In these cases, the associated unit will be regarded as if unscreened and repairs will be made before returning the unit to normal service.

3. **Turbines and Spillways**

a. **Spill gate failure.** If a spill gate becomes inoperable, the operator will 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 Fish Passage O&M Coordination Team.

4. **Adult Fish Passage Facilities**

a. **Scheduled Maintenance**

(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.

(2) **Powerhouse and Spillway Adult Fish Collection Systems.** Preventive maintenance and repair occurs throughout the year. During the 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 diffision 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 (diver or video is acceptable) during the fish passage season, unless a channel must be dewatered for fishway modifications or to correct observed problems (see Dewatering Plans, pg. BON-27). Inspection by 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 unless specially coordinated. Any non-routine maintenance and fishway modifications will be handled on a case by case basis.

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

(3) **Adult Fish Ladders and Counting Stations.** The adult fish ladders will be dewatered (see Dewatering Plans) 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 exceeded. When practicable, rake trash racks during the time of day when fish passage is least affected. Fish count station windows, light panels, and crowder panels will be cleaned when necessary, and when practicable, during the time of day when fish passage is least affected.

b. **Unscheduled Maintenance**

(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 operation according to standards. This will allow the fish facility to operate according to 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.

(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 proceed north.

If closing the orifice gate fails to achieve a minimum fishway head of 1.0 feet when tailwater is greater than 17.0 feet, then operation of newly modified gate 1 and gate 65 weirs becomes necessary. Operational guidelines of these gates will be available upon request from the project or district fishery biologists.

When tailwater elevation is less than 17.0 feet and the gate 65 weir crest is at least 6.0 feet below tailwater, then operation of newly modified gates 1, 2, 64, and 65 becomes necessary. Operational guidelines of these gates will be available upon request from the project or district fishery biologists.

(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 1.0 foot 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 6.0 feet below the tailwater surface is reached. At this point maintain the gate positions until the auxiliary water system is repaired.

(c) **Second Powerhouse.** If either or both of the fishway auxiliary water turbines are unable to provide water sufficient to meet full criteria between 1 April and 31 August, raise the North Upstream Entrance (NUE) in 1.0 foot increments until the weir crest is 6.0 feet below the tailwater or a fishway head of at least 1.0 foot is achieved. If this fails to achieve the above criteria then apply the same procedure, until the criteria are achieved, using in addition the North Downstream Entrance (NDE), then the South Upstream Entrance (SUE), and finally the South Downstream Entrance (SDE). The weir crests for these entrances will not be raised above 6.0 feet below tailwater. If the correct fishway head is still not achieved after this procedure, then fully close NUE and operate in this configuration until repairs can be made to the system.

If one of the fishway water supply turbine units fails between 1 September and 31 March, during a time when tailwater is high enough that normal operation can't be maintained using the remaining fish unit, and repairs can't be made within 24 hours, then the ice and trash sluiceway will be used to supplement discharge to allow operation of the fishway according to the above standards. Care will be taken to keep the trash chute screen free of debris and the downstream end gate will be raised briefly at least once weekly to flush trapped fish and debris out of the chute.

If both of the fishway auxiliary water turbines fail between 1 September and 31 March, and repairs can't be made within 8 hours, then the ice and trash chute will be started up. The adult facility will be operated as follows:

1: Close NDE, SUE, and NUE;

2: Operate the SDE weir crest at 8.0 feet below tailwater;

3: Operate the floating orifice gates. However, if the backup fishway auxiliary water system must be used for a period exceeding 30 days, then block off as many of the center floating orifice gates as possible and open NDE with a weir depth of 8.0 feet below the tailwater surface. While under this configuration, power generation at the second powerhouse will be minimized to reduce fish attraction into this area.

If all auxiliary water systems fail or malfunction, then close SUE, NDE, and NUE and raise SDE weir crest to 6.0 feet below tailwater elevation 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.

(2) Powerhouse and Spillway Adult Fish Collection Systems. Bonneville Project contains several types of fishway entrances. In most cases, if a failure occurs 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 the entrance will be brought back into manual or automatic control at the earliest possible date.

(3) Adult Fish Ladders and Counting Stations. The Bonneville first powerhouse ladder was completed in 1937 and the Bonneville second powerhouse ladder in 1981. Modification of the first powerhouse ladder was completed during the winter of 1981-82. The structures 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"), erosion of concrete 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 consultation with the Fish Passage O&M Coordination Team.

D. Turbine Unit Operation and Maintenance

1. Unit operating priority during the fish passage seasons.

Table IV. Bonneville Dam Fish Passage Season Unit Operating Priority.

1st POWERHOUSE		2nd POWERHOUSE
UNIT OPERATING PRIORITY	TIMES	UNIT OPERATING PRIORITY
1, 10, 9, 2, 3, (5-8), 4.	0500 - 2000	18, **11**, **17**, 12, 16, 13, 14, 15.
	2000 - 0500	18, **17**, **11**, 12, 16, 13, 14, 15.

- Flow distribution between powerhouses will be determined by CENPD-ET-WM.

- Unit 16 will follow unit 17 in priority if unit 18 is out of service.

- If unit 1 is out of service, replace it with unit 2 to maintain station service.

2. During the winter maintenance season, when powerhouse fish collection systems are operating, the operating priority sequence is unit 1, 10, 2, 18, and 11. Additional units will be selected in any sequence at the discretion of the powerhouse operators. Generally, when a unit in this list is not available, then an adjacent unit will be operated. When a fish collection channel is out of service the unit operating sequence will change accordingly, within the limitations of the project's power distribution requirements.

3. Guidelines for operation of the turbine units within 1% of peak efficiency and within cavitaiton limits at various head ranges are provided in **Bonneville Dam Peak Turbine Efficiency Ranges**[2] (p. BON-26).

4. To the extent technically feasible, turbines will be operated within +/-1% of peak turbine efficiency, unless operation outside of that range is necessary to: 1) meet load requirements of the BPA administrator, whose load requests will be consistent with BPA's System Load Shaping Guidelines; 2) avoid excess daytime spill (during the time of year when the 75 kcfs spill cap applies); or 3) comply with other coordinated fishery measures. BPA's System Load Shaping Guidelines (appedix D) apply between 15 March and 31 October. However, during the rest of the year the project will continue to operate units within the peak turbine efficiency range, except as specifically requested by BPA to do otherwise as power requirements demand.

GBFWA recommends operation of all units within 1% of peak turbine efficiency unless otherwise agreed.

(This comment applies to the following item, also.)

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

6. The project's turbine unit maintenance schedules will be reviewed by Project and Operations Division biologists for fishery 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.

a. 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.

b. Unit 1 provides important attraction flow for adult fish, and when the juvenile bypass system flow is reversed, it helps move juvenile fish downstream also. 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.

c. In the event of long-term outages at Bonneville powerhouses, out of service (OOS) 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

[2] The guidance provided is based on an assumption of greater control and gauging accuracy than was originally possible. Elements of Passage Improvements for Endangered Species (PIES) program, completed in 1994, addressed achieving greater actual turbine efficiency.

BONNEVILLE DAM PEAK TURBINE EFFICIENCY RANGES

	FIRST POWERHOUSE				SECOND POWERHOUSE			
Head (ft)	Lower MW Limit	Lower Limit cfs	Upper MW Limit	Upper Limit cfs	Lower MW Limit	Lower Limit cfs	Upper MW Limit	Upper Limit cfs
34	14	6,116	26	11,258	29	12,047	39	16,478
35	14	6,114	27	11,278	29	12,055	40	16,578
36	15	6,112	28	11,297	30	12,063	41	16,578
37	16	6,158	29	11,328	31	12,070	43	16,627
38	16	6,205	30	11,360	32	12,078	44	16,677
39	17	6,251	31	11,391	33	12,086	45	16,727
40	17	6,318	32	11,422	34	12,044	47	16,777
41	18	6,371	33	11,464	35	12,022	49	16,826
42	19	6,424	34	11,506	36	11,960	51	16,876
43	19	6,476	35	11,547	37	11,918	53	16,926
44	20	6,529	36	11,589	38	11,881	55	17,008
45	21	6,582	37	11,631	39	11,844	56	17,090
46	22	6,646	38	11,646	39	11,807	58	17,173
47	22	6,711	39	11,661	40	11,770	59	17,255
48	23	6,775	40	11,677	41	11,733	61	17,337
49	24	6,839	41	11,692	42	11,747	63	17,338
50	25	6,904	41	11,707	43	11,760	65	17,338
51	25	6,968	42	11,722	44	11,774	66	17,339
52	26	7,030	43	117,379	45	11,787	68	17,339
53	27	7,091	44	11,752	46	11,801	70	17,340
54	28	7,153	45	11,768	47	11,842	72	17,340
55	29	7,214	46	11,783	48	11,884	73	17,341
56	29	7,276	46	11,798	49	11,925	75	17,342
57	30	7,337	47	11,813	51	11,967	76	17,342
58	31	7,399	48	11,828	52	12,008	77	17,343
59	32	7,427	49	11,844	53	12,050	77	17,343
60	32	7,455	50	11,859	54	12,091	77	17,344
61	33	7,482	51	11,874	55	12,103	77	16,967
62	33	7,510	52	11,889	56	12,115	77	16,590
63	34	7,538	53	11,904	57	12,128	77	16,214
64	34	7,566	54	11,919	58	12,140	77	15,837
65	35	7,593	55	11,935	59	12,152	77	15,460
66	36	7,621	56	11,950	60	12,164	77	15,083
67	36	7,649	58	11,965	61	12,176	77	14,706
68	37	7,677	58	11,951	62	12,189	77	14,330
69	38	7,704	59	11,937	63	12,201	77	13,953
70	39	7,732	59	11,923	64	12,213	77	13,576

be minimized and the units will be in good operating condition. This may be performed at night, daytime, or whenever unit cycling will have the least effect on fish passage.

7. Until problems with the PH2 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. [3]

E. Dewatering Plans

1. Fish Salvage Plans 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 PH1 DSM is also included in the Fish Salvage Plans.

2. The project fish biologist or alternate Corps fisheries personnel will attend all project activities involving fish handling.

3. The fisheries agencies and tribes will be represented at all ladder dewaterings by the WDFW fish counting program supervisor or an alternate.

4. **Juvenile bypass systems.** Key elements of the fish salvage plan for JBS flow reversal are shown below.

a. With some exceptions, a project biologist or biological technician will attend all activities which involve dropping the JBS water surface below the end of the dewatering screen. One exception is when an operator with recent successful experience reverses PH1 JBS flow, as when required for research which requires flow through the outlet to be stopped and started repeatedly. Another similar exception is under the same circumstances at the PH2 JBS when the ERG gate is opened and closed.

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

c. The trash sweeps will be turned off of automatic control.

d. Flow through the dewatering screen will be minimized before the water level drops below the upper end of the screen.

e. 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. **Adult Fish Ladder**

a. Scheduled Maintenance

(1) When possible, operate the ladder to be dewatered at a reduced flow for at least 24 hours, but no more than 48 hours prior to dewatering. Reduced flow is defined as less than criterion operation, but more than orifice flow.

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[3] Memorandum for All Operations, from BON Chief of Operations, dated 23 September 1993. Subject: Powerhouse 2 Hydraulic Head Gate Operation.

(2) Discontinue all fishway auxiliary water supply at least 24 hours but no more that 48 hours prior to dewatering.

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

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

(5) The project biologist or alternate Corps fisheries personnel will oversee fish rescue when the ladders are dewatered. The project biologist will invite fishery agency and/or Indian tribal biologists participation in the dewatering. Rescue personnel will walk the inside of the ladder from the head gates down to tailwater, salvaging all fish either by moving fish to tailwater within the ladder flow, or capturing and placing the fish in a large water filled tank, which is then transported to the forebay or tailrace depending on the fish' lifestage (adults to forebay, juveniles to tailrace) for release.

b. Unscheduled Maintenance

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

(2) Follow steps 3-5 above.

6. Powerhouse Fish Collection System

a. Scheduled Maintenance

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

(2) The project biologist will assure that rescue equipment is available if needed.

(3) The project biologist will provide technical guidance for fish safety and will assist directly as needed in rescue operations.

7. Turbines

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

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

c. Gatewells which will be drained when the turbine units are dewatered will have fish dipped out before draining.

d. 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.

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

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

g. The project biologist will invite Fish Passage O&M Coordination Team fishery biologists' participation in the dewatering, and will assure that rescue equipment is available if needed.

h. 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.

F. Endnotes

[1] Evaluation of Ice and Trash Sluiceway at Bonneville Dam as a Bypass System for Juvenile Salmonids, 1981. Calculated from hydraulic equation to achieve approximately 475 cfs (3.7 feet of head).

[2] Downstream Movements of Salmonids at Bonnneville Dam. Gauley, Anas, and Schlotherbeck, BCF, USFWS. Special Scientific Report, Fisheries No. 236 (January, 1958).

The Dalles Dam

I. THE DALLES DAM

A. Fish Passage Information. The locations of fish passage facilities are shown on the following general site maps for The Dalles Dam (p. TDA-2 through TDA-4).

1. Juvenile Fish Passage

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

b. Juvenile Migration Timing. The dates of peak passage of Snake River steelhead at The Dalles Dam have ranged from 11 May in 1978 to 21 June in 1977. Peak passage of Snake River spring chinook at The Dalles Dam ranged from 8 May in 1976 to 17 June in 1977. Travel time from the upper Snake River to The Dalles Dam ranges from 12 to 39 days for yearling chinook and 10 to 40 days for steelhead[1] (See Endnotes). The primary juvenile passage period at The Dalles Dam is April through November. The following passage timing data were generated from studies of The Dalles Dam sluiceway in 1977-79, and 1981-82. NMFS conducted smolt monitoring at The Dalles in 1989, 1990, and 1991. The data include Snake River and Columbia River migrants.

Diel passage at The Dalles sluiceway is affected by spill and flow conditions. In 1977, peak passage occurred from 0500 to 2200[2] (See Endnotes); in 1981, from 1200 to 1300; in 1982, from 0600 to 2200 (Willis, 1982). Average April-June flows at The Dalles was 121 kcfs in 1977, 253 kcfs in 1981, and 325 kcfs in 1982. In years of consistently high flow and spill, fish may be distributed higher in the water column and daytime passage may increase.

c. Facility Monitoring and Reporting. Project biologists shall inspect fish passage facilities at the frequencies listed in the juvenile and adult fish facilities operating criteria sections. Project biologists shall prepare weekly reports, throughout the year, summarizing project operations. The weekly reports will provide an overview of how the project and the fish passage facilities operated during the week and an evaluation of resulting fish passage conditions. The reports shall include: any out of criteria situations observed and subsequent corrective actions taken; any equipment malfunctions, breakdowns, or damage along with a summary of resulting repair activities; adult fishway control calibrations; STS and VBS inspections; and any unusual activities which occurred at the project which may affect fish passage. The weekly reports shall cover a Sunday through Saturday time period and shall be sent to CENPP-CO as soon as possible the following week. The project biologist shall prepare an annual report by 31 January summarizing the operation of the project fish passage facilities for the previous year, covering from the beginning of one adult fish facility winter maintenance season to the beginning of the next.

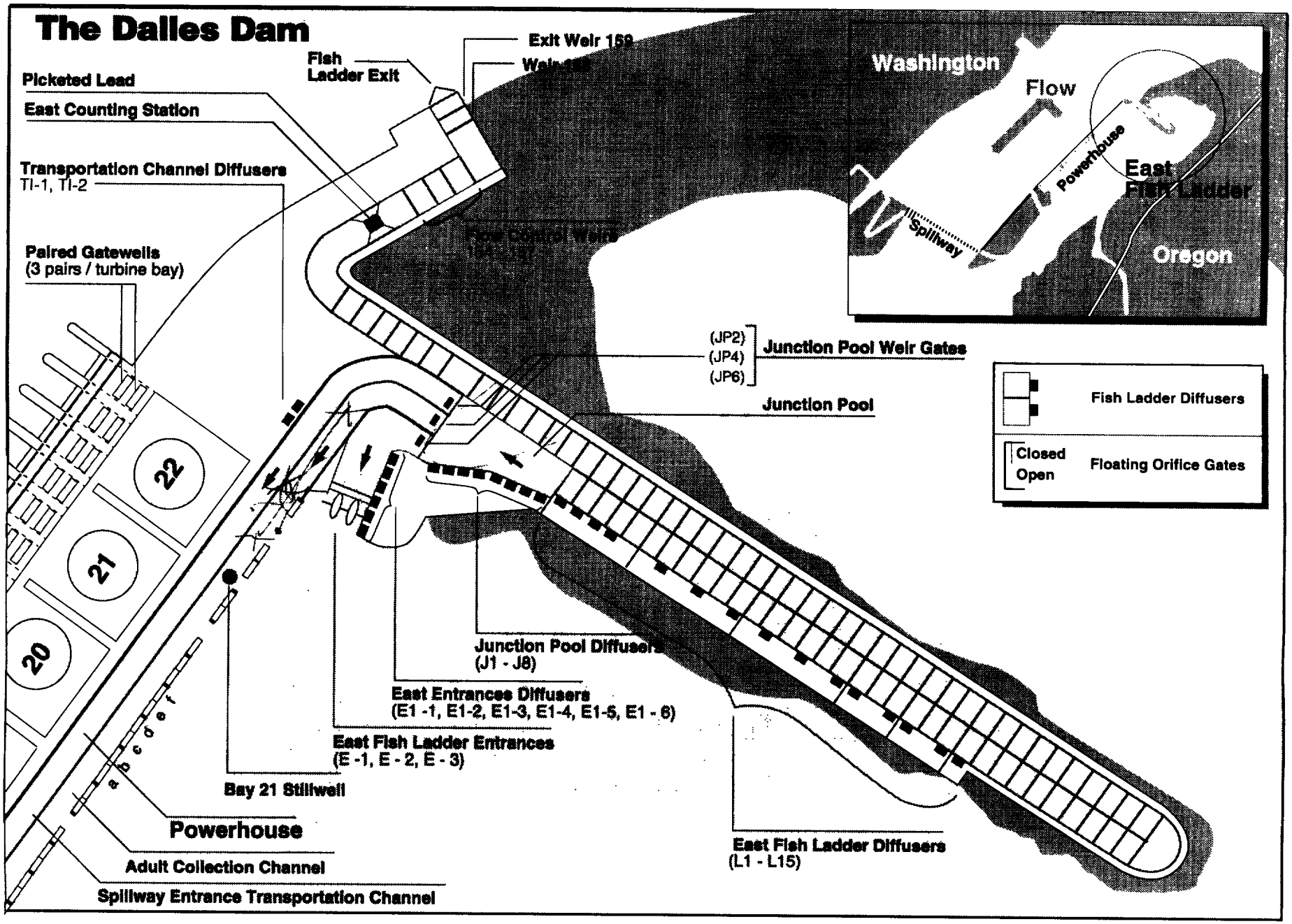

Figure 4 The Dalles Dam East Fish Ladder

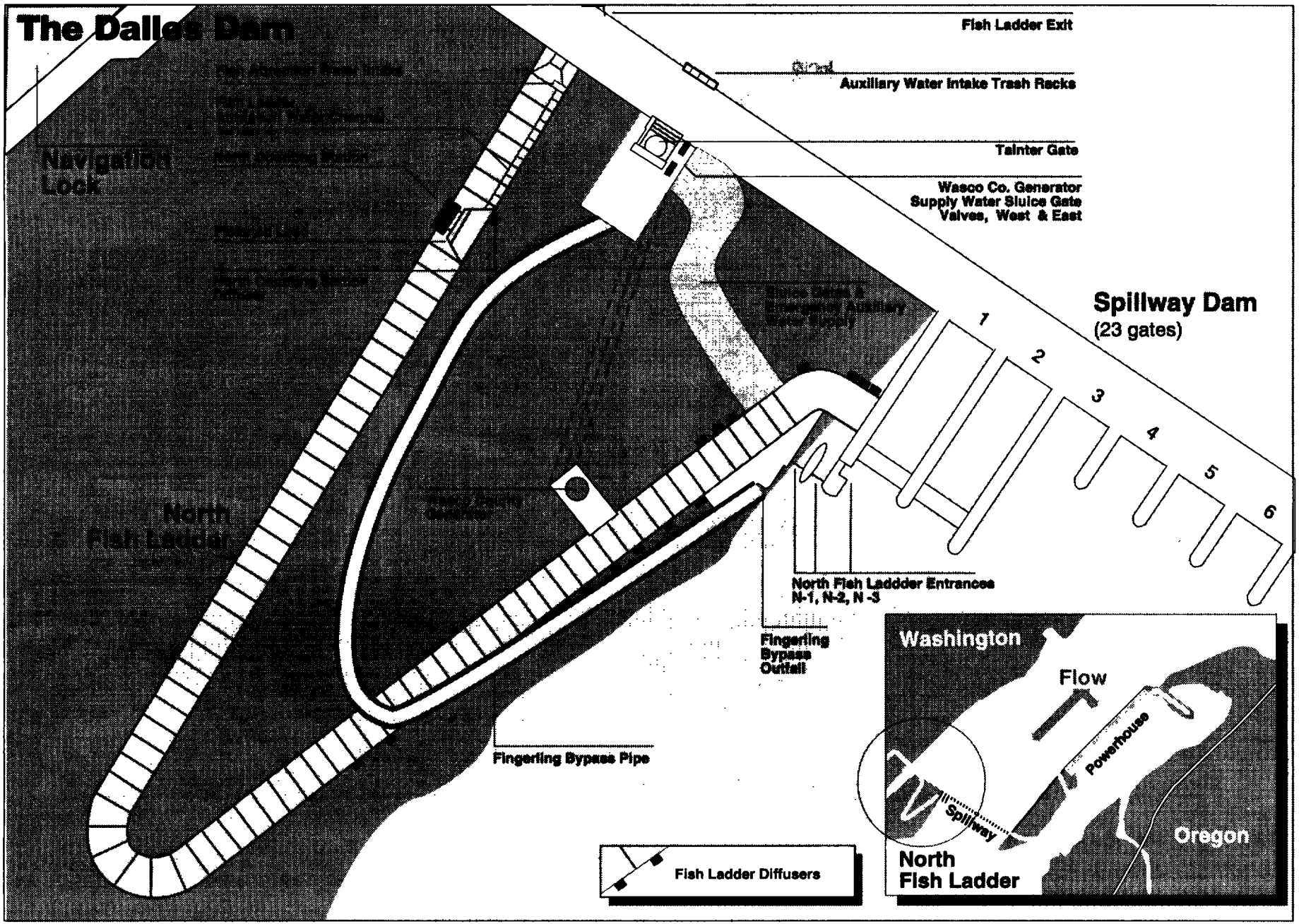

Figure 6 The Dalles Dam North Fish Ladder and Spillway

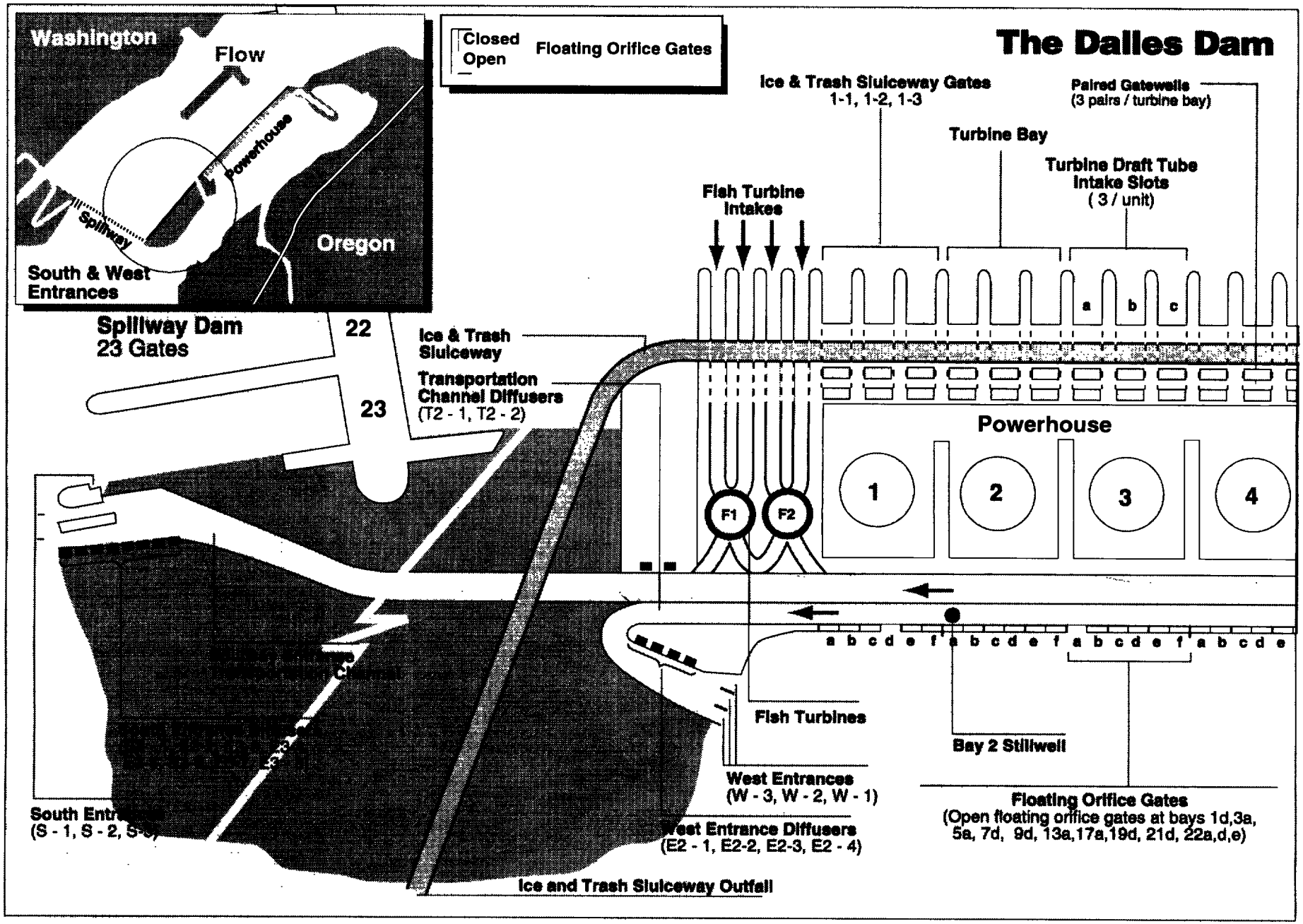

Figure 5 The Dalles Dam South and West Fish Ladder Entrances

SPILL SCHEDULE FOR JUVENILE FISH AT THE DALLES DAM
(2000-0500)

BAY NUMBER																						FEET	KCFS
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23		
1																							1	1.5
2																							2	3.0
2	1																						3	4.5
2	2																						4	6.0
2	2	1																					5	7.5
2	2	2																					6	9.0
2	2	2	1																				7	10.5
2	2	2	2																				8	12.0
2	2	2	2	1																			9	13.5
2	2	2	2	2																			10	15.0
2	2	2	2	2	1																		11	16.5
2	2	2	2	2	2																		12	18.0
2	2	2	2	2	2	1																	13	19.5
2	2	2	2	2	2	2																	14	21.0
2	2	2	2	2	2	2	1																15	22.5
2	2	2	2	2	2	2	2																16	24.0
2	2	2	2	2	2	2	2	1															17	25.5
2	2	2	2	2	2	2	2	2															18	27.0
2	2	2	2	2	2	2	2	2	1														19	28.5
2	2	2	2	2	2	2	2	2	1	1													20	30.0
2	2	2	2	2	2	2	2	2	2	1													21	31.5
2	2	2	2	2	2	2	2	2	2	1	1												22	33.0
2	2	3	2	2	2	2	2	2	2	1	1												23	34.5
2	2	3	3	2	2	2	2	2	2	1	1												24	36.0
2	2	3	3	3	2	2	2	2	2	1	1												25	37.5
2	2	3	3	3	2	2	2	2	2	2	1												26	39.0
2	2	3	3	3	3	2	2	2	2	2	1												27	40.5
2	2	3	3	3	3	3	2	2	2	2	1												28	42.0
2	2	3	3	3	3	3	2	2	2	2	2												29	43.5
2	2	3	3	3	3	3	3	2	2	2	2												30	45.0
2	2	3	3	3	3	3	3	3	2	2	2												31	46.5
2	2	3	3	3	3	3	3	3	2	2	2	1											32	48.0
2	2	3	3	3	3	3	3	3	3	2	2	1											33	49.5

SPILL SCHEDULE FOR JUVENILE FISH AT THE DALLES DAM

(2000-0500)

BAY NUMBER																						FEET	KCFS
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23		
2	2	4	3	3	3	3	3	3	3	2	2	1											34	51.0
2	3	4	3	3	3	3	3	3	3	2	2	1											35	52.5
3	3	4	3	3	3	3	3	3	3	2	2	1											36	54.0
3	3	4	3	3	3	3	3	3	3	2	2	1	1										37	55.5
3	3	4	3	3	3	3	3	3	3	3	2	1	1										38	57.0
3	3	4	4	3	3	3	3	3	3	3	2	1	1										39	58.5
3	3	4	4	3	3	3	3	3	3	3	3	1	1										40	60.0
3	3	4	4	4	3	3	3	3	3	3	3	1	1										41	61.5
3	3	4	4	4	3	3	3	3	3	3	3	2	1										42	63.0
3	3	4	4	4	4	3	3	3	3	3	3	2	1										43	64.5
3	3	4	4	4	4	4	3	3	3	3	3	2	1										44	66.0
3	3	4	4	4	4	4	4	3	3	3	3	2	1										45	67.5
3	3	4	5	4	4	4	4	3	3	3	3	2	1										46	69.0
3	3	4	5	5	4	4	4	3	3	3	3	2	1										47	70.5
3	3	4	5	5	4	4	4	4	3	3	3	2	1										48	72.0
3	3	4	5	5	4	4	4	4	3	3	3	2	2										49	73.5
3	3	4	5	5	5	4	4	4	3	3	3	2	2										50	75.0
3	3	5	5	5	5	4	4	4	3	3	3	2	2										51	76.5
3	3	5	5	5	5	4	4	4	3	3	3	2	2	1									52	78.0
3	4	5	5	5	5	4	4	4	3	3	3	2	2	1									53	79.5
4	4	5	5	5	5	4	4	4	3	3	3	2	2	1									54	81.0
4	4	5	5	5	5	4	4	4	4	3	3	2	2	1									55	82.5
4	4	5	5	5	5	5	4	4	4	3	3	2	2	1									56	84.0
4	4	5	5	5	5	5	4	4	4	4	3	2	2	1									57	85.5
4	4	5	6	5	5	5	4	4	4	4	3	2	2	1									58	87.0
4	4	5	6	5	5	5	4	4	4	4	3	3	2	1									59	88.5
4	4	5	6	5	5	5	5	4	4	4	3	3	2	1									60	90.0
4	4	5	6	6	5	5	5	4	4	4	3	3	2	1									61	91.5
4	5	5	6	6	5	5	5	4	4	4	3	3	2	1									62	93.0
5	5	5	6	6	5	5	5	4	4	4	3	3	2	1									63	94.5
5	5	5	6	6	6	5	5	4	4	4	3	3	2	1									64	96.0
5	5	5	6	6	6	5	5	4	4	4	3	3	2	2									65	97.5
5	5	5	6	6	6	5	5	5	4	4	3	3	2	2									66	99.0
5	5	5	6	6	6	5	5	5	4	4	4	3	2	2									67	100.5

SPILL SCHEDULE FOR JUVENILE FISH AT THE DALLES DAM

(2000-0500)

BAY NUMBER																						FEET	KCFS
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23		
5	5	5	6	6	6	5	5	5	4	4	4	3	3	2									68	102.0
5	5	5	6	6	6	5	5	5	5	4	4	3	3	2									69	103.5
5	5	5	6	6	6	6	5	5	5	4	4	3	3	2									70	105.0
5	5	6	6	6	6	6	5	5	5	4	4	3	3	2									71	106.5
5	5	6	7	6	6	6	5	5	5	4	4	3	3	2									72	108.0
5	6	6	7	6	6	6	5	5	5	4	4	3	3	2									73	109.5
5	6	6	7	6	6	6	6	5	5	4	4	3	3	2									74	111.0
6	6	6	7	6	6	6	6	5	5	4	4	3	3	2									75	112.5
6	6	6	7	7	6	6	6	5	5	4	4	3	3	2									76	114.0
6	6	7	7	7	6	6	6	5	5	4	4	3	3	2									77	115.5
6	6	7	7	7	7	6	6	5	5	4	4	3	3	2									78	117.0
6	6	7	7	7	7	6	6	5	5	5	4	3	3	2									79	118.5
6	6	7	7	7	7	6	6	6	5	5	4	3	3	2									80	120.0
6	6	7	8	7	7	6	6	6	5	5	4	3	3	2									81	121.5
6	6	7	8	7	7	7	6	6	5	5	4	3	3	2									82	123.0
6	6	7	8	7	7	7	6	6	6	5	4	3	3	2									83	124.5
6	6	7	8	8	7	7	6	6	6	5	4	3	3	2									84	126.0
6	6	8	8	8	7	7	6	6	6	5	4	3	3	2									85	127.5
6	7	8	8	8	7	7	6	6	6	5	4	3	3	2									86	129.0
7	7	8	8	8	7	7	6	6	6	5	4	3	3	2									87	130.5
7	7	8	8	8	8	7	6	6	6	5	4	3	3	2									88	132.0
7	7	8	9	8	8	7	6	6	6	5	4	3	3	2									89	133.5
7	7	8	9	8	8	7	6	6	6	5	4	4	3	2									90	135.0
7	7	8	9	8	8	7	7	6	6	5	4	4	3	2									91	136.5
7	7	8	9	8	8	7	7	7	6	5	4	4	3	2									92	138.0
7	7	8	9	9	8	7	7	7	6	5	4	4	3	2									93	139.5
7	7	8	9	9	8	8	7	7	6	5	4	4	3	2									94	141.0
7	7	8	9	9	8	8	7	7	6	5	5	4	3	2									95	142.5
7	7	8	9	9	9	8	7	7	6	5	5	4	3	2									96	144.0
7	7	8	9	9	9	8	7	7	6	6	5	4	3	2									97	145.5
7	8	8	9	9	9	8	7	7	6	6	5	4	3	2									98	147.0
7	8	8	9	9	9	8	7	7	7	6	5	4	3	2									99	148.5
7	8	9	9	9	9	8	7	7	7	6	5	4	3	2									100	150.0
8	8	9	9	9	9	8	7	7	7	6	5	4	3	2									101	151.5

SPILL SCHEDULE FOR JUVENILE FISH AT THE DALLES DAM

(2000-0500)

BAY NUMBER																							FEET	KCFS
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23		
8	8	9	10	9	9	8	7	7	7	6	5	4	3	2									102	153.0
8	8	9	10	9	9	8	7	7	7	6	5	5	3	2									103	154.5
8	8	9	10	9	9	8	7	7	7	6	5	5	4	2									104	156.0
8	8	9	10	9	9	8	7	7	7	6	5	5	4	3									105	157.5
8	8	9	10	9	9	8	7	7	7	6	5	5	4	3	1								106	159.0
8	8	9	10	9	9	8	7	7	7	6	5	5	4	3	2								107	160.5
8	8	9	10	9	9	8	8	7	7	6	5	5	4	3	2								108	162.0
8	8	9	10	9	9	8	8	8	7	6	5	5	4	3	2								109	163.5
8	8	9	10	10	9	8	8	8	7	6	5	5	4	3	2								110	165.0
8	8	9	10	10	9	9	8	8	7	6	5	5	4	3	2								111	166.5
8	8	9	10	10	9	9	8	8	7	6	6	5	4	3	2								112	168.0
8	8	9	10	10	10	9	8	8	7	6	6	5	4	3	2								113	169.5
8	8	9	10	10	10	9	8	8	7	7	6	5	4	3	2								114	171.0
8	9	9	10	10	10	9	8	8	7	7	6	5	4	3	2								115	172.5
8	9	9	10	10	10	9	8	8	8	7	6	5	4	3	2								116	174.0
8	9	10	10	10	10	9	8	8	8	7	6	5	4	3	2								117	175.5
8	9	10	10	10	10	9	9	8	8	7	6	5	4	3	2								118	177.0
8	9	10	10	10	10	9	9	9	8	7	6	5	4	3	2								119	178.5
8	9	10	10	10	10	9	9	9	8	7	6	5	4	3	2	1							120	180.0
8	9	10	10	10	10	9	9	9	8	7	6	5	4	3	2	2							121	181.5
8	9	10	10	10	10	9	9	9	8	7	6	5	4	3	3	2							122	183.0
8	9	10	10	10	10	9	9	9	8	7	6	5	4	4	3	2							123	184.5
8	9	10	10	10	10	9	9	9	8	7	6	5	5	4	3	2							124	186.0
8	9	10	10	10	10	9	9	9	8	7	6	6	5	4	3	2							125	187.5
8	9	10	10	10	10	9	9	9	8	7	7	6	5	4	3	2							126	189.0
8	9	10	10	10	10	10	9	9	8	7	7	6	5	4	3	2							127	190.5
8	9	10	10	10	10	10	10	9	8	7	7	6	5	4	3	2							128	192.0
8	9	10	10	10	10	10	10	9	8	8	7	6	5	4	3	2							129	193.5
8	9	10	10	10	10	10	10	9	9	8	7	6	5	4	3	2							130	195.0
8	9	10	10	10	10	10	10	9	9	8	7	6	5	4	3	2	1						131	196.5
8	9	10	10	10	10	10	10	9	9	8	7	6	5	4	3	2	2						132	198.0
8	9	10	10	10	10	10	10	9	9	8	7	6	5	4	3	3	2						133	199.5
8	9	10	10	10	10	10	10	9	9	8	7	6	5	4	4	3	2						134	201.0
8	9	10	10	10	10	10	10	9	9	8	7	6	5	5	4	3	2						135	202.5

SPILL SCHEDULE FOR JUVENILE FISH AT THE DALLES DAM

(2000-0500)

BAY NUMBER																						FEET	KCFS
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	
8	9	10	10	10	10	10	10	9	9	8	7	6	6	5	4	3	2						136	204.0
8	9	10	10	10	10	10	10	9	9	8	7	7	6	5	4	3	2						137	205.5
8	9	10	10	10	10	10	10	9	9	8	8	7	6	5	4	3	2						138	207.0
8	9	10	10	10	10	10	10	9	9	9	8	7	6	5	4	3	2						139	208.5
8	9	10	10	10	10	10	10	10	9	9	8	7	6	5	4	3	2						140	210.0
																							0	0.0

SPILL SCHEDULE FOR ADULT FISH AT THE DALLES DAM
(0500-2000)

BAY NUMBER																						FEET	KCFS
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23		
																						1	1	1.5
1																						1	2	3.0
1																					1	1	3	4.5
1	1																				1	1	4	6.0
1	1																			1	1	1	5	7.5
1	1	1																		1	1	1	6	9.0
1	1	1																	1	1	1	1	7	10.5
1	1	1	1																1	1	1	1	8	12.0
1	1	1	1															1	1	1	1	1	9	13.5
1	1	1	1	1														1	1	1	1	1	10	15.0
1	1	1	1	1													1	1	1	1	1	1	11	16.5
1	1	1	1	1	1												1	1	1	1	1	1	12	18.0
1	1	1	1	1	1											1	1	1	1	1	1	1	13	19.5
1	1	1	1	1	1	1										1	1	1	1	1	1	1	14	21.0
1	1	1	1	1	1	1									1	1	1	1	1	1	1	1	15	22.5
1	1	1	1	1	1	1	1								1	1	1	1	1	1	1	1	16	24.0
1	1	1	1	1	1	1	1							1	1	1	1	1	1	1	1	1	17	25.5
1	1	1	1	1	1	1	1	1						1	1	1	1	1	1	1	1	1	18	27.0
1	1	1	1	1	1	1	1	1					1	1	1	1	1	1	1	1	1	1	19	28.5
1	1	1	1	1	1	1	1	1	1				1	1	1	1	1	1	1	1	1	1	20	30.0
1	1	1	1	1	1	1	1	1	1			1	1	1	1	1	1	1	1	1	1	1	21	31.5
1	1	1	1	1	1	1	1	1	1	1		1	1	1	1	1	1	1	1	1	1	1	22	33.0
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	23	34.5
1	1	1	1	1	1	1	1	1	1	1	1	2	1	1	1	1	1	1	1	1	1	1	24	36.0
1	1	1	1	1	1	1	1	1	1	2	1	2	1	1	1	1	1	1	1	1	1	1	25	37.5
1	1	1	1	1	1	1	1	1	1	2	1	2	1	2	1	1	1	1	1	1	1	1	26	39.0
1	1	1	1	1	1	1	1	2	1	2	1	2	1	2	1	1	1	1	1	1	1	1	27	40.5
1	1	1	1	1	1	1	1	2	1	2	1	2	1	2	1	2	1	1	1	1	1	1	28	42.0
1	1	1	1	1	1	2	1	2	1	2	1	2	1	2	1	2	1	1	1	1	1	1	29	43.5
1	1	1	1	1	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	1	1	1	30	45.0
1	1	1	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	1	1	1	31	46.5
1	1	1	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	1	32	48.0
1	1	1	1	2	1	2	1	2	2	2	1	2	1	2	1	2	1	2	1	2	1	1	33	49.5
1	1	1	1	2	1	2	1	2	2	2	2	2	1	2	1	2	1	2	1	2	1	1	34	51.0

SPILL SCHEDULE FOR ADULT FISH AT THE DALLES DAM
(0500-2000)

BAY NUMBER																						FEET	KCFS
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23		
1	1	1	1	2	1	2	2	2	2	2	2	2	1	2	1	2	1	2	1	2	1	1	35	52.5
1	1	1	1	2	1	2	2	2	2	2	2	2	2	2	1	2	1	2	1	2	1	1	36	54.0
1	1	1	1	2	2	2	2	2	2	2	2	2	2	2	1	2	1	2	1	2	1	1	37	55.5
1	1	1	1	2	2	2	2	2	2	2	2	2	2	2	2	2	1	2	1	2	1	1	38	57.0
1	1	1	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	1	2	1	1	39	58.5
1	1	1	1	2	2	2	2	2	2	2	2	3	2	2	2	2	2	2	1	2	1	1	40	60.0
1	1	1	1	2	2	2	2	2	2	3	2	3	2	2	2	2	2	2	1	2	1	1	41	61.5
1	1	1	1	2	2	2	2	2	2	3	2	3	2	3	2	2	2	2	1	2	1	1	42	63.0
1	1	1	1	2	2	2	2	3	2	3	2	3	2	3	2	2	2	2	1	2	1	1	43	64.5
1	1	1	1	2	2	2	2	3	2	3	2	3	2	3	2	2	2	2	2	2	1	1	44	66.0
1	1	1	1	2	2	3	2	3	2	3	2	3	2	3	2	2	2	2	2	2	1	1	45	67.5
1	1	1	1	2	2	3	2	3	2	3	2	3	2	3	2	3	2	2	2	2	1	1	46	69.0
1	1	1	1	2	2	3	2	3	2	3	3	3	2	3	2	3	2	2	2	2	1	1	47	70.5
1	1	1	1	2	2	3	2	3	2	3	3	3	2	3	2	3	2	3	2	2	1	1	48	72.0
1	1	1	1	2	2	3	2	3	3	3	3	3	2	3	2	3	2	3	2	2	1	1	49	73.5
1	1	1	1	2	2	3	2	3	3	3	3	3	3	3	2	3	2	3	2	2	1	1	50	75.0
1	1	1	2	2	2	3	2	3	3	3	3	3	3	3	2	3	2	3	2	2	1	1	51	76.5
1	1	1	2	2	2	3	2	3	3	3	3	3	3	3	3	3	2	3	2	2	1	1	52	78.0
1	1	2	2	2	2	3	2	3	3	3	3	3	3	3	3	3	2	3	2	2	1	1	53	79.5
1	1	2	2	2	2	3	2	3	3	3	3	3	3	3	3	3	3	3	2	2	1	1	54	81.0
1	1	2	2	2	2	3	2	3	3	3	3	4	3	3	3	3	3	3	2	2	1	1	55	82.5
1	1	2	2	2	3	3	2	3	3	3	3	4	3	3	3	3	3	3	2	2	1	1	56	84.0
1	1	2	3	2	3	3	2	3	3	3	3	4	3	3	3	3	3	3	2	2	1	1	57	85.5
1	1	2	3	2	3	3	2	3	3	4	3	4	3	3	3	3	3	3	2	2	1	1	58	87.0
1	1	2	3	2	3	3	2	3	3	4	3	4	3	4	3	3	3	3	2	2	1	1	59	88.5
1	1	2	3	2	3	3	2	4	3	4	3	4	3	4	3	3	3	3	2	2	1	1	60	90.0
1	1	2	3	2	3	3	3	4	3	4	3	4	3	4	3	3	3	3	2	2	1	1	61	91.5
1	1	2	3	2	3	4	3	4	3	4	3	4	3	4	3	3	3	3	2	2	1	1	62	93.0
1	1	2	3	2	3	4	3	4	3	4	3	4	3	4	3	3	3	3	2	2	2	1	63	94.5
1	1	2	3	2	3	4	3	4	3	4	4	4	3	4	3	3	3	3	2	2	2	1	64	96.0
1	1	2	3	2	3	4	3	4	4	4	4	4	3	4	3	3	3	3	2	2	2	1	65	97.5
1	1	2	3	2	3	4	3	4	4	4	4	4	4	4	3	3	3	3	2	2	2	1	66	99.0
1	2	2	3	2	3	4	3	4	4	4	4	4	4	4	3	3	3	3	2	2	2	1	67	100.5
1	2	2	3	2	3	4	3	4	4	4	4	4	4	4	3	3	3	3	2	3	2	1	68	102.0

SPILL SCHEDULE FOR ADULT FISH AT THE DALLES DAM

(0500-2000)

BAY NUMBER																						FEET	KCFS
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	
1	2	2	3	2	3	4	3	4	4	4	4	4	4	4	4	3	3	3	2	3	2	1	69	103.5
1	2	2	3	2	3	4	4	4	4	4	4	4	4	4	4	3	3	3	2	3	2	1	70	105.0
1	2	2	3	2	3	4	4	4	4	4	4	5	4	4	4	3	3	3	2	3	2	1	71	106.5
1	2	2	3	2	3	4	4	4	4	5	4	5	4	4	4	3	3	3	2	3	2	1	72	108.0
1	2	2	3	2	3	4	4	5	4	5	4	5	4	4	4	3	3	3	2	3	2	1	73	109.5
1	2	2	3	2	3	4	4	5	4	5	4	5	4	4	4	4	3	3	2	3	2	1	74	111.0
1	2	2	3	2	3	4	4	5	4	5	5	5	4	4	4	4	3	3	2	3	2	1	75	112.5
1	2	2	3	2	3	4	4	5	4	5	5	5	4	5	4	4	3	3	2	3	2	1	76	114.0
1	2	2	3	3	3	4	4	5	4	5	5	5	4	5	4	4	3	3	2	3	2	1	77	115.5
1	2	2	3	3	3	4	4	5	4	5	5	5	5	5	4	4	3	3	2	3	2	1	78	117.0
1	2	3	3	3	3	4	4	5	4	5	5	5	5	5	4	4	3	3	2	3	2	1	79	118.5
1	2	3	3	3	3	4	4	5	5	5	5	5	5	5	4	4	3	3	2	3	2	1	80	120.0
1	2	3	3	4	3	4	4	5	5	5	5	5	5	5	4	4	3	3	2	3	2	1	81	121.5
1	2	3	3	4	3	4	4	5	5	5	5	5	5	5	4	4	3	3	3	3	2	1	82	123.0
1	2	3	3	4	3	4	5	5	5	5	5	5	5	5	4	4	3	3	3	3	2	1	83	124.5
1	2	3	3	4	3	4	5	5	5	5	5	5	5	5	4	4	3	4	3	3	2	1	84	126.0
1	2	3	3	4	4	4	5	5	5	5	5	5	5	5	4	4	3	4	3	3	2	1	85	127.5
1	2	3	3	4	4	4	5	5	5	5	5	5	5	5	5	4	3	4	3	3	2	1	86	129.0
1	2	3	3	4	4	5	5	5	5	5	5	5	5	5	5	4	3	4	3	3	2	1	87	130.5
1	2	3	3	4	4	5	5	5	5	5	5	5	5	5	5	4	3	4	4	3	2	1	88	132.0
1	2	3	3	5	4	5	5	5	5	5	5	5	5	5	5	4	3	4	4	3	2	1	89	133.5
1	2	3	3	5	4	5	5	5	5	5	5	5	5	5	5	4	4	4	4	3	2	1	90	135.0
1	2	3	4	5	4	5	5	5	5	5	5	5	5	5	5	4	4	4	4	3	2	1	91	136.5
1	2	3	4	5	4	5	5	5	5	5	5	5	5	5	5	4	5	4	4	3	2	1	92	138.0
1	2	3	4	5	5	5	5	5	5	5	5	5	5	5	5	4	5	4	4	3	2	1	93	139.5
1	2	3	4	5	5	5	5	5	5	5	5	5	5	5	5	5	5	4	4	3	2	1	94	141.0
1	2	3	4	5	5	5	5	5	5	5	5	5	5	5	5	5	5	4	5	3	2	1	95	142.5
1	2	3	4	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	3	2	1	96	144.0
1	2	3	4	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	4	2	1	97	145.5
1	2	3	4	5	5	5	5	5	5	6	5	5	5	5	5	5	5	5	5	4	2	1	98	147.0
1	2	3	4	5	5	5	5	5	5	6	5	6	5	5	5	5	5	5	5	4	2	1	99	148.5
1	2	3	4	5	5	5	5	6	5	6	5	6	5	5	5	5	5	5	5	4	2	1	100	150.0
1	2	3	4	5	5	5	5	6	5	6	6	6	5	5	5	5	5	5	5	4	2	1	101	151.5
1	2	3	4	5	5	5	5	6	5	6	6	6	6	5	5	5	5	5	5	4	2	1	102	153.0

SPILL SCHEDULE FOR ADULT FISH AT THE DALLES DAM

(0500-2000)

BAY NUMBER																							FEET	KCFS
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23		
1	2	3	4	5	5	5	5	6	6	6	6	6	6	5	5	5	5	5	5	4	2	1	103	154.5
1	2	3	4	5	5	5	5	6	6	6	6	6	6	6	5	5	5	5	5	4	2	1	104	156.0
1	2	4	4	5	5	5	5	6	6	6	6	6	6	6	5	5	5	5	5	4	2	1	105	157.5
1	2	4	4	5	5	5	5	6	6	6	6	6	6	6	5	5	5	5	5	4	3	1	106	159.0
1	2	4	4	5	5	6	5	6	6	6	6	6	6	6	5	5	5	5	5	4	3	1	107	160.5
1	2	4	4	5	5	6	5	6	6	6	6	6	6	6	5	6	5	5	5	4	3	1	108	162.0
1	2	4	4	5	5	6	6	6	6	6	6	6	6	6	5	6	5	5	5	4	3	1	109	163.5
1	2	4	4	5	5	6	6	6	6	6	6	6	6	6	6	6	5	5	5	4	3	1	110	165.0
1	2	4	4	5	5	6	6	6	6	6	6	6	6	6	6	6	6	5	5	4	3	1	111	166.5
1	2	4	5	5	5	6	6	6	6	6	6	6	6	6	6	6	6	5	5	4	3	1	112	168.0
1	2	4	5	5	6	6	6	6	6	6	6	6	6	6	6	6	6	5	5	4	3	1	113	169.5
1	2	4	5	5	6	6	6	6	6	6	6	6	6	6	6	6	6	5	5	4	3	2	114	171.0
1	2	4	5	5	6	6	6	6	6	6	6	6	6	6	6	6	6	5	5	4	4	2	115	172.5
1	2	4	5	5	6	6	6	6	6	7	6	6	6	6	6	6	6	5	5	4	4	2	116	174.0
1	2	4	5	5	6	6	6	6	6	7	6	7	6	6	6	6	6	5	5	4	4	2	117	175.5
1	2	4	5	5	6	6	6	7	6	7	6	7	6	6	6	6	6	5	5	4	4	2	118	177.0
1	2	4	5	5	6	7	6	7	6	7	6	7	6	6	6	6	6	5	5	4	4	2	119	178.5
1	2	4	5	5	6	7	6	7	6	7	6	7	6	7	6	6	6	5	5	4	4	2	120	180.0
1	2	4	5	5	6	7	7	7	6	7	6	7	6	7	6	6	6	5	5	4	4	2	121	181.5
1	2	4	5	5	6	7	7	7	7	7	6	7	6	7	6	6	6	5	5	4	4	2	122	183.0
1	2	4	5	5	6	7	7	7	7	7	7	7	6	7	6	6	6	5	5	4	4	2	123	184.5
1	2	4	5	5	6	7	7	7	7	7	7	7	7	7	6	6	6	5	5	4	4	2	124	186.0
1	2	4	5	5	6	7	7	7	7	7	7	7	7	7	6	6	6	6	5	4	4	2	125	187.5
1	2	4	5	6	6	7	7	7	7	7	7	7	7	7	6	6	6	6	5	4	4	2	126	189.0
1	2	4	5	6	6	7	7	7	7	7	7	7	7	7	6	6	6	6	5	5	4	2	127	190.5
1	2	5	5	6	6	7	7	7	7	7	7	7	7	7	6	6	6	6	5	5	4	2	128	192.0
1	2	5	5	6	6	7	7	7	7	7	7	7	7	7	7	6	6	6	5	5	4	2	129	193.5
1	3	5	5	6	6	7	7	7	7	7	7	7	7	7	7	6	6	6	5	5	4	2	130	195.0
1	3	5	5	6	7	7	7	7	7	7	7	7	7	7	7	6	6	6	5	5	4	2	131	196.5
1	3	5	5	6	7	7	7	7	7	7	7	7	7	7	7	7	6	6	5	5	4	2	132	198.0
1	3	5	6	6	7	7	7	7	7	7	7	7	7	7	7	7	6	6	5	5	4	2	133	199.5
1	3	5	6	6	7	7	7	7	7	7	7	7	7	7	7	7	7	6	5	5	4	2	134	201.0
1	3	5	6	6	7	7	7	7	7	8	7	7	7	7	7	7	7	6	5	5	4	2	135	202.5
1	3	5	6	6	7	7	7	7	7	8	7	7	7	7	7	8	7	6	5	5	4	2	136	204.0

SPILL SCHEDULE FOR ADULT FISH AT THE DALLES DAM

(0500-2000)

BAY NUMBER																						FEET	KCFS
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23		
1	3	5	6	6	7	7	7	8	7	8	7	7	7	7	7	8	7	6	5	5	4	2	137	205.5
1	3	5	6	6	7	7	7	8	7	8	7	8	7	7	7	8	7	6	5	5	4	2	138	207.0
1	3	5	6	6	7	8	7	8	7	8	7	8	7	7	7	8	7	6	5	5	4	2	139	208.5
1	3	5	6	6	7	8	7	8	7	8	7	8	7	8	7	8	7	6	5	5	4	2	140	210.0
1	3	5	6	6	7	8	7	8	8	8	7	8	7	8	7	8	7	6	5	5	4	2	141	211.5
1	3	5	6	6	7	8	7	8	8	8	8	8	7	8	7	8	7	6	5	5	4	2	142	213.0
1	3	5	6	6	7	8	8	8	8	8	8	8	7	8	7	8	7	6	5	5	4	2	143	214.5
1	3	5	6	6	7	8	8	8	8	8	8	8	7	8	7	8	7	6	6	5	4	2	144	216.0
1	3	5	6	7	7	8	8	8	8	8	8	8	7	8	7	8	7	6	6	5	4	2	145	217.5
1	3	5	6	7	7	8	8	8	8	8	8	8	7	8	7	8	7	7	6	5	4	2	146	219.0
1	3	5	7	7	7	8	8	8	8	8	8	8	7	8	7	8	7	7	6	5	4	2	147	220.5
1	3	5	7	7	7	8	8	8	8	8	8	8	8	8	7	8	7	7	6	5	4	2	148	222.0
1	3	5	7	7	8	8	8	8	8	8	8	8	8	8	7	8	7	7	6	5	4	2	149	223.5
1	3	5	7	7	8	8	8	8	8	8	8	8	8	8	8	8	7	7	6	5	4	2	150	225.0

An approved spill schedule which incorporates raising spill bay gates in blocks of four will be implemented when changes in spill discharge are frequent.

Feet of opening required to pass desired amounts of spill vary slightly depending on project operating head.

4. **Juvenile Fish Passage Facilities**

a. **Operating Criteria**

(1) **Prior to Juvenile Fish Passage Season:**

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

(b) Inspect and, where necessary, clean gatewell orifices of debris, such that the orifices are free of debris on 1 April.

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

(d) Inspect and correct any epoxy or concrete deficiencies on walls and floors of ice and trash sluiceway.

(e) Inspect and where necessary, repair spill gates and control system. Spillway, except for coordinated exceptions, must be able to achieve spill patterns on 1 April.

(f) 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 operable by 1 April.

(g) The results of all inspections and the readiness of the facility for operation will be verbally reported to the Corps' Fish Passage O&M Coordination Team immediately prior to the fish passage season.

(2) **Juvenile Fish Passage Season:** (1 April through 30 November).

(a) Measure gatewell drawdown a minimum of once per week. Clean trashracks as flow conditions dictate, or when drawdown in gatewell slots exceeds 1.5 feet or as indicated by fish condition at The Dalles and Bonneville (e.g., higher than expected descaling). Rake trashracks in front of turbine units FU-1 through at least main unit 5 again between 1 June and 15 June.

(b) Remove debris from forebay when needed.

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

CBFWA recommends the gatewells be cleaned before they become half covered with debris.

(d) Operate all gate slot orifices full time.

(e) Operate ice and trash sluiceway gates 1-1, 1-2, & 1-3 at least 16 hours per day (including sunrise to sunset from 1 September through the remainder of the juvenile fish passage season with full surface flow (lower or raise sluice gates completely). During nighttime hours operate the ice and trash sluiceway as a plunge pool for the gateslot orifices. During periods of involuntary spill, sluice gates may be operated continuously. Operate the sluiceway end gate full open from sunrise to sunset. During periods when gates do not operate, set top of bottom end gate at 142.0' elevation to create orifice plunge pool.

(f) Once each week and more frequently if accumulations of debris are observed in the sluiceway, close gates 1-1, 1-2, & 1-3, and open gates 17-3, 18-1, & 18-2 for two hours to flush debris and fish being held in the sluiceway channel east of unit 1. When units are being dewatered, set top of bottom end gate at elevation 142.0' to create an orifice plunge pool, and install orifice gill posts.

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

(h) Reinstall or repair avian predator control lines in present locations as soon as possible following damage or removal. 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.

(3) General

(a) During chain gate operation, maintain forebay level above elevation 158.0' to the extent practicable.

(b) Maintain orifices clear of debris.

(c) Inspect facilities twice each day.

(d) Follow the schedule starting at p. TDA-6 for nighttime spill (2000 - 0500). This schedule was developed for juvenile fish passage.

(4) 1 December through 31 March

(a) Maintain orifices clear of debris.

(b) Set top of bottom end gate at 142.0' elevation to create orifice plunge pool.

(c) Inspect facilities once per day.

5. Adult Fish Passage Facilities

a. Operating Criteria

(1) Prior to 1 March

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

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

(c) Inspect for, and when necessary, clear debris 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 verbally reported at the Corps' Fish Passage O&M Coordination Team meeting immediately prior to the passage season.

(2) **1 March through 30 November** (Adult Fish Passage Period).

(a) **All Adult Facilities**

i) Water depth over fish ladder weirs: 1.0' +/- 0.1' during the non-shad passage season (16 August through 14 May), and 1.3' +/- 0.1' for the remainder of the time.

ii) Measure water temperature within each ladder system and in associated forebay and tailwater locations daily to reveal if temperature variances exist between locations. Additional monitoring equipment will be installed in 1996. Summaries of water temperature measurements will be included in weekly operation monitoring reports.

iii) Head on all entrances: 1.0 to 2.0 feet (prefer 1.3 to 1.5 feet). Refer to maintenance plan when unable to achieve head criteria.

iv) A transportation velocity of 1.5 to 4.0 feet per second (prefer 2.0 fps) shall be maintained in all channels and the lower ends of the fish ladders which are below the tailwater. Water velocities will be measured directly at least once a month to verify channels are operating between 1.5 and 4.0 feet per second.

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

vi) Necessary staff gauges and water level indicators will be readable at all water levels encountered during the fish passage period.

vii) Main entrance weir depths: 8.0 feet or greater below tailwater. When posssible, set gates at 8.5 feet of depth so that even with water fluctuation, the gates will more often exceed 8.0 feet. Weirs will be lowered to bottom when 8.0 feet depth is not possible.

viii) Count station crowders shall remain in the operating position while visual counting and/or video taping is being conducted. If counting is temporarily discontinued due to unscheduled events, or the fishway is dewatered, the crowder shall be fully opened, except during the counters' hourly ten minute break period. Leave fish passage slot lighted overnight.

ix) Inspect facilities twice each day.

x) Inspect and ensure that optimum passage conditions are maintained at fishway entrances and exits.

(b) East Fishway

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

ii) Telescoping weir #159 will adjust to maintain 1.0' +/- 0.1' depth over the weir, measured below the counting station, during the non-shad passage season (16 August through 14 May), and 1.3' +/- 0.1' for the remainder of the time.

iii) Telescoping weir #158 will track 1.0' +/- 0.1' below weir #159 during the non-shad passage season (16 August through 14 May), and 1.3' +/- 0.1' for the remainder of the time.

(c) North Fishway

i) North Fishway Entrance: Operate only entrance N1 regardless of spill.

CBFWA recommends operating both north shore fishway entrances during periods with spill. They further recommend that entrance N2 may be closed during periods without spill, at the discretion of the Fishery Managers.

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ii) Spill through bay 1 as follows: In the summer (1 June through 15 August), spill 1500 cfs from 0400 to 2000 hours. Curtail attraction spill after 15 August.

(d) Powerhouse

i) West Powerhouse Entrance: Operate two entrances (W1 and W2).

ii) East Powerhouse Entrance: Operate entrances E2 and E3 to maintain gate crest at 8.0' or greater below tailwater. Set E1 with gate crest at 81.0'.

iii) Operate east ladder junction pool weirs at the following minimum depths in relation to east entrance tailwater surface elevation, +/- 0.5'. Note that weirs rest on sills when tailwater is below 74.0'.

JP2.....7.0'
JP4.....6.0'
JP6.....7.0'

iv) Operate 12 submerged orifices along the powerhouse collection system. Orifice numbers are: 1d, 3a, 5a, 7d, 9d, 13a, 17a, 19d, 21d, 22a, 22b, and 22c.

v) The cul-de-sac entrance will remain closed.

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

(2) **Powerhouse and Spillway Collection Systems.** Preventive maintenance and repair occurs throughout the year. During the adult fish passage season the maintenance will not involve any operations which will cause a failure to comply with the fishway criteria, unless specially coordinated. Inspection of those parts of the adult collection channel systems, such as diffision gratings, picket 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. Inspection by 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). Any non-routine maintenance and fishway modification will be handled on a case by case basis.

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

(3) **Adult Fish Ladders and Counting Stations.** The adult fish ladders will be dewatered (see Dewatering Plans) once each year during the winter maintenance period. Unless specially coordinated, only one ladder will be dewatered at a time, with the other ladder capable of operating at full season criteria. During this time the ladders are inspected for blocked orifices, projections into the fishway that may injure fish, stability of the weirs, damaged picket leads, exit gate problems, loose diffusion valves, ladder orifice reduction plates, malfunctioning operation equipment at the counting stations, and other potential problems. Problems identified throughout the passage year that do not affect fish passage, as well as those identified during the dewatered period are then repaired. Trashracks at the ladder exits will be raked when criteria is exceeded . When practicable, rake trash racks during the time of day when fish passage is least affected. Fish count station windows will be cleaned when necessary, and when practicable, during the time of day when fish passage is least affected.

b. Unscheduled Maintenance

(1) **Fishway Auxiliary Water Systens.** Most fishway auxiliary water systems operate automatically. If the automatic system fails, the system will be manually operated by the project personnel to maintain criteria. This will allow the fish facility to operate according to criteria while the repair of the automatic system is carries out. When this operation becomes necessary, project personnel will increase the surveillance of the adult system to ensure that criteria are being met.

(a) **Powerhouse.** If one of the two fishway auxiliary water turbines fails or manfunctions during the spring/summer adult migration season (1 March - 31 July), use the following sequential procedure until a fishway head of 1.0 feet is achieved:

1: Raise the open West Powerhouse Entrance weirs W1 and W2 (W3 stationary at 78.0') in 1.0 foot increments until the weirs reach 6.0 feet of depth below the tailwater surface.

2: Raise the East Entrance weirs E2 and E3 (E1 closed at tailwater below 81.0 ') in 1.0 foot increments to 6.0 feet of depth below the tailwater surface.

3: Close West Powerhouse Entrance weir W2.

4: Close one East Entrance weir E2.

5: Raise the South Spillway Entrance weirs S1 and S2 in 1.0 foot increments to 6.0 feet of depth below the tailwater surface.

6: Close one South Spillway Entrance (S2).

7: Close alternating floating orifices starting from the west end of the powerhouse.

8: If a fishway head of 1.0 foot is still not achieved leave in this configuration until more auxiliary water becomes available. Then reverse the above procedure.

If one of the fishway auxiliary water turbines fails, malfunctions, or is out of service for necessary maintenance during the fall adult migration or winter maintenance season (1 August through February) assuming no spill during this period, use the following sequential procedure until a fishway head of 1.0 feet is achieved:

1: Close the South Spillway Entrance weirs and all diffusers associated with these entrances, including those adjacent to the entrances and those at the east and west ends of the powerhouse.

2: Close entrance E2 (leaving E3 open at 8.0' depth).

3: Close West Entrance weir W2, leaving W1 open to 8.0 feet below tailwater surface elevation.

4: Raise entrance weir W1 to 6.0 feet below tailwater surface elevation.

5: Raise entrance weir E3 to 7.0 feet below tailwater. If 1.0 foot of head is still not achieved, then raise it an additional 1.0 foot to a 6.0 foot minimum below tailwater surface.

6: For long term outages, close every other floating orifice starting at the west end of the powerhouse.

7: If a fishway head of 1.0 foot is still not achieved, then leave in this configuration until more auxiliary water becomes available.

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

1: S1 open with the weir crest 6.0 feet below the tailwater surface, S2 closed.

2: The junction pool weir supplying the powerhouse collection system and west powerhouse entrances will be closed.

3: E3 will be open with the weir crest 6.0 feet below the tailwater surface and E1 and E2 will be closed.

(b) North Ladder. If the North Wasco County Power unit auxiliary water system fails, the backup auxiliary water system will be started and the system operated at criteria. If the backup auxiliary water system fails, N1 will remain open with a weir depth of 6.0 feet below the tailwater surface and N2 will be closed.

(2) Powerhouse and Spillway Adult Fish Collection Systems. The Dalles Project contains several types of fishway entrances. In most cases, if failures occur, then 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 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. The entrance will be repaired in

an expedient manner and the entrance will be returned to manual or automatic control at the earliest possible date.

(3) **Adult Fish Ladders and Counting Stations.** The structures 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"), erosion of concrete around the picket leads or missing pickets can allow fish into areas where escape is not possible. If picket lead failure or concrete erosion occurs, then the timing and method of repair will depend upon the severity of the problem. The decision of whether or not to dewater the fishway and repair any problem will be made in consultation with the appropriate resource agencies through the Fish Passage Center (FPC) representative on the Fish Passage O&M Coordination Team.

D. Turbine Unit Operation and Maintenance

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

2. The project's turbine unit maintenance schedules will be reviewed by project and district biologists for fishery impacts.

3. Guidelines for operation of the turbine units within 1% peak efficiency at various head ranges are shown in **The Dalles Dam Peak Turbine Efficiency Ranges** (p. TDA-26)[1].

4. To the extent technically feasible, turbines will be operated within +/- 1% of peak turbine efficiency, as described in appendix D of this plan, unless operation outside of that range is necessary to: 1) meet load requirements of the BPA administrator, whose load requests will be consistent with BPA's System Load Shaping Guidelines; or 2) comply with other coordinated fishery measures. BPA's System Load Shaping Guidelines apply between 15 March and 31 October. However, during the rest of the year the project will continue to operate units within the peak turbine efficiency range, except as specifically requested by BPA to do otherwise as power requirements demand.

CBFWA recommends operation of all units within 1% of peak turbine efficiency unless otherwise agreed.

5. When it is necessary to operate turbines outside of peak efficiency, the units will be selected according to the following guidance: Units 7 through 14 will be selected first, spacing by at least one unit. For example, assuming they're available to operate, the following sequence might be used: 7, 9, 11, 13, 15, 5, 3, 1, 8, etc.

[1] Reference, CENPD-ET-HD.

THE DALLES DAM PEAK TURBINE EFFICIENCY RANGES

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

E. Dewatering Plans

1. Detailed plans have been developed and must be adhered to for most project facilities dewaterings. These plans include consideration for fish safety and are consistent with the following general guidance.

2. The project fish biologist or alternate Corps fisheries personnel will attend all project activities involving fish handling.

3. The fisheries agencies and tribes will be represented at all ladder dewaterings by the WDFW fish counting program supervisor or an alternate.

4. Adult Fish Ladder

a. Scheduled maintenance

(1) When possible, operate ladder to be dewatered at a reduced flow for at least 24 hours, but not more than 48 hours prior to dewatering. Reduced flow is defined as less than criterion operation, but more than orifice flow.

(2) Discontinue all fishway auxiliary water supply at least 24 hours, but no more than 48 hours prior to dewatering.

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

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

(5) The project biologist or alternate Corps fisheries personnel will oversee fish rescue when the ladders are dewatered. The project biologist will invite fishery agency and/or Indian tribal biologists' participation in the dewatering. Rescue personnel will walk the inside of the ladder from the head gates down to tailwater salvaging all fish either by moving fish to tailwater within the ladder flow or capturing and placing the fish in a large water filled tank which is then transported to the forebay or tailwater, depending on the fish' lifestage (adults to forebay, juveniles to tailrace), for release.

b. Unscheduled Maintenance

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

(3) Follow steps (3) - (5) above.

5. Powerhouse Collection System

a. Scheduled Maintenance

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

(2) The project biologist will assure that rescue equipment is available if needed.

(3) The project biologist or alternate Corps fisheries personnel, will provide technical guidance on fish safety and will assist directly in rescue operations.

6. Turbines.

a. When units with STSs and VBSs installed are drained, gatewells which will be drained will have fish removed by dipping with an appropriate basket.

b. When a unit which has not yet been equipped with a VBS is to be drained, its gatewells need not be dipped, as is required at other projects. Instead, the following procedure may be used. The unit will be shut down for at least 24 hours before it is drained. Then, immediately before draining it will be operated very briefly to flush fish out of the draft tube.

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

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

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

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

g. The project biologist will assure that rescue equipment is available if needed.

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

F. Endnotes

[1] Migrations of Juvenile Chinook Salmon and Steelhead Trout in the Snake River from 1973 to 1979. Sims & Ossiander, NMFS,CZES, June 1981. 31 pp.

[2] Evaluation of The Dalles Dam Ice-Trash Sluiceway as a Downstream Migrant Bypass During 1977. Nichols, D., et. al., ODFW., 1978. 15 pp.

[3] Annual Fish Passage Report - 1994. Columbia and Snake River Projects. US COE.

John Day Dam

I. JOHN DAY DAM

A. Fish Passage Information. The locations of fish passage facilities are shown on the following general site plans for John Day Lock and Dam (pp. JDA-2 and JDA-3).

1. Juvenile Fish Passage

a. Facilities Description. Juvenile fish bypass facilities at John Day Dam, completed in 1987, include the following:

(1) VBSs, STSs, and 14 inch diameter orifices in each of the project's 16 turbine units.

(2) An enlarged orifice bypass collection conduit.

(3) A transportation channel to carry fish from the collection conduit to the river below the dam.

(4) A fingerling sampler and juvenile fish evaluation facility is located in the lower portion of the transportation channel. This facility is normally not operated, pending improvements for fish safety.

b. New Juvenile Bypass/Monitoring Facility. Currently, in FY96, a new juvenile bypass/monitoring facility is being constructed at John Day Dam, and is planned to be operational sometime in FY97. A description of the new facility will appear in the next revised edition of the Fish Passage Plan, to be released in the spring of FY97, or as requested from the project or district biologists when it becomes available.

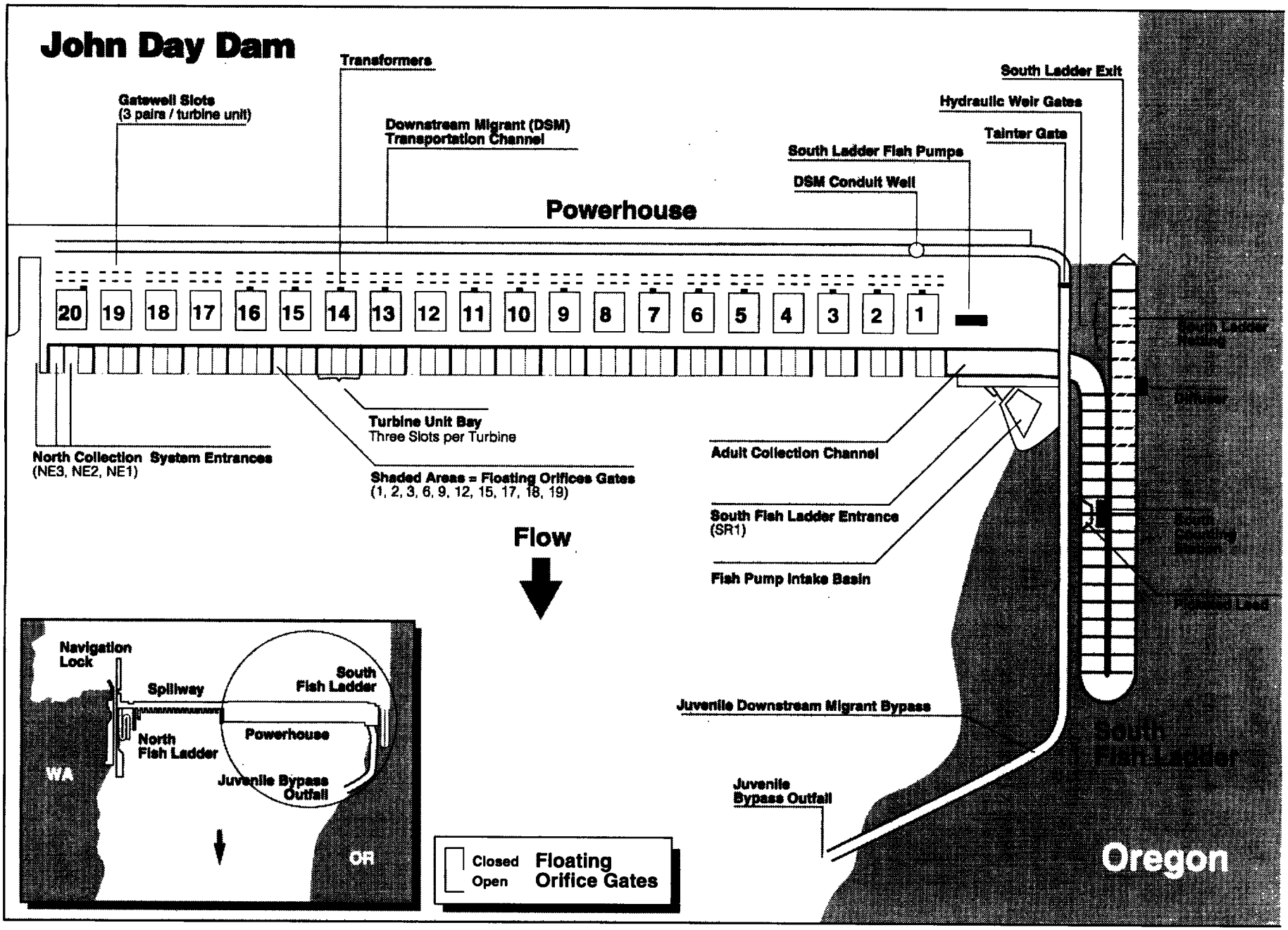

Figure 7 John Day South Fish Ladder and Powerhouse Collection System.

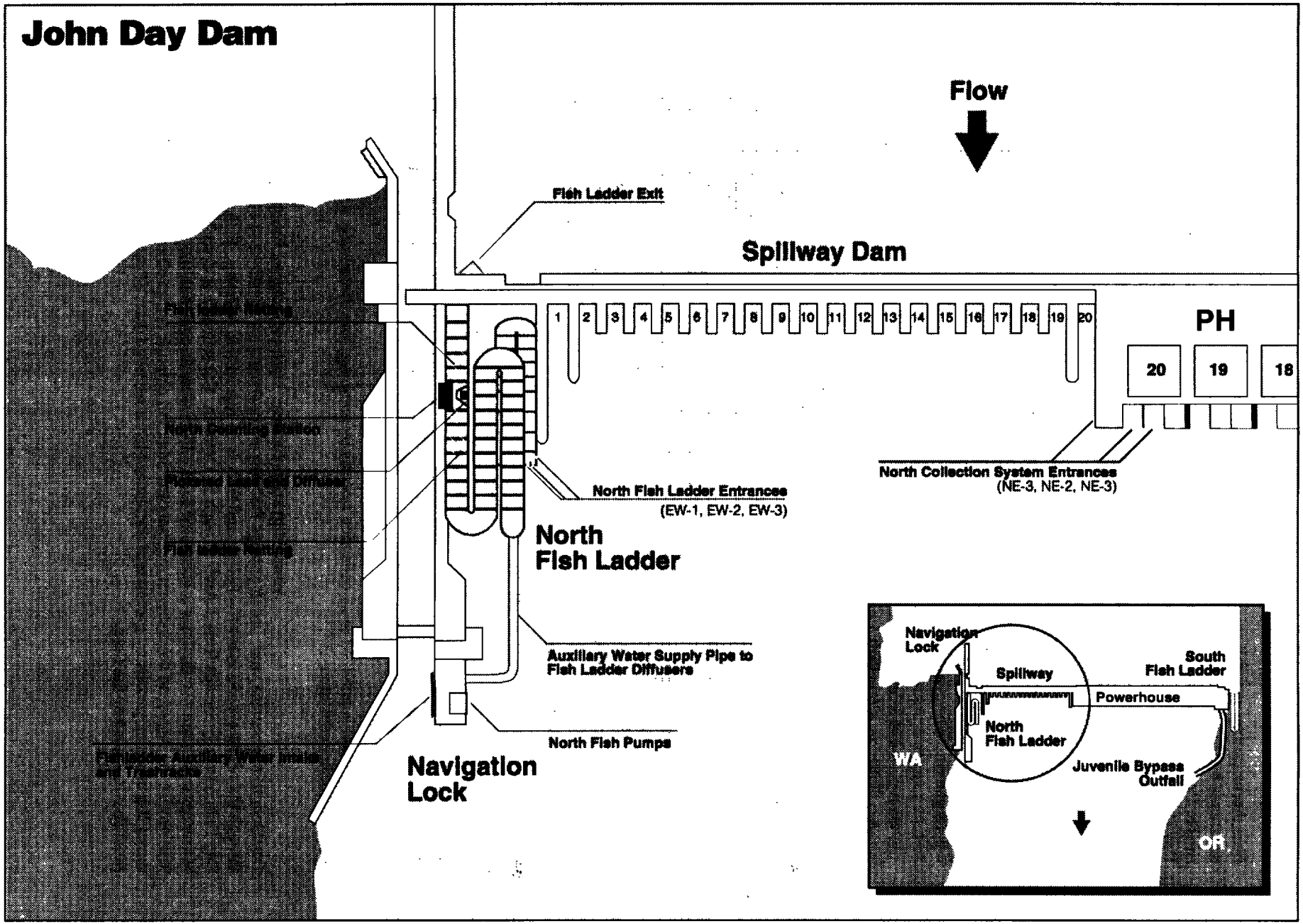

Figure 8 John Day Dam Spillway and North Fish Ladder.

c. **Juvenile Migration Timing.** Juvenile passage timing has been determined by gatewell sampling at John Day Dam (Table I). Hydroacoustic monitoring has been conducted but has generally been concentrated on peak days and hours of passage, and therefore, connot be used to evaluate seasonal or diel passage patterns. Extended monitoring conducted into December at John Day Dam in 1982 and 1983 showed that less than 3 percent of subyearling chinook migrants move past John Day Dam after 31 October. As a result, smolt monitoring under the Water Budget Measures Program is now discontinued on 31 October. Maintenance of juvenile fish facilities is scheduled for approximately 1 December through 31 March to minimize impact on downstream migrants.

Diel passage was monitored by hydroacoustics and gatewell sampling (see Endnotes, pp. JDA-29, 30)[1] [2 3 4]. Peak passage occurred between the hours of 2300 and 2400 with a long period of elevated passage until dawn when passage decreases. Passage increases dramatically at dusk, about 2000. Gatewell sampling data indicate that roughly 80 percent of the juvenile migrants pass John Day Dam between 2100 and 0600. For example, the weighted average passage for subyearling chinook in July and August 1986 was 82 percent. However, some variation from this pattern has been noted such as in 1984. In that year, daytime passage at John Day Dam increased beginning on 23 May. During the peak of the spring juvenile migration period at John Day Dam, 40 percent of the spring chinook and steelhead daily passage occurred between 0700 and 2200. Unit 3 gatewell sampling and hydroacoustic sampling confirmed the diel pattern.

d. **Facility Monitoring and Reporting.** Project biologists shall inspect fish passage facilities at the frequencies listed in the juvenile and adult fish facilities operating criteria sections. Project biologists shall prepare weekly reports, throughout the year, summarizing project operations. The weekly reports will provide an overview of how the project and the fish passage facilities operated during the week and an evaluation of resulting fish passage conditions. The reports shall include: any out of criteria situations observed and subsequent corrective actions taken; any equipment malfunctions, breakdowns, or damage along with a summary of resulting repair activities; adult fishway control calibrations; STS and VBS inspections; and any usual activities which occurred at the project which may affect fish passage. The weekly reports shall cover a Sunday through Saturday time period and shall be sent to CENPP-CO as soon as possible the following week via electronic mail. The project biologist shall prepare an annual report by 31 January summarizing the operation of the project fish passage facilities for the previous year. It will cover from the beginning of an adult fish facilities winter maintenance season to the beginning of the next.

2. **Adult Fish Passage**

a. **Facilities Description.** The adult fish passage facilities at John Day Dam comprise a north shore fish ladder which passes fish from entrances at the north end of the spillway, and a south shore fish ladder which passes fish from entrances along a collection channel which extends the full length of the powerhouse.

Auxiliary water is provided to all collection systems by pumping from the tailrace. Counting stations are provided in both fishways.

b. **Adult Migration Timing.** Upstream migrant fish are present at John Day Dam throughout the year. Adult passage facilities are operated year round. However, passage through the winter months is relatively light and there is no regular fish counting. Fish counting at John Day Dam normally extends from 1 April through 31 October. The schedule is described appendix B. Maintenance of adult fish facilities is scheduled from 1 December through February (In-water work period) to minimize the impact on downstream migrants and adult fall chinook and steelhead fallback. Table II shows fish counting periods by species and earliest and latest recorded dates of peak passage, from fish count data compiled by the Corps.

Table I. John Day Dam Juvenile Migration Timing, 1987 - 1995.

% PAST PROJECT	YEAR/DATE								
	1987	1988	1989	1990[a]	1991	1992	1993	1994	1995
Yearling chinook									
10%	5/2	4/24	5/2	4/25	4/26	5/2	5/6	5/2	4/29
90%	5/31	6/1	5/27	NA	6/7	6/10	6/1	6/18	5/29
Subyearling chinook									
10%	6/7	6/22	6/7	NA	6/6	6/24	6/21	7/8	6/8
90%	9/18	9/7	8/16	NA	8/15	8/15	8/17	8/2	7/24
Steelhead (all)									
10%	5/1	4/26	4/24	4/29	5/4	5/3	----	----	----
90%	5/29	6/2	5/27	NA	5/29	5/28	----	----	----
Steelhead (wild)									
10%	----	----	----	----	----	----	4/30	4/27	5/3
90%	----	----	----	----	----	----	5/26	5/26	5/25
Steelhead (hatchery)									
10%	----	----	----	----	----	----	5/10	5/9	5/7
90%	----	----	----	----	----	----	5/26	6/1	5/26
Coho									
10%	5/6	5/6	4/28	4/27	5/11	5/2	5/9	5/12	5/8
90%	5/30	5/31	5/29	NA	6/4	5/27	5/30	5/29	5/21
Sockeye									
10%	5/14	5/12	5/8	5/4	5/16	5/8	5/16	5/11	5/9
90%	6/6	6/3	6/3	NA	6/1	5/27	5/31	6/5	5/26

[a] Fish sampling was done at unit 5 at John Day Dam. Outages of this unit during the periods April 16 - 19, May 30 - June 10, June 21 - 23, and August 13 - 16, make computed percentiles gross approximations only. It is likely that dates would be up to several days later if uninterrupted sampling had occurred. Dates where not even gross estimation is feasible are denoted by "NA".

Table II. John Day Dam Adult Migration Timing, 1968 - 1993.

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

B. Project Operation

1. General

a. Research, non-routine maintenance, and other fishery related activities will not be conducted within 100' of any fishway entrance or exit, or directly in, above, or adjacent to any fishway, unless concurred with by Regional fishery managers through ESA and other fish passage issues. Alternate actions will be considered by district and project biologists in conjunction with the fishery 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.

2. Spill Management

a. The spill schedule on pp. JDA-7 through JDA-10 will be used for juvenile fish passage during 2000-0500 hours.

b. The spill schedule on pp. JDA-11 through JDA-16 will be used for adult fish passage during 0500-2000 hours.

c. **Dissolved Gas Management and Control.** Spill management requests will be based upon dissolved gas monitoring data and the observed condition of migrating juveniles and adults, along with juvenile migration monitoring data. Total dissolved gas monitoring will be conducted by the Corps at the John Day Dam forebay automated station and reported every four hours from 1 April through Labor Day. Related data reported at the same time will be spill volume and total project flow. The dissolved gas monitoring system is described in detail in appendix E.

Excessive Total Dissolved Gas 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.

SPILL SCHEDULE FOR JUVENILE FISH AT JOHN DAY DAM

(2000-0500)

BAY NUMBER																				STOPS	KCFS
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20		
																			6	6	9.6
																			7	7	11.2
																			8	8	12.8
																			9	9	14.4
																		5	5	10	16.0
																		5	6	11	17.6
																		6	6	12	19.2
																		6	7	13	20.8
																		7	7	14	22.4
																		7	8	15	24.0
																		8	8	16	25.6
																		8	9	17	27.2
																		9	9	18	28.8
																	6	6	7	19	30.4
																	6	7	7	20	32.0
																	7	7	7	21	33.6
																	7	7	8	22	35.2
																	7	8	8	23	36.8
																	8	8	8	24	38.4
																	8	8	9	25	40.0
																	8	9	9	26	41.6
																	9	9	9	27	43.2
																7	7	7	7	28	44.8
																7	7	7	8	29	46.4
																7	7	8	8	30	48.0
																7	8	8	8	31	49.6
																8	8	8	8	32	51.2
																8	8	8	9	33	52.8
																8	8	9	9	34	54.4
																8	9	9	9	35	56.0
																9	9	9	9	36	57.6
															7	7	7	8	8	37	59.2
															7	7	8	8	8	38	60.8

SPILL SCHEDULE FOR JUVENILE FISH AT JOHN DAY DAM

(2000-0500)

BAY NUMBER																				STOPS	KCFS
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20		
															7	8	8	8	8	39	62.4
															8	8	8	8	8	40	64.0
															8	8	8	8	9	41	65.6
															8	8	8	9	9	42	67.2
															8	8	9	9	9	43	68.8
															8	9	9	9	9	44	70.4
															9	9	9	9	9	45	72.0
														7	7	8	8	8	8	46	73.6
														7	8	8	8	8	8	47	75.2
														8	8	8	8	8	8	48	76.8
														8	8	8	8	8	9	49	78.4
														8	8	8	8	9	9	50	80.0
1														8	8	8	8	9	9	51	81.6
1	1													8	8	8	8	9	9	52	83.2
1	1	1												8	8	8	8	9	9	53	84.8
1	1	1	1											8	8	8	8	9	9	54	86.4
1	1	1	2											8	8	8	8	9	9	55	88.0
1	1	2	2											8	8	8	8	9	9	56	89.6
1	2	2	2											8	8	8	8	9	9	57	91.2
2	2	2	2											8	8	8	8	9	9	58	92.8
2	2	2	3											8	8	8	8	9	9	59	94.4
2	2	3	3											8	8	8	8	9	9	60	96.0
2	3	3	3											8	8	8	8	9	9	61	97.6
3	3	3	3											8	8	8	8	9	9	62	99.2
3	3	3	3	1										8	8	8	8	9	9	63	100.8
3	3	3	3	1										8	8	8	9	9	9	64	102.4
3	3	3	3	1										8	8	9	9	9	9	65	104.0
3	3	3	3	1										8	9	9	9	9	9	66	105.6
3	3	3	3	1										9	9	9	9	9	9	67	107.2
3	3	3	3	2										9	9	9	9	9	9	68	108.8
3	3	3	3	2									7	8	8	8	8	8	8	69	110.4
3	3	3	3	2									8	8	8	8	8	8	8	70	112.0
3	3	3	3	2									8	8	8	8	8	8	9	71	113.6
3	3	3	3	2									8	8	8	8	8	9	9	72	115.2

SPILL SCHEDULE FOR JUVENILE FISH AT JOHN DAY DAM
(2000-0500)

BAY NUMBER																				STOPS	KCFS
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20		
3	3	3	3	3									8	8	8	8	8	9	9	73	116.8
3	3	3	3	3									8	8	8	8	9	9	9	74	118.4
3	3	3	3	3									8	8	8	9	9	9	9	75	120.0
3	3	3	3	3									8	8	9	9	9	9	9	76	121.6
3	3	3	3	3									8	9	9	9	9	9	9	77	123.2
3	3	3	3	3	1								8	9	9	9	9	9	9	78	124.8
3	3	3	3	3	1								9	9	9	9	9	9	9	79	126.4
3	3	3	3	3	1							8	8	8	8	8	8	8	8	80	128.0
3	3	3	3	3	1							8	8	8	8	8	8	8	9	81	129.6
3	3	3	3	3	1							8	8	8	8	8	8	9	9	82	131.2
3	3	3	3	3	2							8	8	8	8	8	8	9	9	83	132.8
3	3	3	3	3	2							8	8	8	8	8	9	9	9	84	134.4
3	3	3	3	3	2							8	8	8	8	9	9	9	9	85	136.0
3	3	3	3	3	2							8	8	8	9	9	9	9	9	86	137.6
3	3	3	3	3	2							8	8	9	9	9	9	9	9	87	139.2
3	3	3	3	3	3							8	8	9	9	9	9	9	9	88	140.8
3	3	3	3	3	3							8	9	9	9	9	9	9	9	89	142.4
3	3	3	3	3	3							9	9	9	9	9	9	9	9	90	144.0
3	3	3	3	3	3						8	8	8	8	8	8	8	8	9	91	145.6
3	3	3	3	3	3						8	8	8	8	8	8	8	9	9	92	147.2
3	3	3	3	3	3	1					8	8	8	8	8	8	8	9	9	93	148.8
3	3	3	3	3	3	1					8	8	8	8	8	8	9	9	9	94	150.4
3	3	3	3	3	3	1					8	8	8	8	8	9	9	9	9	95	152.0
3	3	3	3	3	3	1					8	8	8	8	9	9	9	9	9	96	153.6
3	3	3	3	3	3	1					8	8	8	9	9	9	9	9	9	97	155.2
3	3	3	3	3	3	2					8	8	8	9	9	9	9	9	9	98	156.8
3	3	3	3	3	3	2					8	8	9	9	9	9	9	9	9	99	158.4
3	3	3	3	3	3	2					8	9	9	9	9	9	9	9	9	100	160.0
3	3	3	3	3	3	2					9	9	9	9	9	9	9	9	9	101	161.6
3	3	3	3	3	3	2				8	8	8	8	8	8	8	8	9	9	102	163.2
3	3	3	3	3	3	3				8	8	8	8	8	8	8	8	9	9	103	164.8
3	3	3	3	3	3	3				8	8	8	8	8	8	8	9	9	9	104	166.4
3	3	3	3	3	3	3				8	8	8	8	8	8	9	9	9	9	105	168.0
3	3	3	3	3	3	3				8	8	8	8	8	9	9	9	9	9	106	169.6

SPILL SCHEDULE FOR JUVENILE FISH AT JOHN DAY DAM
(2000-0500)

BAY NUMBER																				STOPS	KCFS
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20		
3	3	3	3	3	3	3				8	8	8	8	9	9	9	9	9	9	107	171.2
3	3	3	3	3	3	3	1			8	8	8	8	9	9	9	9	9	9	108	172.8
3	3	3	3	3	3	3	1			8	8	8	9	9	9	9	9	9	9	109	174.4
3	3	3	3	3	3	3	1			8	8	9	9	9	9	9	9	9	9	110	176.0
3	3	3	3	3	3	3	1			8	9	9	9	9	9	9	9	9	9	111	177.6
3	3	3	3	3	3	3	1			9	9	9	9	9	9	9	9	9	9	112	179.2
3	3	3	3	3	3	3	2			9	9	9	9	9	9	9	9	9	9	113	180.8
3	3	3	3	3	3	3	2		8	8	8	8	8	8	8	8	9	9	9	114	182.4
3	3	3	3	3	3	3	2		8	8	8	8	8	8	8	9	9	9	9	115	184.0
3	3	3	3	3	3	3	2		8	8	8	8	8	8	9	9	9	9	9	116	185.6
3	3	3	3	3	3	3	2		8	8	8	8	8	9	9	9	9	9	9	117	187.2
3	3	3	3	3	3	3	3		8	8	8	8	8	9	9	9	9	9	9	118	188.8
3	3	3	3	3	3	3	3		8	8	8	8	9	9	9	9	9	9	9	119	190.4
3	3	3	3	3	3	3	3		8	8	8	9	9	9	9	9	9	9	9	120	192.0
3	3	3	3	3	3	3	3		8	8	9	9	9	9	9	9	9	9	9	121	193.6
3	3	3	3	3	3	3	3		8	9	9	9	9	9	9	9	9	9	9	122	195.2
3	3	3	3	3	3	3	4		8	9	9	9	9	9	9	9	9	9	9	123	196.8
3	3	3	3	3	3	3	4		9	9	9	9	9	9	9	9	9	9	9	124	198.4
3	3	3	3	3	3	3	4	8	8	8	8	8	8	8	8	9	9	9	9	125	200.0
3	3	3	3	3	3	3	4	8	8	8	8	8	8	8	8	9	9	9	9	126	201.6
3	3	3	3	3	3	3	4	8	8	8	8	8	8	9	9	9	9	9	9	127	203.2
3	3	3	3	3	3	4	4	8	8	8	8	8	8	9	9	9	9	9	9	128	204.8
3	3	3	3	3	3	4	4	8	8	8	8	8	9	9	9	9	9	9	9	129	206.4
3	3	3	3	3	3	4	4	8	8	8	8	9	9	9	9	9	9	9	9	130	208.0
3	3	3	3	3	3	4	4	8	8	8	9	9	9	9	9	9	9	9	9	131	209.6

Spill bay openings are expressed in gate stops.

Use the same pattern trend for spill levels exceeding 210 kcfs (i.e. 80% at south bays, 20% at north bays).

SPILL SCHEDULE FOR ADULT FISH AT JOHN DAY DAM

(0500-2000)

BAY NUMBER																				STOPS	KCFS
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20		
1																				1	1.6
1																			1	2	3.2
1	1																		1	3	4.8
1	1																	1	1	4	6.4
1	1	1																1	1	5	8.0
1	1	1															1	1	1	6	9.6
1	1	1															2	1	1	7	11.2
1	2	1															2	1	1	8	12.8
1	2	1														1	2	1	1	9	14.4
1	2	2														1	2	1	1	10	16.0
1	2	2	1													1	2	1	1	11	17.6
1	2	2	1													2	2	1	1	12	19.2
1	2	2	2													2	2	1	1	13	20.8
1	2	2	2													2	2	2	1	14	22.4
1	2	2	2	1												2	2	2	1	15	24.0
1	2	2	2	2												2	2	2	1	16	25.6
1	2	2	2	2											1	2	2	2	1	17	27.2
1	2	2	2	2											2	2	2	2	1	18	28.8
1	2	2	2	2	1										2	2	2	2	1	19	30.4
1	2	2	2	2	2										2	2	2	2	1	20	32.0
1	2	2	2	2	2									1	2	2	2	2	1	21	33.6
1	2	2	2	2	2									2	2	2	2	2	1	22	35.2
1	2	2	2	2	2	1								2	2	2	2	2	1	23	36.8
1	2	2	2	2	2	2								2	2	2	2	2	1	24	38.4
1	2	2	2	2	2	2							1	2	2	2	2	2	1	25	40.0
1	2	2	2	2	2	2							2	2	2	2	2	2	1	26	41.6
1	2	2	2	2	2	2	1						2	2	2	2	2	2	1	27	43.2
1	2	2	2	2	2	2	2						2	2	2	2	2	2	1	28	44.8
1	2	2	2	2	2	2	2					1	2	2	2	2	2	2	1	29	46.4
1	2	2	2	2	2	2	2					2	2	2	2	2	2	2	1	30	48.0
1	2	2	2	2	2	2	2	1				2	2	2	2	2	2	2	1	31	49.6
1	2	2	2	2	2	2	2	2				2	2	2	2	2	2	2	1	32	51.2
1	2	2	2	2	2	2	2	2			1	2	2	2	2	2	2	2	1	33	52.8
1	2	2	2	2	2	2	2	2			2	2	2	2	2	2	2	2	1	34	54.4

SPILL SCHEDULE FOR ADULT FISH AT JOHN DAY DAM

(0500-2000)

BAY NUMBER																				STOPS	KCFS
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20		
1	2	2	2	2	2	2	2	2	1	*	2	2	2	2	2	2	2	2	1	35	56.0
1	2	2	2	2	2	2	2	2	2		2	2	2	2	2	2	2	2	1	36	57.6
1	2	2	2	2	2	2	2	2	2	1	2	2	2	2	2	2	2	2	1	37	59.2
1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	1	38	60.8
1	2	2	2	2	2	2	2	2	2	3	2	2	2	2	2	2	2	2	1	39	62.4
1	2	2	2	2	2	2	2	2	3	3	2	2	2	2	2	2	2	2	1	40	64.0
1	2	2	2	2	2	2	2	2	3	3	3	2	2	2	2	2	2	2	1	41	65.6
1	2	2	2	2	2	2	2	3	3	3	3	2	2	2	2	2	2	2	1	42	67.2
1	2	2	2	2	2	2	2	3	3	3	3	3	2	2	2	2	2	2	1	43	68.8
1	2	2	2	2	2	2	3	3	3	3	3	3	2	2	2	2	2	2	1	44	70.4
1	2	2	2	2	2	2	3	3	3	3	3	3	3	2	2	2	2	2	1	45	72.0
1	2	2	2	2	2	3	3	3	3	3	3	3	3	2	2	2	2	2	1	46	73.6
1	2	2	2	2	2	3	3	3	3	3	3	3	3	3	2	2	2	2	1	47	75.2
1	2	2	2	2	3	3	3	3	3	3	3	3	3	3	2	2	2	2	1	48	76.8
1	2	2	2	2	3	3	3	3	3	3	3	3	3	3	3	2	2	2	1	49	78.4
1	2	2	2	3	3	3	3	3	3	3	3	3	3	3	3	2	2	2	1	50	80.0
1	2	2	3	3	3	3	3	3	3	3	3	3	3	3	3	2	2	2	1	51	81.6
1	2	2	3	3	3	3	3	3	3	3	3	3	3	3	3	3	2	2	1	52	83.2
1	2	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	2	2	1	53	84.8
1	2	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	2	1	54	86.4
1	2	3	3	3	3	3	3	3	3	4	3	3	3	3	3	3	3	2	1	55	88.0
1	2	3	3	3	3	3	3	3	4	4	3	3	3	3	3	3	3	2	1	56	89.6
1	2	3	3	3	3	3	3	3	4	4	4	3	3	3	3	3	3	2	1	57	91.2
1	2	3	3	3	3	3	3	4	4	4	4	3	3	3	3	3	3	2	1	58	92.8
1	2	3	3	3	3	3	3	4	4	4	4	4	3	3	3	3	3	2	1	59	94.4
1	2	3	3	3	3	3	4	4	4	4	4	4	3	3	3	3	3	2	1	60	96.0
1	2	3	3	3	3	3	4	4	4	4	4	4	4	3	3	3	3	2	1	61	97.6
1	2	3	3	3	3	4	4	4	4	4	4	4	4	3	3	3	3	2	1	62	99.2
1	2	3	3	3	3	4	4	4	4	4	4	4	4	4	3	3	3	2	1	63	100.8
1	2	3	3	3	4	4	4	4	4	4	4	4	4	4	3	3	3	2	1	64	102.4
1	2	3	3	3	4	4	4	4	4	4	4	4	4	4	4	3	3	2	1	65	104.0
1	2	3	3	4	4	4	4	4	4	4	4	4	4	4	4	3	3	2	1	66	105.6
2	3	4	4	3	3	3	3	4	4	4	4	4	3	3	3	4	4	3	2	67	107.2
2	3	4	4	3	3	3	4	4	4	4	4	4	3	3	3	4	4	3	2	68	108.8

SPILL SCHEDULE FOR ADULT FISH AT JOHN DAY DAM
(0500-2000)

BAY NUMBER																				STOPS	KCFS
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20		
2	3	4	4	3	3	3	4	4	4	4	4	4	4	3	3	4	4	3	2	69	110.4
2	3	4	4	3	3	4	4	4	4	4	4	4	4	3	3	4	4	3	2	70	112.0
2	3	4	4	3	3	4	4	4	4	4	4	4	4	4	3	4	4	3	2	71	113.6
2	3	4	4	3	4	4	4	4	4	4	4	4	4	4	3	4	4	3	2	72	115.2
2	3	4	4	3	4	4	4	4	4	4	4	4	4	4	4	4	4	3	2	73	116.8
2	3	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	3	2	74	118.4
2	3	4	4	4	4	4	4	4	4	5	4	4	4	4	4	4	4	3	2	75	120.0
2	3	4	4	4	4	4	4	4	5	5	4	4	4	4	4	4	4	3	2	76	121.6
2	3	4	4	4	4	4	4	4	5	5	5	4	4	4	4	4	4	3	2	77	123.2
2	3	4	4	4	4	4	4	5	5	5	5	4	4	4	4	4	4	3	2	78	124.8
2	3	4	4	4	4	4	4	5	5	5	5	5	4	4	4	4	4	3	2	79	126.4
2	3	4	4	4	4	4	5	5	5	5	5	5	4	4	4	4	4	3	2	80	128.0
2	3	4	4	4	4	4	5	5	5	5	5	5	5	4	4	4	4	3	2	81	129.6
2	3	4	4	4	4	5	5	5	5	5	5	5	5	4	4	4	4	3	2	82	131.2
2	3	4	4	4	4	5	5	5	5	5	5	5	5	5	4	4	4	3	2	83	132.8
2	3	4	4	4	5	5	5	5	5	5	5	5	5	5	4	4	4	3	2	84	134.4
2	3	4	4	4	5	5	5	5	5	5	5	5	5	5	5	4	4	3	2	85	136.0
2	3	4	4	5	5	5	5	5	5	5	5	5	5	5	5	4	4	3	2	86	137.6
2	3	4	5	5	5	5	5	5	5	5	5	5	5	5	5	4	4	3	2	87	139.2
2	4	4	5	5	5	5	5	5	5	5	5	5	5	5	5	4	4	3	2	88	140.8
2	4	4	5	5	5	5	5	5	5	6	5	5	5	5	5	4	4	3	2	89	142.4
2	4	4	5	5	5	5	5	5	6	6	5	5	5	5	5	4	4	3	2	90	144.0
2	4	4	5	5	5	5	5	5	6	6	6	5	5	5	5	4	4	3	2	91	145.6
2	4	4	5	5	5	5	5	6	6	6	6	5	5	5	5	4	4	3	2	92	147.2
2	4	4	5	5	5	5	5	6	6	6	6	6	5	5	5	4	4	3	2	93	148.8
2	4	4	5	5	5	5	6	6	6	6	6	6	5	5	5	4	4	3	2	94	150.4
2	4	4	5	5	5	5	6	6	6	6	6	6	6	5	5	4	4	3	2	95	152.0
2	4	4	5	5	5	6	6	6	6	6	6	6	6	5	5	4	4	3	2	96	153.6
2	4	4	5	5	5	6	6	6	6	6	6	6	6	6	5	4	4	3	2	97	155.2
2	4	4	5	5	6	6	6	6	6	6	6	6	6	6	5	4	4	3	2	98	156.8
2	4	4	5	5	6	6	6	6	6	6	6	6	6	6	6	4	4	3	2	99	158.4
2	4	4	5	6	6	6	6	6	6	6	6	6	6	6	6	4	4	3	2	100	160.0
2	4	5	5	6	6	6	6	6	6	6	6	6	6	6	6	4	4	3	2	101	161.6
2	4	5	5	6	6	6	6	6	6	6	6	6	6	6	6	5	4	3	2	102	163.2

SPILL SCHEDULE FOR ADULT FISH AT JOHN DAY DAM

(0500-2000)

BAY NUMBER																				STOPS	KCFS
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20		
2	4	5	6	6	6	6	6	6	6	6	6	6	6	6	6	5	4	3	2	103	164.8
2	4	5	6	6	6	6	6	6	6	6	6	6	6	6	6	5	5	3	2	104	166.4
2	4	6	6	6	6	6	6	6	6	6	6	6	6	6	6	5	5	3	2	105	168.0
2	4	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	5	3	2	106	169.6
2	4	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	5	4	2	107	171.2
2	4	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	4	2	108	172.8
2	4	6	6	6	6	6	6	6	6	7	6	6	6	6	6	6	6	4	2	109	174.4
2	4	6	6	6	6	6	6	6	7	7	6	6	6	6	6	6	6	4	2	110	176.0
2	4	6	6	6	6	6	6	6	7	7	7	6	6	6	6	6	6	4	2	111	177.6
2	4	6	6	6	6	6	6	7	7	7	7	6	6	6	6	6	6	4	2	112	179.2
2	4	6	6	6	6	6	6	7	7	7	7	7	6	6	6	6	6	4	2	113	180.8
2	4	6	6	6	6	6	7	7	7	7	7	7	6	6	6	6	6	4	2	114	182.4
2	4	6	6	6	6	6	7	7	7	7	7	7	7	6	6	6	6	4	2	115	184.0
2	4	6	6	6	6	7	7	7	7	7	7	7	7	6	6	6	6	4	2	116	185.6
2	4	6	6	6	6	7	7	7	7	7	7	7	7	7	6	6	6	4	2	117	187.2
2	4	6	6	6	7	7	7	7	7	7	7	7	7	7	6	6	6	4	2	118	188.8
2	4	6	6	6	7	7	7	7	7	7	7	7	7	7	7	6	6	4	2	119	190.4
2	4	6	6	7	7	7	7	7	7	7	7	7	7	7	7	6	6	4	2	120	192.0
2	4	6	7	7	7	7	7	7	7	7	7	7	7	7	7	6	6	4	2	121	193.6
2	4	6	7	7	7	7	7	7	7	7	7	7	7	7	7	7	6	4	2	122	195.2
2	4	6	7	7	7	7	7	7	7	8	7	7	7	7	7	7	6	4	2	123	196.8
2	4	6	7	7	7	7	7	7	8	8	7	7	7	7	7	7	6	4	2	124	198.4
2	4	6	7	7	7	7	7	7	8	8	8	7	7	7	7	7	6	4	2	125	200.0
2	4	6	7	7	7	7	7	8	8	8	8	7	7	7	7	7	6	4	2	126	201.6
2	4	6	7	7	7	7	7	8	8	8	8	8	7	7	7	7	6	4	2	127	203.2
2	4	6	7	7	7	7	8	8	8	8	8	8	7	7	7	7	6	4	2	128	204.8
2	4	6	7	7	7	7	8	8	8	8	8	8	8	7	7	7	6	4	2	129	206.4
2	4	6	7	7	7	8	8	8	8	8	8	8	8	7	7	7	6	4	2	130	208.0
2	4	6	7	7	7	8	8	8	8	8	8	8	8	8	7	7	6	4	2	131	209.6
2	4	6	7	7	8	8	8	8	8	8	8	8	8	8	7	7	6	4	2	132	211.2
2	4	6	7	7	8	8	8	8	8	8	8	8	8	8	8	7	6	4	2	133	212.8
2	4	6	7	8	8	8	8	8	8	8	8	8	8	8	8	7	6	4	2	134	214.4
2	4	6	8	8	8	8	8	8	8	8	8	8	8	8	8	7	6	4	2	135	216.0
2	4	6	8	8	8	8	8	8	8	8	8	8	8	8	8	8	6	4	2	136	217.6

SPILL SCHEDULE FOR ADULT FISH AT JOHN DAY DAM

(0500-2000)

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

SPILL SCHEDULE FOR ADULT FISH AT JOHN DAY DAM
(0500-2000)

BAY NUMBER																				STOPS	KCFS
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20		
2	5	6	9	10	10	11	11	11	11	11	11	11	11	10	10	9	6	4	2	171	273.6
2	5	6	9	10	10	11	11	11	11	11	11	11	11	11	10	9	6	4	2	172	275.2
2	5	6	9	10	11	11	11	11	11	11	11	11	11	11	10	9	6	4	2	173	276.8
2	5	6	9	10	11	11	11	11	11	11	11	11	11	11	11	9	6	4	2	174	278.4
2	5	6	9	11	11	11	11	11	11	11	11	11	11	11	11	9	6	4	2	175	280.0
																				0	0.0

Continue as in rows above, opening from ends toward center, using 1 stop increments on innermost gate of gates 5 through 16 if necessary.

Gates 1, 2, 18, 19 and 20 limit at 9 stops.

3. **Juvenile Fish Passage Facilities**

a. **Operating Criteria**

(1) **Prior to Juvenile Fish Passage Season:**

(a) Remove debris from forebay, all trash racks, and gatewell slots, such that these areas are free of debris on 1 April.

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

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

(d) By 1 April, place STS in each intake of all operational units.

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

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

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

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

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

(j) Reinstall or repair avian predator control lines in present locations as soon as possible following damage or removal. Install and maintain new avian predator control lines in locations determined to be significantly impacted by avian predators. Implement other avian abatement measures as necessary in areas where avian lines are not practical. Install and test operate avian water cannon on the JBS outfall. Avian abatement measures shall be operable by 1 April.

(k) The results of all inspections and the readiness of the facility for operation will be verbally reported at the Corps' Fish Passage O&M Coordination Team meeting immediately prior to the start of the juvenile fish passage season.

(2) **Juvenile Fish Passage Season** (1 April through 15 December).

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

(b) Main units one through five will be raked every two weeks between 1 April and 1 July.

(c) Units six through ten or units eleven through sixteen will be alternately raked with units one through five (above) from 1 April through 1 July.

(d) If descaling is at least 5% higher in airlift sampled fish, arrangements will be made to remove the airlift for inspection and repair (guidance screens will also be inspected).

(e) NMFS will inspect the airlift sampler at least weekly or more frequently if sudden increases in descaling are noted.

(f) Debris accumulations in the forebay of 500 square feet or more will be removed within 48 hours. Efforts should continue until the debris load has been removed.

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

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

(i) Inspect each STS once per month and each VBS a minimum of once every two months (video is acceptable). VBS inspections will occur immediately prior to peaks in the juvenile fish migrations (mid-May and mid-July). Inspections will be concentrated on the priority units and those others with the longer operating time. More frequent inspections may be required under the following conditions: 1) deterioration of fish condition; 2) increased debris load in bypass system; and 3) other indications of STS or VBS malfunction or failure. Prior to pulling VBS' for inspections, shut off units and dip gatewells. If STS or VBS damage or plugging is detected, follow procedures in the following maintenance plan. Records of inspections or summary of such records will be made available to the FPC by 1 January. Screen inspections will not occur in main unit 1 until after 1200 hours. Main unit 2 will operate (within 1%, but not regulated by the 100 MW criteria) for the duration of the outage.

CBFWA recommends that VBS inspections be conducted once per month through the fish passage season.

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

(k) Inspect each STS watt meter readings at least once per shift. If an STS failure occurs follow procedures in the following maintenance plan.

(l) Inspect all STS gatewells daily. The project will clean before gatewell water surface becomes half covered with debris. If, due to the volume of debris, it is

not possible to keep the gatewell surfaces at least clear, they will be cleaned at least once daily. Turbines with a gatewell fully covered with debris will not be operated except to be in compliance with other coordinated fishery measures, and then only on a last on/first off basis. The powerhouse gatewell orifices will be closed during the debarking operation. After debarking a gatewell, cycle the orifice in that gatewell. Check gatewell drawdown.

CBFWA recommends that the gatewells be cleaned before they become half covered with debris.

(m) 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 consultation with FPC or NMFS. Regardless of unit operating status, oil accumulations will be dealt with promptly.

(n) Coordinate gatewell cleaning with personnel operating downstream migrant sampling facilities.

(o) STS operation cycling may begin when the mean length of the majority of juvenile chinook passing the project reaches or exceeds 112 mm. This time will be determined by the project biologist and coordinated with the Fish Passage Center (FPC) prior to implementation of cycling. A cycling time of a maximum 20 minutes off and a minimum of 2 minutes on must be followed. Cycling will be discontinued if warranted by fish condition or debris problems. STSs in intakes used for juvenile indexing will run continuously.

(p) 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. Maintain operation of the avian water cannon on the JBS outfall.

(q) Turbine units without full complements of STSs will not operate, except to be in compliance with other coordinated fishery measures.

CBFWA recommends no operation of partially or fully unscreened turbine units unless otherwise agreed.

(r) Inspect facilities twice each day, unless other guidance is provided elsewhere within this plan for specific facilities.

(3) 15 December through 31 March

(a) Remove all STSs.

(b) Dewater DSM channel (see Dewatering Plans, page JDA-28) only when required for maintenance. The period of maintenance will be minimized to the extent practicable.

(c) All units are available to meet power demands.

(d) Inspect facilities once per day.

4. Adult Fish Passage Facilities

b. Operating Criteria

(1) Prior to 1 March

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

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

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

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

(e) Repair or, when necessary, upgrade netting at top of both fish ladders to keep fish from leaping out of the ladders.

(f) The results of all inspections and the readiness of the facility for operation will be verbally reported at the Corps' Fish Passage O&M Coordination Team meeting immediately prior to the fish passage season.

(2) 1 March through 30 November (Adult Fish Passage Period).

(a) All Adult Facilities

i) Water depth over fish ladder weirs: 1.0' +/-0.1'. If shad passage becomes a problem, water depth should be increased to 1.3' +/- 0.1'.

ii) Measure water temperature within each ladder system and at associated forebay and tailwater locations daily to reveal if temperature variances exist between locations. Summaries of water temperature measurements will be included in weekly operation monitoring reports.

iii) Head on all entrances: 1.0 to 2.0 feet (prefer 1.5'). Refer to the maintenance plan in 4. b. (2) (a) vii) (p. JDA-22) when unable to achieve head criteria.

iv) A transportation velocity of 1.5 to 4.0 feet per second (prefer 2.0 fps) shall be maintained in all channels and the lower ends of the fish ladders which are below the tailwater.

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

vi) Staff gauges and water level indicators will be readable at all water levels encountered during the fish passage period.

vii) Main entrance weir depths: 8.0 feet or greater below tailwater. When possible, set gates at 8.5 feet of depth so that even with water fluctuation, the gates will more often exceed 8.0 feet. Weirs fully lowered when 8.0 feet of depth is not possible.

viii) Count station crowders shall remain in the operating position while visual counting and/or video taping is being conducted. If counting is temporarily discontinued due to unscheduled events, or the fishway is dewatered, the crowder shall be fully opened, except during the counters' hourly ten minute break period. Leave fish passage slot lighted overnight after counting ends each day.

ix) Inspect facilities twice each day.

x) Inspect and ensure that optimum passage conditions are maintained at fishway entrances and exits.

(b) North Fishway

i) Operate two downstream gates (EW-1 and EW-3). Use staff gauge nearest entrance weirs to calculate entrance head.

ii) Spill through bay 1 as follows: In the summer and fall (1 June through 31 October), spill 1800 cfs from 0400 - 2000 hours.

(c) South Fishway

i) Operate downstream gate SE-1. Use staff gauge in the Fish Pump Intake Stilling Basin for tailwater elevation, and staff gauge in the channel immediately upstream from gate SE-1 to calculate entrance head.

(d) Powerhouse

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

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

iii) Operate SE-1

iv) From 0400 - 2000 P.S.T., operate powerhouse turbine unit #1 near 100 megawatts (+/- 10MW) to facilitate best entrance conditions, unless additional load is required to: 1) meet the load requirements of the BPA administrator, whose load requests will be made in accordance with BPA's load shaping guidelines; 2) be in compliance with other coordinated fishery measures; or 3) avoid forcing an unscreened unit to operate to provide required load.

(3) 1 December through February (Winter Operating Period, or In-water Work Period).

(a) Adult Fish Facilities

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

ii) Only one of the two fish facilities may be out of service at a time unless specially coordinated. The other facility must be operated at full passage season criteria unless specially coordinated with the fishery agencies and tribes through the Corps' Fish Passage O&M Coordination Team. However, operation of unit 2 may be substituted for unit 1 without special coordination.

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

iv) Maximum of 0.5' head on attraction water intakes and trashracks at all ladder exits. Debris shall be removed when significant amounts accumulate.

v) Inspect the facilities once per day.

C. Fish Facilities Maintenance

1. General

a. Scheduled Maintenance

(1) Staff gauges will be installed, cleaned, and/or repaired as required.

(2) A zebra mussel monitoring program will continue. These organisms have become a serious problem elsewhere in the country and are expected to eventually be introduced into the Columbia.

(3) 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.

2. Juvenile Fish Passage Facilities

a. Scheduled Maintenance

(1) Submersible Traveling Screens. The STS system may receive preventive maintenance or repair anytime during the year including the winter maintenance period when all STSs may be removed from the intakes. 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. About one third of the STSs at John Day are scheduled for complete overhaul each year resulting in a three year maintenance cycle unless future developments indicate that a longer life expectancy is possible.

(2) Juvenile Bypass System. The John Day juvenile bypass facilities may receive preventive maintenance at all times of 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 system is dewatered downstream of the gatewell orifices. The system is then visually inspected in all accessible areas for damaged equipment and areas that may cause problems to the juvenile fish. Any problems identified are 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 channel are also completed at this time.

Main units one through five will be reaked every two weeks between 1 April and mid June. Units six through ten or units eleven through sixteen will be alternately raked with units one through five from 1 April to 1 July. If descaling is at least 5% higher in airlift sampled fish than in dip net sampled fish, arrangements will be made to remove the airlift for inspection and repair (guidance screens will also be inspected). NMFS will inspect the airlift sampler at least weekly, and more frequently if sudden increases in descaling are noted. It may be necessary to vary slightly from predetermined dip net sampling dates if emergency response is necessary due to high descaling levels in airlifted fish. Debris accumulations in the forebay of 500 square feet or more will be removed within 48 hours. Efforts should continue until the debris load has been completely removed. If debris loads are obvious in the forebay, trash will be raked in front of the affected units weekly until the debris load has been removed. Additional raking will occur whenever trash accumulations are suspected because of increased differential (1.5') across the trash racks, or as determined by the project biologist in reference to indicators such as increased juvenile fish descaling at the dam or increased accumulations of tumbleweeds in the forebay. The gatewell orifices must be closed during the raking process.

(3) **Turbines and Spillway.** The maintenance and routine repair of project turbines and spillways is a regular and recurring process which requires that units be shut down for up to two months (see Dewatering Plans). The maintenance schedules for these turbines and spillways will be coordinated through the Corps' Fish Passage O&M Coordination Team. Certain turbine and spillway discharges at the projects are secondarily used to attract adult fish to the area of fishway entrances, to keep predator fish from accumulating in the area of juvenile release sites and to move juveniles downstream away from the project. The maintenance schedules for these turbines and spillways will reflect equal weighting given to fish, power, and water management and will be coordinated with the appropriate fisheries agencies.

Some types of maintenance on turbines will result in the requirement to test operate the turbines throughout it's full range of capability before returning the turbine to normal service.

b. Unscheduled Maintenance

(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. Between 16 April and 31 August, and the six days following a juvenile fish release in the John Day pool or as determined by the project biologist based on juvenile salmon passage by John Day Dam, a crane crew will be taken off lower priority work or will work overtime to remove and replace (if spare available) a damaged or malfunctioning STS or VBS from any unit needed or likely to be needed for power within the next 48 hours. Crews will work overtime or on weekends as required.

(2) **Juvenile Bypass System.**

(a) John Day's juvenile bypass system is controlled by automatic systems. If the automatic system fails, it can usually be operated manually. This allows the facility to operate according to criteria while repair of the automatic system is completed. If the orifices become plugged with debris they are mechanically cleaned.

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

CBFWA recommends that the gatewells be cleaned before they become half covered with debris.

(c) If the bypass system fails in the powerhouse conduit, tainter gate, or transportation outfall making the system unsafe for fish, the decision to dewater for repairs will be made in coordination with the agencies on the Fish Passage O&M Coordination Team. During this emergency operating mode, power generation will be minimized to the extent practicable. If this operating mode is expected to last longer than four days, then all units required for generation will be sequentially shut down, fish salvaged from the gatewell, the STS removed, and the unit restarted. The orifice gates will be closed, then opened once each day to float any debris accumulating around the orifice.

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

(3) Turbines and Spillways.

(a) If a spill gate becomes inoperable, the operators will immediately notify the Operations supervisor and project biologist to determine the best pattern to follow until repairs can be made.

(b) Unit 2 will replace unit 1 for adult attraction, should unit 1 become inoperative.

3. Adult Passage Facilities

a. Scheduled Maintenance

(1) **Fishway Auxiliary Water Systems.** The John Day Dam has pump style auxiliary water systems. Preventive maintenance and normal repair are carried out throughout the year. Trashracks for the AWS intakes will be raked when drawdown exceeds criteria. When practicable, rake trashracks during the time of day when fish passage is least affected.

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

(2) **Powerhouse and Spillway Fish Collection Systems.** Preventive maintenance and repair occurs throughout the year. During the adult fish passage season this maintenance will not involve any operations which will cause a failure to comply with the adult fishway criteria unless specially coordinated with the fishery agencies and tribes through the Fish Passage Center representative on the Corps' Fish Passage O&M Coordination Team. Inspection of those parts of the adult collection channel systems which require dewatering such as diffusion gratings, picket leads, and entrance gates will be scheduled at least 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 Dewatering Plans). Inspection by 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. Any non-routine maintenance and fishway modifications will be handled on a case by case basis.

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

(3) Adult Fish Ladders and Counting Stations. The adult fish ladders will be dewatered once each year (unless specially coordinated) during the winter maintenance period (see Dewatering Plans). During this time the ladders are inspected for blocked orifices, projections into the fishway that may injure fish, stability of the weirs, damaged picket leads, exit gate problems, loose diffusion gratings, unreadable or damaged staff gauges, defective diffusion valves, and malfunctioning operating equipment at the counting stations. Potential problems identified throughout the passage year that do not impact fish passage, as well as those identified during the dewatered period, are then repaired. Trashracks at the ladder exits will be raked when criteria is exceeded. When practicable, rake trashracks during the time of day when fish passage is least affected. Fish count station windows will be cleaned when necessary, and when practicable, during the time of day when fish passage is least affected.

The netting installed on the ladders to prevent fish leaping will be inspected weekly and maintained when necessary. Summaries of inspections will be included in the weekly activity report.

b. Unscheduled maintenance

(1) Fishway Auxiliary Water Systems. The fishway auxiliary water systems are operated mostly automatically. If the automatic system fails, the system will be operated manually by project personnel. This will allow the fish facilty to operate according to criteria while the automatic system is repaired. If this operation becomes necessary, then project personnel will increase the surveillance of the adult system to ensure that criteria are being met.

(a) South Ladder. If one of the three auxiliary water turbines fails, assuming all three turbines are being used to meet criteria, bulkheads will be installed in the failed turbine discharge conduit and the output of the two remaining turbines will be increased to bring the fishway into agreement with the adult fishway criteria.

If a second turbine unit fails, bulkheads will be installed in the second failed turbine intake conduit, and the adult fish facility will be operated as follows until a fishway head of 1.0 foot is achieved.

1: Raise the north powerhouse entrances (NE-1, NE-2) in 1.0 foot increments to 6.0 feet of total depth below the tailwater surface.

2: Close NE-1.

3: Raise the south powerhouse entrance weir (SE-1) in 1.0 foot increments to 6.0 feet of depth below the tailwater surface.

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

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

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

1: SE-1 will be open with the weir crest 6.0 feet below the tailwater surface.

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

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

(b) **North Ladder.** This system can operate according to the adult fishway criteria under most conditions by using fewer than the six auxiliary water pumps. If one pump fails, one of the standby pumps will be started. This routine will be followed until the available pumps can no longer meet the adult fishway criteria. If this occurs, then EW-2 will be raised in 1.0 foot increments until a fishway head of 1.0 foot is met or until the weir crest reaches a depth of 6.0 feet below the tailwater surface. If this fishway criterion is still not met, EW-1 will be raised in 1.0 foot increments until that criterion is met or the weir crest reaches a depth of 6.0 feet below the tailwater surface. If the criterion is still not achieved, close EW-2 and the EW-1 weir will be maintained at the 8.0 foot level. If head of 1.0 is not met, then raise EW-1 in 1.0 foot increments until the weir crest reaches a depth of 6.0 feet below tailwater surface. Maintain in this condition until repairs reach a stage which allows more water to be added to the system. The weirs will then be opened in the reverse order in which they were closed.

(2) **Powerhouse and Spillway Fish Collection Systems.** The John Day Dam 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. 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 until expedient repairs are affected. If this is not possible, then the entrance will be repaired in an expedient manner (receive high priority) and the entrance will be brought back into manual or automatic control at the earliest possible time.

(3) **Adult Fish Ladders and Counting Stations.** The structures of the ladders include picket leads, counting stations, fishway exits, and overflow weirs with orifices. Pickets with excessive spacing (greater than 1"), erosion of concrete around the picket leads, or missing pickets can allow fish into areas where escape is not possible. In some instances of picket lead failure, there are spare picket leads and spare installation slots. 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 Corps' decision of whether or not to dewater the fishway and repair any problem will be made in coordination with the Fish Passage O&M Coordination Team, according to the described coordination procedures.

D. Turbine Unit Operation and Maintenance

1. The project's turbine unit maintenance schedules will be reviewed by project and district biologists for fishery impacts.

2. Guidelines for operation of the turbine units within 1% peak efficiency at various head ranges are as shown in Table V[1].

3. To the extent technically feasible, turbines will be operated within +/- 1% of peak turbine efficiency, unless operation outside of that range is necessary to: 1) meet load requirements of the BPA administrator, whose load requests will be consistent with BPA's System Load Shaping Guidelines; or 2) comply with other coordinated fishery measures. BPA's System Load Shaping Guidelines (appendix D) apply between 15 March and 31 October. However, during the rest of the year, the project will continue to operate units within the peak turbine efficiency range, except as specifically requested by BPA to do otherwise as power requirements demand.

CBFWA recommends operation of all units within 1% of peak turbine efficiency unless otherwise agreed. (These comments apply to the following item, also.)

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[1] Reference, CENPD-ET-HD.

JOHN DAY DAM PEAK TURBINE EFFICIENCY RANGES				
Head (ft)	Lower MW Limit	Lower Limit cfs	Upper MW Limit	Upper Limit cfs
85	80	12,966	137	22,317
86	81	12,966	140	22,441
87	81	12,797	141	22,331
88	82	12,796	142	22,239
89	83	12,793	144	22,151
90	84	12,790	145	22,067
91	84	12,651	146	21,982
92	85	12,653	149	22,106
93	87	12,657	150	22,023
94	88	12,666	151	21,943
95	89	12,677	152	21,866
96	89	12,563	154	21,793
97	90	12,577	155	21,724
98	91	12,588	155	21,478
99	92	12,589	155	21,237
100	92	12,481	155	21,024
101	93	12,486	155	20,816
102	94	12,489	155	20,588
103	95	12,492	155	20,365
104	95	12,390	155	20,146
105	96	12,390	155	20,146

4. Juvenile fish passage decreases through units from South to the North, making inefficient operation of unit 16 least likely to impact fish. Based on this, if it is necessary to select turbines to operate outside the peak efficiency range, they will be selected in sequence from North to South. However, allowance will also be given to special project requirements for stable voltage control which require load distribution between transformer banks.

E. Dewatering Plans

1. Detailed plans have been developed and must be adhered to for project facilities dewaterings. These plans include consideration for fish safety and are consistent with the following general guidance.

2. The project fish biologist or alternate Corps fisheries personnel will attend all project activities involving fish handling.

3. The fisheries agencies and tribes will be represented at all ladder dewaterings by the WDFW fish counting program supervisor or an alternate.

4. Adult Fish Ladder

a. Scheduled Maintenance

(1) When possible, operate ladder to be dewatered at reduced flow for at least 24 hours, but not more than 48 hours prior to dewatering. Reduced flow is defined as less than criterion operation, but more than orifice flow.

(2) Discontinue all fishway auxiliary water supply at least 24 hours, but no more than 48 hours prior to dewatering.

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

(4) Project personnel will install head gates to shut down ladder flow. Where possible, a flow of 1-2 inches will ber maintained in the ladder until fish are rescued.

(5) The project biologist or alternate Corps fisheries personnel will oversee fish rescue when the ladders are dewatered. The project biologist will invite fishery agency and/or Indian tribal biologists' participation in the dewatering. Rescue personnel will walk the inside of the ladder from the head gates down to tailwater salvaging all fish either by moving fish to tailwater within the ladder flow, or capturing and placing the fish in a large water filled tank, which is then transported to the forebay or tailwater, depending on the fish' lifestage (adults to forebay, juveniles to tailrace), for release.

b. Unscheduled Maintenance

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

(2) Follow steps (3) - (5) above.

5. Powerhouse Fish Collection System

a. Scheduled Maintenance

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

(2) The project biologist will assure that rescue equipment is available if needed.

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

6. Juvenile Bypass System

a. Scheduled Maintenance

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

7. Turbines

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

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

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

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

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

f. The project biologist will assure that rescue equipment is available if needed.

g. If the turbine unit is planned to be partially dewatered for less than 4 days and low numbers of fish are trapped, then removal of fish from draft tubes will not be necessary as long as an adequate "safety pool" is maintained. Adequate inspections will need to be conducted to endsure that the safety pool is maintained and fish are in good condition.

F. Endnotes

[1] Hydroacoustic Monitoring of Downstream Migrant Juvenile Salmonids at John Day Dam in 1983. R. Magne et.al., US COE research Report. 35 pp. plus appendices. (1987)

[2] Hydroacoustic Monitoring of Downstream Migrant Juvenile Salmonids at John Day Dam 1984-85. R. Magne et. al. , US COE Research Report. 29 pp. plus appendices. (1987)

[3] Hydroacoustic Evaluation of Juvenile Salmonid Fish Passage at John Day Dam in Summer 1986. Sue Kuehl, BioSonics, Inc. Final Report. Prepared for US COE under Contract No. DACW57-86-C-0088. 61 pp. plus appendices. (1987)

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

McNary Dam

McNary Dam

A. Fish Passage Information.

The locations of fish passage facilities are shown on the following general site plan for McNary Lock and Dam (Figure 9).

1. Juvenile Fish Passage.

a) Facilities Description. The juvenile facilities at McNary Dam consist of submersible traveling screens (STS), gatewell orifices, a concrete collection channel with emergency bypass outlets, primary and secondary dewatering structures, and a pipeline/corrugated metal flume for transporting juvenile fish to the transportation facilities or bypassing them back to the river. Juvenile transportation facilities at McNary include: a separator to sort juvenile fish by size and to separate them from adult fish; a flume system for distributing fish among the raceways; covered raceways for holding fish; sampling facilities; an office and sampling building with fish marking facilities; barge and truck loading facilities; and PIT tag detection and deflection systems. In 1996, extended length bar screens (ESBS) with flow vanes and improved modified balanced flow vertical barrier screens are being installed at McNary. Installation will take place throughout the passage season with completion by December, 1996. It is anticipated that up to 8 units will be equipped with extended screens for the spring juvenile fish migration and potentially 10 units for the summer migration.

b) Juvenile Migration Timing.

Table 23. Juvenile Migration Timing at McNary Dam.

% Past Project	1986	1987	1988	1989	1990	1991	1992
Yearling chinook							
10%	4/10	4/27	4/18	4/30	4/23	4/17	4/17
90%	5/26	5/19	5/22	5/23	5/23	6/6	5/28
Steelhead							
10%	4/29	5/1	4/30	5/2	4/29	5/1	5/2
90%	6/3	5/24	5/30	5/28	6/2	5/27	6/13
Sub-yearling chinook							
10%	6/8	6/20	6/15	6/16	6/14	6/24	6/19
90%	8/1	7/15	7/18	7/18	7/20	7/31	7/16
Sockeye							
10%	5/1	5/7	5/4	4/30	4/28	5/8	5/1
90%	6/6	5/31	5/26	5/27	6/3	5/29	5/25

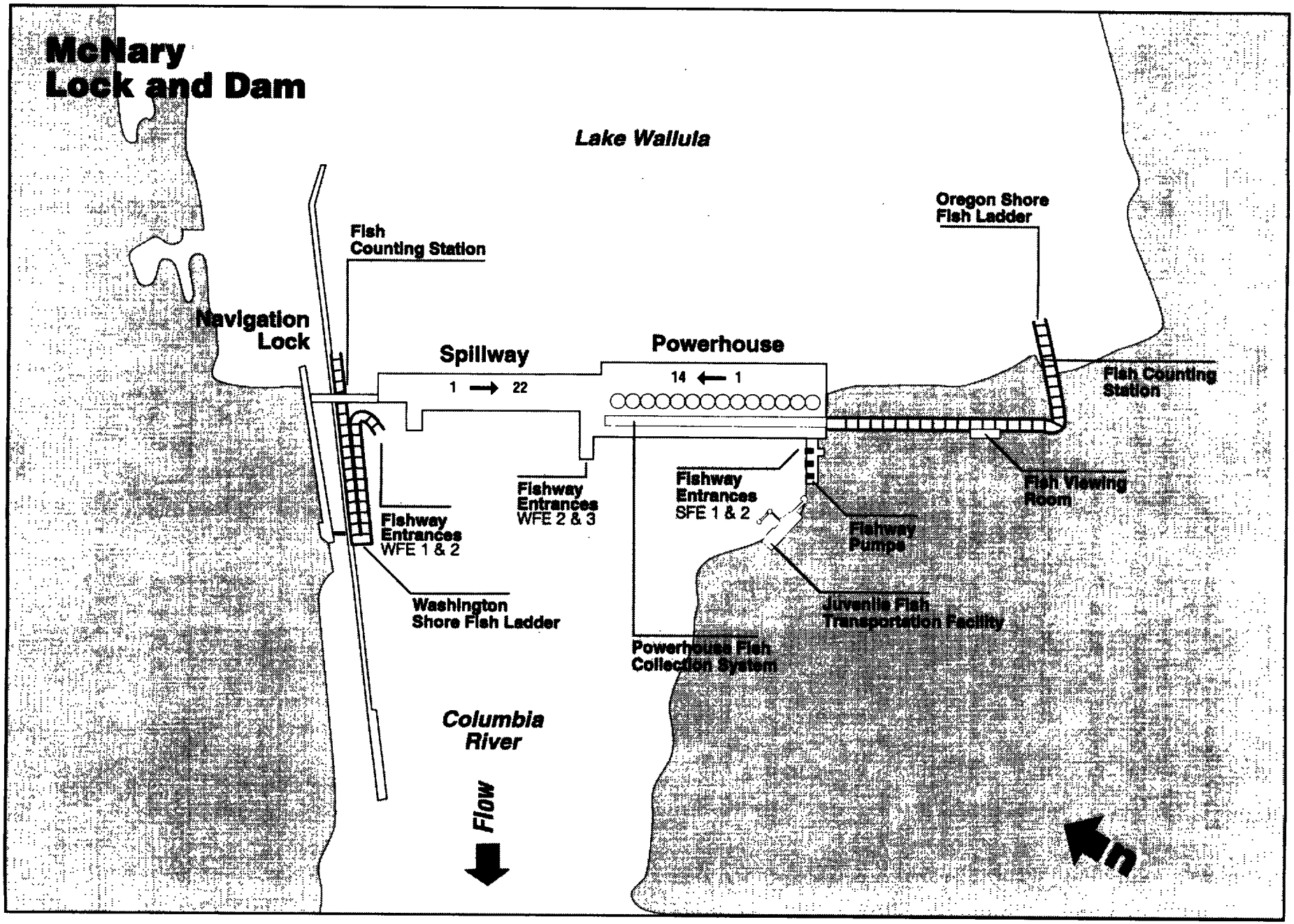


Figure 9 McNary Lock and Dam General Site Plan

2. Adult Fish Passage.

a) Facilities Description. The adult fish passage facilities at McNary consist of separate north and south shore facilities. The north shore facilities are made up of a fish ladder with counting station, a small collection system, and a gravity-flow auxiliary water supply system. The collection system has three downstream entrances and a side entrance into the spillway basin. Two of the downstream entrances are used during normal operation. The gravity-flow auxiliary water supply system takes water from the forebay through 2 conduits and distributes it through diffusers at the bottom of the ladder and in the transportation channel. The south shore facilities are comprised of a fish ladder with counting station, two south shore entrances, a powerhouse collection system, and gravity and pumped auxiliary water supply systems. The powerhouse collection system contains three downstream and one side entrance into the spillway basin at the north end of the powerhouse, twelve floating orifices located across the powerhouse, and a common transportation channel for all of the entrances. At the north end of the powerhouse, two of the downstream entrances are used during normal operation with the other downstream and side entrances closed. The gravity-flow auxiliary water is provided by one conduit from the forebay and supplies the diffusers at the bottom of the ladder at tailwater level. The pumped auxiliary water is supplied by three electric pumps with variable-pitched blades. Two pumps are capable of providing the required flow when the third pump is bulkheaded to prevent water from flowing back through the pump to the river. The electric pumps supply the auxiliary water for the diffusers at the entrances and in the transportation channel. Excess water from the primary dewatering structure in the juvenile fish collection channel is routed to the adult collection system at the north end of the powerhouse.

b) Adult Migration Timing. Upstream migrants are present at McNary Dam year round. Maintenance of upstream passage facilities is scheduled for January through February to minimize impacts on upstream migrants. Table 24 shows primary passage periods by species and the earliest and latest dates of peak passage on record, from fish count data compiled by the Corps of Engineers. Adult fish are normally counted 16-hours per day (0400 through 2000 Pacific Standard Time) from April 1 through October 31.

Table 24. Adult Migration Timing from Fish Counts 1954-1992.

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

B. Project Operation.

1. Spill Management. Spill at McNary is the result of river flow exceeding powerhouse capacity or the failure of a key component of the juvenile fish passage facility which forces the project to spill to provide juvenile fish passage. Spill at McNary shall be distributed in accordance with the adult fish passage spill pattern included at the end of this section, Table 25. Special spills for juvenile fish passage may be provided as detailed in Appendix B (Special Project Operations and Research).

2. Dissolved Gas Management and Control. Dissolved gasses at McNary are monitored in accordance with the Dissolved Gas Monitoring Program, Appendix E. Total dissolved gas monitoring in the McNary forebay is at two locations: at the navigation lock on the north shore to monitor the mid-Columbia arm of the McNary pool; and on the south end of the powerhouse to monitor Snake River inflow. The McNary north and south shore stations have been automated wherein data are transmitted via satellite. Total dissolved gas levels will be reported every four hours from April 1 through September 30. Total dissolved gas levels will also be monitored in the McNary tailrace. Related data collected at the same time for McNary Project will be spill volume and total project flow. Implementation of requests for spill at McNary will be based in part upon dissolved gas monitoring data and the observed condition of migrant juveniles and adults, along with juvenile migrant monitoring data. Requests for spill will be coordinated through the Technical Management Team.

3. Operating Criteria

a) Juvenile Fish Passage Facilities: April 1 to December 15 operate according to criteria listed below and in Appendix C (Corps Juvenile Fish Transportation Program Operating Criteria) for the bypassing, collection, and transportation of juvenile salmonids. The transportation program may be revised in accordance with the ESA Section 10 permit and NMFS's biological opinion. In late November and December adverse weather may cause

ice to form in parts of the juvenile bypass system. If this happens, the McNary Project Manager will make the decision on when the juvenile bypass system must be unwatered to protect the integrity of the system or for personnel safety. Bad road conditions between McNary Dam and Bonneville Dam may also halt the juvenile fish transportation program prior to its scheduled completion date. National Marine Fisheries Service will be consulted prior to the unwatering of the bypass system.

1) Prior to April 1 each year:

a> Forebay Area and Intakes:

1> Remove debris from forebay and trash racks.

2> Rake trash racks.

3> Remove debris from gatewell slots.

4> Measure and log drawdown in gatewell slots.

b> Submersible Traveling Screens (STS), Extended Length Bar Screens (ESBS), Flow Vanes, and Vertical Barrier Screens (VBS):

1> Maintenance completed on all STS's and ESBS's.

2> Inspect STS's for good running order and operate one trial run (dogged off at deck level).

3> Inspect ESBS's for good running order and operate debris cleaner one trial run (dogged off at deck level).

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

5. Inspect VBS's once per year.

c> Collection Channel:

1> Orifice lights operational.

2> Orifices clean and operational.

4> Orifice valves operational.

5> Orifice air backflush system operational.

d> Dewatering Structure and Flume:

1> Inclined and side dewatering screens clean and in good condition with no holes.

2> Cleaning brush systems maintained and operational.

3> All valves in good operating order.

4> Flume and pipe smooth with no rough edges.

e> Transportation Facilities:

1> Flume switch gate maintained and operational.

2> Flume smooth with no rough edges.

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

4> Check wet separator and fish distribution system for operation as designed.

5> Brushes on crowders in good order.

6> Crowders operate properly.

7> All valves, slide gates, and switch gates in good operating order.

8> Retainer screens in place with no holes or sharp wires protruding.

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

10> Barge loading boom maintained and tested.

11> All sampling equipment maintained and operable.

e> Powerhouse Tailrace Area:

Bird wires in place and in good repair.

f> Fish Transport Trailers:

1> All systems operate properly.

2> No leaks around air stone fittings.

3> Plugs in end of air stones.

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

5> Each trailer carries two 5-inch hoses and necessary 5-inch "Kamlock" caps.

6> All valves operating properly.

7> Overall condition of trailer in good shape including hatch covers, release gates, and oxygen manifold system.

g> Maintenance Records:

Record all maintenance and inspections.

2) April 1 - December 15:

a> Forebay Area and Intakes:

1> Remove debris from forebay.

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

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

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

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

6> Inspect vertical barrier screens once per year. Repair as needed.

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

b> Submersible Traveling Screens (STS), Extended Length Bar Screens (ESBS), Flow Vanes, and Vertical Barrier Screens (VBS):

1> Operate STS's in continuous mode when the average fork length of chinook salmon in the daily sample is less than 112 mm, or when a sudden decline in fish condition warrants continuous operation. Cycling may resume when fish size exceeds the specified fork length and fish condition is at an acceptable level.

2> Operate ESBS's with flow vanes attached to screen.

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

2> Inspect STS's and ESBS's in at least 3 operating turbine units per week. Develop inspection procedures for ESBS's. ESBS inspection procedures will be coordinated through FPOM.

3> Conduct additional STS and ESBS inspections if fish condition warrants it.

4> Record STS amp readings daily.

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

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

8> Inspect a VBS between the spring and summer migration periods. If a debris accummulation is noted, inspect other VBS's and clean debris as necessary.

c> Collection Gallery:

1> Operate at least one orifice per gate slot (preferably the south orifice). If orifices must be closed to repair any part of the facility, do not close orifices in operating turbine units with ESBS's in place for longer than 10 hours. Monitor fish condition in gatewells during orifice closure.

2> Orifices clean and operating.

3> Orifice lights operating on open orifices.

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

5> Orifice valve either full open or closed.

6> Backflush orifices once per day. During periods of high debris, orifices may need to be backflushed several times per day.

d> Dewatering Structure:

1> No holes in side and inclined screens.

2> Trash sweeps operating correctly.

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

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

e> Transportation Facilities:

1> No holes in screens.

2> Crowder screen brushes in good operating condition.

3> Retainer screens in raceway clean with no holes or protruding wires.

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

5> Truck and barge loading facilities in good operating condition.

f> Facility Inspections:

Inspect all facilities according to fish facilities monitoring plan. Record all inspections.

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

1) Prior to March 1:

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

b> Dewater all ladders and inspect all dewatered sections of fish facilities for projections, debris, or plugged orifices which could injure fish or impede fish passage up the ladder. Inspect all diffuser gratings and chambers either visually or by video according to CENPW-OP-TF approved inspection program. Repair deficiencies.

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

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

e> Inspect all spillgates and ensure that they are operable.

2) March 1 through December 31 (Adult Fish Passage Period):

a> Fishway Ladders:

Water depth over weirs: 1.0 to 1.3 feet

b> Head on all Entrances:

Head range: 1.0 to 2.0 feet

c> Collection Channel Transportation Velocity:

1.5 to 4 feet per second.

d> North Shore Entrances (WFE 1 & 2):

1> Operate 2 downstream gates

2> Weir depth: 8.0 feet or greater below tailwater.

e> North Powerhouse Entrances (NFE 2 & 3):

1> Operate 2 downstream gates.

2> Weir depth: 9.0 feet or greater below tailwater.

f> Powerhouse Collection System Floating Orifices:

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

g> South Shore Entrances (SFE 1 & 2):

1> Operate 2 entrances.

2> Weir depth: 9.0 feet or greater below tailwater.

h> Head on Trashracks:

1> Maximum head of 0.5 feet on ladder exits

2> Maximum head on picketed leads shall be 0.5 feet. Normal head differential on clean leads is 0.3 feet.

i> Staff Gauges and Water Level Indicators:

Shall be readable at all water levels encountered during the fish passage period.

j> Facility Inspections:

1> Powerhouse operators shall inspect facilities once per day.

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

3> Project personnel shall check calibration of fishway control system twice per month to ensure that it is kept within calibration. This may be done as part of routine fishway inspections.

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

5> Record all inspections.

c> Facility monitoring and reporting: Project biologists shall inspect fish passage facilities at the frequencies listed in the juvenile and adult fish facilities operating criteria sections. Project biologists shall prepare weekly reports, from March 1 through December 31, summarizing project operations. The weekly reports should provide an overview of how the project and the fish passage facilities operated during the week and an evaluation of resulting fish passage conditions. The reports shall include: any out of criteria situations observed and subsequent corrective actions taken; any equipment malfunctions, breakdowns, or damage along with a summary of resulting repair activities; adult fishway control calibrations; ESBS, STS, and VBS inspections; and any unusual activities which occurred at the project which may effect fish passage. The weekly reports shall cover a Friday through Thursday time period and shall be sent to CENPW-OP-TF by noon the following Monday via electronic mail. Project biologist shall prepare a draft annual report by February 10 and a final report by March 15 summarizing the operation of the project fish passage facilities for the previous year.

C. Project Maintenance.

Project biologists should be present to provide technical guidance at all project activities which may involve fish handling. All dewaterings shall be accomplished in accordance with approved project dewatering plans.

1. Juvenile Fish Passage Facilities.

a) Scheduled Maintenance: Scheduled maintenance of the juvenile facilities is conducted during the entire year. Long-term maintenance or modification of facilities which require them to be out of service for extended periods of time are conducted during the winter maintenance period from December 16 to March 31. During the fish passage season, parts of the facilities are maintained on a daily, weekly, or longer interval to keep them in proper operating condition.

b) Unscheduled Maintenance: Unscheduled maintenance is the correction of any situation which prevents the facilities from operating according to criteria or which will impact fish passage and/or survival. Maintenance of facilities such as traveling screens, which sometimes break down during the fish passage season, will be carried out as described below. Unscheduled maintenance which will have a significant impact on

juvenile fish passage shall be coordinated with the CBFWA (through the FPC) and NMFS on a case-by-case basis by CENPW-OP-TF. CENPW-OP-TF will be notified as soon as possible after it becomes apparent that maintenance repairs are required. The Project Manager has the authority to initiate work prior to notifying CENPW-OP-TF when in his opinion delay of the work will result in an unsafe situation for people, property, or fish. Information required by CENPW-OP-TF includes:

1. Description of the problem.

2. Type of outage required.

3. Impact on facility operation.

4. Length of time for repairs.

5. Expected impacts on fish passage.

1) Traveling screens and extended-length bar screens: Screens are inspected periodically throughout the juvenile migration season with a video monitoring system. If a screen is found to be damaged it will be removed and either replaced with the spare a STS or ESBS (whichever is required) or repaired and returned to service. A turbine unit shall not be operated with a known damaged or nonfunctioning STS, ESBS, or VBS, or without a full compliment of STS's, ESBS's and flow vanes, and VBS's. If a screen fails on a weekend or at night when maintenance crews are not available, the respective turbine unit will be shut down and generation switched to another, fully screened unit. If all screened turbine units are in service, water may be spilled until the affected screen can be removed and repaired or replaced.

2) Gatewell orifices: Each gatewell has two orifices with valves to allow fish to exit the gatewell. Under normal operation, one orifice per gatewell is operated. If an orifice becomes blocked with debris or is damaged, it will be closed and the alternate orifice for that gatewell operated until repairs can be made. If both orifices are blocked with debris or damaged, the turbine unit will be taken out of service until repairs can be made. If there is a major failure with the bypass system which prevents the gatewell orifices from operating, traveling screens and bar screens will remain in operation. Turbine units with bar screens in place shall not be operated with blocked or closed orifices for longer than 10 hours. During any orifice closure, gatewells shall be monitored by project personnel for signs of fish problems or mortality. If repairs are expected to take longer than two days, a salvage program will be initiated to dip the juveniles from the gatewells with a gatewell basket until repairs are made and the system watered up again or orifices opened. Juvenile fish shall not remain in gatewells longer than 48 hours. During periods of high fish

passage, it may be necessary to cease operation of turbine units with ESBS's in place and with closed orifices in less than 10 hours, depending on fish numbers and condition. Spill may occur to provide an alternate avenue for fish passage furing facility outages.

3) Dewatering Structure: The dewatering structure acts as a transition from the collection channel to the bypass pipe/flume. An inclined screen and a side dewatering screen allow excess water to be bled off, with all fish and remaining water transitioning into the bypass pipe. The excess water is discharged into the adult fish facility auxiliary water supply system and is used as the water supply for the transportation facilities. The dewatering structure contains trash sweeps for cleaning the dewatering screens of impinged debris. If a trash sweep breaks and interferes with juvenile fish passage through the structure or if a screen is damaged, an emergency bypass system in the collection channel may be used to bypass juveniles while repairs are made. Operation of the emergency bypass system requires the juvenile bypass system to be unwatered and stoplogs inserted at the upstream end of the inclined screen. The emergency bypass is then opened and the bypass system operated with one orifice per gatewell open. Spill may also be required to bypass juvenile fish while in emergency bypass operations.

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

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

2. Adult Fish Passage Facilities.

a) Scheduled Maintenance: Scheduled maintenance of a facility which must be unwatered to work on or whose maintenance will have a significant effect on fish passage will be done during the winter maintenance period from January 1 to March 1. Maintenance of facilities which will not effect fish passage may be conducted during the rest of the year. Maintenance is

normally conducted on one fish ladder at a time during the winter to provide some fish passage at the project at all times. When facilities are not being maintained during the winter maintenance period, they will be operated according to the normal operating criteria, unless otherwise coordinated with the fishery agencies and tribes.

b) Unscheduled Maintenance: Unscheduled maintenance which will significantly affect the operation of a facility will be coordinated with the CBFWA (through the FPC) and NMFS. Coordination procedures for unscheduled maintenance of adult facilities are the same as for juvenile facilities. If part of a facility malfunctions or is damaged during the fish passage season and the facility can still be operated within criteria without any detrimental effects on fish passage, repairs may not be conducted until the winter maintenance period or until fewer numbers of fish are passing the project so there will be less impact of it being unwatered or taken out of service. If part of a facility is damaged or malfunctions that may significantly impact fish passage, it will be repaired as soon as possible.

1) Fish Ladders and Counting Stations. The fish ladders contain tilting weirs, fixed weirs, counting stations with picketed leads, and fish exits with trash racks. If any part of the fish ladder fails or is blocked with debris during the fish passage season, efforts will first be made to correct it without unwatering the ladder. Trash racks, picketed leads, tilting weir mechanisms, and counting stations can sometimes be repaired or maintained without unwatering the ladder. The decision on whether to unwater the ladder and make repairs during the fish passage season or wait until the winter maintenance period will be made after consultation with the fishery agencies and tribes.

2) North Shore Auxiliary Water Supply System: During normal operation, conduits 1 and 4 are operated along with entrance weirs WFE2 and WFE3. Conduit #4 feeds diffusers 1 through 4 and conduit #1 feeds diffusers 5 through 12. Each diffuser has two or more rotovalves which control the amount of water going into a diffuser. If a rotovalve fails, the closest rotovalve that is closed will be opened to provide the required flow. If more rotovalves fail than there are closed valves and it is not possible to operate the entrances within criteria, WFE2 weircrest will be raised at one-foot increments to maintain the required 1.0 to 2.0 head differential. If this is not possible by the time the weir reaches 4 feet below tailwater, the entrance will be closed. If one conduit fails, WFE2 will be closed and WFE3 will be operated as deep as possible to maintain the 1.0 to 2.0 feet head differential. If it is not possible to maintain the head differential at a depth of 6 feet or greater, the weir will be maintained at 6 feet regardless of the head. If both conduits fail, WFE2 will be closed and WFE3 operated at a depth of 6 feet until repairs can be made.

3) South Shore Auxiliary Water Supply System: The south shore auxiliary water is made up of a combination of gravity flow from the forebay and pumped water from the tailrace. The gravity flow supplies the diffusers above weir 253 (diffusers 7 through 14) and the pumps supply the diffusers below weir 253 (diffusers 1 through 7 and the main unit diffusers). Diffuser 7 is where both systems meet and is supplied by either gravity flow or pumped flow. The gravity flow diffusers are regulated by rotovalves and the pumped flow diffusers by sluicegates. If a rotovalve fails, the nearest closed rotovalve will be opened to supply the flow. If more rotovalves fail than there are closed valves the sluicegates in diffusers 3 through 7 will be opened more to provide the required transportation flows. If any sluicegates fail, the sluicegates nearest it will be opened further to make up the water. If one pump fails, the other two pumps will be operated to maintain the facilities within criteria. If two pumps fail, SFE2 and NFE3 will be closed and SFE1 and NFE2 will be operated as deep as possible to maintain the 1.0 to 2.0-foot head differential. If all three pumps fail, the powerhouse transportation channel will be bulkheaded off at the junction pool and SFE1 and SFE2 operated a deep as possible and to maintain the 1.0 to 2.0-foot head differential. If a depth of 6 feet on both gates cannot be maintained, SFE2 will be closed. If the gravity flow and pumped auxiliary water supply systems both fail, the powerhouse transportation channel will be bulkheaded off at the junction pool, SFE2 closed, and SFE1 operated at 6 feet below tailwater until repairs can be made.

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

D. Turbine Unit Operation and Maintenance.

1. Turbine Unit Operation. When in operation, turbine units will be operated to enhance adult and juvenile fish passage from March 1 through November 30. During this time period, turbine units will be operated (as needed to meet generation requirements) in the following order: 1, 2, 3 through 10 (in any order), and then 11 through 14 (in any order) when units are available for operation. Unit operating priority may be coordinated differently to allow for fish research, construction, or project maintenance activities. If the project is bypassing juvenile fish back to the river through the juvenile release pipe, turbine units 1 through 4 shall be operated first (if available for operation) to provide flows at the outfall. During the summer, turbine operating priority should change to north powerhouse loading if warm water temperatures result in increased juvenile fish mortality or if project temperature monitoring indicates a temperature gradient exists across the powerhouse. Under north powerhouse loading, turbine units shall be loaded consecutively from unit 14 back through unit 8. Starting and stopping of units should be avoided if possible. If more generation is required, additional units will be operated in consecutive order from the north to south end of the powerhouse.

To the extent technically feasible, turbine units will be operated within 1% of peak efficiency from March 15 through November 30 (or as specified in BPA's load shaping guidelines) unless operation outside of that range is necessary to: 1) meet the load requirements of the BPA Administrator whose load requests will be made in accordance with BPA's policy, statutory requirements, and load shaping guidelines (Appendix D); or 2) be in compliance with other coordinated fishery measures. Project personnel shall record when turbine units are operated outside the 1% peak efficiency range and shall provide the information to BPA on a weekly basis according to the load shaping guidelines. Between December 1 and March 15, turbine units will continue to be operated within the 1% peak efficiency range except when BPA load requests require the units to be operated outside the 1% range.

Guidelines for operation of the turbine units within 1% of peak efficiency at various head ranges are as follows:

Head Feet	Lower Generator Limits (MW)	Lower Generator Limits (CFS)	Upper Generator Limits (MW)	Upper Generator Limits (CFS)
67	38	8,019	59	12,484
68	38	7,999	60	12,399
69	39	7,980	62	12,314
70	39	7,960	63	12,229
71	40	7,940	64	12,144
72	41	7,916	65	12,287
73	41	7,893	67	12,430
74	41	7,869	68	12,574
75	42	7,846	69	12,717
76	42	7,822	71	12,860
77	43	7,731	72	12,939
78	44	7,640	73	13,018
79	44	7,549	74	13,096
80	45	7,458	75	13,175
81	45	7,548	77	13,250
82	46	7,639	79	13,326
83	46	7,729	81	13,401

[The CBFWA recommends that turbine units be operated within 1% of peak efficiency unless otherwise agreed.]

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

Table 25. McNary Dam Spill Pattern for Adult Fish Passage.

Discharges in KCFS at Forebay Elevation 339

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

_ Means open this gate first.

Table 25 (Continued). McNary Dam Spill Pattern for Adult Fish Passage.

KCFS Spill	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	Total Stops
112.6	4	5	2	2	3	3	3	3	3	4	4	3	3	4	4	3	3	3	2	2	5	68
114.2	4	5	2	2	3	3	3	3	3	4	4	3	3	4	4	3	3	3	3	2	5	69
117.6	4	5	2	2	3	3	3	3	4	4	4	3	3	4	4	4	3	3	3	2	5	71
121.0	4	5	2	2	3	3	3	3	4	4	4	3	4	4	4	4	4	3	3	2	5	73
123.1	4	5	2	2	3	3	3	3	4	4	4	3	4	4	4	4	4	3	3	3	6	75
126.5	4	5	2	2	3	3	3	3	4	4	4	4	4	4	4	4	4	3	4	3	6	77
129.2	5	5	2	3	3	3	3	3	4	4	4	4	4	4	4	4	4	3	4	3	6	79
130.9	5	5	2	3	3	3	3	4	4	4	4	4	4	4	4	4	4	3	4	3	6	80
133.0	5	6	2	3	3	3	3	4	4	4	4	4	4	4	4	4	4	3	4	4	6	82
136.3	5	6	3	3	3	4	3	4	4	4	4	4	4	4	4	4	4	3	4	4	6	84
139.0	6	6	3	4	3	4	3	4	4	4	4	4	4	4	4	4	4	3	4	4	6	86
142.2	6	6	3	4	3	4	3	4	4	4	5	4	5	4	4	4	4	3	4	4	6	88
144.4	6	7	3	4	3	4	3	4	4	4	5	4	5	4	4	4	4	3	4	4	7	90
147.7	6	7	3	4	3	4	4	4	4	4	5	4	5	5	4	4	4	3	4	4	7	92
148.8	7	7	3	4	3	4	4	4	4	4	5	4	5	5	4	4	4	3	4	4	7	93
152.0	7	7	3	4	3	4	4	5	4	4	5	4	5	5	5	4	4	3	4	4	7	95
155.2	7	7	3	4	3	4	4	5	4	5	5	5	5	5	5	4	4	3	4	4	7	97
158.6	7	7	4	4	3	4	4	5	4	5	5	5	5	5	5	4	4	4	4	4	7	99
161.3	7	8	4	4	3	4	4	5	4	5	5	5	6	5	5	4	4	4	4	4	7	101
164.5	7	8	4	4	3	4	4	5	5	5	5	5	6	5	5	4	5	4	4	4	7	103
167.9	7	8	4	4	4	4	4	5	5	5	6	5	6	5	5	4	5	4	4	4	7	105
171.2	7	8	4	4	4	5	4	5	5	5	6	6	6	5	5	4	5	4	4	4	7	108
173.9	8	8	4	4	4	5	4	5	5	6	6	6	6	5	5	4	5	4	4	4	7	109
177.3	8	8	4	4	4	5	4	5	6	6	6	6	6	6	5	4	5	4	4	4	7	111
179.9	8	8	4	4	4	5	4	5	6	6	6	7	6	6	5	4	5	4	4	4	8	113
183.1	8	8	4	4	4	5	4	5	6	6	7	7	7	6	5	4	5	4	4	4	8	115
186.3	8	8	4	4	4	5	5	5	6	6	7	7	7	6	5	5	5	4	4	4	8	117
189.6	8	8	4	4	4	5	5	5	6	7	7	7	7	6	6	5	5	4	4	4	8	119
192.2	8	9	4	4	4	5	5	6	6	7	7	7	7	6	6	5	5	4	4	4	8	121
195.4	8	9	4	4	4	5	5	6	7	7	7	8	7	6	6	5	5	4	4	4	8	123
198.6	8	9	4	5	4	5	5	6	7	7	7	8	7	6	6	5	5	4	5	4	8	125
198.5	9	9	4	5	4	5	5	6	7	7	7	8	7	6	6	5	5	4	5	4	8	126
222.4	9	10	4	5	5	6	5	6	7	8	8	9	9	9	7	6	5	5	5	4	9	141
247.6	10	11	5	6	5	6	6	6	7	8	9	10	10	10	9	8	6	5	6	5	10	158

_ Means open this gate first.

Ice Harbor Dam

Ice Harbor Dam

A. Fish Passage Information.

The locations of fish passage facilities are shown on the following general site plan for Ice Harbor Lock and Dam (Figure 10).

1. Juvenile Fish Passage.

a) Facilities Description. The juvenile fish passage facilities at Ice Harbor consist of standard length STS's, vertical barrier screens, 12-inch orifices, collection channel and dewatering structure, sampling facilities, and transportation flume/pipe to the tailrace below the project.

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

2. Adult fish Passage.

a) Facilities Description. The adult fish passage facilities at Ice Harbor are made up of separate north and south shore facilities. The north shore facilities include a fish ladder with counting station, a small collection system, and a pumped auxiliary water supply system. The collection system includes two downstream entrances and one side entrance into the spillway basin. In normal operation one downstream entrance is used and the other two entrances are closed. The auxiliary water is supplied by three electric pumps with all three pumps normally operated. The south shore facilities are comprised of a fish ladder with counting station, two south shore entrances, a powerhouse collection system, and a pumped auxiliary water supply system. The powerhouse collection system includes two downstream entrances and one side entrance into the spillway basin at the north end of the powerhouse, twelve floating orifices, and a common transportation channel. One of the downstream north powerhouse entrances and seven of the floating orifices are used during normal operation. At the south shore entrances, one entrance is normally used. The auxiliary water is supplied by eight electric pumps of which from six to eight are normally used to provide the required flows. The excess water from the juvenile fish passage facilities is routed into the fish discharge chamber to provide additional attraction flow.

b) Adult Migration Timing. Migrants are present at Ice Harbor year around. The maintenance of adult passage facilities is scheduled for the period of January through February to minimize impact on adult migrants. Table 26 shows primary passage periods for each species and shows earliest and latest

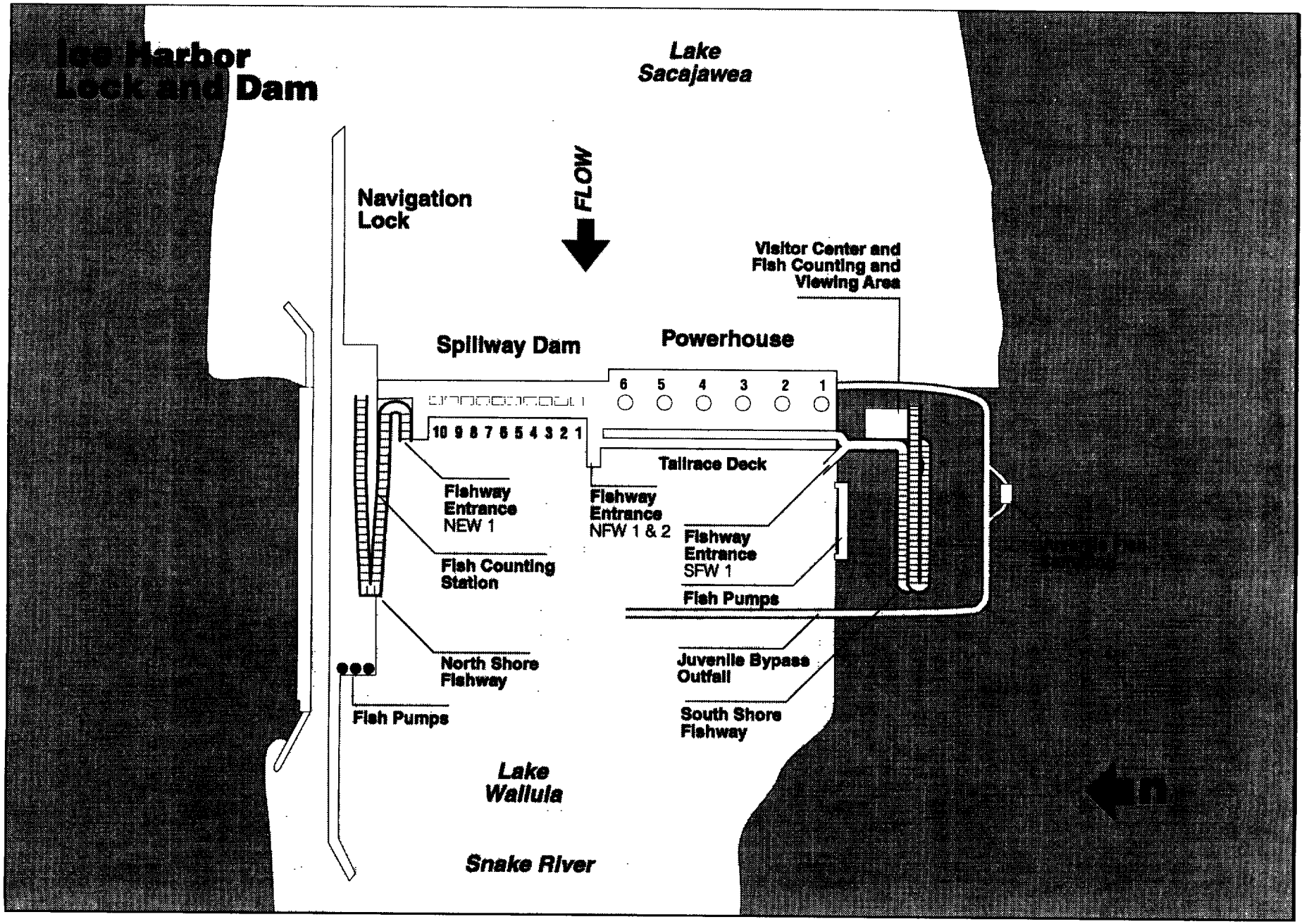


Figure 10 Ice Harbor Lock and Dam General Site Plan

date of peak passage on record from fish count data compiled by the Corps of Engineers. Adult fish are normally counted 16-hours per day (0400 to 2000 Pacific Standard Time) from April 1 through October 31. Additional counting for endangered species concerns is detailed in Appendix B (Special Project Operations and Research).

Table 26. Adult Migration Timing at Ice Harbor Dam From 1962-1992 Fish Counts.

SPECIES	COUNTING PERIOD	EARLIEST PEAK	LATEST PEAK
Spring Chinook	4/1 - 6/11	4/24	5/26
Summer Chinook	6/12 - 8/10	6/12	7/23
Fall Chinook	8/11 - 10/31	9/07	9/30
Sockeye	4/1 - 10/31	7/01	9/22
Steelhead	4/1 - 10/31		

B. Project Operation.

1. Spill Management. Spill at Ice Harbor is the result of river flow exceeding powerhouse capacity or the failure of a key component of the juvenile fish passage facility which forces the project to spill to provide juvenile fish passage. Spill at Ice Harbor will be distributed in accordance with the adult spill pattern listed in Table 27. Special spills for juvenile fish passage may be provided as detailed in Appendix B (Special Project Operations and Research).

2. Dissolved Gas Management and Control. Dissolved gasses at Ice Harbor are monitored in accordance with the Dissolved Gas Monitoring Program, Appendix E. Total dissolved gas will be monitored in the Ice Harbor forebay. Total dissolved gas data will be collected every hour and reported every four hours from April 1 through September 30. Total dissolved gas will also be monitored hourly at several locations downstream of Ice Harbor Dam from April 1 through September 30. Related data collected at the same time will be spill volume and total project flow. Implementation of requests for spill will be based in part upon dissolved gas monitoring data along with juvenile migration data. Requests for spill will be coordinated through the Technical Management Team.

3. Operating Criteria.

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

1) Prior to April 1 each year:

a> Forebay Area and Intakes:

1> Remove debris from forebay and gatewell slots.

2> Rake trash racks.

3> Measure drawdown in gatewell slots.

b> Submersible Traveling Screens (STS) and Vertical Barrier Screens (VBS):

1> Inspect STS's for good running order and operate one trial run (dogged off on deck).

2> Log trial Run.

3> Inspect VBS's once per year. Repair as needed.

c> Collection Gallery:

1> Water-up valve operational.

2> Orifice lights operational.

3> Orifices clean and operational.

d> Dewatering Structure and Flume:

1> Inclined screen clean and in good condition with no holes.

2. Screen cleaning system maintained and operational.

3> Overflow weirs maintained and tested.

4> All valves in good operating order.

5> Flume smooth with no rough edges.

e> Sampling Facilities:

1> Flume dewatering structure maintained and in good operating condition. No holes in dewatering screens.

2> Flume drop gate maintained and in good operating condition.

3> Check wet separator and fish distribution system for operation as designed.

4> All dewatering screens in separator and flume in good condition with no holes or sharp edges.

5> Valves and switch gate in good operating order.

6> All sampling equipment maintained and operable.

f> Powerhouse Tailrace Area:

Inspect bird wires and repair as needed.

2) April 1 to December 15:

a> Forebay Area and Intakes:

1> Remove debris from forebay.

2> Remove debris from trashracks as required to maintain less than one foot of additional drawdown in gate slots. Additional raking may be required when heavy debris loads are present in the river.

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

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

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

b> Submersible Traveling Screens (STS):

1> Operate STS's in cycling mode when average fork length of subyearling fall chinook and/or sockeye is greater than 120 mm at Lower Monumental collection facility.

2> Operate STS's in continuous operational mode when average fork length of fall chinook subyearlings and/or sockeye is less than 120 mm at Lower Monumental collection facility, or if there is other evidence that smaller juvenile fish are present at the project.

3> Inspect each STS once per month.

4> Record STS amp readings daily.

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

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

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

c> Collection Gallery Checks:

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

2> Orifice lights operational and operating on open orifices.

3. Orifice jets hitting no closer than 3 feet from wall (bypass channel full).

4. Backflush orifices once per day or more frequently if required.

5. Water-up valve operational.

d> Dewatering Structure:

1> Trash sweep operating correctly. Set frequency of sweep as necessary to maintain a clean screen.

2> Clean trapezoidal section as required to maintain in clean condition. Clean at least once per day.

3> Overflow weirs operating correctly.

4> No holes in inclined screen.

e> Sampling Facilities:

1> No holes in screens.

2> Operate wet separator and fish distribution system as designed. Sample fish twice per week during the main juvenile bypass season to monitor juvenile fish descaling and other fish condition parameters. Provide information in project weekly report.

3> Crowder screen brushes in good operating condition. No holes or sharp edges in crowder screen.

4> Operate preanesthetic system as designed.

f> Inspection and Record Keeping:

Inspect all facilities according to fish facilities monitoring plan. Record all maintenance and inspections.

b) Adult Fish Passage Facilities. Operate the adult fish passage facilities according to the following criteria:

1) Prior to March 1:

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

b> Dewater all ladders and inspect all dewatered sections of fish facilities for projections, debris, or plugged orifices which could injure fish or impede fish passage up the ladder. Inspect all diffuser gratings and chambers either visually or by video according to CENPW-OP-TF approved inspection program. Repair deficiencies.

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

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

e> Inspect all spillgates and ensure that they are operable.

2) March 1 through December 31 (Adult fish Passage Period):

a> Fishway ladders:

Water depth over weirs: 1.0 to 1.3 feet

b> Head on all entrances:

Head range: 1.0 to 2.0 feet

c> North Shore Entrance (NEW 1):
(Elevation of top of gate when on sill - 332.25)

1> Operate downstream gate closest to shore.

2> Weir depth: 8 feet or greater below tailwater.

(Note: At low river flow and tailwater, some of the diffusers are above tailwater and project may only be able to maintain a 6 foot weir depth.)

[CBFWA recommends a weir depth of 8 feet or greater at all times]

d> North Powerhouse Entrance (NFE 1 & 2):

(Elevation of top of gate when on sill - 332.25)

1> Operate 1 downstream gate.

2> Weir depth: 8 feet or greater below tailwater.

(Note: at low tailwater, weirs will bottom out and will be less than 8 feet below tailwater.)

e> Powerhouse Collection System:

Operate 7 floating orifices (O.G. numbers 1, 2, 4, 6, 8, 10, and 12).

f> South Shore Entrance (SFE-1):
(Elevation of top of gate when on sill - 332.25)

1> Operate entrance closest to powerhouse.

2> Weir depth: 8 feet or greater below tailwater.

(Note: at low tailwater, weirs will bottom out and will be less than 8 feet below tailwater.)

g> Channel Transportation Velocity:

1.5 to 4 feet per second.

h> Head on Trashracks:

1> Maximum head of 0.5 feet on ladder exits.

2> Maximum head on picketed leads shall be 0.3 feet.

i> Staff Gauges and Water Level Indicators:

Shall be readable at all water levels encountered during fish passage period.

j> Facility Inspections:

1> Powerhouse operators shall inspect facilities once per day. Maintain computerized fishway control system record keeping system.

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

3> Project personnel shall check computerized fishway control system twice per month to ensure that it is kept within calibrations.

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

5> Record all inspections.

c> Facility monitoring and reporting: Project biologists shall inspect fish passage facilities at the frequencies listed in the juvenile and adult fish facilities operating criteria sections. Project biologists shall prepare weekly reports, from March 1 through December 31, summarizing project operations. The weekly reports should provide an overview of how the project and the fish passage facilities

operated during the week and an evaluation of resulting fish passage conditions. The reports shall include: any out of criteria situations observed and subsequent corrective actions taken; any equipment malfunctions, breakdowns, or damage along with a summary of resulting repair activities; adult fishway control calibrations; STS and VBS inspections; and any unusual activities which occurred at the project which may effect fish passage. The weekly reports shall cover a Friday through Thursday time period and shall be sent to CENPW-OP-TF by noon the following Monday via electronic mail. Project biologist shall prepare a draft annual report by February 10 and a final report by March 15 summarizing the operation of the project fish passage facilities for the previous year.

C. Project Maintenance.

Project biologist should be present to provide technical guidance at all project activities which may involve fish handling. All dewaterings shall be accomplished in accordance with approved project dewatering plans.

1. Juvenile Fish Passage Facilities.

a) Scheduled Maintenance: Scheduled maintenance of the juvenile facilities is conducted during the non-fish passage season from December 16 to March 31. Long-term maintenance or modifications to the facilities which require them to be out of service are done during this period. During the fish passage season, the facilities are inspected on a daily basis to insure that they are operating correctly.

b) Unscheduled Maintenance: Unscheduled maintenance is the correction of any situation which prevents the facilities from operating according to criteria or which will impact fish passage and survival. Unscheduled maintenance of facilities such as submersible traveling screens, which sometimes break down during the fish passage season, will be carried out according to procedures described below. In these cases, repairs will be made as prescribed and CENPW-OP-TF notified for further coordination. Unscheduled maintenance which will have a significant impact on juvenile fish passage shall be coordinated with the CBFWA (through the FPC) and NMFS on a case-by-case basis by CENPW-OP-TF. CENPW-OP-TF will be notified as soon as possible after it becomes apparent that maintenance repairs are required. The Project Manager has the authority to initiate work prior to notifying CENPW-OP-TF when in his opinion delay of the work will result in an unsafe situation for people, property, or fish. Information required by CENPW-OP-TF includes:

1. Description of the problem.

2. Type of outage required.

3. Impact on facility operation.

4. Length of time for repairs.

5. Expected impacts on fish passage.

1) **Traveling Screens:** Traveling screens are inspected periodically throughout the juvenile migration season with a video monitoring system. If a screen is found to be damaged it will be removed and either replaced with the spare STS or repaired and returned to service. A turbine unit shall not be operated with a known damaged or nonfunctioning STS or without a full compliment of STS's. If an STS fails on a weekend or at night when maintenance crews are not available, the respective turbine unit will be shut down and generation switched to another, fully screened unit. If all screened turbine units are in service, water may be spilled until the affected STS can be removed and repaired or replaced.

2) **Gatewell Orifices:** Each gatewell has two 12-inch orifices with air operated valves to allow fish to exit the gatewell. Under normal operation, one orifice per gatewell is operated. To minimize blockage from debris, orifices should be cycled and backflushed every day. If an air-valve fails or is blocked with debris, the valve should be closed and the alternate orifice for that gatewell operated until repairs can be made. If both orifices are blocked with debris or damaged, the turbine unit will be taken out of service until repairs can be made. If repairs are to take longer than 48 hours, juvenile fish will be dipped from the gatewell with a gatewell dip basket.

3) **Dewatering Structure:** The dewatering structure acts as a transition from the collection channel to the corrugated metal flume. An inclined screen allows excess water to be bled off, with all fish and remaining water transitioning into the corrugated metal flume. The excess water is discharged into the adult fish facility auxiliary water supply system and is also used as the water supply for the sampling facilities. The dewatering structure contains a trash sweep for cleaning the rectangular portion of the inclined screen, and an air blowback system for cleaning the transition (trapezoidal) section of the screen. If the trash sweep breaks and interferes with juvenile fish passage through the structure or if the inclined screen or other component of the structure is damaged, the orifices may need be closed and the collection channel dewatered to allow repairs to be made. If the orifices are closed and the collection channel unwatered, the traveling screens will remain in operation. Fish will be allowed to accumulate in the gatewells for up to 2 days. If repairs are to take longer than 2 days, a salvage program will be initiated to remove fish from gatewells, with a gatewell dip basket, until repairs can be made and the system watered up again. While the collection channel is

out of service, project personnel shall monitor gatewells for signs of fish problems or mortality. Spill may be provided as an alternative avenue for fish passage during the collection channel outage.

4) Bypass Flume/Pipe: The bypass flume/pipe transports fish to the sampling facilities and to the tailrace below the project. If there is a problem with the flume/pipe which requires it to be unwatered, procedures will be taken similar to under 3) above.

5) Sampling Facilities: Under normal operation, juvenile fish are routed around the sampling facilities, except when sampling is being conducted. If there is a problem with the sampling facilities when it is in operation, the drop gate will be lowered to keep all juvenile fish in the bypass flume/pipe to bypass them directly to the river below the project. All fish in the sampling facility will be released back to the river if required.

2. Adult Fish Passage Facilities.

a) Scheduled Maintenance: Scheduled maintenance of a facility which must be unwatered to work on or whose maintenance will have a significant effect on fish passage will be done during the winter maintenance period from January 1 to March 1. Maintenance of facilities which will not have a significant affect on fish passage may be conducted during the rest of the year. Maintenance is normally conducted on one fish ladder at a time during the winter to provide some fish passage past the project at all times. When facilities are not being maintained during the winter maintenance period, they will be operated according to normal criteria, unless otherwise coordinated with the fishery agencies and tribes.

b) Unscheduled Maintenance: Unscheduled maintenance which will significantly effect the operation of a facility will be coordinated with the CBFWA and NMFS. Coordination procedures for unscheduled maintenance of adult facilities are the same as for juvenile facilities. If part of a facility malfunctions or is damaged during the fish passage season and the facility can still be operated within criteria without any detrimental affects on fish passage, repairs may not be conducted until the winter maintenance period or until fewer numbers of fish are passing the project. If part of a facility is damaged or malfunctions and may significantly impact fish passage, it will be repaired as soon as possible.

1) Fish Ladders and Counting Stations: The fish ladders contain fixed weirs, counting stations with picketed leads, and fish exits with trash racks. If any part of the ladder fails or is blocked with debris during the fish passage season, efforts will first be made to correct it without

unwatering the ladder. Trash racks, picketed leads, and counting stations can sometimes be repaired or maintained without unwatering the ladder. The decision on whether to unwater the ladder and make repairs during the fish passage season or wait until the winter maintenance period will be made after consultation with the fishery agencies and tribes.

2) North Shore Auxiliary Water Supply System: The north shore facilities contain three electric pumps which provide auxiliary water to the diffusers at the bottom of the ladder and at the entrances. During normal operation two or three pumps are required, depending on the tailwater elevation, to provide the necessary auxiliary water. If a pump fails during a two-pump operation, the pump on standby will be operated to provide the necessary flows. If a pump fails during a three-pump operation, NEW1 will be raised until the required 1.0 to 2.0-foot head differential is achieved. If this cannot be met by the time the weir reaches 6 feet below tailwater, the gate will remain at that level regardless of the head. If two or all three pumps fail, the weir will be maintained at a level of 6 feet below tailwater until repairs are made.

3) South Shore Auxiliary Water Supply System: The south shore auxiliary water is supplied by eight electric pumps and the excess water from the juvenile fish passage facilities. Fluctuating tailwater levels require from six to eight pumps to be operated to provide the auxiliary water. If one pump fails, a standby pump will be started to keep the fishway within criteria. If more pumps fail, this procedure will continue until all the standby pumps are in operation. If criteria cannot be met, the floating orifices should be closed in the following order: OG-12, OG-10, OG-8, and OG-6. If the required head differential of 1.0 to 2.0 feet cannot be reached when the floating orifices are closed, SSE 1 and NFE 2 will be closed equally at one-foot intervals until it is reached or until the weirs are 5 feet below tailwater. Then the remaining floating orifices should be closed in the following order: OG-4, OG-1, and OG-2. If there is still not enough auxiliary water to maintain the head differential on the two main entrances, NFE 2 will be closed, the transportation channel bulkheaded off at the junction pool, and SSE 1 operated as deep as possible to maintain the head differential. If it cannot be maintained at a depth of 6 feet or greater, the weir will remain at 6 feet regardless of the head.

4) Fishway Entrances: The fishway entrances are made up of main entrance weirs with hoists and automatic controls, and floating orifices which regulate themselves with tailwater fluctuations. If any of the automatic controls malfunction, the weirs can usually be operated manually by project personnel and kept within criteria. If there is a further failure which prevents the entrance from being operated manually, an alternate entrance will be opened until repairs can be made. If a floating orifice fails, it will be pulled out of

the water and the entrance bulkheaded off until the floating orifice is repaired.

D. Turbine Unit Operation and Maintenance.

1. Turbine Unit Operation. When in operation, turbine units will be operated to enhance adult and juvenile fish passage from March 1 through November 30. During these dates, turbine units will be operated (as needed to meet generation requirements) in the following order: 1, 2, 3, and then 4 through 6 (in any order) when units are available for operation. Unit operating priority may be coordinated differently to allow for fish research, construction, or project maintenance activities. To minimize mortality to juvenile fish passing through the turbine units from April 1 through October 31 (or as long as there is sufficient river flow and/or generation requests to operate turbines 4, 5, and 6 within 1 percent of peak efficiency) operating priority during nighttime hours from 2000 to 0400 hours shall be units 3 and then 4, then 5 and 6 (in any order), and then units 1, and 2 as needed. Units 3 and 4 should remain in operation as much as possible to maintain positive downstream flows at the juvenile bypass outfall. If a turbine unit is taken out of service for maintenance or repair, the next unit in the priority list shall be operated.

To the extent technically feasible, turbine units will be operated within 1% of peak efficiency from March 15 through November 30 (or as specified in BPA's load shaping guidelines) unless operation outside of that range is necessary to: 1) meet the load requirements of the BPA administrator whose load requests will be made in accordance with BPA's policy, statutory requirements, and load shaping guidelines (Appendix D); or 2) be in compliance with other coordinated fishery measures. Project personnel shall record when turbine units are operated outside the 1% peak efficiency range and shall provide the information to BPA on a weekly basis according to the load shaping guidelines. Between December 1 and March 15, turbine units will continue to be operated within the 1% peak efficiency range except when BPA load requests require the units to be operated outside the 1% range.

Guidelines for operation of the turbine units within 1% of peak efficiency at various head ranges are as follows:

Turbine Units 1-3: The following 1% peak efficiency ranges were calculated using results from 1994 index testing of turbine unit 3. Maximum generation of units 1 through 3 at 115% overload is 103 MW.

****With Standard Length Submersible Traveling Screens Installed.**

Head Feet	Lower Generator Limits		Upper Generator Limits	
	(MW)	(CFS)	(MW)	(CFS)
85	50	7,924	79	12,377
86	51	7,982	80	12,363
87	52	8,039	80	12,349
88	53	8,104	81	12,349
89	53	8,004	82	12,335
90	54	8,067	83	12,335
91	55	8,129	85	12,471
92	55	8,031	86	12,455
93	57	8,092	86	12,321
94	58	8,152	88	12,453
95	59	8,210	88	12,321
96	59	8,124	90	12,450
97	60	8,172	91	12,434
98	61	8,228	92	12,433
99	61	8,145	93	12,432
100	62	8,200	93	12,431
101	63	8,255	94	12,429
102	64	8,308	94	12,308
103	66	8,502	94	12,202
104	67	8,552	96	12,321
105	67	8,470	96	12,204

Turbine Units 1-3:

Without Submersible Traveling Screens Installed:

Head Feet	Lower Generator Limits		Upper Generator Limits	
	(MW)	(CFS)	(MW)	(CFS)
85	51	8,049	90	14,241
86	52	8,143	91	14,241
87	53	8,135	92	14,225
88	54	8,224	94	14,225
89	54	8,162	95	14,209
90	55	8,255	96	14,193
91	56	8,196	98	14,332
92	56	8,236	99	14,314
93	57	8,277	99	14,113
94	58	8,267	101	14,263
95	59	8,311	101	14,153
96	59	8,296	103	14,228
97	60	8,284	104	14,226
98	61	8,327	105	14,209
99	61	8,310	106	14,207
100	62	8,407	107	14,206
101	63	8,393	108	14,189
102	64	8,486	108	14,034
103	66	8,635	108	13,898
104	67	8,625	111	14,034
105	67	8,610	111	14,026

Turbine Units 4-6: The following 1% peak efficiency ranges were calculated using results from January 1994 index testing on unit 6 and are with submersible traveling screens installed in operating units. If screens are not installed, upper generator limits are 10 MW's lower. Maximum generation of units 4 through 6 at 115% overload is 127 MW.

Head Feet	Lower Generator Limits		Upper Generator Limits	
	(MW)	(CFS)	(MW)	(CFS)
85	58	9,174	122	19,234
86	59	9,222	123	19,194
87	60	9,157	124	18,925
88	60	9,132	125	19,037
89	61	9,121	126	18,900
90	62	9,167	128	18,866
91	63	9,155	129	18,717
92	64	9,258	130	18,805
93	64	9,128	131	18,712
94	65	9,172	132	18,683
95	66	9,151	134	18,524
96	67	9,189	135	18,488
97	67	9,058	136	18,386
98	68	9,225	137	18,613
99	69	9,201	138	18,455
100	70	9,248	140	18,443
101	70	9,167	141	18,439
102	71	9,207	142	18,414
103	72	9,191	143	18,280
104	73	9,241	144	18,280
105	73	9,166	146	18,282

[The CBFWA recommends that turbine units be operated within 1% of peak efficiency unless otherwise agreed.]

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

Table 27. Ice Harbor Dam Spillway Pattern for Adult Fish Passage.

Gate Number										
1	2	3	4	5	6	7	8	9	10	Total
(1)									1.5	2.5
1	(1)							1	1.5	4.5
1	1	(1)					1	1	1.5	6.5
1	(2)	1					1	2	1.5	8.5
1	2	1	(1)			1	1	2	1.5	10.5
1	2	1	1	(1)	1	1	1	2	1.5	12.5
1	2	(2)	1	1	1	1	2	2	1.5	14.5
1	2	2	(2)	1	1	2	2	2	1.5	16.5
1	2	2	2	(2)	2	2	2	2	1.5	18.5
1	2	2	2	(3)	3	2	2	2	1.5	20.5
1	2	2	(3)	3	3	3	2	2	1.5	22.5
1	2	(3)	3	3	3	3	3	2	1.5	24.5
1	2	3	3	(4)	4	3	3	2	1.5	26.5
1	2	3	3	4	4	4	3	2	1.5	27.5
1	2	3	3	(5)	5	4	3	2	1.5	30.5
1	2	3	(4)	5	5	4	3	3	1.5	31.5
1	(3)	3	5	5	5	4	3	3	1.5	33.5
1	3	(4)	5	6	5	4	3	3	1.5	35.5
(2)	3	4	(6)	6	5	4	4	3	1.5	38.5
2	3	4	6	6	(6)	5	4	3	1.5	40.5
2	3	(5)	6	6	6	5	4	3	1.5	41.5
2	3	5	6	(7)	6	5	5	3	1.5	43.5
2	3	5	(7)	7	6	6	5	3	1.5	45.5
2	3	(6)	7	8	6	6	5	3	1.5	47.5
2	(4)	6	7	8	6	6	5	3	1.5	50
2	4	6	7	8	(7)	7	5	4	2	52
2	4	6	(8)	8	7	7	6	4	2	54
2	4	6	8	(9)	8	7	6	4	2	56
2	4	(7)	8	9	9	7	6	4	2	58
2	4	7	(9)	10	9	7	6	4	2	60
2	4	7	(10)	10	9	8	6	4	2	62
2	4	7	10	11	9	8	(7)	4	2	64
2	4	7	(11)	11	10	8	7	4	2	66
2	4	(8)	11	12	10	8	7	4	2	68
2	4	8	11	13	10	(9)	7	4	2	70

-* Values in parentheses may be 1 foot less than values shown. For example: 1 means 0 or 1 foot. 2 means 1 or 2 feet. Each foot of opening equals about 1.7 kcfs at forebay elevation 439.0.

Lower Monumental Dam

Lower Monumental Dam

A. Fish Passage Information.

The locations of fish passage facilities are shown on the following general site plan for Lower Monumental Lock and Dam (Figure 11).

1. Juvenile Fish Passage.

a) Facilities Description. Lower Monumental's juvenile facilities consist of standard length STS's, vertical barrier screens, 12-inch orifices, collection gallery, dewatering structure, and bypass flume to the tailrace below the project. Transportation facilities consist of a separator to sort juvenile fish by size and to separate them from adult fish, sampling facilities, raceways, office and sampling building, truck and barge loading facilities, and PIT tag detection and deflector systems.

b) Juvenile Migration Timing. Gatewell sampling for juvenile salmonids was conducted from 1986 through 1991. Fish that volitionally entered the gatewell were sampled. These samples should be representative of the migration timing. The dates when 10, 50, and 90 percent of the migration passed the project in 1986 through 1991 are listed in Table 28. These dates were calculated from data collected during the sampling period and do not represent the entire juvenile migration since sampling was not consistent over the range of project operations that occurred (the 1987-89 90 percent dates are particularly questionable).

Table 28. Juvenile Migration Timing at Lower Monumental Dam.

% Migration past project	Year/Date 1987	1988	1989	1990	1991
Yearling chinook					
10%	4/29	4/24	4/22	4/21	4/30
50%	5/2	5/8	5/3	4/30	
90%	5/15	5/29	5/19	5/30	5/25
peak	5/2	5/8	4/26	4/26	
Subyearling chinook					
10%	6/16	5/9	6/11	N/A	5/18
50%	7/10	6/4	6/22	N/A	
90%	7/23	6/25	7/15	N/A	7/27
peak	7/19	6/4	6/23	N/A	
Steelhead					
10%	5/1	5/3	5/5	4/30	5/6
50%	5/9	5/20	5/18	5/17	
90%	5/26	6/10	6/6	6/4	5/29
peak	5/10	5/8	5/18	5/31	

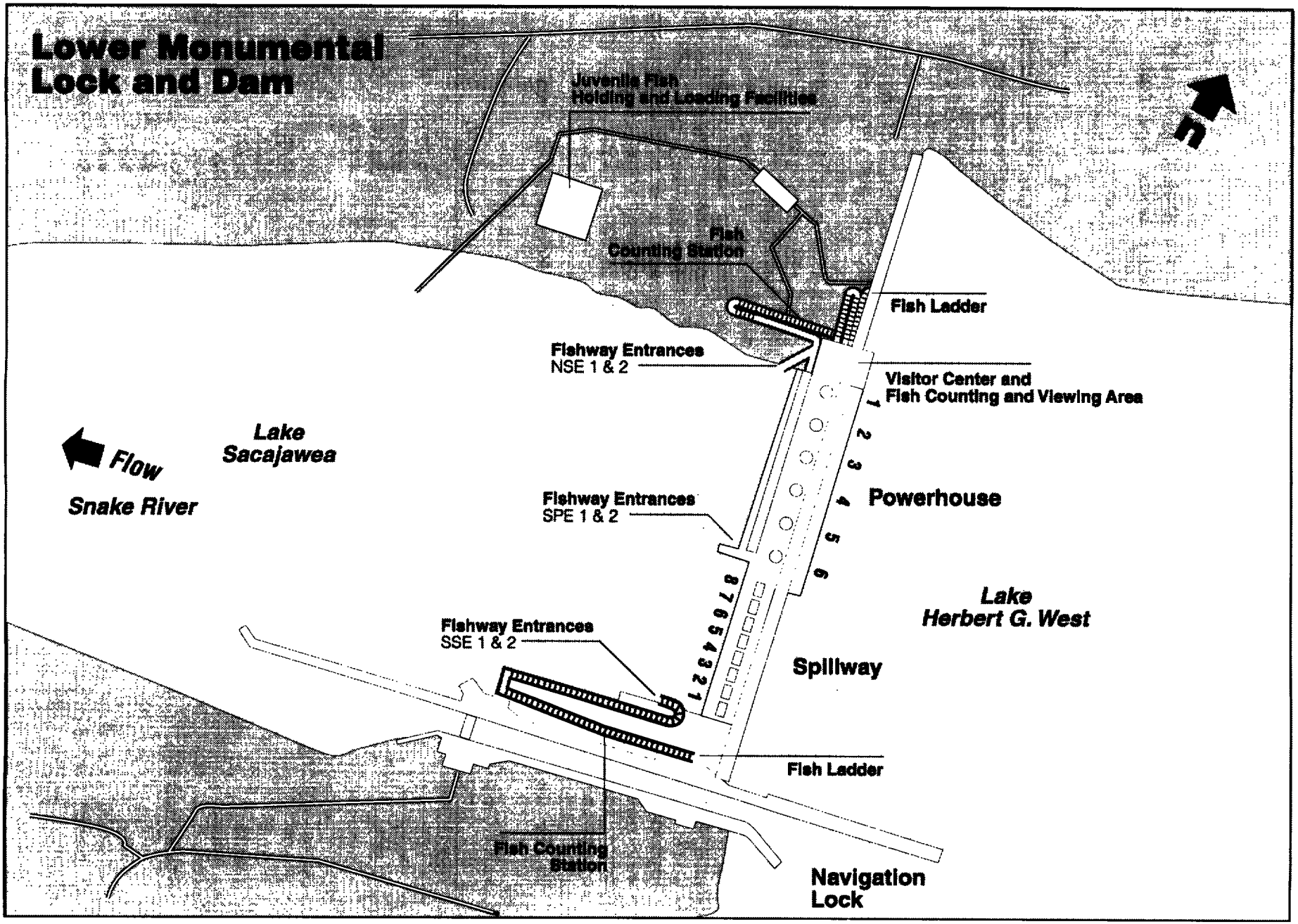


Figure 11 Lower Monumental Lock and Dam General Site Plan

2. Adult Fish Passage.

a) Facilities Description. The adult fish passage facilities at Lower Monumental are comprised of north and south shore fish ladders and collection systems with a common auxiliary water supply. The north shore fish ladder connects to two north shore entrances and the powerhouse collection system. The powerhouse collection system has two downstream entrances and one side entrance into the spillway basin at the south end of the powerhouse, ten floating orifices, and a common transportation channel. The two north shore entrances, two downstream south powerhouse entrances, and five of the floating orifices are used during normal operation. The south shore fish ladder has two downstream entrances and a side entrance into the spillway basin. The two downstream entrances are used during normal operation. The auxiliary water is supplied by three turbine-driven pumps located in the powerhouse on the north side of the river. The water is pumped into a supply conduit which travels under the powerhouse collection channel, distributing water to the powerhouse diffusers, and under the spillway to the diffusers in the south shore collection system. Excess water from the juvenile fish bypass system (approximately 200-240 cfs) is added to the auxiliary water supply system for the powerhouse collection system.

b) Adult Migration Timing. Upstream migrants are present at Lower Monumental dam all year. Maintenance of adult fish facilities is scheduled in January and February to minimize impacts to adult migrants. Facilities are usually shut down one shore at a time for maintenance to minimize impacts on adult fish passage. Table 29 shows the primary passage periods by species and shows the latest and earliest recorded dates of peak passage from fish count records complied by the Corps. Adult fish are normally counted 16-hours per day (0400 to 2000 Pacific Standard Time) from April 1 through October 31.

Table 29. Adult Migration Timing at Lower Monumental Dam From 1969-1992.

SPECIES	COUNTING PERIOD	EARLIEST PEAK	LATEST PEAK
Spring Chinook	4/1 - 6/13	4/20	5/27
Summer Chinook	6/14 - 8/13	6/14	7/12
Fall Chinook	8/14 - 10/31	9/13	9/30
Steelhead	4/1 - 10/31	9/15	10/13
Sockeye	4/1 - 10/31	6/24	7/25

B. Project Operation.

1. Spill Management. Spill at Lower Monumental is the result of river flow exceeding powerhouse capacity, insufficient generation loads to pass the river flow, or the failure of a key component of the juvenile fish passage facility which forces the project to spill to provide juvenile fish passage. Spill at Lower Monumental will be distributed across the spillway in accordance with the spill pattern in Table 30. Special spills for juvenile fish passage may be provided as detailed in Appendix B (Special Project Operations and Research).

2. Dissolved Gas Management and Control. Dissolved gasses at Lower Monumental are monitored in accordance with the Dissolved Gas Monitoring Program, Appendix E. Dissolved gas is monitored in the forebay at Lower Monumental Dam from April 1 through September 30. Data will be collected hourly and transmitted via satellite every 4 hours. Total dissolved gas information will also be monitored hourly in the Lower Monumental tailrace from April 1 through September 30. Implementation of spill management requests will be based upon total dissolved gas monitoring and juvenile migration data. Requests for spill will be coordinated through the Technical Management Team.

3. Operating Criteria.

a) Juvenile Fish Passage Facilities: Operate from April 1 to October 31 for juvenile fish bypass, collection and transportation and from November 1 through December 15 for bypassing adult fallbacks. Operate the juvenile facilities according to the criteria listed below and in Appendix C (Corps' Juvenile Fish Transportation Program Operating Criteria) for the bypassing, collection, and transportation of juvenile salmonids.

1) Prior to April 1 each year:

a> Forebay Area and Intakes:

1> Remove debris from forebay and gatewell slots.

2> Rake trash racks.

3> Measure drawdown in gatewell slots.

b> Submersible Traveling Screens (STS) and Vertical Barrier Screens (VBS):

1> Inspect STS's for good running order and operate on one trial run (dogged off on deck).

2> Log trial run.

3> Inspect VBS's once per year. Repair as needed.

c> Collection Gallery:

1> Water-up valve operational.

2> Orifice lights operational.

3> Orifices clean and operational.

d> Dewatering Structure and Flume:

1> Inclined screen clean and in good condition with no holes.

2> Cleaning brush system maintained and operational.

3> Overflow weirs maintained and tested.

4> All valves in good operating order.

5> Flume smooth with no rough edges.

e> Transportation Facilities:

1> Flume switch gate maintained and operational.

2> Flume smooth with no rough edges.

3> Perforated plate edges smooth with no rough edges.

4> Check wet separator and fish distribution system for operation as designed.

5> Brushes on crowders in good order.

6> Crowders operate properly.

7> All valves, slide gates, and switch gates in good operating order.

8> Retainer screens in place with no holes or sharp wires protruding.

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

10> Barge loading boom maintained and tested.

11> All sampling equipment maintained and operable.

e> Powerhouse Tailrace Area:

Inspect birdwires and repair as needed.

f> Maintenance Records:

Record all maintenance and inspections.

2) April 1 to December 15:

a> Forebay Area and Intakes:

1> Remove debris from forebay.

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

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

4> Log drawdown differentials at least once a week.

5> Remove debris from forebay and trashracks as required to maintain less than one foot of additional drawdown in gate slots. Additional raking may be required when heavy debris loads are present in the river.

6> Coordinate cleaning effort with personnel operating juvenile collection facilities.

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

b> Submersible Traveling Screens (STS) and Vertical Barrier Screens (VBS):

1> Operate STS's in cycling mode when average fork length of subyearling fall chinook and/or sockeye is greater than 120 mm.

2> Operate STS's in continuous operational mode when average fork length of fall chinook subyearlings and/or sockeye is less than 120 mm or if fish condition deteriorates.

3> Inspect each STS once per month.

4> Record STS amp readings daily.

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

6> Half of the STS's may be pulled after October 1 for maintenance as long as unscreened turbine units are not operated.

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

8> Inspect a VBS between the spring and summer migration periods. If a debris accumulation is noted, inspect other VBS's and clean debris as necessary.

c> Collection Gallery Checks:

1> Orifices clean and operating.

2> Orifice lights operational and operating on open orifices.

3> Orifice jets hitting no closer than 3 feet from wall (bypass gallery full).

4> Operate at least one 12-inch orifice per slot (preferably the north orifice). If the project is operating at MOP, additional orifices may be operated to maintain a full collection channel.

5> Backflush orifices once per day.

6> Water-up valve operational.

d> Dewatering Structure:

1> Trash sweep operating correctly.
2> Hand clean trapezoidal section as often as required to maintain in clean condition.

3> Overflow weirs operating correctly.

4> No holes in inclined screen.

e> Transportation Facilities:

1> No holes in screens.

2> Crowder screen brushes in good operating condition.

3> Retainer screens in raceway clean with no holes or protruding wires.

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

5> Shade at least one-third of each active raceway from July 1 through August 31 .

6> Truck and barge loading facilities in good operating condition.

f> Inspection and Record Keeping:

1> Inspect fish facilities once each shift. Inspect all facilities according to fish facilities monitoring program.

2> Record all maintenance and inspections.

b) Adult Fish Passage Facilities: Operate the adult fish passage facilities according to the following criteria:

1) Prior to March 1:

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

b> Dewater all ladders and inspect all dewatered sections of fish facilities for projections, debris, or plugged orifices which could injure fish or impede fish passage up the

ladder. Inspect all diffuser gratings and chambers either visually or by video according to CENPW-OP-T approved inspection program. Repair deficiencies.

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

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

e> Inspect all spillgates and ensure that they are operable.

2) March 1 through December 31 (Adult Fish Passage Period):

***Note:** Ice Harbor pool may be operated at minimum operating pool (MOP), between elevations 437 and 438, as part of the Corps' efforts for improving migration conditions for juvenile salmonids. This will result in some of the adult fishway entrances at Lower Monumental bottoming out on their sills prior to reaching criteria depths. Continuous operation at MOP may also result in increased pumping head on the auxiliary water supply pumps, decreasing the amount of water supplied by the pumps.

a> Fishway Ladders:

Water depth over weirs: 1.0 to 1.3 feet

b> Head on all Entrances:

Head range: 1.0 to 2.0 feet

c> North Shore Entrances (NSE 1 & 2):
(Elevation of top of gate when on sill - 429.0)

1> Operate both gates.

2> Weir depth: 8 feet or greater below tailwater.

d> Powerhouse Collection System:

Operate 5 floating orifices (O.G numbers 1, 3, 5, 7, 9).

e> South Powerhouse Entrances (SPE 1 & 2):
(Elevation of top of gate when on sill - 432.0)

1> Operate both downstream gates.

2> Weir depth: 8 feet or greater below tailwater.

f> South Shore Entrances (SSE 1 & 2):
(Elevation of top of gate when on sill - 431.0)

1> Operate both downstream gates.

2> Weir depth: SSE 1 operate 8 feet or greater below tailwater. SSE 2 raise 6 feet above sill.

g> Transportation Velocity:

1.5 to 4 feet per second.

h> Head on Trashracks:

1> Maximum head of 0.5 feet on ladder exits.

2> Maximum head on south shore picketed leads shall be 0.3 feet. Maximum head on north shore picketed leads shall be 0.4 feet.

i> Staff Gauges and Water Level Indicators:

Gauges shall be readable at all water levels encountered during fish passage period.

j> Facility Inspections:

1> Powerhouse operators shall inspect facilities once per day.

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

3> Project personnel shall check calibration of fishway control system twice per month to ensure that it is kept within calibration.

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

5> Record all inspections.

c> Facility monitoring and reporting: Project biologists shall inspect fish passage facilities at the frequencies listed in the juvenile and adult fish facilities operating criteria sections. Project biologists shall prepare weekly reports, from March 1 through December 31, summarizing

project operations. The weekly reports should provide an overview of how the project and the fish passage facilities operated during the week and an evaluation of resulting fish passage conditions. The reports shall include: any out of criteria situations observed and subsequent corrective actions taken; any equipment malfunctions, breakdowns, or damage along with a summary of resulting repair activities; adult fishway control calibrations; STS and VBS inspections; and any unusual activities which occurred at the project which may effect fish passage. The weekly reports shall cover a Friday through Thursday time period and shall be sent to CENPW-OP-T by noon the following Monday via electronic mail. Project biologist shall prepare a draft annual report by February 15 and a final report by March 15 summarizing the operation of the project fish passage facilities for the previous year.

C. Project Maintenance.

Project biologist should be present to provide technical guidance at all project activities which may involve fish handling. All dewaterings shall be accomplished in accordance with approved project dewatering plans.

1. Juvenile fish passage facilities.

a) Scheduled Maintenance: Scheduled maintenance of the juvenile facilities is conducted during the entire year. Long-term maintenance or modifications to the facilities which require them to be out of service for extended periods of time are conducted during the winter maintenance period from December 16 through March 31. During the fish passage season, parts of the facilities are maintained on a daily, weekly, or longer interval to keep them in proper operating condition.

b) Unscheduled Maintenance: Unscheduled maintenance is the correction of any situation which prevents the facilities from operating according to criteria or which will impact fish passage and/or survival. Unscheduled maintenance of facilities such as submersible traveling screens, which sometimes break down during the fish passage season, will be carried out according to procedures described below. In these cases, repairs will be made as prescribed and CENPW-OP-T notified for further coordination. Unscheduled maintenance which will have a significant effect on fish passage will be coordinated with the CBFWA and NMFS on a case-by-case basis by CENPW-OP-T. CENPW-OP-T will be notified as soon as possible after it becomes apparent that maintenance repairs are required. The Project Manager has the authority to initiate work prior to notifying CENPW-OP-T when in his opinion delay of the work will result in an unsafe situation for people, property, or fish. Information required by CENPW-OP-T includes:

1. Description of the problem.

2. Type of outage required.

3. Impact on facility operation.

4. Length of time for repairs.

5. Expected impacts on fish passage.

1) Traveling Screens: Traveling screens are inspected periodically throughout the juvenile migration season with a video monitoring system. If a screen is found to be damaged it will be removed and either replaced with the spare STS or repaired and returned to service. A turbine unit shall not be operated with a known damaged or nonfunctioning STS or without a full compliment of STS's. If an STS fails on a weekend or at night when maintenance crews are not available, the respective turbine unit will be shut down and generation switched to another, fully screened unit. If all screened turbine units are in service, water may be spilled until the affected STS can be removed and repaired or replaced.

2) Gatewell Orifices: Each gatewell has two 12-inch orifices with air operated valves to allow fish to exit the gatewell. Under normal operation, one orifice per gatewell is operated. To minimize blockage from debris, orifices should be cycled and backflushed every day. If an air-valve fails, the valve should be closed and the alternate orifice for that gatewell operated until repairs can be made. If both orifices are blocked with debris or damaged, the turbine unit will be taken out of service until repairs can be made. If repairs are to take longer than 48 hours, juvenile fish will be dipped from the gatewell with a gatewell dip basket.

3) Dewatering Structure: The dewatering structure acts as a transition from the collection channel to the corrugated metal flume. An inclined screen allows excess water to be bled off, with all fish and remaining water transitioning into the corrugated metal flume. The excess water is discharged into the adult fish facility auxiliary water supply system and used as the water supply for the transportation facilities. The dewatering structure contains a trash sweep for cleaning the inclined screen of impinged debris. If the trash sweep breaks and interferes with juvenile fish passage through the structure or if the inclined screen is damaged, an emergency bypass system at the upstream end of the dewatering structure will be used to bypass juveniles while repairs are made. Operation of the emergency bypass system requires the juvenile bypass system to be unwatered and stoplogs inserted at the upstream end of the inclined screen. The emergency bypass is then opened and the bypass system operated with 6 gatewell orifices open. Orifices will then need to be routinely rotated in order to let juveniles emigrate from all of the gatewells. While the facilities are in

emergency bypass operation, project personnel shall monitor gatewells for signs of fish problems or mortality. Spill may be provided as an alternative avenue for fish passage during a collection channel outage.

4) Bypass Flume: The corrugated metal flume transports juveniles to either the transportation facilities or to the river below the project. If there is a problem with the flume which interferes with its operation, the emergency bypass system at the upper end of the flume can be opened and all of the fish in the bypass system diverted to the river below the project through the emergency bypass pipe while repairs are made.

5) Transportation Facilities: The transportation facilities can be operated to either collect and hold juveniles for the transportation program or to bypass them back to the river. If part of the facility malfunctions or is damaged, efforts will first be made to bypass the fish around the damaged area. If this is not possible, the fish will be bypassed around the transportation facilities.

2. Adult Fish Passage Facilities.

a) Scheduled Maintenance: Scheduled maintenance of a facility which must be unwatered to work on or whose maintenance will have a significant effect on fish passage will be done during the winter maintenance period from January 1 to March 1. Maintenance of facilities which will not have a significant affect on fish passage may be conducted during the rest of the year. Fishway auxiliary water supply pumps require monthly, semi-annual, and annual maintenance. Monthly maintenance requires a one-day outage per pump, semi-annual maintenance requires a two-day outage per pump in July, and annual maintenance requires a two-week outage per pump during the winter maintenance period. Maintenance is normally conducted on one fish ladder at a time during the winter to provide some fish passage at the project at all times. When facilities are not being maintained during the winter maintenance period, they will be operated according to normal operating criteria unless otherwise coordinated with the fishery agencies and tribes.

b) Unscheduled Maintenance: Unscheduled maintenance which will significantly affect the operation of a facility will be coordinated with the CBFWA and NMFS. Coordination procedures for unscheduled maintenance of adult facilities are the same as for juvenile facilities. If part of a facility malfunctions or is damaged during the fish passage season and the facility can still be operated within criteria without any detrimental affects on fish passage, repairs may not be conducted until the winter maintenance period or until fewer numbers of fish are passing the project. If part of a facility is damaged or malfunctions and may significantly impact fish passage, it will be repaired as soon as possible.

(1) Fish Ladders and Counting Stations: The fish ladders contain fixed weirs, counting stations with picketed leads, and fish exits with trash racks. If any part of the ladder fails or is blocked with debris during the fish passage season, efforts will first be made to correct it without unwatering the ladder. Trash racks, picketed leads, and counting stations can sometimes be repaired or maintained without unwatering the ladder. The decision on whether to dewater the ladder and make repairs during the fish passage season or wait until the winter maintenance period will be made after consultation with the fishery agencies and tribes.

(2) Auxiliary Water Supply System: The auxiliary water for the fish ladders and the collection systems is supplied by three turbine-driven pumps on the north shore with all three pumps being required for normal operation. If one, two, or all three pumps fail, the fishway will be adjusted in the following manner until repairs can be made: SPE 2 and SSE 2 will be closed and SPE 1 raised to provide the required 1.0 to 2.0 foot head differential in the system. If the desired head differential cannot be reached by the time SPE 1 reaches 5 feet below tailwater, the floating orifices should be closed starting at OG-9 and working north across the powerhouse. If the head differential still cannot be maintained when all the floating orifices are closed, SPE 1 should be closed, the collection channel bulkheaded off at the junction pool, and NSE 1 and 2 and SSE 1 operated as deep as possible to maintain the head. If it cannot be maintained at a depth greater than 6 feet, the weirs should be maintained at 6 feet regardless of the head differential.

(3) Fishway Entrances: The fishway entrances are made up of main entrance weirs with hoists and automatic controls, and floating orifices which regulate themselves with tailwater fluctuations. If any of the automatic controls malfunction, the weirs can be operated manually by project personnel and kept within criteria. If there is a further failure which prevents an entrance from being operated manually, the weirs can usually be left in a lowered position while repairs are being conducted or the entrance closed and the water redistributed to other entrances while repairs are made. If a floating orifice is damaged, it will be pulled out of the water and the entrance bulkheaded off until it is repaired.

D. Turbine Unit Operation and Maintenance.

1. Turbine Unit Operation. When in operation, turbine units at Lower Monumental will be operated to enhance adult fish passage from March 1 through November 30. During this time period, turbine units will be operated (as needed to meet generation requirements) in the following order: 1, 2, 3, and then 4 through 6 (in any order) when units are available for

operation. Unit operating priority may be coordinated differently to allow for fish research, construction, or project maintenance activities. To minimize mortality to juvenile fish passing through the turbine units from April 1 through October 31 (or as long as there is sufficient river flow and/or generation requests to operate turbine units 4, 5, and 6 within 1 percent of peak efficiency), operating priority during nighttime hours from 2000 to 0400 hours shall be units 4, 5, and 6 (in any order), and then units 1, 2 and 3 as needed. Nighttime unit priority for turbine units 2 through 6 may be started at 1800 hours if turbine units must be shut off to implement nighttime juvenile fish passage spills. If the project is bypassing fish back to the river, nighttime turbine unit operation shall be units 1 and then 4, 5, and 6 (in any order), and then 2, and 3. If a turbine unit is taken out of service for maintenance or repair, the next unit in the priority list shall be operated. Zero nighttime flow (no generation) may be implemented during the August 15 through November 30 time period. If this occurs, the special operation will be coordinated with CBFWA and NMFS.

To the extent technically feasible, turbine units will be operated within 1% of peak efficiency from March 15 through November 30 (or as specified in BPA's load shaping guidelines) unless operation outside of that range is necessary to: 1) meet the load requirements of the BPA administrator whose load requests will be made in accordance with BPA's policy, statutory requirements and load shaping guidelines (Appendix C); or 2) be in compliance with other coordinated fishery measures. Project personnel shall record when turbine units are operated outside the 1% peak efficiency range and shall provide the information to BPA on a weekly basis according to the load shaping guidelines. Between December 1 and March 15, turbine units will continue to be operated within the 1% peak efficiency range except when BPA load requests require the units to be operated outside the 1% range.

Guidelines for operation of the turbine units within 1% of peak efficiency at various head ranges are listed below. The following 1% peak efficiency ranges were calculated using results from 1994 index testing of turbine unit 3 at Little Goose Dam. Maximum generation of turbine units at 115% overload is 155 MW.

Turbine Units 1-3:

****With Standard Length Submersible Traveling Screens Installed:**

Head Feet	Lower Generator Limits		Upper Generator Limits	
	(MW)	(CFS)	(MW)	(CFS)
85	80	12,966	137	22,317
86	81	12,966	140	22,441
87	81	12,797	141	22,331
88	82	12,796	142	22,239
89	83	12,793	144	22,151
90	84	12,790	145	22,067
91	84	12,651	146	21,982
92	85	12,653	149	22,106
93	87	12,657	150	22,023
94	88	12,666	151	21,943
95	89	12,677	152	21,866
96	89	12,563	154	21,793
97	90	12,577	155	21,724
98	91	12,588	155	21,478
99	92	12,589	155	21,237
100	92	12,481	155	21,024
101	93	12,486	155	20,816
102	94	12,489	155	20,588
103	95	12,492	155	20,365
104	95	12,390	155	20,146
105	96	12,502	155	19,954

Turbine Units 1-3:

****Without Submersible Traveling Screens:**

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

Turbine Units 4-6:

****With Standard Length Submersible Traveling Screens Installed:**

Head Feet	Lower Generator Limits		Upper Generator Limits	
	(MW)	(CFS)	(MW)	(CFS)
85	86	13,525	120	18,945
86	87	13,516	122	19,014
87	88	13,509	124	19,080
88	89	13,502	126	19,142
89	90	13,495	128	19,200
90	91	13,487	130	19,255
91	92	13,480	132	19,310
92	93	13,477	134	19,364
93	94	13,475	135	19,255
94	95	13,472	137	19,305
95	96	13,469	138	19,203
96	98	13,559	139	19,264
97	99	13,554	140	19,180
98	100	13,547	141	19,102
99	102	13,632	142	19,027
100	104	13,720	143	18,956
101	106	13,808	143	18,746
102	107	13,801	143	18,542
103	108	13,796	143	18,342
104	109	13,791	145	18,418
105	110	13,785	147	18,434

Turbine Units 4-6:

****Without Submersible Traveling Screens:**

Head Feet	Lower Generator Limits		Upper Generator Limits	
	(MW)	(CFS)	(MW)	(CFS)
85	98	15,421	126	19,896
86	99	15,410	128	19,968
87	100	15,402	131	20,037
88	102	15,394	133	20,103
89	103	15,386	135	20,164
90	104	15,377	137	20,221
91	105	15,370	139	20,279
92	106	15,366	141	20,336
93	107	15,364	142	20,221
94	108	15,361	144	20,273
95	110	15,357	145	20,167
96	112	15,460	147	20,231
97	113	15,454	148	20,142
98	114	15,446	149	20,060
99	116	15,543	150	19,982
100	119	15,643	151	19,907
101	121	15,744	151	19,686
102	122	15,736	151	19,472
103	123	15,730	151	19,262
104	124	15,724	153	19,343
105	126	15,717	155	19,359

[The CBFWA recommends that turbine units be operated within 1% of peak efficiency unless otherwise agreed.]

2. Turbine Unit Maintenance. The project's turbine unit maintenance schedule will be reviewed annually by project and Operations Division biologists for fishery impacts. If possible, maintenance of priority units will be scheduled for non-fish passage periods, or when there are low numbers of fish passing the project. Each turbine unit requires annual maintenance which may take from several days to two weeks. Annual maintenance of all turbine units is normally scheduled during the mid-July to late November time frame. The maintenance of priority units for adult passage is normally conducted in mid-August, when fewer adults are migrating, to minimize impacts on migrating adults. Turbine units may occasionally require overhauls to repair major problems with the turbine or generator. Overhauls may take over one year to accomplish. Turbine units, governors, exciters, and control systems require periodic maintenance, calibration, and testing which may take them outside of the one percent peak efficiency. This work will be scheduled in compliance with BPA load shaping guidelines (Appendix C) to minimize impacts on juvenile fish. Transformers are doble tested every 3 years. Testing may need to be more frequent if there is a known problem with a transformer. These tests normally take 2 to 3 work days. To conduct the testing, the distribution lines have to be disconnected from the transformers and normal generation stopped. One turbine unit will operate in a speed-no-load condition to provide project power and operation of fish passage facilities. Spill may be provided to meet minimum required project discharges during the testing hours. The doble tests are normally scheduled for the August time period to minimize impacts on adult and juvenile fish passage.

Table 30. Lower Monumental Dam Spillway Pattern for Adult Fish Passage.

Gate Number								Total Stops	Total KCFS
1	2	3	4	5	6	7	8		
1								1	1.1
1							1	2	2.2
1	1						1	3	3.3
1	1					1	1	4	4.4
2	1					1	1	5	6.1
2	1					1	2	6	7.8
2	1	1				1	2	7	8.9
2	1	1			1	1	2	8	10.0
2	1	1	1		1	1	2	9	11.1
2	1	1	1	1	1	1	2	10	12.2
2	1	2	1	1	1	1	2	11	13.9
2	1	2	1	1	2	1	2	12	15.6
2	1	2	2	1	2	1	2	13	17.3
2	1	2	2	2	2	1	2	14	19.0
3	1	2	2	2	2	1	2	15	20.8
3	2	2	2	2	2	1	2	16	22.5
3	2	2	2	2	2	1	3	17	24.3
3	2	2	2	2	2	2	3	18	26.0
4	2	2	2	2	2	2	3	19	27.7
4	2	2	2	3	2	2	3	20	29.5
4	2	2	2	3	2	2	4	21	31.2
4	2	2	2	3	2	3	4	22	33.0
4	2	3	2	3	2	3	4	23	34.8
4	3	3	2	3	2	3	4	24	36.6
4	3	3	3	3	2	3	4	25	38.4
4	3	3	3	3	3	3	4	26	40.2
4	3	3	4	3	3	3	4	27	41.9
4	3	3	4	4	3	3	4	28	43.6
5	3	3	4	4	3	3	4	29	45.3
5	4	3	4	4	3	3	4	30	47.0
5	4	3	4	4	3	3	5	31	48.7
5	4	3	4	4	3	4	5	32	50.4
5	4	4	4	4	3	4	5	33	52.1
5	4	4	4	4	4	4	5	34	53.8
5	4	4	5	4	4	4	5	35	55.5
5	4	4	5	4	5	4	5	36	57.2
6	4	4	5	4	5	4	5	37	58.9
6	5	4	5	4	5	4	5	38	60.6
6	5	4	5	4	5	4	6	39	62.3
6	5	4	5	4	5	5	6	40	64.0
6	5	5	5	4	5	5	6	41	65.7
6	5	5	5	5	5	5	6	42	67.4
6	5	5	6	5	5	5	6	43	69.1
6	5	5	6	5	6	5	6	44	70.8
7	5	5	6	5	6	5	6	45	72.5

Table 30. Lower Monumental Dam Spillway Pattern for Adult Fish Passage (Continued).

Gate Number								Total Stops	Total Kcfs
1	2	3	4	5	6	7	8		
7	6	5	6	5	6	5	6	46	74.2
7	6	5	6	5	6	5	7	47	75.9
7	6	5	6	5	6	6	7	48	77.6
7	6	6	6	5	6	6	7	49	79.3
7	6	6	6	6	6	6	7	50	81.0
7	6	6	7	6	6	6	7	51	82.7
7	6	6	7	6	7	6	7	52	84.4
8	6	6	7	6	7	6	7	53	86.3
8	7	6	7	6	7	6	7	54	88.0
8	7	6	7	6	7	6	8	55	89.9
8	7	6	7	6	7	7	8	56	91.6
8	7	7	7	6	7	7	8	57	93.3
8	7	7	7	7	7	7	8	58	95.0
8	7	7	8	7	7	7	8	59	96.9
8	7	7	8	7	8	7	8	60	98.8
9	7	7	8	7	8	7	8	61	100.4
9	8	7	8	7	8	7	8	62	102.3
9	8	7	8	7	8	7	9	63	103.9
9	8	7	8	7	8	8	9	64	105.8
9	8	8	8	7	8	8	9	65	107.7
9	8	8	8	8	8	8	9	66	109.6
9	8	8	9	8	8	8	9	67	111.2
9	8	8	9	8	9	8	9	68	112.8
10	8	8	9	8	9	8	9	69	114.6
10	9	8	9	8	9	8	9	70	116.2
10	9	8	9	8	9	8	10	71	118.0
10	9	8	9	8	9	9	10	72	119.6
10	9	9	9	8	9	9	10	73	121.2
10	9	9	9	9	9	9	10	74	122.8
10	9	9	10	9	9	9	10	75	124.6
10	9	9	10	9	10	9	10	76	126.4
11	9	9	10	9	10	9	10	77	128.1
11	10	9	10	9	10	9	10	78	129.9
11	10	9	10	9	10	9	11	79	131.6
11	10	9	10	9	10	10	11	80	133.4
11	10	10	10	9	10	10	11	81	135.2
11	10	10	10	10	10	10	11	82	137.0
11	10	10	11	10	10	10	11	83	138.7
11	10	10	11	10	11	10	11	84	140.4
12	10	10	11	10	11	10	11	85	142.2
12	11	10	11	10	11	10	11	86	143.9
12	11	10	11	10	11	10	12	87	145.7
12	11	10	11	10	11	11	12	88	147.4
12	11	11	11	10	11	11	12	89	149.1
12	11	11	11	11	11	11	12	90	150.8

Little Goose Dam

Little Goose Dam

A. Fish Passage Information.

The locations of fish passage facilities are shown in the following general site plan of Little Goose Lock and Dam (Figure 12).

1. Juvenile Fish Passage.

a) Facilities Description. Little Goose's juvenile facilities consist of a bypass system and juvenile transportation facilities. The bypass system contains submersible traveling screens, vertical barrier screens, 12-inch gatewell orifices, a bypass channel running the length of the powerhouse, a metal flume mounted on the face of the dam and the upper end of the fish ladder, a dewatering structure to eliminate excess water, two emergency bypass systems, and a corrugated metal flume to transport the fish to either the transportation facilities or to the river. The transportation facilities include a separator structure, raceways for holding fish, a distribution system for distributing the fish among the raceways, a sampling and marking building, truck and barge loading facilities, and PIT tag detection and deflection systems.

b) Juvenile Migration Timing. Juvenile passage timing at Little Goose corresponds closely with juvenile passage at Lower Granite Dam. Maintenance of juvenile fish facilities is scheduled from November through March to minimize the impact on downstream migrants.

2. Adult Fish Passage.

a) Facilities Description. The adult fish passage facilities at Little Goose are comprised of one fish ladder on the south shore, two south shore entrances, a powerhouse collection system, north shore entrances with a transportation channel underneath the spillway to the powerhouse collection system, and auxiliary water supply system. The powerhouse collection system is comprised of four floating orifices, two downstream entrances and one side entrance into the spillway basin on the north end of the powerhouse, and a common transportation channel. The four floating orifices and the two downstream entrances at the north end of the collection system are normally used. The north shore entrances are made up of two downstream facing entrances and a side entrance into the spillway basin with the two downstream entrances normally used. The auxiliary water is supplied by three turbine-driven pumps that pump water from the tailrace into the distribution system for the diffusers. Additional water is supplied to the auxiliary water supply system from the juvenile fish passage facilities primary dewatering structure.

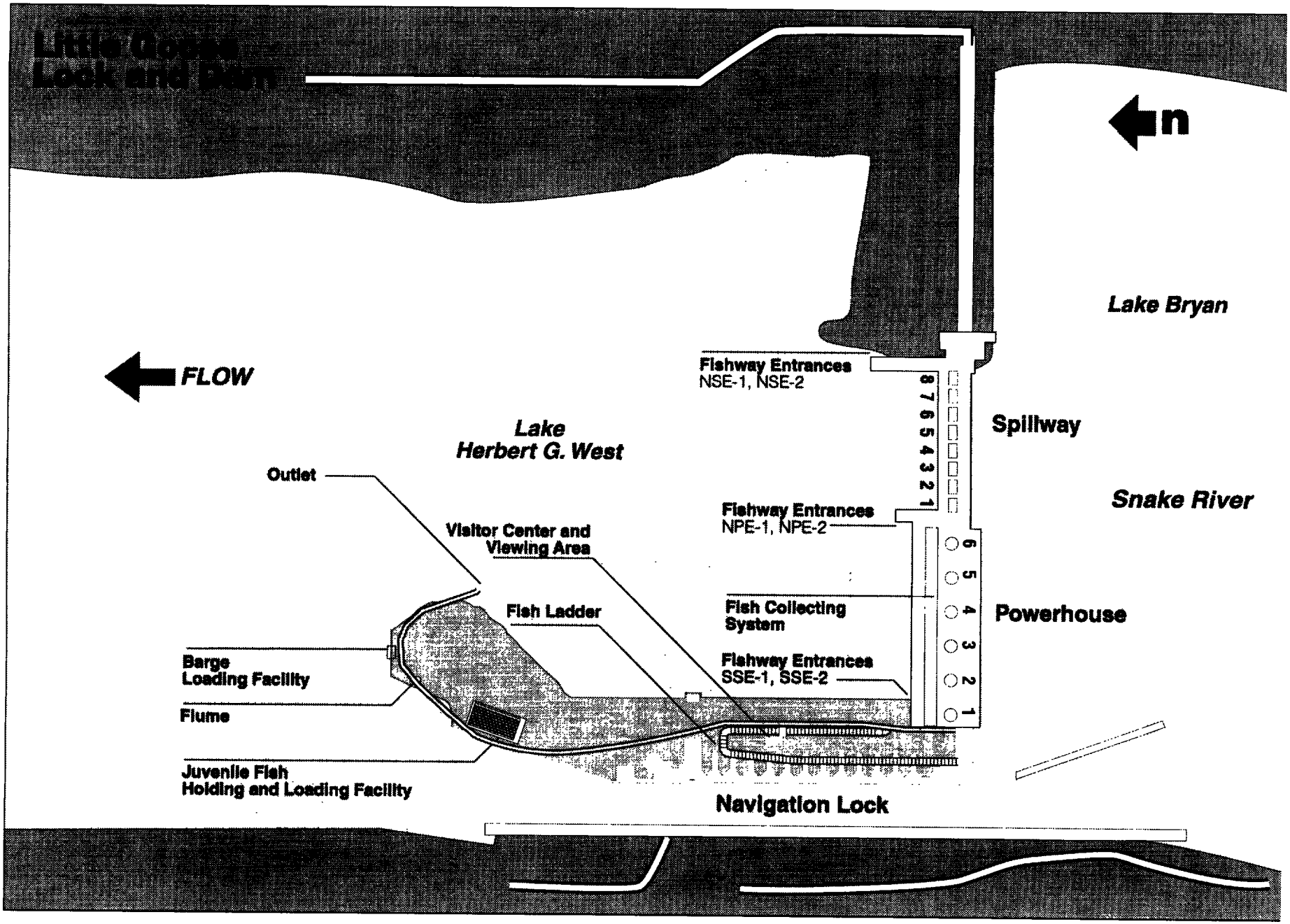


Figure 12 Little Goose Lock and Dam General Site Plan

3> Perforated plate smooth with no rough edges.

4> Check wet separator and fish distribution system for operation as designed.

5> Brushes on crowders in good order.

6> Crowders operate properly.

7> All valves, slide gates, and switch gates in good operating order.

8> Retainer screens in place with no holes or sharp wires protruding.

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

10> Barge loading boom maintained and tested.

11> All sampling equipment maintained and operable.

f> Maintenance Records:

Record all maintenance and inspections.

g> Powerhouse Tailrace Area:

Inspect birdwires and replace as needed.

2) April 1 to December 15:

a> Forebay Area and Intakes:

1> Remove debris from forebay.

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

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

4> Log drawdown differentials at least once a week.

5> Remove debris from forebay and trashracks as required to maintain less than one foot of additional drawdown in gate slots. Additional raking may be required when heavy debris loads are present in the river.

6> Coordinate cleaning effort with personnel operating juvenile collection facilities.

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

c> Submersible Traveling Screens (STS) and Vertical Barrier Screens (VBS):

1> Operate STS's in cycling mode when average fork length of subyearling fall chinook and/or sockeye is greater than 120 mm.

2> Operate STS's in continuous mode when average fork length of fall chinook subyearlings and/or sockeye is less than 120 mm or if fish condition deteriorates.

3> Inspect each STS once per month.

4> Record STS amp readings daily.

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

6> One-half of the STS's may be pulled after October 1 for maintenance as long as unscreened turbine units are not operated.

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

8> Inspect a VBS between the spring and summer migration periods. If a debris accumulation is noted, inspect other VBS's and clean debris as necessary.

d> Collection Gallery Checks:

1> Orifices clean and operating.

2> Orifice lights operating on operating orifices.

3> Orifice jets not within three feet of back wall (bypass gallery full).

4> Operate at least one 12-inch orifice per gatewell slot (preferably the north orifice). If the project is operating at MOP, additional orifices may be operated to maintain a full collection gallery.

5> Backflush orifices once per day.

6> Makeup water gate operational.

e> Dewatering Structure:

1> Trash sweep operating correctly.

2> Overflow weirs operating correctly.

3> Hand clean trapezoidal section as often as required to maintain in clean condition.

4> No holes in inclined screen.

f> Transportation Facilities:

1> No holes in screens.

2> Crowder screen brushes in good operating condition.

3> Retainer screens in raceways clean with no holes or protruding wires.

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

5> Truck and barge loading facilities in good operating condition.

g> Inspection and Record Keeping:

1> Inspect fish facilities once each shift. Inspect all facilities according to fish facilities monitoring program.

2> Record all maintenance and inspections.

b) Adult Fish Passage Facilities. Operate the adult fish passage facilities according to the following criteria:

1) Prior to March 1:

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

b> Dewater all ladders and inspect all dewatered sections of fish facilities for projections, debris, or plugged orifices which could injure fish or impede fish passage up the ladder. Inspect all diffuser gratings and chambers either visually or by video according to CENPW-OP-T approved inspection program. Repair deficiencies.

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

d> Calibrate all mechanical and electronic water level sensing devices, as necessary, for proper facility operations.

e> Inspect all spillgates and ensure that they are operable.

2) March 1 through December 31 (Adult Fish Passage Period):

***Note:** Lower Monumental pool may be operated at minimum operating pool (MOP), between elevations 537 and 538, as part of the Corps' efforts to improve migration conditions for juvenile salmonids. This may result in some of the adult fishway entrances at Little Goose bottoming out on their sills prior to reaching criteria depths. Continuous operation at MOP may also result in increased pumping head on the auxiliary water supply pumps, decreasing the amount of water supplied by the pumps.

a> Fishway Ladder:

Water depth over weirs: 1.0 to 1.3 feet

b> Head on all Entrances:

Head range: 1.0 to 2.0 feet

c> North Shore Entrances (NSE 1 & 2):
(Elevation of top of gates when on sill - 529.0)

1> Operate both downstream gates.

2> Weir depth: 6 feet or greater below tailwater.

d> North Powerhouse Entrances (NPE 1 & 2):
(Elevation of top of gates when on sill - 532.0)

1> Operate both downstream gates.

2> Weir Depth: 8 feet or greater below tailwater, tailwater permitting.

[CBFWA recommends that weir depths be operated at 8 feet or greater below tailwater at all times]

e> Powerhouse Collection System:

Operate 4 floating orifices (numbers 1, 4, 6, and 10).

f> South Shore Entrances (SSE 1 & 2):
(Elevation of top of gates when on sill - 529.0)

1> Operate both gates.

2> Weir depth: 8 feet or greater below tailwater.

g> Transportation Velocity:

1.5 to 4 feet per second.

h> Tunnel Lights:

Lights in the tunnel section, under the spillway, shall be on during fish passage period.

i> Head on Trashracks:

1> Maximum head of 0.5 feet on ladder exit.

2> Maximum head on picketed leads shall be 0.3 feet.

j> Staff Gauges and Water Level Indicators:

Shall be readable at all water levels encountered during fish passage period.

k> Facility Inspections:

1> Powerhouse operators shall inspect facilities once per day.

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

3> Project personnel shall check calibration of fishway control system twice per month to ensure that it is kept within calibration.

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

5> Record all inspections.

c> Facility monitoring and reporting: Project biologists shall inspect fish passage facilities at the frequencies listed in the juvenile and adult fish facilities operating criteria sections. Project biologists shall prepare weekly reports, from March 1 through December 31, summarizing project operations. The weekly reports should provide an overview of how the project and the fish passage facilities operated during the week and an evaluation of resulting fish passage conditions. The reports shall include: any out of criteria situations observed and subsequent corrective actions taken; any equipment malfunctions, breakdowns, or damage along with a summary of resulting repair activities; adult fishway control calibrations; STS and VBS inspections; and any unusual activities which occurred at the project which may effect fish passage. The weekly reports shall cover a Friday through Thursday time period and shall be sent to CENPW-OP-TF by noon the following Monday via electronic mail. Project biologist shall prepare a draft annual report February 10 and a final report by March 15 summarizing the operation of the project fish passage facilities for the previous year.

C. Project Maintenance.

Project biologists should be present to provide technical guidance at all project activities which may involve fish handling. All dewaterings shall be accomplished in accordance with approved project dewatering plans.

1. Juvenile Fish Passage Facilities.

a) Scheduled Maintenance: Scheduled maintenance of the juvenile facilities is conducted during the entire year. Long-term maintenance or modification of facilities which requires them to be out of service for extended periods of time are

conducted during the winter maintenance period from December 16 to March 31. During the fish passage season, parts of the facilities are maintained on a daily, weekly, or longer interval to keep them in proper operating condition.

b) Unscheduled Maintenance: Unscheduled maintenance is the correction of any situation which prevents the facilities from operating according to criteria or which will impact fish passage and survival. Maintenance of facilities such as traveling screens, which sometimes break down during the fish passage season, will be carried out according to procedures described below. In these cases, repairs will be made as prescribed and CENPW-OP-TF notified for further coordination. Unscheduled maintenance which will have a significant impact on juvenile fish passage shall be coordinated with the CBFWA and NMFS on a case-by-case basis by CENPW-OP-TF. CENPW-OP-TF will be notified as soon as possible after it becomes apparent that maintenance repairs are required. The Project Manager has the authority to initiate work prior to notifying CENPW-OP-TF when in his opinion delay of the work will result in an unsafe situation for people, property, or fish. Information required by CENPW-OP-TF includes:

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

1) Submersible Traveling Screens (STS): STS's are inspected periodically throughout the juvenile migration season with a video monitoring system. If a screen is found to be damaged or malfunctions at any time it will be removed and either replaced with a spare STS or repaired and returned to service. A turbine unit shall not be operated during the juvenile bypass season with a missing, known damaged, or non-operating traveling screen. If an STS fails on a weekend or at night when maintenance crews are not available, the respective turbine unit will be shut down and generation switched to another, fully screened unit. If all screened turbine units are in service, water may be spilled until the affected STS can be removed and repaired or replaced.

2) Gatewell Orifices: Each gatewell has two 12-inch orifices with air operated valves to allow fish to exit the gatewell. Under normal operation, at least one orifice per gatewell is operated. To minimize blockage from debris, orifices should be backflushed every day. If an air valve fails, the valve should be closed and the alternate valve for that gatewell

operated until repairs can be made. If both orifices are blocked with debris or damaged, the turbine unit will be taken out of service until repairs can be made. If repairs are to take longer than 48 hours, juvenile fish will be dipped from the gatewell with a gatewell dip basket.

3) Dewatering Structure: The dewatering structure acts as a transition from the collection channel to the corrugated metal flume. An inclined screen allows excess water to be bled off, with all fish and remaining water transitioning into the corrugated metal flume. The excess water can be either discharged into the river or added to the adult passage facilities auxiliary water supply system, and is also used as the water supply for the transportation facilities. The dewatering structure contains a trash sweep for cleaning the inclined screen of impinged debris. If the trash sweep breaks and interferes with juvenile fish passage through the structure or if the inclined screen is damaged, an emergency bypass system at the upstream end of the dewatering structure will be used to bypass juveniles while repairs are made. Operation of the emergency bypass system requires the juvenile bypass system to be unwatered and stoplogs inserted at the upper end of the inclined screen. The emergency bypass is then opened and the bypass system operated with 6 gatewell orifices open. Orifices will then need to be routinely rotated to allow juveniles to emigrate from all of the gatewells. Spill may be used as an alternative avenue for fish passage during a collection channel outage.

4) Bypass Flume: The corrugated metal flume transports juveniles to either the transportation facilities or to the river below the project. If there is a problem with the flume which interferes with its operation, an emergency bypass system at the upper end of the flume can be opened and all of the fish in the bypass system diverted to the river below the project through a 30-inch pipe while repairs are made.

5) Transportation Facilities: The transportation facilities can be operated to either collect and hold juveniles for the transportation program or to bypass them back to the river. If part of the facility malfunctions or is damaged, efforts will first be made to bypass the fish around the damaged area. If this is not possible, the fish will be bypassed around the transportation facilities.

2. Adult Fish Passage Facilities.

a) Scheduled Maintenance: Scheduled maintenance of a facility which must be unwatered to work on or whose maintenance will have a significant effect on fish passage will be done during the winter maintenance period from January 1 to March 1. Maintenance of facilities which will not have a significant effect on fish passage may be conducted during the rest of the

year. Fishway auxiliary water supply pumps require monthly, semi-annual, and annual maintenance. Monthly maintenance requires a one-day outage per pump, semi-annual maintenance requires a two-day outage per pump in July, and annual maintenance requires a two-week outage per pump during the winter maintenance period. When facilities are not being maintained during the winter maintenance period, they will be operated according to normal operating criteria unless otherwise coordinated with the fishery agencies and tribes.

b) Unscheduled Maintenance: Unscheduled maintenance which will significantly affect the operation of a facility will be coordinated with the CBFWA and NMFS. Coordination procedures for unscheduled maintenance of adult facilities shall be the same as for juvenile facilities. If part of a facility malfunctions or is damaged during the fish passage season and the facility can still be operated within criteria without any detrimental affects on fish passage, repairs may not be conducted until the winter maintenance period or until fewer numbers of fish are passing the project. If part of a facility is damaged or malfunctions that may significantly impact fish passage, it will be repaired as soon as possible.

1) Fish Ladder and Counting Station: The fish ladder contains fixed weirs, a counting station with picketed leads, and a fish exit with trashrack. If any part of the ladder fails or is blocked with debris during the fish passage season, efforts will first be made to correct it without unwatering the ladder. Trash racks, picketed leads, and counting stations can sometimes be repaired or maintained without unwatering the ladder. The decision to dewater the ladder and make repairs during the fish passage season or wait until the winter maintenance period will be made after consultation with the fishery agencies and tribes.

2) Auxiliary Water Supply System: The auxiliary water for the fish ladder and the powerhouse collection system is supplied by three turbine-driven pumps on the south shore with all three pumps being required for normal operation. If one, two, or all three pumps fail, the fishway will be adjusted down in the following manner to get the best fish passage conditions possible until repairs can be made: First, NSE 2 and NPE 2 should be closed and NPE 1 operated to provide the required 1.0 to 2.0-foot head differential. If the desired head differential cannot be maintained at a depth of 5 feet or greater, then NSE 1 should be raised until a depth of 5 feet below tailwater is reached. If the head differential cannot be maintained at this point, floating orifices OG-6 and OG-4 should be closed and SSE 1 and 2 should be raised at one-foot increments until 6 feet below tailwater is reached. If the head differential still cannot be maintained, the transportation channel to the north shore should be bulkheaded off at the end of the powerhouse collection channel. Next, OG-10 and OG-1 should be closed followed by NPE 1

and the powerhouse collection channel bulkheaded off at the junction pool. SSE 1 and 2 should then be operated as deep as possible to maintain the head, but not shallower than 6 feet regardless of the head.

c) Fishway Entrances: The fishway entrances are made up of main entrance weirs with hoists and automatic controls, and floating orifices which regulate themselves with tailwater level. If any of the automatic controls malfunction, the weirs can be operated manually by project personnel and kept within criteria. If there is a further failure which prevents an entrance from being operated manually, the weirs can usually be left in a lowered position while repairs are being conducted or the entrance closed and the water redistributed to other entrances while repairs are made. If a floating orifice is damaged, it will be pulled out of the water and the entrance bulkheaded off until it is repaired.

D. Turbine Unit Operation and Maintenance.

1. Turbine Unit Operation. When in operation turbine units will be operated to enhance adult and juvenile fish passage from March 1 through November 30. During this time period turbine units will be operated (as needed to meet generation requirements) in the following order: 1, 2, 3, and then 4 through 6 (in any order) when units are available for operation. Unit operating criteria may be coordinated differently to allow for fish research, construction, or project maintenance activities. To minimize mortality to juvenile fish passing through the turbine units from April 1 through October 31 (or as long as there is sufficient river flow and/or generation requests to operate turbine units 4, 5, and 6 within 1 percent of peak efficiency), operating priority during nighttime hours from 2000 to 0400 hours shall be units 4, 5, and 6 (in any order), and then units 1, 2, and 3 as needed. If the project is bypassing juvenile fish back to the river, nighttime unit operating priority shall be unit 1, then units 4 through 6, and followed by units 2 and 3. If a turbine unit is taken out of service for maintenance or repair, the next unit in the priority list shall be operated. Zero nighttime flow (no generation) may be implemented during the August 15 through November 30 time period. If this occurs, the special operation will be coordinated with CBFWA and NMFS.

To the extent technically feasible, turbine units will be operated within 1% of peak efficiency from March 15 through November 30 (or as specified in BPA's load shaping guidelines) unless operation outside of that range is necessary to: 1) meet the load requirements of the BPA administrator whose load requests will be made in accordance with BPA's policy, statutory requirements, and load shaping guidelines (Appendix C); or 2) be in compliance with other coordinated fishery measures. Project personnel shall record when turbine units are operated outside

the 1% peak efficiency range and shall provide the information to BPA on a weekly basis according to the load shaping guidelines. Between December 1 and March 14, turbine units will continue to be operated within the 1% peak efficiency range except when BPA load requests require the units to be operated outside the 1% range.

Guidelines for operation of the turbine units within 1% of peak efficiency at various head ranges are listed below. The 1% peak efficiency ranges were calculated using results from 1994 index testing of turbine units 3 and 5 at Little Goose Dam. Maximum generation of units 1 through 6 at 115% overload is 155 MW.

Turbine Units 1-3:

****With Standard Length Submersible Traveling Screens Installed:**

Head Feet	Lower Generator Limits		Upper Generator Limits	
	(MW)	(CFS)	(MW)	(CFS)
85	80	12,966	137	22,317
86	81	12,966	140	22,441
87	81	12,797	141	22,331
88	82	12,796	142	22,239
89	83	12,793	144	22,151
90	84	12,790	145	22,067
91	84	12,651	146	21,982
92	85	12,653	149	22,106
93	87	12,657	150	22,023
94	88	12,666	151	21,943
95	89	12,677	152	21,866
96	89	12,563	154	21,793
97	90	12,577	155	21,724
98	91	12,588	155	21,478
99	92	12,589	155	21,237
100	92	12,481	155	21,024
101	93	12,486	155	20,816
102	94	12,489	155	20,588
103	95	12,492	155	20,365
104	95	12,390	155	20,146
105	96	12,502	155	19,527

Turbine Units 1-3:

****Without Submersible Traveling Screens:**

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

Turbine Units 4-6:

****With Standard Length Submersible Traveling Screens Installed:**

Head Feet	Lower Generator Limits		Upper Generator Limits	
	(MW)	(CFS)	(MW)	(CFS)
85	86	13,525	120	18,945
86	87	13,516	122	19,014
87	88	13,509	124	19,080
88	89	13,502	126	19,142
89	90	13,495	128	19,200
90	91	13,487	130	19,255
91	92	13,480	132	19,310
92	93	13,477	134	19,364
93	94	13,475	135	19,255
94	95	13,472	137	19,305
95	96	13,469	138	19,203
96	98	13,559	139	19,264
97	99	13,554	140	19,180
98	100	13,547	141	19,102
99	102	13,632	142	19,027
100	104	13,720	143	18,956
101	106	13,808	143	18,746
102	107	13,801	143	18,542
103	108	13,796	143	18,342
104	109	13,791	145	18,418
105	110	13,785	147	18,434

Turbine Units 4-6:

****Without Submersible Traveling Screens:**

Head Feet	Lower Generator Limits		Upper Generator Limits	
	(MW)	(CFS)	MW)	(CFS)
85	98	15,421	126	19,896
86	99	15,410	128	19,968
87	100	15,402	131	20,037
88	102	15,394	133	20,103
89	103	15,386	135	20,164
90	104	15,377	137	20,221
91	105	15,370	139	20,279
92	106	15,366	141	20,336
93	107	15,364	142	20,221
94	108	15,361	144	20,273
95	110	15,357	145	20,167
96	112	15,460	147	20,231
97	113	15,454	148	20,142
98	114	15,446	149	20,060
99	116	15,543	150	19,982
100	119	15,643	151	19,907
101	121	15,744	151	19,686
102	122	15,736	151	19,472
103	123	15,730	151	19,262
104	124	15,724	153	19,343
105	126	15,717	155	19,359

[The CBFWA recommends that turbine units be operated within 1% of peak efficiency unless otherwise agreed.]

2. Turbine Unit Maintenance. The project's turbine unit maintenance schedule will be reviewed annually by project and Operations Division biologists for fishery impacts. If possible, maintenance of priority units will be scheduled for non-fish passage periods, or when there are low numbers of fish passing the project. Each turbine unit requires annual maintenance which may take from several days to two weeks. Annual maintenance of all turbine units is normally scheduled during the mid-July to late November time frame. The maintenance of priority units for adult passage is normally conducted in mid-August, when fewer adults are migrating, to minimize impacts on migrating adults. Turbine units may occasionally require overhauls to repair major problems with the turbine or generator. Overhauls may take over one year to accomplish. Turbine units, governors, exciters, and control systems require periodic maintenance, calibration, and testing which may take them outside of the one percent peak efficiency. This work will be scheduled in compliance with BPA load shaping guidelines (Appendix C) to minimize impacts on juvenile fish. Transformers are doble tested every 3 years. Testing may need to be more frequent if there is a known problem with a transformer. These tests normally take 2 to 3 work days. To conduct the testing, the transmission lines have to be disconnected from the transformers and normal generation stopped. One turbine unit will operate in a speed-no-load condition to provide project power and operation of fish passage facilities. Spill may be provided to meet minimum required project discharges during the testing hours. The doble tests are normally scheduled for the August time period to minimize impacts on adult and juvenile fish passage.

Table 32. Little Goose Dam Spillway Pattern for Adult Fish Pattern.

1.9 KCFS Per Stop

BAY 1	BAY 2	BAY 3	BAY 4	BAY 5	BAY 6	BAY 7	BAY 8	STOPS	KCFS
							1	1	1.9
									3.8
1						1	1	3	5.7
									7.6
1	1				1	1	1	5	9.5
									11.4
1	1	1		1	1	1	1	7	13.3
									15.2
1	1	1	1	1	2	1	1	9	17.1
									19.0
1	1	2	1	2	2	1	1	11	20.9
									22.8
2	1	2	2	2	2	1	1	13	24.7
									26.6
2	2	2	2	2	2	1	2	15	28.5
									30.4
2	2	2	2	2	2	2	3	17	32.3
									34.2
3	2	2	3	2	2	2	3	19	36.1
									38.0
3	3	3	3	2	2	2	3	21	39.9
									41.8
3	3	3	3	2	3	2	4	23	43.7
									45.6
3	3	3	3	3	3	3	4	25	47.5
									49.4
4	3	3	4	3	3	3	4	27	51.3
									53.2
4	4	4	4	3	3	3	4	29	55.1
									57.0
5	4	4	4	3	3	4	4	31	58.9
									60.8
5	5	4	4	4	3	4	4	33	62.7
									64.6
5	5	5	4	4	3	4	5	35	66.5
									68.4

Table 32. Continued.

BAY 1	BAY 2	BAY 3	BAY 4	BAY 5	BAY 6	BAY 7	BAY 8	STOPS	KCFS
5	5	5	5	4	4	4	5	37	70.3
5	6	5	5	4	4	4	5	38	72.2
5	6	5	5	4	4	4	6	39	74.1
5	6	5	5	4	4	5	6	40	76.0
5	6	5	5	4	5	5	6	41	77.9
6	6	5	5	4	5	5	6	42	79.8
6	6	5	5	5	4	6	6	43	81.7
6	6	5	5	5	5	6	6	44	83.6
6	6	5	5	5	5	6	7	45	85.5
6	6	6	5	5	5	6	7	46	87.4
7	6	5	5	6	5	6	7	47	89.3
7	6	6	5	6	5	6	7	48	91.2
7	6	5	6	6	6	6	7	49	93.1
7	6	6	6	6	6	6	7	50	95.0
7	6	6	6	7	6	6	7	51	96.9
7	6	6	6	7	7	6	7	52	98.8
7	6	6	7	7	7	6	7	53	100.7
7	7	6	7	7	7	6	7	54	102.6
7	7	6	7	7	7	7	7	55	104.5
7	7	7	7	7	7	7	7	56	106.4
8	7	7	7	7	7	7	7	57	108.3
8	7	7	7	7	7	7	8	58	110.2
8	7	7	7	8	7	7	8	59	112.1
8	7	7	7	8	8	7	8	60	114.0
8	7	8	7	8	8	7	8	61	115.9
8	7	8	8	8	8	7	8	62	117.8
8	7	8	8	8	8	8	8	63	119.7
8	8	8	8	8	8	8	8	64	121.6
8	8	8	8	8	8	8	9	65	123.5
9	8	8	8	8	8	8	9	66	125.4
9	8	8	8	9	8	8	9	67	127.3
9	8	9	8	9	8	8	9	68	129.2
9	8	9	8	9	9	8	9	69	131.1
9	8	9	9	9	9	8	9	70	133.0

Lower Granite Dam

Lower Granite Dam

A. Fish Passage Information.

The locations of fish passage facilities are shown on the following general design drawing of Lower Granite Lock and Dam (Figure 13).

1. Juvenile Fish Passage.

a) Facilities Description: Lower Granite's juvenile facilities consist of a bypass system and juvenile transportation facilities. The bypass system contains extended length bar screens with flow vanes , improved modified balanced flow vertical barrier screens, gatewell orifices, a bypass channel running the length of the powerhouse, and a bypass pipe to transport the fish to the transportation facilities or to the river. The transportation facilities include an upwell and separator structure to separate the juveniles from the excess water and adult fish, raceways for holding fish, a distribution system for distributing the fish among the raceways, a sampling and marking building, truck and barge loading facilities, and PIT tag detection and deflection systems.

b) Juvenile Fish Migration Timing. Maintenance of fish facilities should be scheduled for October through March to minimize impact on downstream migrants. Transportation of juvenile migrants is conducted according to the criteria listed in Appendix C.

Table 33. Juvenile Migration Timing at Lower Granite Dam.

% Migration Past Project	1986	1987*	1988*	1989*	1990*	1991	1992
Yearling chinook							
10%	4/10	4/18	4/18	4/17	4/16	4/23	4/16
90%	5/21	5/8	5/24	5/25	5/21	5/20	5/15
Steelhead							
10%	4/27	4/28	4/27	4/28	4/26	5/4	5/1
90%	5/31	5/29	6/2	6/1	6/1	5/29	6/12
Sub-yearlings							
10%	6/10	---	---	---	---	6/11	6/6
90%	7/16	---	---	---	---	8/1	7/17

* 1987 through 1990 data combines yearling and subyearling chinook

2. Adult Fish Passage.

a) Facilities Description: The adult fish passage facilities at Lower Granite are made up of one fish ladder on the south shore, two south shore entrances, a powerhouse collection system, north shore entrances with a transportation channel underneath the spillway to the powerhouse collection system, and

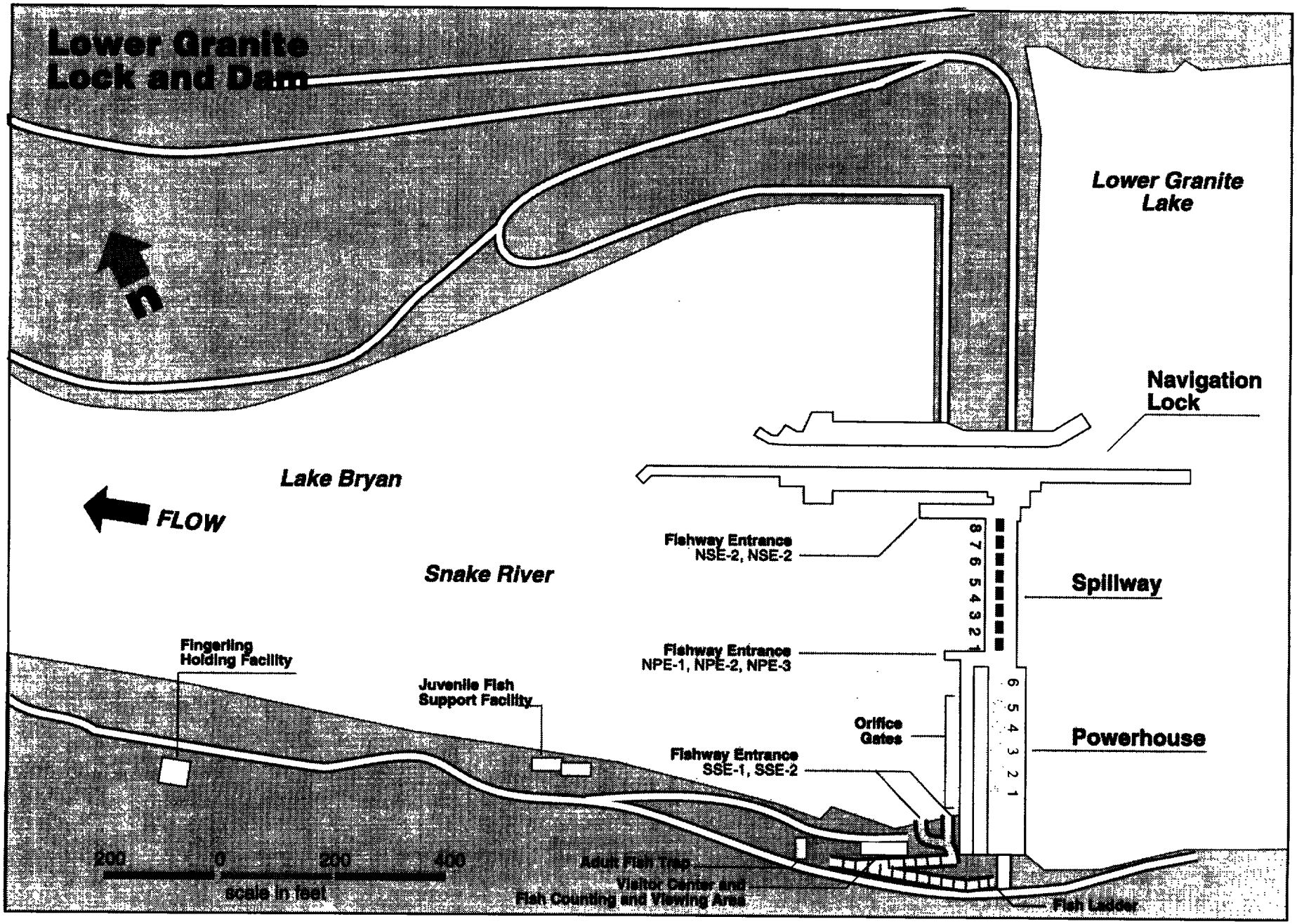


Figure 13 Lower Granite Lock and Dam General Site Plan

an auxiliary water supply system. The powerhouse collection system is comprised of ten floating orifices, two downstream entrances and one side entrance into the spillway basin on the north end of the powerhouse, and a common transportation channel. Four of the floating orifices and the two downstream entrances at the north end of the collection system are normally used. The north shore entrances are made up of two downstream entrances and a side entrance into the spillway basin with the two downstream entrances normally used. The auxiliary water is supplied by three electric pumps that pump water from the tailrace to the diffusers with two pumps normally used to provide the required flows.

b) Adult Migration Timing. Upstream migrants are present at Lower Granite throughout the year. Maintenance of adult facilities is scheduled for the period of January through February to minimize the impact on upstream migrants. Adult fish are normally counted from March 1 through December 15. Counting in March is for 8-hours per day (0800 to 1600 Pacific Standard Time) with 16-hours per day counting being conducted from April 1 through October 31 (0400 to 2000 Pacific Standard Time). Fish counting in November and December is for 10-hours per day (0600 to 1600 Pacific Standard Time). Fish counting during March, November, and December is done by video taping of fish passage and later interrogation of the video tapes. Additional counting for endangered species concerns is detailed in Appendix B (Special Project Operations and Research). Primary passage periods by species and earliest and latest date of peak passage follow.

Table 34. Adult Migration Timing at Lower Granite Dam From 1975-1992.

SPECIES	COUNT PERIOD	EARLIEST PEAK	LATEST PEAK
Spring chinook	3/1 - 6/17	5/3	5/27
Summer chinook	6/18 - 8/17	6/18	7/17
Fall chinook	8/18 - 12/15	9/5	10/6
Sockeye	3/1 - 12/15	7/1	7/19
Steelhead	3/1 - 12/15	9/3	10/16

B. Project Operation.

1. Spill Management. Spill at Lower Granite is the result of river flow exceeding powerhouse capacity or the failure of a key component of the juvenile fish passage facility which forces the project to spill to provide juvenile fish passage. Spill at Lower Granite shall be distributed in accordance with the adult fish passage spill pattern included at the end of this section, Table 35. Special spills for juvenile fish passage may be

provided as detailed in Appendix B (Special Project Operations and Research).

2. Dissolved Gas Management and Control. Dissolved gasses at Lower Granite are monitored in accordance with the Dissolved Gas Monitoring Program, Appendix E. Total dissolved gas will be monitored hourly at the Lower Granite forebay automated station and reported every four hours from April 30 through September 30. Total dissolved gas will also be monitored hourly in the Lower Granite tailwater from April 1 through September 30. Related data reported at the same time will be spill volume and total project flow. Implementation of spill management requests will be based in part upon dissolved gas monitoring data and the observed condition of migrant juveniles and adults, along with juvenile migration monitoring data. Requests for spill will be coordinated through the Technical Management Team.

3. Operating Criteria.

a) Juvenile Fish Passage Facilities. Operate from April 1 to October 31 for juvenile fish bypass, collection, and transportation and from November 1 through December 15 for bypassing adult fallbacks. Operate the juvenile facilities according to the criteria listed below and in Appendix C (Corps' Juvenile Fish Transportation Program Operating Criteria) for the bypassing, collection, and transportation of juvenile salmonids. The transportation program may be revised in accordance with the ESA Section 10 permit and NMFS's biological opinion.

1) Prior to April 1 each year:

a> Forebay Area and Intakes:

1> Remove debris from forebay and gatewell slots.

2> Rake trash racks.

b> Extended Length Submersible Bar Screens (ESBS), Flow Vanes, and Vertical Barrier Screens (VBS):

1> Maintenance completed on all ESBS's.

2> Inspect ESBS's for good running order and operate debris cleaner one trial run (dogged off on deck).

3> Log results of trial run.

4> Inspect VBS's once per year.

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

c> Collection Gallery:

1> Makeup water gates and float control equipment operational.

2> Orifice lights operational.

3> Orifices clean and operational.

d> Transportation Facilities:

1> 42-inch and 72-inch sluice gates operational.

2> Inclined screens clean and in repair with no holes.

3> Perforated plate edges smooth with no rough edges.

4> Check wet separator and fish distribution system for correct operation.

5> Brushes on crowder screens in good order.

6> Crowder operates properly.

7> All valves, slide gates, and switch gates in and around separator and raceways in good operating order.

8> Retainer screens in place with no holes or sharp wires protruding.

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

10> Barge loading boom maintained and tested.

11> All sampling facilities maintained and operable.

f> Barges:

1> All pumps in good working order.

2> Dump gates operational.

3> No rough edges or support beams protruding into compartments.

4> No brass or galvanized fittings in circulation lines.

5> All loading hoses properly installed so fish will not hit sides of compartments or support beams when loading.

6> Loading hoses in good shape with rubber gaskets in "Kamlock" fittings.

7> Inside edges of Kamlock joints should be beveled to avoid sharp edges.

8> Warning systems tested and operational.

9> Provide net and/or deck covers.

g> Maintenance Records:

Record all maintenance and inspections.

h> Powerhouse Tailrace Area:

Inspect bird wires and replace as needed.

2) April 1 to December 15 :

a> Forebay Area and Intakes:

1< Remove debris from forebay.

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

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

4> Log drawdown differentials at least once per week.

5> Remove debris from forebay and trashracks as required to maintain less than one foot of additional drawdown in gate slots. Additional raking may be required when heavy debris loads are present in the river.

6> Coordinate cleaning effort with personnel operating juvenile collection facilities.

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

c> Extended-length Submersible Bar Screens (ESBS) and Vertical Barrier Screens (VBS)

1> Operate ESBS's with flow vanes attached to screen..

2> Operate ESBS's with debris cleaners in automatic mode. Set cleaning frequency as required to maintain good fish condition. Change cleaning frequency as needed.

3> Develop inspection procedures for ESBS's. Inspect each ESBS once per month.

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

5> One-half of the ESBS's may be pulled after October 1 for maintenance as long as unscreened turbine units are not operated.

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

7> Inspect a VBS between the spring and summer migration periods. If a debris accumulation is noted, inspect other VBS's and clean debris as necessary.

d> Collection Gallery Checks:

1> Orifices clean and operating.

2> Orifice lights operating on open orifices.

3> Orifice jets not hitting back wall, bypass gallery full.

4> Operate at least one orifice per bulkhead slot (preferably the north orifice)(18 open). If the project is operating at MOP, additional orifices may be operated to maintain a full collection channel. If orifices must be closed to repair any part of the facility, <u>do not close orifices in operating turbine units with ESBS's in place for longer than 5 hours</u>.

Monitor fish condition in gatewells during orifice closure period.

5> Alternate orifices in fish screens slots daily (6 open).

6> Backflush orifices once per day. During periods of high debris, orifices may need to be backflushed more than once per day.

7> Makeup water gates and associated float controls operational.

e> Transportation Facilities:

1> 42-inch and 48-inch sluice gate operational.

2> Maintain stable water conditions in upwell and separator.

3> No holes in inclined screen.

4> Crowder and brushes in good operating order.

5> All valves, slide gates, and switch gates in and around separator and raceways operational.

6> Raceway retainer screens to be clean and have no holes or protruding wire.

f> Barge and Truck Loading Facilities:

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

g> Inspection and Record Keeping:

1> Inspect fish facilities once each shift. Inspect facilities according to fish facilities monitoring program.

2> Record all maintenance and inspections.

b. Adult Fish Passage Facilities. Operate the adult fish passage facilities according to the following criteria:

1) Prior to March 1:

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

b> Dewater all ladders and inspect all dewatered sections of fish facilities for projections, debris, or plugged orifices which could injure fish or impede fish passage up the ladder. Inspect all diffuser gratings and chambers either visually or by video according to CENPW-OP-T approved inspection program. Repair deficiencies.

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

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

e> Inspect all spillgates and ensure that they are operable.

2) March 1 through December 31 (Adult Fish Passage Period):

***Note:** Little Goose pool may be operated at minimum operating pool (MOP), between elevations 633 and 634, as part of the Corps' efforts to improve migration conditions for juvenile salmonids. This will result in some of the adult fishway entrances at Lower Granite bottoming out on their sills prior to reaching criteria depths. Continuous operation at MOP may also result in increased pumping head on the auxiliary water supply pumps, decreasing the amount of water by the pumps.

a> Fishway Ladder:

Water depth over weirs: 1.0 to 1.3 feet

b> Head on all Fishway Entrances:

Head range: 1.0 to 2.0 feet.

c> North Shore Entrances (NSE 1 & 2):
(Elevation of top of gates when on sill - 625)

1> Operate both downstream gates.

2> Weir depth: 7 feet or greater below tailwater.

d> North Powerhouse Entrances (NPE 1 & 2):
(Elevation of top of gates when on sill - 628)

1> Operate both downstream gates.

2> Weir depth: 8 feet or greater below tailwater.

e> Powerhouse Collection System:

Operate 4 floating orifices (numbers 1, 4, 7, and 10).

f> South Shore Entrances (SSE 1 & 2):
(Elevation of top of gates when on sill - 625)

1> Operate both gates.

2> Weir depth; 8 feet or greater below tailwater.

g> Transportation Velocity:

1.5 to 4 feet per second.

h> Tunnel Lights:

Lights in the tunnel section, under the spillway, shall be on during fish passage period.

i> Head on Trashracks:

1> Maximum head of 0.5 feet on ladder exits.

2> Maximum head on picketed leads shall be 0.3 feet.

j> Staff Gages and Water Level Indicators:

Shall be readable at all water levels encountered during fish passage period.

k> Facility Inspections:

1> Powerhouse operators shall inspect facilities once per day.

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

3> Project personnel shall check calibration of fishway control system twice per month to ensure that it is kept within calibration.

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

5> Record all inspections.

c> Facility monitoring and reporting: Project biologists shall inspect fish passage facilities at the frequencies listed in the juvenile and adult fish facilities operating criteria sections. Project biologists shall prepare weekly reports, from March 1 through December 31, summarizing project operations. The weekly reports should provide an overview of how the project and the fish passage facilities operated during the week and an evaluation of resulting fish passage conditions. The reports shall include: any out of criteria situations observed and subsequent corrective actions taken; any equipment malfunctions, breakdowns, or damage along with a summary of resulting repair activities; adult fishway control calibrations; ESBS and VBS inspections; and any unusual activities which occurred at the project which may effect fish passage. The weekly reports shall cover a Friday through Thursday time period and shall be sent to CENPW-OP-TF by noon the following Monday via electronic mail. Project biologist shall prepare a draft annual report by February 10 and a final report by March 15 summarizing the operation of the project fish passage facilities for the previous year.

C. Project Maintenance.

Project biologists shall be present to provide technical guidance at all project activities which may involve fish handling. All dewaterings shall be accomplished in accordance with approved project dewatering plans.

1. Juvenile Fish Passage Facilities.

a) Scheduled Maintenance: Scheduled maintenance of the juvenile facilities is conducted during the entire year. Long-term maintenance or modification of facilities which require them to be out of service for extended periods of time are conducted during the winter maintenance period from December 16 to March 31. During the fish passage season parts of the facilities are maintained on a daily, weekly, or longer interval to keep them in proper operating condition.

b) Unscheduled Maintenance: Unscheduled maintenance is the correction of any situation which prevents the facilities from operating according to criteria or which will impact fish passage and survival. Maintenance of facilities such as ESBS's, which sometimes break down during the fish passage season, will be carried out according to procedures described below. In these cases, repairs will be made as prescribed and CENPW-OP-TF notified for further coordination. Unscheduled maintenance which will have a significant impact on juvenile fish passage shall be coordinated with the CBFWA and NMFS on a case-by-case basis by CENPW-OP-TF. CENPW-OP-TF will be notified as soon as possible after it becomes apparent that maintenance repairs are required. The Project Manager has the authority to initiate work prior to notifying CENPW-OP-TF when in his opinion delay of the work will

result in an unsafe situation for people, property, or fish. Information required by CENPW-OP-TF includes:

1. Description of the problem.

2. Type of outage required.

3. Impact on facility operation.

4. Length of time for repairs.

5. Expected impacts on fish passage.

1) Extended-length Bar Screens: Extended-length bar screens are inspected periodically throughout the juvenile migration season with a video monitoring system. If a screen is found to be damaged or malfunctions at any time, it will be removed and either replaced with a spare or repaired and returned to service. A turbine unit shall not be operated during the juvenile fish passage season with a missing, damaged, or non-operating ESBS. If an ESBS fails on a weekend or at night when maintenance crews are not available, the respective turbine unit will be shut down and generation switched to another, fully screened unit. If all screened turbine units are in service, water may be spilled until the affected ESBS can be removed and repaired or replaced.

2) Gatewell Orifices: Each turbine intake has 4 orifices, 2 10-inch orifices with air operated valves in the bulkhead slot and 2 8-inch orifices with manually operated slide gates in the fish screen slot, for allowing the fish to exit the slots. Under normal operation, a total of 24 orifices are operated with 18 being bulkhead slot orifices and 6 being fish screen slot orifices. At least 1 orifice is open in each bulkhead slot with the fish screen slot orifices rotated. If an orifice becomes blocked with debris it will normally be cleaned and remain in operation. If an orifice is damaged, it will be closed and the alternate orifice for that gatewell operated until repairs can be made. If both orifices are blocked with debris or damaged, the turbine unit will be taken out of service until repairs can be made. If repairs are to take longer than 48 hours, juvenile fish will be dipped from the gatewell with a gatewell dip basket.

3) Bypass Pipe: The bypass pipe goes from the end of the powerhouse bypass channel to the transportation facilities downstream of the dam. All juvenile fish in the bypass system must pass through this to the transportation facilities or to the tailrace. If any part of the bypass pipe is damaged, the gatewell orifices will be closed and the bypass system unwatered until repairs can be made. Turbine units will not be operated for longer than 5 hours with ESBS's in place and orifices closed. If an outage takes longer than 5 hours, spill will be provided to bypass juvenile fish. During any orifice closure, gatewells shall be monitored by project personnel for signs of fish

problems or mortality. During periods of high fish passage, orifice closure times may be less than 5 hours depending on fish numbers and condition.

4) Transportation Facilities: The transportation facilities can be operated to either collect and hold juveniles for the transportation program or to bypass them back to the river. If part of the facility malfunctions or is damaged, efforts will first be made to bypass the fish around the damaged area. If this is not possible, the fish will be bypassed around the transportation facilities or the entire bypass system unwatered until repairs are made. Spill may be used as an alternative avenue for fish passage during a bypass system outage.

2. Adult Fish Passage Facilities.

a) Scheduled Maintenance: Scheduled maintenance of a facility which must be unwatered to work on or whose maintenance will have a significant effect on fish passage will be done during the winter maintenance period from January 1 to March 1. Maintenance of facilities which will not have a significant effect on fish passage may be conducted during the rest of the year. When facilities are not being maintained during the winter maintenance period, they will be operated according to normal operating criteria unless otherwise coordinated with the fishery agencies and tribes.

b) Unscheduled Maintenance: Unscheduled maintenance which will significantly affect the operation of a facility will be coordinated with the fishery agencies and tribes. Coordination procedures for unscheduled maintenance of the adult facilities are the same as for juvenile facilities. If part of a facility malfunctions or is damaged during the fish passage season and the facility can still be operated within criteria without any detrimental effects on fish passage, repairs may not be conducted until the winter maintenance period or until fewer numbers of fish are passing the project. If part of a facility is damaged or malfunctions that may significantly impact fish passage, it will be repaired as soon as possible.

1) Fish Ladder and Counting Station: The fish ladder contains fixed weirs, a counting station with picketed leads, an adult fish trap located in an offshoot from the ladder, and a fish exit with trashrack. If any part of the ladder fails or is blocked with debris during the fish passage season, efforts will first be made to correct it without unwatering the ladder. Trash racks, picketed leads, and counting stations can sometimes be repaired or maintained without unwatering the ladder. If the fish trap malfunctions or is damaged, fish may be passed around it until repairs are made. The decision to dewater the ladder and make repairs during the fish passage season or wait until the winter maintenance period will be made after consultation with the fishery agencies and tribes.

2) Auxiliary Water Supply System: The auxiliary water for the fish ladder and the powerhouse collection system is supplied by three electric pumps. During normal operations and most flow conditions, two pumps are capable of providing the required flows. If a pump fails during the two-pump operation, the pump on standby will be operated to make up the flows. If two pumps fail, NSE 2 and NPE 2 will be closed and NPE 1 raised in one-foot increments to provide the required 1.0 to 2.0-foot head differential. If the head cannot be maintained by the time the top of the weir reaches 5 feet, the floating orifices should be closed in the following order: OG-4, OG-7, OG-10, and OG-1. If the head in the system still cannot be maintained at this point, SSE 1 and SSE 2 should be raised in one-foot increments until 5 feet below tailwater is reached. If all three pumps fail, NSE 1 and NPE 1 should be closed, the powerhouse collection channel bulkheaded off at the junction pool, and SSE 1 and SSE 2 operated at 6 feet below tailwater regardless of the head.

3) Fishway Entrances: The fishway entrances consist of main entrance weirs with hoists and automatic controls, and floating orifices which regulate themselves with tailwater level. If any of the automatic controls malfunction, the weirs can be operated manually by project personnel and kept within criteria. If there is a further failure which prevents an entrance from being operated manually. The weirs can usually be left in a lowered position while repairs are being conducted or the entrance closed and the water redistributed to other entrances while repairs are made. If a floating orifice is damaged, it will be pulled out of the water and the entrance bulkheaded off until it is repaired.

D. Turbine Unit Operation and Maintenance.

1. Turbine Unit Operation. When in operation, turbine units will be operated to enhance adult and juvenile fish passage from March 1 through December 15. During this time period, turbine units will be operated (as needed to meet generation requirements) in the following order: 1, 2, 3, and then 4 through 6 (in any order) when units are available for operation. Unit operating priority may be coordinated differently to allow for fish research, construction, or project maintenance activities. To minimize mortality to juvenile fish passing through the turbine units from April 1 through October 31 (or as long as there is sufficient river flow and/or generation requests to operate turbine units 4, 5, and 6 within 1 percent of peak efficiency), operating priority during nighttime hours from 2000 to 0400 hours shall be units 4, 5, and 6 (in any order) and then units 1, 2, and 3 as needed. If a turbine unit is taken out of service for maintenance or repair, the next unit in the priority list shall be operated. Zero nighttime flow (no generation) may be implemented during the August 15 through November 30 time period. If this occurs, the special operation will be coordinated with CBFWA and NMFS.

To the extent technically feasible, turbine units will be operated within 1% of peak efficiency from March 15 through November 30 (or as specified in BPA's load shaping guidelines) unless operation outside of that range is necessary to: 1) meet the load requirements of the BPA administrator whose load requirements will be made in accordance with BPA's policy, statutory requirements, and load shaping guidelines (Appendix C); or 2) be in compliance with other coordinated fishery measures. Project personnel shall record when turbine units are operated outside the 1% peak efficiency range and shall provide the information to BPA on a weekly basis according to the load shaping guidelines. Between December 1 and March 15, turbine units will continue to be operated within the 1% peak efficiency range except when BPA load requests require the units to be operated outside the 1% range.

Guidelines for operation of the turbine units within 1% of peak efficiency at various head ranges are listed below. The following 1% peak efficiency ranges were calculated using results from 1994 index testing of turbine unit 3 at Little Goose Dam. Maximum generation of units 1 through 6 at 115% overload is 155 MW.

Turbine Units 1-3:

****With Standard Length Submersible Traveling Screens Installed:**

Head Feet	Lower Generator Limits		Upper Generator Limits	
	(MW)	(CFS)	(MW)	(CFS)
85	80	12,966	137	22,317
86	81	12,966	140	22,441
87	81	12,797	141	22,331
88	82	12,796	142	22,239
89	83	12,793	144	22,151
90	84	12,790	145	22,067
91	84	12,651	146	21,982
92	85	12,653	149	22,106
93	87	12,657	150	22,023
94	88	12,666	151	21,943
95	89	12,677	152	21,866
96	89	12,563	154	21,793
97	90	12,577	155	21,724
98	91	12,588	155	21,478
99	92	12,589	155	21,237
100	92	12,481	155	21,024
101	93	12,486	155	20,816
102	94	12,489	155	20,588
103	95	12,492	155	20,365
104	95	12,390	155	20,146
105	96	12,502	155	19,954

Turbine Units 1-3:

****Without Submersible Traveling Screens:**

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

Turbine Units 4-6:

****With Standard Length Submersible Traveling Screens Installed:**

Head Feet	Lower Generator Limits		Upper Generator Limits	
	(MW)	(CFS)	(MW)	(CFS)
85	86	13,525	120	18,945
86	87	13,516	122	19,014
87	88	13,509	124	19,080
88	89	13,502	126	19,142
89	90	13,495	128	19,200
90	91	13,487	130	19,255
91	92	13,480	132	19,310
92	93	13,477	134	19,364
93	94	13,475	135	19,255
94	95	13,472	137	19,305
95	96	13,469	138	19,203
96	98	13,559	139	19,264
97	99	13,554	140	19,180
98	100	13,547	141	19,102
99	102	13,632	142	19,027
100	104	13,720	143	18,956
101	106	13,808	143	18,746
102	107	13,801	143	18,542
103	108	13,796	143	18,342
104	109	13,791	145	18,418
105	110	13,785	147	18,434

Turbine Units 4-6:

****Without Submersible Traveling Screens:**

Head Feet	Lower Generator Limits		Upper Generator Limits	
	(MW)	(CFS)	(MW)	(CFS)
85	98	15,421	126	19,896
86	99	15,410	128	19,968
87	100	15,402	131	20,037
88	102	15,394	133	20,103
89	103	15,386	135	20,164
90	104	15,377	137	20,221
91	105	15,370	139	20,279
92	106	15,366	141	20,336
93	107	15,364	142	20,221
94	108	15,361	144	20,273
95	110	15,357	145	20,167
96	112	15,460	147	20,231
97	113	15,454	148	20,142
98	114	15,446	149	20,060
99	116	15,543	150	19,982
100	119	15,643	151	19,907
101	121	15,744	151	19,686
102	122	15,736	151	19,472
103	123	15,730	151	19,262
104	124	15,724	153	19,343
105	126	15,717	155	19,359

[The CBFWA recommends that turbine units be operated within 1% of peak efficiency unless otherwise agreed.]

2. Turbine Unit Maintenance. The project's turbine unit maintenance schedule will be reviewed annually by project and Operations Division biologists for fishery impacts. If possible, maintenance of priority units will be scheduled for non-fish passage periods, or when there are low numbers of fish passing the project. Each turbine unit requires annual maintenance which may take from several days to two weeks. Annual maintenance of all turbine units is normally scheduled during the mid-July to late November time frame. The maintenance of priority units for adult passage is normally conducted during mid-August, when fewer adults are migrating, to minimize impacts on migrating adults. Turbine units may occasionally require overhauls to repair major problems with the turbine or generator. Overhauls may take over one year to accomplish. Turbine units, governors, exciters, and control systems require periodic maintenance, calibration, and testing which may take them outside of the one percent peak efficiency. This work will be scheduled in compliance with BPA load shaping guidelines (Appendix C) to minimize impacts on juvenile fish. Transformers are doble tested every 3 years. Testing may need to be more frequent if there is a known problem with a transformer. These tests normally take 2 to 3 work days. To conduct the testing, the transmission lines have to be disconnected from the transformers and normal generation stopped. One turbine unit will operate in a speed-no-load condition to provide project power and operation of fish passage facilities. Spill may be provided to meet minimum required project discharges during the testing hours. The doble tests are normally scheduled for the August time period to minimize impacts on adult and juvenile fish passage.

Table 35. Lower Granite Spillway Pattern for Adult Fish Passage.

Elevation 737

Gate Number								Total	
1	2	3	4	5	6	7	8	Stops	kcfs
1								1	1.75
1							1	2	3.5
1						1	1	3	5.25
1	1				1	1	1	4	7.00
1	1				1	1	1	5	8.75
1	1	1			1	1	1	6	10.50
1	2	1			1	1	1	7	12.37
1	2	1			1	2	1	8	14.25
1	2	1	1		1	2	1	9	15.99
1	2	2	1		1	2	1	10	17.86
1	2	2	1	1	1	2	1	11	19.61
1	2	2	2	1	1	2	1	12	21.48
1	2	2	2	2	1	2	1	13	23.35
1	2	2	3	2	1	2	1	14	25.27
2	2	2	3	2	1	2	1	15	27.14
2	2	2	3	3	1	2	1	16	29.06
2	2	2	3	3	2	2	1	17	30.93
2	2	3	3	3	2	2	1	18	32.85
2	3	3	3	3	2	2	1	19	34.77
2	3	3	4	3	2	2	1	20	36.67
3	3	3	4	3	2	2	1	21	38.61
3	3	4	4	3	2	2	1	22	40.53
3	3	4	4	3	3	2	1	23	42.45
3	4	4	4	3	3	2	1	24	44.37
3	4	4	4	4	3	2	1	25	46.29
3	4	4	5	4	3	2	1	26	48.21
3	4	5	5	4	3	2	1	27	50.13
4	4	5	5	4	3	2	1	28	52.05
4	5	5	5	4	3	2	1	29	53.97
4	5	5	5	4	4	2	1	30	55.89
4	5	5	5	5	4	2	1	31	57.81
4	5	5	6	5	4	2	1	32	59.73
4	5	6	6	5	4	2	1	33	61.65
4	6	6	6	5	4	2	1	34	63.57

NOTE: Spills over 64,000 should be employed only at night if possible. Schedule is based on model studies and needs to be verified.

APPENDIX B

SPECIAL PROJECT OPERATIONS AND RESEARCH

Bonneville Dam

BONNEVILLE DAM

1. **Spring Creek Hatchery Release.** Project operated to achieve 70 percent fish passage efficiency (FPE) during Spring Creek Hatchery Release which normally occurs in March. The latest subyearling chinook (before 6/15) fish guidance efficiency (FGE) data will be used to calculate FPE. The first powerhouse will operate as first priority during the hatchery release operation. The second powerhouse can be operated only after the first powerhouse has been fully loaded. If the second powerhouse is started, it must continue to be operated through the daylight hours.

2. **Special Project Operations.** Powerhouse priority during the spring juvenile salmon outmigration season and bypass screen operation during the summer juvenile salmon outmigration season are being reviewed in consultation with NMFS, and may be revised.

a. Spring Operations.

The first powerhouse will operate as first priority during the spring juvenile salmon outmigration season. The second powerhouse can be operated only after the first powerhouse has been fully loaded. If the second powerhouse is started it must continue to be operated through the daylight hours. Initial spring operations to achieve 70 percent FPE for lower river outmigrants, including spill, will begin after the first 10 percent of the spring migration has passed the project, but no later than 2000 hours 15 April. Spill to achieve 80 percent FPE, as requested in the NMFS Biological Opinion to protect endangered salmon species, will commence at 0001 hours on 20 April. All voluntary spill is subject to limitations to avoid producing excessive TDG levels downstream. Initially, the latest yearling chinook FGE (Table 1) will be used to calculate the project FPE. If migrating juvenile Snake River sockeye are detected in sufficient numbers in the lower Columbia River, changing to the latest sockeye FGE to calculate the project FPE will be considered.

b. Summer Operations.

The first powerhouse will operate as first priority during the summer juvenile salmon outmigration season. The second powerhouse can be operated only after the first powerhouse has been fully loaded. If the second powerhouse is started it must continue to be operated through the daylight hours. Operations to achieve 80 percent FPE for summer migrants will occur from 1 July through 31 August. The latest subyearling chinook (after 6/15) FGE data will be used to calculate project FPE.

c. Additional Special Project Operations.

The following priorities are in effect throughout the juvenile and adult fish passage season (end of the work week closest to March 1 through November 30). Maintain first powerhouse flows of at least 60 kcfs to provide favorable tailwater conditions for juvenile outmigration. If the second powerhouse is operating, also maintain flows of at least 60 kcfs. Both powerhouse can be reduced below 60 kcfs to minimum unit loading if needed to achieve the desired FPE and if necessary due to low river flows. The minimum loading in the first powerhouse is units 1, 2, 9, and 10. Units 9 and 10 are required to provide suitable flow to disperse juvenile fish from the JBS release site. Units 1 and 2 are necessary to provide energy to meet critical project loads including station service for the first powerhouse, navigation lock, fish hatchery, sewage treatment plant, project office buildings, well pumps, and an emergency first and second powerhouse interconnection. Normally, unit 1 is tied to the feeder bus and unit 2 remains on line, as a redundancy, in the event unit 1 fails. The minimum loading in the second powerhouse is units 11, 17 and 18. These units provide suitable flow conditions for migrating fish.

Any spill occurring during the daylight hours will not exceed 75,000 cfs or be reduced below 50,000 cfs, without special coordination and to the extent possible, depending on powerhouse limitations and special flow requirements. Nighttime spill to achieve 80 percent FPE will be limited as necessary to avoid producing excessive TDG downstream. The Corps' RCC will determine maximum nighttime spill to avoid producing excessive dissolved gas levels, and provide specific flow distribution guidelines to the project.

Table I. FGE values for the first and second powerhouses used to calculate FPE.

	Bonneville First	Bonneville Second
Chinook yearlings	37%	48%
Chinook subyearlings (before 6/15)	39%	50%
Chinook subyearlings (after 6/15)	10%	32%
Coho	63%	55%
Sockeye	23%	37%
Steelhead	56%	41%

3. Research.

a. Numerous evaluations will be conducted at the projects to document salmonid behavioral responses to particular hydraulic flow fields. This information will be used to evaluate specific structural modifications intended to improve passage conditions. Hydroacoustics, radio telemetry, sonic tags, and various acoustic methodologies will be used to survey, and in some cases (i.e. acoustic technologies) attempt to modify fish behaviors. Direct capture and mark and recapture studies will be used to evaluate fish condition and migration patterns, and hydraulic velocity mapping (ADCP) will document and verify forebay flow fields.

b. Special operations required to support these studies will be conducted outside of the juvenile fish migration period to the extent practicable. However, some modifications to standard project operations will be necessary to complete specific studies. These could include increasing or reducing spill and sluiceway volumes, adjusting powerhouse or turbine unit loads, and manipulating pool elevations.

c. At this time, study designs being developed for the Surface Bypass Program will include installing up to four baffled spillway structures at The Dalles dam. At least one spillway bay will be equipped with an 'I' configured baffle, and at least one additional bay will be equipped with an overflow weir. Studies will probably include modifying the spill pattern to incorporate use of these baffled structures on a random basis throughout the fish passage season. Overflow weirs may also be tested at Bonneville and John Day Dams in similar fashion.

d. The effects of lowering the zone of flow separation into a turbine unit will be tested at both Bonneville and The Dalles Dams. At Bonneville, two main units will have trashracks blocked down to an elevation of approximately 30' for two week testing blocks in the spring and summer. Sluicegates will be operated over the test units for the duration of these studies, as opposed to those gates currently required for normal operation (7A, 10C). The second powerhouse trash chute will also be operated periodically to sample fish passage effectiveness, and efficiency relative to the rest of the Bonneville project. Trashracks will be

randomly blocked at The Dalles Dam in front of as many as seven turbine units, including the two fishwater turbine units, for much of the fish passage season. Operation of The Dalles Dam sluiceway will only be effected while trashrack blocks are being manipulated.

e. Additional studies to be conducted at Portland District Columbia River Projects will include the Lower Columbia River Adult Salmon and Steelhead Passage Evaluation. Adult fish will be collected at the Bonneville Dam adult collection facility, tagged and released for tracking throughout the basin. Extended guidance screen research will occur at John Day Dam, requiring special operation of main units six and seven. FGE, OPE, and descaling evaluations will be included in this study, will require a fyke net in main unit seven, and daily gatewell sampling from the test units. Horizontal distribution may also be surveyed via periodic gatewell samples taken from additional units at the powerhouse.

f. All special operational requests will be coordinated through the Anadromous Fish Evaluation Program.

4. Fish Counting Program.

a. 1 January - 31 March: Video count 24 hours per day.

b. 1 April - 31 October: Visual count 16 hours per day (0400 - 2000 PST).

c. 1 April - 31 October: Video count 8 hours per day (2000 - 0400 PST).

d. 1 November - 31 December: Video count 24 hours per day.

5. Project Improvements for Endangered Species.

a. **Spill Pattern Modifications.** This item is to: 1) develop a new spill pattern for use at night for juvenile fish (completed in 1992); 2) develop a new spill pattern for use during the daytime for adult fish attraction (completed October 1993) and; 3) automate spill gates to enable closer adherence to prescribed spill patterns (scheduled to be completed by April 1996).

b. **STS, VBS & Orifice Inspection System.** This item is to provide a more efficient and reliable way to inspect the condition of JBS components during the passage season. Prototype system is scheduled to be completed by March 1995. Testing will be conducted on the unit at John Day Dam for one year prior to procurement of additional units for Bonneville and The Dalles dams.

c. **Gatewell Debris Removal System.** This item is to enable debris removal from gatewells with minimum impact on fish. Methodology is being developed at Bonneville Dam and will be tested in 1995.

d. **Modify Upstream Migrant Fishway Entrances.** This item is to modify entrances to the first powerhouse collection system to present better entrance conditions throughout the full range of tailwater elevation change. Scheduled to be completed by April 1996.

6. Other.

a. Additional temperature monitoring equipment will be installed, operated, and maintained in adult fishways, forebays, and tailraces as required by the NMFS Biological Opinion.

The Dalles Dam

THE DALLES DAM

1. Special Project Operations.

a. Spill.

Spill will be provided continuously from 20 April through 31 August to achieve 80 percent FPE for spring and summer migrants, consistent with TDG management to avoid excessive gas supersaturation conditions. Spill and TDG management will be implemented in accordance with NMFS recommendations contained in Section VIII.A.2. of their ESA Biological Opinion on hydrosystem operation, dated 2 March 1995, Reasonable and Prudent Alternative.

2. Research.

a. Numerous evaluations will be conducted at the projects to document salmonid behavioral responses to particular hydraulic flow fields. This information will be used to evaluate specific structural modifications intended to improve passage conditions. Hydroacoustics, radio telemetry, sonic tags, and various acoustic methodologies will be used to survey, and in some cases (i.e. acoustic technologies) attempt to modify fish behaviors. Direct capture and mark and recapture studies will be used to evaluate fish condition and migration patterns, and hydraulic velocity mapping (ADCP) will document and verify forebay flow fields.

b. Special operations required to support these studies will be conducted outside of the juvenile fish migration period to the extent practicable. However, some modifications to standard project operations will be necessary to complete specific studies. These could include increasing or reducing spill and sluiceway volumes, adjusting powerhouse or turbine unit loads, and manipulating pool elevations.

c. At this time, study designs being developed for the Surface Bypass Program will include installing up to four baffled spillway structures at The Dalles dam. At least one spillway bay will be equipped with an 'I' configured baffle, and at least one additional bay will be equipped with an overflow weir. Studies will probably include modifying the spill pattern to incorporate use of these baffled structures on a random basis throughout the fish passage season. Overflow weirs may also be tested at Bonneville and John Day Dams in similar fashion.

d. The effects of lowering the zone of flow separation into a turbine unit will be tested at both Bonneville and The Dalles Dams. At Bonneville, two main units will have trashracks blocked down to an elevation of approximately 30' for two week testing blocks in the spring and summer. Sluicegates will be operated over the test units for the duration of these studies, as opposed to those gates currently required for normal operation (7A, 10C). The second powerhouse trash chute will also be operated periodically to sample fish passage effectiveness, and efficiency relative to the rest of the Bonneville project. Trashracks will be randomly blocked at The Dalles Dam in front of as many as seven turbine units, including the two fishwater turbine units, for much of the fish passage season. Operation of The Dalles Dam sluiceway will only be effected while trashrack blocks are being manipulated.

e. Additional studies to be conducted at Portland District Columbia River Projects will include the Lower Columbia River Adult Salmon and Steelhead Passage Evaluation. Adult fish will be collected at the Bonneville Dam adult collection facility, tagged and released for tracking throughout the basin. Extended

guidance screen research will occur at John Day Dam, requiring special operation of main units six and seven. FGE, OPE, and descaling evaluations will be included in this study, will require a fyke net in main unit seven, and daily gatewell sampling from the test units. Horizontal distribution may also be surveyed via periodic gatewell samples taken from additional units at the powerhouse.

f. All special operational requests will be coordinated through the Anadromous Fish Evaluation Program.

3. Fish Counting Program.

a. 1 April - 31 October: Visual count 16 hours per day (0400 - 2000 PST).

4. Project Improvements for Endangered Species.

a. **Adult Fish Attraction Emergency Water Supply**. This item is to reduce the dependency of the adult fishways on the two fishwater units. Parts are being provided to reduce extended outages of the fish units, and fish unit transformers. A new water supply is being considered under alternate programming.

5. Other.

a. Additional temperature monitoring equipment will be installed, operated, and maintained in adult fishways, forebays, and tailraces as required by the NMFS Biological Opinion.

John Day Dam

JOHN DAY DAM

1. Special Project Operations.

a. Spill.

Spill will be provided for 12 hours each night from 20 April through 31 August to achieve 80 percent FPE for spring and summer migrants, consistent with TDG management to avoid excessive gas supersaturation conditions. Spill and TDG management will be implemented in accordance with NMFS recommendations contained in Section VIII.A.2. of their ESA Biological Opinion on hydrosystem operation, dated 2 March 1995, Reasonable and Prudent Alternative.

b. Special Operation for Adult Passage.

From 0400 to 2000 hours, March 1 through November 30, operate unit 1 in the 90 to 110 MW range to provide best ladder entrance condition for adult fish passage, except as required under special coordinated conditions.

2. Research.

a. Numerous evaluations will be conducted at the projects to document salmonid behavioral responses to particular hydraulic flow fields. This information will be used to evaluate specific structural modifications intended to improve passage conditions. Hydroacoustics, radio telemetry, sonic tags, and various acoustic methodologies will be used to survey, and in some cases (i.e. acoustic technologies) attempt to modify fish behaviors. Direct capture and mark and recapture studies will be used to evaluate fish condition and migration patterns, and hydraulic velocity mapping (ADCP) will document and verify forebay flow fields.

b. Special operations required to support these studies will be conducted outside of the juvenile fish migration period to the extent practicable. However, some modifications to standard project operations will be necessary to complete specific studies. These could include increasing or reducing spill and sluiceway volumes, adjusting powerhouse or turbine unit loads, and manipulating pool elevations.

c. At this time, study designs being developed for the Surface Bypass Program will include installing up to four baffled spillway structures at The Dalles dam. At least one spillway bay will be equipped with an 'I' configured baffle, and at least one additional bay will be equipped with an overflow weir. Studies will probably include modifying the spill pattern to incorporate use of these baffled structures on a random basis throughout the fish passage season. Overflow weirs may also be tested at Bonneville and John Day Dams in similar fashion.

d. The effects of lowering the zone of flow separation into a turbine unit will be tested at both Bonneville and The Dalles Dams. At Bonneville, two main units will have trashracks blocked down to an elevation of approximately 30' for two week testing blocks in the spring and summer. Sluicegates will be operated over the test units for the duration of these studies, as opposed to those gates currently required for normal operation (7A, 10C). The second powerhouse trash chute will also be operated periodically to sample fish passage effectiveness, and efficiency relative to the rest of the Bonneville project. Trashracks will be randomly blocked at The Dalles Dam in front of as many as seven turbine units, including the two fishwater

turbine units, for much of the fish passage season. Operation of The Dalles Dam sluiceway will only be effected while trashrack blocks are being manipulated.

e. Additional studies to be conducted at Portland District Columbia River Projects will include the Lower Columbia River Adult Salmon and Steelhead Passage Evaluation. Adult fish will be collected at the Bonneville Dam adult collection facility, tagged and released for tracking throughout the basin. Extended guidance screen research will occur at John Day Dam, requiring special operation of main units six and seven. FGE, OPE, and descaling evaluations will be included in this study, will require a fyke net in main unit seven, and daily gatewell sampling from the test units. Horizontal distribution may also be surveyed via periodic gatewell samples taken from additional units at the powerhouse.

f. All special operational requests will be coordinated through the Anadromous Fish Evaluation Program.

3. Fish Counting Program.

a. 1 April - 31 October: Visual count 16 hours per day (0400 - 2000 PST).

4. Project Improvements for Endangered Species.

a. **Modify South Ladder Diffuser**. This item is to modify the upper part of the south ladder to reduce fish holding and leaping. Temporary modifications will be made permanent by March, 1996.

5. Other.

a. Additional temperature monitoring equipment will be installed, operated, and maintained in adult fishways, forebays, and tailraces as required by the NMFS Biological Opinion.

McNary Dam

McNary Dam

1. **Special Project Operations.**

a. **North Shore Fish Ladder.** North Wasco County PUD is constructing a hydroelectric facility on the north shore fish ladder auxiliary water supply system. As part of the construction work, the high velocity/gravity flow diffuser system will be converted to a low velocity/low head orifice and overflow weir system. The north fish ladder will be unwatered for three extended winter maintenance seasons to facilitate the construction work. The dates of the three outages are: December 1, 1994 through March 15, 1995; December 1, 1995 through March 15, 1996; and December 1, 1996 through March 15, 1997. Construction outside of the fish ladder will take place during the 1995, 1996, and 1997 fish passage seasons. Endangered Species Act consultation with National Marine Fisheries Service has placed specific requirements on the contractor's activities to minimize impacts to fish passage.

b. **Installation of New ESBS's, Flow Vanes, and VBS's.** Installation of new ESBS's, flow vanes, and VBS's will take place during 1996. The delivery schedule is staggered with 6 new ESBS's being delivered every 2 months with final delivery scheduled in December. New VBS's are scheduled to be installed prior to the installation dates for the ESBS's. This will require unit outages throughout the year for the installation of the VBS's and testing of the new ESBS's. Additional unit outages may take place between when new VBS's are installed and the time when the new ESBS's are delivered. Efforts will be made to maintain at least 12 units in service during the spring runoff period. Prototype ESBS's and ESTS's, used for fish guidance research from 1993 through 1995, will be used to minimize unit outages when possible. After the new ESBS's are installed, project personnel may need to gatewell dip fish to evaluate fish condition if descaling rates and other fish condition parameters monitored at the juvenile fish collection facilities warrant it.

c. **Spill.** Spill for fish passage will be provided during the spring outmigration season, in accordance with spill specifications in the NMFS Biological Opinion on hydrosystem operation (Appendix F) as updated in 1996 through the TMT Water Management Plan. Special daytime or nighttime spill patterns may be implemented to control dissolved gas levels to agreed upon levels, while attempting to achieve desired spillway discharges.

Alternative spill patterns to reduce TDG levels should be coordinated through the TMT. During February and March, gas abatement spill tests may be conducted to explore spill patterns which may minimize dissolved gas generation per unit spill.

2. **Research**.

a. **Adult Fish Passage.** An evaluation of adult fish passage at the 4 lower Columbia River projects, including McNary Dam, is scheduled to begin in 1996. The objectives of the 1996 study at McNary Dam are to determine dam and reservoir passage times, fishway entrance use and passage, and impacts of project operations on fish passage. This study may include special project operations including; different turbine operating priorities, alternative spill patterns, alternating between downstream and side powerhouse entrances, and opening or closing floating orifice gates.

Ice Harbor Dam

Ice Harbor Dam

1. **Special Project Operations.**

a. **Turbine Operations.** The generator on turbine unit 5 is presently being rewound by a contractor. The work is scheduled to be completed and the turbine returned to service in mid-April.

b. **Juvenile Bypass System Construction.** A new juvenile bypass system is being constructed at Ice Harbor. The new system is replacing the existing ice and trash sluiceway operations with a collection channel, dewatering structure, bypass flume, and juvenile fish sampling facilities. The new facilities are scheduled to be in operation for the 1996 juvenile fish passage season.

c. **Spill.** Spill for fish passage will be provided during spring and summer outmigration seasons, in accordance with spill specifications in the NMFS Biological Opinion on hydrosystem operations (Appendix F). Special daytime and nighttime spill patterns may be implemented to control dissolved gas levels to agreed upon levels, while attempting to achieve desired spillway discharges. Alternative spill patterns to reduce TDG levels should be coordinated through the TMT.

2. **Fish Counting Program.** In addition to the normal 16 hour per day counting program from April 1 through October 31, adult fish will be counted:

a. April 1 - October 31: Video count from 2000 - 0400 PST.

b. November 1 - December 15: Video count 24 hours per day.

3. **Research.**

a. **Juvenile Fish Radio Tag Antenna Test.** A study may be conducted in 1996 to develop methods for monitoring passage of radio tagged juvenile fish for future surface bypass collector or guidance curtain related studies. This work includes installing antennas in turbine units, spillbays, and the juvenile bypass collection channel. This may require short term outages of turbine units or spillbays while antennas are installed.

b. **Juvenile Bypass System Post Construction Evaluation.** A post construction evaluation of the juvenile bypass system will be conducted in 1996. The testing may require some changes in operating criteria when the testing is conducted.

c. **Adult Fish Passage.** Spring/summer chinook tagged at Bonneville Dam will be monitored as they pass the project. The study will evaluate passage through the forebay for possible future surface bypass collector related studies.

Lower Monumental Dam

Lower Monumental Dam

1. **Special Project Operations.**

a. **Turbine Cavitation Repair.** A contractor will be conducting turbine blade cavitation repair on turbine units 4 and 5. The contractor will be working on one turbine unit at a time and is allowed 120 days per turbine unit. The contract work is scheduled to take place from early January through late September.

b. **Spill.** Spill for fish passage will be provided during the spring outmigration season under certain conditions of higher flow, according to specifications in the NMFS Biological Opinion on hydrosystem operation (Appendix F). Special nighttime spill patterns may be implemented to control dissolved gas levels to agreed upon levels, while attempting to achieve desired spillway discharges. Alternative spill patterns to reduce TDG levels should be coordinated through the TMT. During February and March, gas abatement spill tests may be conducted to explore spill patterns which may minimize dissolved gas generation per unit spill.

Little Goose Dam

Little Goose Dam

1. **Special Project Operations.**

a. **Spill.** Spill for fish passage will be provided during the spring outmigration season under certain conditions of higher flow, according to specifications in the NMFS Biological Opinion on hydrosystem operation (Appendix F). Special nighttime spill patterns may be implemented to control dissolved gas levels to agreed upon levels, while attempting to achieve desired spillway discharges. Alternative spill patterns to reduce TDG levels should be coordinated through the TMT. During March, gas abatement spill tests may be conducted to explore spill patterns which may minimize dissolved gas generation per unit spill.

2. **Research.**

a. **Adult Fish Passage.** An adult fish passage study will be conducted at the 4 lower Columbia River projects. Radio telemetry equipment may be in place at Little Goose to monitor radio tagged adults as they pass the project. If river flows are high enough to provide sufficient involuntary spill during the spring, alternative spill patterns may be used to evaluate fish passage under various spill patterns.

Lower Granite Dam

Lower Granite Dam

1. **Special Project Operations.**

a. **Monitoring of Fish Condition With New ESBS's and VBS's.** New ESBS's, flow vanes, and VBS are scheduled to be installed at Lower Granite in 1996 prior to the juvenile fish outmigration. After the new ESBS's are installed, project personnel may need to gatewell dip fish to evaluate fish condition if descaling rates and other fish condition parameters monitored at the juvenile fish collection facilities warrant it.

b. **Fish Screen Slot Closure.** Closure devices were installed in the fish screen slots and associated Wagner horns at Lower Granite Dam in 1995. In 1996, project personnel will periodically dip fish screen slots to determine if fish are getting past the slot closure devices.

c. **Spill.** Spill for fish passage will be provided during the spring outmigration season under certain conditions of higher flow, according to specifications in the NMFS Biological Opinion on hydrosystem operation (Appendix F). Special nighttime spill patterns may be implemented to control dissolved gas levels to agreed upon levels, while attempting to achieve desired spillway discharges. Alternative spill patterns to reduce TDG levels should be coordinated through the TMT.

2. **Fish Counting Program.** In addition to the normal fish counting program at Lower Granite Dam, adult fish will be counted:

a. April 1 - October 31: Video count from 2000 - 0400 PST.

b. November 1 - December 15: Video count from 1600 - 0600 PST.

3. **Research.**

a. **Surface Bypass Collector Study.** A prototype surface bypass collector will be constructed at Lower Granite Dam for the 1996 juvenile fish outmigration. The surface bypass collector will be in front of turbine units 4, 5, and 6 and will be connected to spillbay 1. When the surface bypass collector is operated, spillbay 1 will be used for discharging the flow. Spillbay 1 will not be operated when the surface bypass collector

is not operated. The operation of the surface bypass collector may also require discharges through spillbays 2 and 3 for training of the spillbay 1 flow. The operation and evaluation of the surface bypass collector may require changes in the turbine operating priority and spill patterns. The surface bypass collector will be evaluated using hydroacoustics and radio tagged juvenile fish. A survival study of juvenile fish passage through the surface bypass collector may also be conducted using tagged fish.

b. **Adult Fish Passage.** An adult fish passage study will be conducted at the 4 lower Columbia River projects. Radio telemetry equipment will be in place at Lower Granite to monitor radio tagged adults as they pass Lower Granite project. This work will serve as a continuation of the 4 year lower Snake River adult fish passage evaluation and will provide information for the surface bypass collector study. Radio tagged squawfish will also be monitored at Lower Granite in 1996. Special project operations will not be required for these studies.

APPENDIX C

CORPS OF ENGINEERS
JUVENILE FISH TRANSPORTATION PLAN

Corps of Engineers' Juvenile Fish Transportation Plan

1. Introduction:

a. The Juvenile Fish Transportation Plan describes operations and establishes criteria for the transportation of juvenile salmon and steelhead from Lower Granite, Little Goose, Lower Monumental, and McNary dams (collector dams) to release areas below Bonneville Dam. This work plan supplements normal operating criteria presented in Appendix A of the Fish Passage Plan for the collector dams.

b. Collection and transportation is accomplished by the Walla District, Corps of Engineers (CENPW), under an Endangered Species Act (ESA) permit from the National Marine Fisheries Service (NMFS). On-site biological oversight is provided by fishery agencies through Cooperative Agreements between CENPW and the Washington Department of Fish and Wildlife (WDFW), and Oregon Department of Fish and Wildlife (ODFW). On-site quality control is provided by WDFW at Lower Granite, Lower Monumental and McNary Dams, and ODFW at Little Goose Dam.

c. The transport program will be coordinated with other fishery monitoring, research, and management activities by CENPW. Coordination will be achieved with the fishery agencies and tribes through the Fish Passage Advisory Committee (FPAC), the Fish Passage Center (FPC), and other agencies as required.

2. Objective: The objective of CENPW and the transportation program is to maximize survival of fish collected and transported by:

a. Providing safe and efficient collection and barge or truck transport of juvenile salmon and steelhead from collector dams to release areas below Bonneville Dam;

b. Identifying and recommending programs or facility changes that would benefit fish collection and transportation or bypass operations;

c. Assuring that collection, transport, and release site facilities are ready for operation prior to the beginning of transport operations;

d. Assuring that collection, transport, and release site facilities are properly maintained throughout the transport season;

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

f. Coordinating changes needed to accommodate fluctuations in the outmigration with project, FPAC, and FPC personnel;

g. Coordinating transport evaluation and other research with the transportation program;

h. Providing the training of new personnel associated with collection and transport facilities and equipment;

i. Providing all parties involved a list of emergency points of contact and appropriate telephone numbers so that any emergency can be coordinated and corrected efficiently;

j. Preparing an annual report detailing transportation activities and results for the previous year, and identifying maintenance, replacement, or modifications needed for the next transport season.

3. Program Duration:

a. Starting Operations: Transport operations will start during the last week of March at Lower Granite Dam. Start-up at Little Goose and Lower Monumental dams will be keyed off fish collection numbers at Lower Granite Dam and the anticipated migration times to Little Goose and Lower Monumental dams. McNary Dam will begin sampling for PIT tags, monitoring facility operations. and the Smolt Monitoring Program during the last week of March. Transport operations at McNary Dam will not begin until conditions specified under paragraph 4.a.(2) are met.

b. Summer Transport Operations: At McNary Dam, summer operations will begin when the number of subyearling chinook exceeds the number of yearling salmon in the daily sample for 3 consecutive days. At Lower Granite, Little Goose, and Lower Monumental dams, summer operations will begin either when fish numbers have dropped below 500 fish per day, or water temperatures have reached approximately 70 degrees Fahrenheit (70°F) and sheltered holding areas are required. Sampling will convert to 100% and mini-tankers may be used. Steelhead, which

state biologists determine are in poor condition or are reverting to the parr stage, may be bypassed to the river.

c. Ending Operations: Transport operations are anticipated to continue through approximately October 31 at Lower Granite, Little Goose, and Lower Monumental dams, and December 15 at McNary Dam.

d. Emergency Termination Criteria: Project Biologists will report to the CENPW Transportation Coordinator when high water temperatures or other factors increase collection mortality to 6 percent of daily collection for 3 consecutive days or if daily collection mortality exceeds 10,000 fish. The Transportation Coordinator will evaluate the situation and shall notify or arrange a conference call with FPAC and FPC to discuss the options of continuing collection and transportation or to bypass fish. In the event of a fish loss exceeding conditions set forth in the ESA Section 10 Permit for the transportation program, the Corps shall notify NMFS and reopen consultation as needed. If icing conditions threaten facility integrity or present unsafe conditions on the transport route, transport operations may be terminated early by the Project Manager. Emergency termination will be coordinated by the CENPW Transportation Coordinator with NMFS, FPAC, and FPC.

4. Operating Criteria:

a. Collection and Transportation: Juvenile fish shall be transported in accordance with the ESA Section 10 permit, the Biological Opinion prepared under ESA Section 7 consultation with NMFS, and transportation program criteria. During transport operations, collected juvenile fish will be bypassed back to the river if the number of collected fish exceed facility and barge holding capacities. Holding for transportation will resume when adequate capacities are available to hold and transport fish according to transportation program criteria. Maximum holding time and loading criteria will not be exceeded without CENPW review and approval. Marked or PIT tagged fish will be released to the river if they are part of an approved research study or smolt monitoring program travel time evaluation. Specifics of the transportation may be altered during the transportation season based on recommendations from the Technical Management Team.

(1) At Lower Granite, Little Goose, and Lower Monumental dams, all juvenile fish collected shall be transported.

(2) At McNary Dam, fish collected during the spring shall be bypassed through the transportation facilities back to the river until subyearling chinook predominate the daily total chinook collection for 3 consecutive days. When this occurs, fish will be collected and held for transportation with all fish collected being transported. During the spring, juvenile fish may be sampled for the Smolt Monitoring program and for monitoring facility operations.

b. Peak Migration Periods: For the purpose of transport operations, the peak migration period is defined as beginning when total collection at an individual project reaches 20,000 fish per day (actual peak days may range from 250,000 to 830,000 fish per day). Normally, truck transportation will be used before and after the peak, and barge transportation will be used during the peak. Peak migration generally occurs between April 15 and May 31 at Lower Granite, Little Goose, Lower Monumental, and McNary Dams. At McNary Dam, a summer peak also occurs from late June through August.

c. Collection Facility Operations:

(1) Once transport operations begin, collection facilities will be staffed 24 hours per day until operations cease.

(2) Flows at the juvenile fish separator will be monitored at least every 15 minutes throughout separator operations.

(3) When collection systems are not providing safe fish passage or meeting operating criteria, project managers and biologists will make operational changes that are in the best interests of the fish, then notify CENPW as soon as possible. The CENPW Transport Coordinator will coordinate changes with NMFS, FPAC and FPC.

d. Sampling Procedures:

(1) Sampling will be accomplished in accordance with sampling guidelines recommended by FPAC.

(2) Fish that are sampled will be counted by electronic counting tunnels and the counts verified and adjusted

by hand counts. All fish number estimates, raceway, truck, and barge loading densities and rates will be based on a sample of fish collected. Samples will be taken hourly 24 hours per day.

Sample rates will be coordinated with smolt monitoring personnel and set by project biologists.

(3) Species composition and weight samples will be taken to determine loading densities for raceways, barges, and trucks. Project personnel will keep a running total of hourly estimates of fish numbers, raceway totals, and direct loading totals for barges based on these estimates. Daily samples for monitoring descaling will include a minimum of 100 fish of the dominant group(s) for which descaling information is recorded. During periods of low fish passage, descaling will be monitored daily for facility operations. During extended transport operations, samples may be evaluated every other day to minimize handling stress and to allow all collected fish to be held in the sample holding tanks.

(4) Where smolt monitoring activities are conducted at collector dams, project biologists may utilize daily total information gathered by those personnel.

e. Loading Criteria:

(1) Raceways: Maximum raceway holding capacity will be 0.5 lbs. of fish per gallon of water. Inflow to raceways is approximately 1,200 gallons per minute (gpm) at Lower Granite and Little Goose dams, and 2,600 gpm at Lower Monumental and McNary dams. Individual raceway volume is approximately 12,000 gallons of water at Lower Granite and Little Goose, and 24,000 gallons at Lower Monumental and McNary.

(2) The 0.5 pounds per gallon criterion is not to be exceeded without CENPW review and approval. Such decisions will be coordinated with FPAC, FPC, and NMFS, and a joint decision whether to exceed criteria or bypass fish to the river will be made based on: (1) species composition; (2) total anticipated collection during the critical holding period; (3) in-river fish passage conditions; and (4) fish condition. Project biologists will provide information to the CENPW Transport Coordinator upon which to base these decisions.

(3) Distribution Among Raceways: Collected fish should be spread among raceways to minimize crowding and stress, and to reduce the risk of disease transmission. Additional groups should be added to each raceway at the discretion of the

project biologist until holding capacity is reached. Whenever possible, small fish will be held in raceways separate from large fish.

(4) Holding Time: Maximum holding time in raceways will be 2 days.

(5) Truck and Barge Capacities: Loading criteria are 5 pounds of fish per gpm inflow for barges and 0.5 pounds of fish per gallon of water for trucks. Capacities per vehicle are:

Barge	Capacity (gal)	Inflow(gpm)	Fish Capacity(lbs)
SOCKEYE (2127)	85,000	4,600	23,000
BLUEBACK (2817)	85,000	4,600	23,000
STEELHEAD (4382)	100,000	10,000	50,000
COHO (4394)	100,000	10,000	50,000
CHINOOK (8105)	150,000	15,000	75,000
KING SALMON (8106)	150,000	15,000	75,000
Truck	3,500		1,750
Mini-tank	150		75

f. Summer (Extended) Transport Operations:

(1) During the extended season all collected fish at Lower Granite and Little Goose dams will be routed to the sample holding tanks, which are shaded. All collected fish will be handled for Smolt Monitoring Program requirements, and for loading from the sample holding tanks into trucks. To minimize handling stress, facility samples may be processed every other day.

(2) At Lower Monumental Dam, all collected fish will be routed to the sample tanks when fish numbers drop to an acceptable handling level. At that time all fish collected will be handled as part of the daily sample. To minimize handling stress, facility samples may be processed every other day. When large trucks are used, fish will be loaded from the raceways. When mini-tankers are used, Corps and agency project biologists will select the best method of transferring fish from the lab to the mini-tanker.

(3) During summer months at McNary Dam, from June 15 through August 31, water temperatures will be measured along the face of the powerhouse, in B-slot gatewells, and within the collection channel on a daily basis. These temperature measurements will be used for management of north powerhouse

loading criteria contained in appendix A of the Fish Passage Plan. During warm water periods, collected fish may be transported by truck or barge on a daily basis to minimize stress and mortality from warm water conditions. Other special operations may be required at McNary Dam during summer months to minimize impacts of project operations on juvenile fish collection during warm water temperature periods.

g. Facility and Equipment Logbooks and Records: To document collection and transportation activities, the following items will be logged at each dam by either project personnel or state biologists:

(1) Juvenile fish facilities: Records will be maintained recording fish counts by hour, by day, and by species, numbers and species of fish trucked or barged, number and species of fish sampled, descaling rates, and mortality rates. Records will be transmitted daily to CENPW for processing and transmittal to CENPD. Facility personnel will follow standard operating procedures (SOPs), and will note in facility logbooks accomplishment of SOPs at various stations at the collection facilities. General observations of fish condition and juvenile fish passage will be documented in facility logbooks by state biologists.

(2) Truck and Barge Logbooks: Each truck and barge shall have a logbook for recording fish loading rates, fish condition, estimated mortalities, area of release, equipment malfunctions, and accomplishment of scheduled work under the SOPs. When consecutive loading of trucks or barges occurs at downstream projects, truck drivers or barge riders will record numbers and condition of fish loaded. Towboat captains will keep logbooks on towboat activities. Barge riders will be authorized as inspectors by the Contracting Officer's Representative to initial entries noting towboat passage, loading, or fish release activities, and comments on barging operations. State biologists will report truck and barge mortality information in their weekly reports.

(3) Weekly Reports: State biologists shall prepare weekly reports documenting daily and weekly collection and transportation numbers, sampling information, facility and sampling mortality, descaling rates, and adult fallbacks. The weekly reports will be used by CENPW for any weekly reports required in the ESA Section 10 permit issued by NMFS.

5. Transport Operations:

a. Truck Operations: Seven fish transport trucks and three mini-tanks are available for hauling fish. One mini-tank will be provided at each Snake River project. Mini-tanks are small units that can be mounted onto pickup trucks. Normally trucks will be distributed two at Lower Granite Dam, one at Little Goose Dam, one at Lower Monumental Dam, and two at McNary Dam. A spare truck will be kept at McNary Dam. Trucks may be redistributed to meet transport demands.

(1) Truck/Mini-tank Release Sites: The normal spring release site for trucked fish will be at Bradford Island adjacent to Bonneville First Powerhouse. From mid-June through the end of the transport season, trucks and mini-tanks will be transported by barge from a boat ramp located several miles below Bonneville dam to a mid-river release area. Mid-river releasing of trucked fish will continue as long as river levels allow safe loading of trucks onto the barge.

(2) Operation of Truck Life Support Systems: Truck drivers will be trained by project biologists and maintenance personnel on the operation of truck life support systems, the requirements of fish to be met, and signs of stress for which to watch. Routine checks will be made on support systems and fish condition at check points identified by project biologists. Life support system data and information on fish condition will be entered into the truck driver's logbook at each check point and at the release point. The truck driver's logbook will be reviewed by the project biologist upon the truck driver's return after each trip.

(3) If required to maintain transport schedules, transport trucks and mini-tanks leaving Lower Granite may take on additional fish at Little Goose Dam, or trucks leaving Little Goose may take on additional fish at Lower Monumental Dam. Loading schedules will be coordinated so that fish will be kept separated by size.

b. Barge Operations: Six fish barges will be available for use.

(1) Barge Scheduling: By combining small and medium sized barges in tandem and alternating the tandem barges with large barges, 73,000 to 75,000 pounds of fish can be transported daily. It takes approximately 81 hours to make a trip from Lower Granite Dam to the release area near the Skamania light buoy below Bonneville Dam and return. When collection exceeds 20,000 fish per day at Lower Granite Dam, one barge will leave Lower

Granite Dam every other day. At the highest part of the migration, a large barge, medium barge, or a combination of small and medium-sized barges in tandem will leave Lower Granite Dam each day. The sequence will operate in reverse as fish numbers decline. During spring operations, barges will take on additional fish at Little Goose, and Lower Monumental dams as barge capacity allows. When daily collection exceeds barge capacity, juvenile fish will be bypassed to the river until collection numbers drop to where juvenile fish can be barged within barge carrying capacity criteria. During the summer, two barges will be used from McNary Dam. A round trip from McNary Dam to the release area takes less than 48 hours. One barge will leave McNary Dam every two days when numbers allow, and every day during higher fish collection days. Summer barge operations will continue while collection at McNary exceeds 3,500 pounds of fish per day (the capacity of two trucks) or trends indicate numbers will exceed the 3,500 pound trigger number. The number of barges used will be governed by fish collection rates, with the second towboat used on an intermittent basis shifting from one to two barge operation as authorized by CENPW.

(2) Barge Loading: Whenever possible, small and large fish will be loaded in separate compartments in barges.

(3) Barge Riders: Project barge riders will accompany each barge trip, supervising all loading and release operations, and barge operations en-route. Barge riders will be trained on barge operation, maintenance, and emergency procedures by project biologists and maintenance personnel. Barge riders will also be cross-trained in facility operations, and may rotate with facility operators as decided by project management. Barge riders shall be responsible for monitoring fish condition, barge equipment operations, and water quality (temperature and dissolved oxygen levels) at regular intervals during downriver trips. Barge riders shall maintain logbooks recording loading activities and times, loading densities by barge compartment, information on equipment operations, and release locations. Standard operational procedure forms shall be filled out during routine monitoring of equipment operation and shall include fish mortality and water quality data. At each subsequent dam where fish are loaded onto the barge, the barge rider shall make appropriate notations in the logbook. The barge rider shall also serve as an inspector for the towboat contract, and record information required by the Contracting Officer's Representative, and shall initial the towboat captain's logbook confirming operational information and lockage times. Any unresolved differences between barge riders and towboat crews shall

immediately be reported to the Contracting Officer's Representative.

(4) Barge Release Area: The barge schedule is based on release at the Skamania light buoy (approximately RM 140) with arrival at that point pre-determined to occur during night-time hours to minimize predation impacts. Barge travel time is affected by weather and river flows. As allowed by arrival time at Bonneville Dam, barge riders will randomly select barge release sites from Skamania light buoy upstream to Warrendale (approximately RM 141) to further decrease the ability of predators to prey on fish released from the barge. Project biologists will provide maps designating specific release sights to ensure that fish will not be released in the same area on consecutive trips.

6. Emergency Procedures:

a. Emergency procedures will be followed at any time an emergency occurs, 24 hours per day, 7 days per week during the transport season. Emergencies will be reported to the CENPW Transport Coordinator as soon as possible.

b. In the event of an emergency (equipment failure at a facility or on a truck or barge, emergency lock outage, chemical spill in the river, etc.), facility workers, truck drivers, and barge riders will be expected to take immediate appropriate actions to protect fish. If time allows, the worker, driver, or rider should consult with his/her supervisor by phone or radio to jointly make emergency decisions. If time does not allow consultation, the worker, driver, or rider must take appropriate action on his/her own initiative, then report to his/her supervisor as soon as possible after the action has been completed.

c. A complete listing of persons to be notified in case of emergencies and their business and home telephone numbers will be provided to each person involved in the transport program. Facility operators, truck drivers, and barge riders will be trained on emergency notification procedures by project biologists and CENPW. For the purpose of reporting an emergency, the person involved will immediately notify his/her supervisor, or the next person up the line until the emergency has been properly reported and corrective action has been initiated. In addition to telephone reporting, barge riders will report emergencies by the towboat radio to the nearest Corps dam. The

operator on duty will relay the message to the person or persons identified by the barge rider.

7. Fishery Agency Roles:

a. The fishery agencies provide biological oversight of fish at transportation dams. CENPW funds state fish biologists at each collector facility by Cooperative Agreements with WDFW and ODFW.

b. Task Orders under the Cooperative Agreements specify that state agency personnel at collector dams accomplish specific tasks for the Project Manager including:

(1) Supervising or conducting handling, inspection, and recording of data from fish sampled at the collection facility;

(2) Evaluating and recording fish condition, and recommending operational changes or inspection of facilities if fish condition indicates a problem;

(3) Providing hand counts of sampled fish, assisting the project biologist in adjusting electronic fish counts, checking hourly and daily fish counts for accuracy, and coordinating facility counts with counts of FPC smolt monitoring teams where appropriate;

(4) Conducting quality control inspections of collection facilities and transport equipment including visits to other collection facilities when work schedules can be so arranged;

(5) Monitoring the effects of smolt monitoring and research projects on fish condition and transportation activities and reporting impacts, including numbers of fish handled for research purposes and the disposition of those fish, to the project biologist;

(6) Participating in gatewell dipping as required to monitor fish condition;

(7) Preparing weekly reports summarizing fish numbers and transport activities, and;

(8) Preparing text and tabular information in the correct format for project annual reports.

8. Dissemination of Information:

a. Project biologists or agency biologists at each collector dam will be responsible for entering all pertinent information into the computer database and for transmitting daily reports to CENPW. Weekday information will be transmitted by 1500 hours on the day collected. Weekend information will be transmitted to CENPW by 1200 hours on the following Monday.

b. CENPW will process the reports and will transmit reports to CENPD on a weekly basis.

c. CENPW will coordinate daily reporting with the FPC Smolt Monitoring Program for their dissemination of information to user groups. The FPC will provide weekly summary reports of fish collected and transported in conjunction with their reports on Water Budget management, smolt monitoring activities, and hatchery release information.

d. Agency biologists will provide weekly reports detailing fish collection and transportation numbers, descaling estimates, and facility and transportation mortality estimates. The report will also contain a narrative on project activities and compliance with operating criteria. If research or smolt monitoring activities are occurring at the project, the weekly reports will include information on the number of fish sampled and sacrificed also.

9. Project Requirements for Fishery Agency Activities and Research:

a. Coordination: Agencies and tribes expecting to work at Corps dams will provide early coordination including work proposals, evidence of approval by CBFWA, information for preparation of the ESA permit for the collection and transportation program if their operation requires additional fish to be handled in the daily sample, copies of ESA permits, and project needs and requirements through written correspondence to the Chief, Operations Division, of CENPW, and shall not start work until written approval has been received;

b. Protocol: To maintain good working relationships and safe working conditions, fishery agencies, tribes, and research organizations will be required to follow courtesy and safety protocols as follows.

(1) Check in with the Project Manager upon first arrival at the project to receive information on who will be the project point of contact, and what courtesy and safety requirements must be followed;

(2) Notify the point of contact whenever arriving or departing from the project so they will know where personnel will be working and when they will be on the project;

(3) Adhere to project clearance, safety, and work procedures, and;

(4) Notify the Project Manager or his/her representative of unscheduled or non-routine work and activities.

(5) Notify the point of contact of expected guests or changes in personnel and assure that these individuals are aware of safety and work procedures.

APPENDIX D

BPA's SYSTEM LOAD SHAPING GUIDELINES TO ENABLE OPERATING TURBINES AT PEAK EFFICIENCY

BONNEVILLE POWER ADMINISTRATION'S SYSTEM LOAD SHAPING GUIDELINES TO ENABLE OPERATING TURBINES AT PEAK EFFICIENCY

Background

Outmigrating juvenile salmonids have several potential routes of passage past hydroelectric dams on the mainstem Columbia and Snake Rivers, including turbines, mechanical bypass, sluiceways, and spillways. Fish passage survival varies depending on the route of passage. As a result of reported high mortality rates for fish passage through turbines (Long 1968; Schoeneman et al. 1961), regional efforts have been focused on providing non-turbine passage routes for juvenile fish as a means to reduce turbine-related mortality and improve fish survival. Nevertheless, substantial numbers of juvenile fish may continue to pass through turbines; therefore, effort to minimize turbine-related mortality is a priority of the fishery agencies and Indian Tribes, National Marine Fisheries Service (NMFS), U.S. Army Corps of Engineers (Corps), and Bonneville Power Administration (BPA).

Turbine operating efficiency has a relatively direct effect on fish passage survival; the relationship between survival of juvenile fish passing through Kaplan turbines is positively correlated and roughly linear to the efficiency at which the turbines are operated. Bell (1981) recommended making every effort to operate turbines at peak efficiency at a given head during periods of peak fish passage to minimize fish mortality.

A. Turbine Efficiency

For the purposes of this document, peak turbine efficiency operation shall be based on efficiency tables provided by the Corps for each project in the Fish Passage Plan (FPP). The Corps shall ensure that these efficiency ranges are based on the best available information, and that updates are coordinated with BPA, and the Fish Facility Operation and Maintenance Committee and operating agencies. The tables will be distributed to all operating agencies prior to implementation, allowing at least two working days after receipt of the tables for implementation.

Operating efficiency of turbines is a result of wicket gate opening and blade angle for a given head (Bell 1981). As a result, there is a family of turbine efficiency curves for each project (or turbine design) for various head differentials. Operational decisions affecting turbine operations are based on efficiency curves for incremental changes in head, as provided by turbine manufacturers or empirical testing.

B. Guidelines

Objective: To reduce the mortality of outmigrating juvenile salmonids, BPA will provide the Corps' hydrosystem projects with generation requests that allow turbines at the Lower Snake (LSN) and Lower Columbia (LCOL) projects to operate within one percent of peak efficiency, or as otherwise specified, during the Peak Efficiency Operating Period, within the guidelines outlined below.

1. Peak Efficiency Operating Period.
This period is defined as 24 hours per day from March 15 through October 31 for the LCOL river projects and through November 30 for the LSN river projects.

During the period from April 1 through August 31, BPA will maintain generation requests that allow turbines to operate within 1 percent of peak efficiency in accordance with these guidelines, subject to the limitations listed in C.

During the period from March 15 through March 31, and September 1 through October 31 for the LCOL river projects and through November 30 for the LSN river projects, BPA will maintain generation requests that allow turbines to operate within 1 percent of peak efficiency in accordance with these guidelines; however, operation may occur outside 1 percent of peak efficiency subject to the limitations listed in C and D.

Reporting of generation requests outside the 1 percent peak efficiency range relative to the applicable peak efficiency limitations during the Peak Efficiency Operating Period will be provided as outlined in E.

2. Unit Priorities.
The Corps should make every effort to adhere to unit priorities. The Corps shall follow a unit priority list that specifies which units at each LSN and LCOL project should be operated within the range of peak efficiency, to minimize impact to salmon stocks. Likewise, the Corps will also indicate the priority for operating units outside the one percent peak efficiency minimum or maximum ranges. The list will be based on the best available fish passage and turbine efficiency information, developed by the Corps in coordination with the Fish Facility Operations and Maintenance Committee, and will be included in the FPP.

The Corps will coordinate and communicate any changes to the unit priority list prior to implementing a prioritized operation per the coordination process outlined

in B.4.

3. Project Priorities.
If units must be operated out of the 1 percent peak efficiency range, then BPA will make every effort to assure that generation requests to the Corps projects adhere to project priorities. Project priority will be developed weekly, based on in-season fish passage information, in coordination with NMFS and the Fish Passage Center.. Project priority will then be coordinated with the action agencies (BPA, Corps, Bureau of Reclamation (BOR)) through the process outlined in B.4.

4. Coordination.
Coordination processes should facilitate implementation by taking advantage of pre-existing interagency coordinating mechanisms (such as the COE, BOR, BPA and NMFS in-season mangement process, as described in the 1995 Biological Opinion on Operation of the Federal Columbia River Power System (FCRPS).

Coordination is also intended to minimize frequent disruption of FCRPS by allowing the action agencies sufficient lead time to include system operational changes in their planning activities. Sufficient time is defined as a minimum of two working days before implementation, unless an emergency situation exists. In the event of an emergency, implementation will begin as soon as practical given concurrent operations, hydraulic situations and loads.

Reasonable and prudent operation outside of peak efficiency for limitations listed in C.1 and C.2 below is at the discretion of the BPA and Corps. BPA and the Corps will coordinate with NMFS when operation of turbines outside of the peak efficiency range may be appropriate under provisions C.3 through C.9. Coordination will occur during the weekly in-season management team meetings, as described in the 1995 Biological Opinion on Operation of the FCRPS.

Emergency situations, described in limitations C1 and C2 below, that require an immediate change in FCRPS operation to avoid excessive take of listed salmonids may be directly coordinated at any time between NMFS and the action agencies. Coordination of an emergency change in FCRPS operation shall normally be completed immediately, with information supplied to the in-season managment team described above as soon as practicial. Implementation of the change(s) will occur as soon as practical given operational, hydraulic and load conditions. The action agencies shall provide points of contact to allow such emergency coordination to occur.

C. Limitations for the period March 15 through October 31 for the LCOL river projects and through November 30 for the LSN river projects

Conditions that may affect BPA's ability to operate in such a manner include:

1. System Reliability.
   BPA's ability to operate the power system in a manner that enables the Corps to maximize operation of turbines within peak range will be constrained by requirements to maintain system reliability (including requirements necessary for transient and voltage stability of the transmission system), and the ability to meet system response criteria. Additionally, it is necessary to maintain a margin of resource generation on line to fulfill Northwest Power Pool (NWPP), Western System Coordinating Council (WSCC), and the North American Electric Reliability Council (NERC) reliability requirements.

   BPA's Reliability Criteria for Operations, the Northwest Power Pool Operating Manual, the Western Systems Coordinating Council Operations Committee Handbook, and the North American Electric Reliability Council Operating Manual define system response criteria and margin of resource generation.

   Predictable instances of deviation from within the peak range as a consequence of prudent utility operation for control of short term system dynamics include:

   -Routine responses to loss of generation, load or transmission within the interconnection including delivery of Operating Reserve Obligation to NWPP members upon request. The duration of these deviations is minimal, but dependent upon recovery by the interconnection member with the problem.

   -Routine starting and stopping of generation units. These deviations are unavoidable, but very short in duration.

   -Deliberate dropping of generation, i.e., instantaneous interruption of output, to preserve system integrity. This dropping could cause a brief excursion.

2. Firm and Direct Service Industry (DSI) load.
   The LCOL and LSN projects will be operated within one percent of peak efficiency to the extent that the ability to meet firm loads is not jeopardized. According to the Regional Act, the Power Sales Contract with the DSI's and House Report 96-976 dated September 16, 1980," the total DSI load will be considered firm for purposes of resource operation."

3. Gas Supersaturation.
   Total dissolved gas saturation levels will be monitored at each project during the

fish passage season. Signs of gas bubble disease will be monitored at all Smolt Monitoring Program sampling sites and selected in-river sites. Peak turbine efficiency operation may be modified if representative monitoring data indicate that gas saturation is affecting fish survival. Necessary operational modifications will be coordinated through the process outlined in B.4, above.

4. Coordinated fishery operations.
In the event that coordinated fishery operations and approved fishery research are not in accord with operating turbines at peak efficiency, operational modifications will be coordinated through the process outlined in B.4.

5. Grand Coulee (GCL) and Chief Joseph (CHJ) flexibility.
Within system reliability and firm load limitations, flexibility at GCL and CHJ will be fully used, whenever possible, before generation requests to LCOL and LSN projects are outside the peak efficiency range.

6. Flow augmentation operations.
Flow augmentation requests for LCOL flows at McNary (MCN) are primarily met by water releases from GCL. The decision on whether to use GCL flexibility to provide inflows to MCN at the level necessary to meet the week's LCOL flow request when fish collection is maximized for transport during the flow augmentation period shall be made through the coordination process outlined in B.4.

   In-season management team flow augmentation requests for flows may exceed the one percent peak efficient operation range at LCOL/LSN projects. Meeting this flow request will take precedent over peak efficient operations. Coordination of the implementation of the flow requests will occur through the process outlined in B.4.

7. Transport projects.
Resolution of the conflict between spill management and turbine operation within one percent of peak efficiency at transport projects during the transport season shall be determined through the coordination process outlined in B.4, and in accordance with fish transportation guidelines, based on in-season flow and fish passage information. Care should be taken during transition periods close to the upper flow boundary to avoid frequent switching of priorities between spill and generation.

8. Routine maintenance and testing.
All units at all projects must undergo maintenance and associated testing. The testing necessitates deviation from the 1 percent peak efficiency band for periods of from 15 minutes to 8 hours. Scheduling of maintenance testing will be

coordinated through the process outlined in B.4 above, to ensure that it is conducted during times of low fish passage within a day to minimize impacts on fish.

9. Flood Control.

The FCRPS provides multiple benefits to the region. Flood control is a primary function of many of the projects on the Columbia River. In the event that river flow conditions require flood control operations, operation of turbines within the 1% peak efficiency range may be modified or suspended based on the Corps' direction. Allowing excursions from 1% peak efficiency for flood control operations would facilitate transportation, reduce excessive dissolved gas levels, and lower the risk of gas bubble disease in fish. Coordination of flood control operations will occur as outlined in B.4. See also Limitations C.3 and C.5.

During flood control operation, compliance reporting will follow procedures outlined in Section E.2.

D. Limitations for the period March 15 through March 31, and September 1 through October 31 for the LCOL river projects and through November 30 for the LSN river projects.

Conditions that may affect BPA's ability to operate in such a manner include all limitations in C.1 through C.9, plus the requirement for prudent use of the FCRPS storage capability necessary to import energy into the FCRPS for fish storage and firm load requirements.

E. Quality Control

The purpose of compliance reporting is to provide quality control for implementation of the Guidelines. BPA will consolidate information for the reports from BPA's system operation data, data provided by Corps project operators at LCOL and LSN projects, as well as other appropriate data sources.

BPA will provide these reports to NMFS, the FPC, and the Corps on a semi-monthly basis (mid-month and end-of-month). Amended reports will be provided where subsequent data indicates errors in previously reported information. Excursions outside 1% due to unknown causes will also be documented.

The reports compiled by BPA will summarize reportable events on a per project basis for each reporting period, as allowed under limitations listed in Section C of these Guidelines. Reportable events include: (1) 1% excursions of greater than 15

minutes in duration; and (2) more than five, five minute excursions within a day.

1. Normal river operation. BPA will consolidate information and prepare three reports per month: a mid month and end-of-month report on individual excursions, and an end-of-month report describing the ratio of project time outside the 1% peak efficiency range to total turbine unit operating time.

A brief explanation of the reason(s) for unit operation outside the peak efficiency range, the date, and the associated period of time will also be provided for documented excursions. Other excursions (e.g., excursions for unknown reasons) will also be reported.

2. Flood Control operation. During flood control operations, tracking individual 1% excursions becomes difficult and time consuming, and, because system flexibility is greatly reduced under these conditions, does not provide NMFS, BPA and the Corps with useful information to manage the system.

When the Corps has declared a flood control operation, compliance reporting will be limited to a diel (daylight vs. night-time) measurement of the gross ratio of total hours not within the 1% peak efficiency range (N1%) to total hours generating. Reports of this measure will be done on a project basis. BPA will consolidate the information, from sources described above, to track this ratio on a semi-monthly basis. Information will be distributed as noted above.

APPENDIX E

DISSOLVED GAS MONITORING PROGRAM
PLAN OF ACTION

DISSOLVED GAS MONITORING PROGRAM
PLAN OF ACTION FOR 1996

5 March 1996

INTRODUCTION

The total dissolved gas (TDG) monitoring program consists of a range of activities designed to provide management information about dissolved gas and spill conditions. These activities include time-series measurements, data analysis, synthesis and interpretation, and calibration of numerical models. Four broad categories of objectives are involved:

- data acquisition, to provide decision-makers with synthesized and relevant information to control dissolved gas supersaturation on a real-time basis,
- compliance, to ascertain the extent to which existing state dissolved gas standards and federal criteria are being met;
- trend monitoring, to identify long-term changes in basinwide dissolved gas saturation levels resulting from water management decisions; and
- model refinement, to enhance predictive capability of existing models used to evaluate management objectives.

As part of the overall Corps of Engineers' restructuration, Portland, Seattle and Walla Walla Districts will assume direct responsibilities for TDG monitoring at their respective projects, including data collection, transmission, analysis and reporting. The Division's Reservoir Control Center (RCC) will continue to coordinate this activity with the Districts and other State and Federal agencies and private parties as needed to insure the information received meet all real-time operational and regulatory requirements. Districts and Division roles and functions are described in more detail in later sections of this document.

The Corps considers TDG monitoring a high priority activity with considerable potential for adversely affecting reservoir operations and ongoing regional efforts to save the salmon. It will make all reasonable efforts toward achieving at least a data quality and reliability level comparable to that provided in 1995. Furthermore, the Corps believes it is important to maintain a two-way communication between those conducting the monitoring and the users of monitoring information. These interactions give decision-makers and managers an understanding of the limitations of monitoring and, at the same

time, provide the technical staff with an understanding of what questions should be answered. Therefore, comments and recommendations received from users were and continue to be very useful in establishing monitoring program priorities and defining areas requiring special attention.

This Plan of Action for 1996 summarizes the role and responsibilities of the Corps of Engineers as they relate to dissolved gas monitoring, and identifies channels of communication with other cooperating agencies and interested parties. The Plan summarizes what to measure, how, where, and when to take the measurements and how to analyze and interpret the resulting data. It also provides for periodic review and alteration or redirection of efforts when monitoring results and/or new information from other sources justify a change.

DIVISION/DISTRICT RESPONSIBILITIES

Districts Functions. Each District will perform all the activities required at their TDG monitoring sites. Data will be collected and transmitted from those sites systematically and without interruption to the Columbia River Operational Hydromet Management System (CROHMS) (or any alternate data base as may be specified) year between 1 March and 15 September. This includes but is not limited to the following tasks:

- preparing annual monitoring plan of action and schedule
- procuring data collection/transmission instruments
- preparing and awarding equipment and service contracts
- performing initial instrument installation and testing
- setting up permanent monitoring installations, if requested
- collecting and transmitting raw TDG data to CROHMS
- reviewing data for early detection of instrument malfunction
- making periodic biweekly service and maintenance calls
- providing emergency service calls as needed and/or when so notified
- performing special TDG measurements if needed
- keeping records of instrument calibration and/or adjustments
- retrieving, servicing, and storing instruments at the end of the season
- making final data correction and posting in separate data base
- performing data analysis to establish/strengthen spill vs. TDG relationship
- preparing an annual activity report for inclusion in Annual TDG Monitoring Report

Each District will also be responsible for (1) preparing an annual report on instrument performances, and (2) providing the necessary material including test and data analyses, charts, maps, etc. for incorporation in the Corps Annual TDG Report, which will be finalized by the Division. Additional monitoring at selected locations may also be required on an as-needed-basis. Dissemination of data to outside users will remain a Division responsibility to avoid duplication and uncoordinated service.

Division's Functions. Close coordination will be maintained between the Program Coordinator at the division and his/her counterparts at the districts, the contractors helping with field monitoring, and other cooperating agencies. The Program Coordinator will be the main point of contact for technical issues related to the TDG monitoring at Corps projects. Problems of common interest will be discussed at relevant forums such as the NMFS/EPA Gas Bubble Disease Technical Work Group (TWG) for peer review and open discussion. Final decision on technical issues will be made by the Program Coordinator after considering all input received from all interested parties.

The Corps' TDG Monitoring will be coordinated by a Program Coordinator. The Chief, Fish & Water Quality Section, CENPD-ET-WM(RCC), is the designated TDG Program Coordinator. He will report through the chain of command through Chief, Reservoir Control Center and Chief, Water Management Division to Director, Engineering & Technical Services Directorate. He will consult as needed with interested environmental staff in Planning Division, Pacific Salmon Coordination Office, Construction-Operations Division, and others. His role is to provide overall guidance and coordination to his District counterparts to ensure that the monitoring program is carried out according to the plan outlined in this document, including adherence to a general schedule and operating QA/QC protocols.

The TDG Program Coordinator will meet with his District counterparts in January to discuss detailed implementation plan and schedule for the current year. Discussion will address selection of monitoring sites, equipment and procedures to be used for data collection and transmission, service and maintenance program priorities, budget, etc. Following discussion and acceptance by District representatives, the Division will issue a set of specific performance standards to supplement and/or strengthen existing QA/QC protocols. The TDG Program Coordinator will review and monitor District performances based on those standards. An annual performance review meeting will be held annually to provide a critique of the operations and identify areas needing changes and/or improvements.

Division will initially maintain a shadow operation with existing minimum standby staff to fill any vacuum that may occur in the early 1996 introductory phase of the Division-to-Districts Program transfer. This will ensure that the Reservoir Control center continues to get real-time data it needs for its daily scheduling of reservoir operation at selected critical locations.

1996 ACTION PLAN

The 1996 Action Plan consists of the usual seven phases observed in previous years, namely :

(1) Program start-up;

(2) Instrument Installation;
(3) In-season Monitoring and Problem Fixing;
(4) Instrument Removal and Storage;
(5) Data Compilation, Analysis and Storage;
(6) Program Evaluation and Report; and
(7) Special Field Studies

Based in part on discussions held at the 5 and 8 December 1995 TWG meetings and as agreed to by Corps and NMFS technical staffs, changes and/or adjustments to the Program will include the following:

- Sutron DCP 8200 models (or equivalents) will continue to be used throughout the network to the maximum extent possible to avoid going through another learning curve period. These models were first introduced in 1995 and have provided satisfactory results once initial installation and programming problems were resolved;

- backup instruments and infrequently used stations may be replaced by data loggers so that O&M efforts can be concentrated on the remaining stations and instruments;

- backup instruments at The Dalles and Warrendale will not be installed;

- current fixed stations will not be changed to avoid relocation costs and having to establish new baseline conditions. If, based on transect studies, readings at those stations need corrections for operational and regulatory purposes, final decision on the nature and extent of the corrections will be deferred to NMFS and the States;

- in the interest of time, raw data received from the field will be immediately posted on the CROHMS without delay. Data corrections, if and when applicable, will be done as soon as possible thereafter.

Phase 1: Program Start-Up

Responsible parties (See Table 1) will be invited for topical peer review discussions on TDG monitoring in a forum provided by TWG. Discussions will include preliminary instrument deployment plan for the next monitoring season. This is to ensure a good and mutual understanding of the objectives of the dissolved gas monitoring program, including data to be collected, instrument location, procedures to be used, etc. The meeting also provides an opportunity to objectively assess the adequacy of past, present and anticipated monitoring efforts; and consequently, to recommend commensurate program changes if deemed necessary.

As stated above, the Corps will finalize its monitoring plan at the January 1996 meeting between interested Division and Districts staff. Instrument maintenance and service contracts are renewed in early January. Land owners are also contacted in early January

to ensure the continued site availability of Warrendale, Oregon and other Lower Columbia River locations below Bonneville Dam. Orders for new TDG instruments and DCPs, if applicable, will be placed in January. All paper work for outside contracting, if needed, will be completed in January.

Phase 2: Instrument Installation

Instruments to be installed and their assigned locations are listed in Table 2 and shown in Figure 1. There will be one forebay and one tailwater fully automated instrument at each of the Columbia/Snake River Corps dam, with the following exceptions:

- Dworshak: tailwater only
- McNary: two forebay stations, on Oregon and Washington sides respectively
- Bonneville: Warrendale and Skamania used as tailwater station substitutes
- Two additional stations will be installed on the Clearwater River mainstem.

This is basically the same instrument setup as in 1995. However, as discussed at the 5 December 1995 TWG meeting and subsequently agreed to by Corps and NMFS technical staffs, only essential instruments will be retained to ensure an adequate level of service and maintenance can be provided to the remaining instruments. In that context, the following steps will be taken:

- remove the infrequently used station of Hood Park, below Ice Harbor
- downgrade the Kalama and Wauna Mill stations to recording (non-telemetry) stations
- replace backup instruments at McNary-OR and Ice Harbor tailwater with data loggers
- remove backup instruments at The Dalles and Warrendale

The Plan also includes the Bureau of Reclamation's (USBR) instruments located at the International Boundary and below Grand Coulee, the Corps' instrument located at Chief Joseph reservoir forebay, the mid-Columbia Public Utility Districts' (PUD) forebay instruments at Rocky Reach, Rock Island, Wanapum, and Priest Rapids Dams, plus the tailwater instruments below Wanapum and Priest Rapids dams. Monitoring requirement below Libby Dam will be determined later on an as-needed basis. As mentioned earlier, two new stations will be installed on the Clearwater River mainstem, one at the USGS Spalding gauging station below the North Fork Clearwater confluence and the other, at the City of Lewiston municipal water intake above the Snake River confluence.

The instruments are scheduled for installation and, if applicable, interface with SUTRON Data Collection Platforms (or equivalents) no later than 1 April at all Corps projects. Monitoring stations below Bonneville are scheduled to be in place first, prior to the release of Spring Creek Hatchery fish, which is scheduled to start in mid-March. District Water Quality staff, together with maintenance and service contractors, if applicable, will conduct a pre-season assessment of monitoring site integrity and fix any damages that may have occurred over the winter. They will then perform the installation, calibration

and testing of all equipment at those stations. Selected project personnel may also be requested to assist as needed.

Phase 3: In-season Monitoring and Problem Fixing

Actual data collection and transmission activities will start prior to the first Spring Creek Hatchery release, but no later than 15 March for stations below Bonneville, and no later than 1 April for the remainder of the monitoring network. Exact starting dates will be coordinated with the Corps' Reservoir Control Center (CENPD-ET-WM), project biologists and cooperating agencies, based on run-off, spill, and fish migration conditions.

The following data will be collected approximately every hour:

- WC, Water Temperature (^{o}C)
- BH, Barometric Pressure (mm of Hg)
- NT, Total Dissolved Gas Pressure (mm of Hg)
- OP, Dissolved Oxygen Pressure (mm of Hg)
- NP, Nitrogen + Argon Pressure (mm of Hg)

The 2-channel stations will monitor WC and NT; the 3-channel: WC, BH and NT; the 4-channel: WC, NT, OP, and NP; and the 5-channel stations will monitor all five parameters. The minimum required for forebay stations are WC, BH and NT. At tailwater stations, when BH is not measured; BH forebay values will be used instead.

Data transmission from nonautomated instruments via Columbia Basin Teletype (CBT) network will be done twice a day, between 0915 to 1100 and 2115 to 2300 hours. CBT coding sheets should be made available to the RCC for data reconciliation purposes. Data transmission from automated stations interfaced with a Sutron data collection platform (or equivalent) will be transmitted automatically every four hours. This will be done preferably via the GOES Satellite, to the Corps' ground-receive station in Portland or any other proven and reliable mode. After decoding, all data will be stored in the CROHMS data base. Data from stations with recorders will be posted on the CROHMS as soon as are retrieved (once every two weeks).

Data transmission from Portland and Seattle Districts' monitoring sites will be via the GOES satellite. The USGS is planning to have the satellite data going into CROHMS and ADAPS (internal to the USGS) simultaneously to allow for some pre-screening and expeditious posting.

Data transmission from Walla Walla District's sites will be different than in recent years. Common Sensing instruments signals will be detected by ZENO DCPs on-site at 10 minute intervals. Depending on the site, that information will then be either transmitted

via telephone line or 900 Mhz spread spectrum radio to a modem linked to one of the eight remote PCs. No satellite transmission will occur. The remote PCs will manage data transmission via telephone line to a main server located in the District's Water Quality Laboratory. After automated incoming data verification and flagging of suspect data, pre-screened files will be transmitted to the Division's CROHMS system. This pilot operation is worth experimenting in view of the many potential benefits that could be derived. It will allow the system operators bi-directional communication with every instrument, DCP and computer system. Other benefits include voice-over (telephone communication with personnel while on site), capability to do remote troubleshooting from the District office or anywhere PC modem connection can be made, an alarm system that will notify (i.e. pager) when the incoming data violate the control limits set for the current operations, and collection of measurements at any frequency other than the hourly "grab" samples. As the system develops, the RCC will also be able to interrogate the instruments directly when real-time data are desired.

Irrespective of the transmission mode, daily reports summarizing TDG and related information will be posted on the CROHMS system. To the extent feasible, the measured TDG data will be compared with model predicted values so that suspicious values can be flagged and/or discarded before they are released. Information provided in CROHMS Reports 101, 102, and 103 will include the following data:

- Station Identifier
- Date and Time of the Tensionometer Probe Readings
- Water Temperature, ^{o}C
- Barometric Pressure, mm of Hg
- TDG Pressure, mm of Hg
- Calculated TDG Saturation Percent (%)
- Project Hourly Spill, Kcfs (QS)
- Project Total Hourly Outflow, Kcfs (QR)
- Number of Spillway Gates Open

Stop settings, if different from the numbers provided in the Fish Passage Plan, will also be given.

This information will be available for viewing by all those who have access to CROHMS. Reconciliation between data received via the CBT and those manually recorded on the coding sheets will be made by the RCC based on the input from the field, before the data are permanently stored in the Corps' Water Quality Data Base. Additional data posting in a public computer area such as the Internet web page will also be attempted in conjunction with the Technical Management Team and the Dissolved Gas Abatement Study.

To improve instrument reliability and accuracy, a systematic service and maintenance program will be implemented. Every two weeks on the average a contractor will visit the monitoring sites to check for and, if necessary, fix site problems (probes clogging, instruments out of calibration, etc.) using a portable calibration instrument as reference. Details of the QA/QC procedures are available on files. Adequate inventory of spare instruments will be maintained to allow for quick response times (between 24 and 48 hours for most sites). TDG instruments will be maintained by District staff and/or contractors. Tensionometers needing repairs that are beyond the staff's capability will be shipped to the manufacturer. Repairs of communication network will be done by in-house water quality and information management staff. Service and repairs of the DCPs will be handled by contractors.

To better understand the physical process of dissolved gas distribution across the reservoirs and its dissipation along the various pools, selected transect studies will continue to be conducted on an as-time-permits basis. An additional objective for this activity is to be able to define how representative readings from current monitoring sites are with respect to the entire river reach. Model runs using GASSPILL and other acceptable tools such as a Neural Network model will be performed as needed to define the range of expected/acceptable TDG levels under various spill conditions.

Phase 4: Instrument Removal and Storage

Tensionometers will be removed shortly after the end of the monitoring season (15 September) by the contractors and relevant Corps district/project personnel. They will be serviced by the maintenance and service contractors and stored at a convenient location until the beginning of the next monitoring season. DCPs will be returned to their lending parties. A selected number of tensionometers and spare DCPs will be available for off-season special monitoring activities upon request.

Phase 5: Data Compilation, Analysis and Storage

Time and staff availability permitting, statistical analyses will be conducted by Corps staff and contractors to fill data gaps and develop trends and relationships between spill and TDG saturation. Efforts will continue to be expanded on the calibration and application of GASSPILL (Dissolved Gas) and COLTEMP (Water Temperature) models, and finding ways to facilitate and/or improve user access to the TDG and TDG-related data base. The GASSPILL model will be modified to accommodate calculation time step shorter than the current daily time increment. Work will continue in training Neural Network models to simulate different flow and spill conditions for all river reaches of interest. Data collected at and transmitted from all network stations will be ultimately stored at CENPD-ET-WM, where they can be accessed through a data management system such as HEC-DSS.

Phase 6: Program Evaluation and Summary Report

An annual report will be prepared after the end of the monitoring season to summarize the yearly highlights of the TDG monitoring program. It will include a general program evaluation of the adequacy and timeliness of the information received from the field, and how that information is used to help control TDG supersaturation and high water temperature in the Columbia River basin. Information on the performance of the instruments (including accuracy, precision and bias associated with each parameter) and the nature and extent of instrument failures will be documented. The Annual TDG Monitoring Report will be prepared by Division staff, based on field input and other material provided by each District. It will also contain suggestions and recommendations to improve the quality of the data during the FY97 monitoring program.

Phase 7: Special Field Studies

As provided for in Phase 3, additional monitoring of dissolved gas saturation will be conducted on a as-needed basis. Current plan for additional monitoring includes transect measurements below selected dams to : 1) establish the relationship between various spill amounts and TDG saturation, and 2) plot TDG variations within a given cross-section of the river, especially a cross-section that includes a fixed monitoring station. Efforts will also be expanded in learning more about dissolved gas saturation dissipation along the fish migration route, using monitoring made from moving fish barges and deployment of self-contained wireless probes. These on-going efforts are expected to continue for several years.

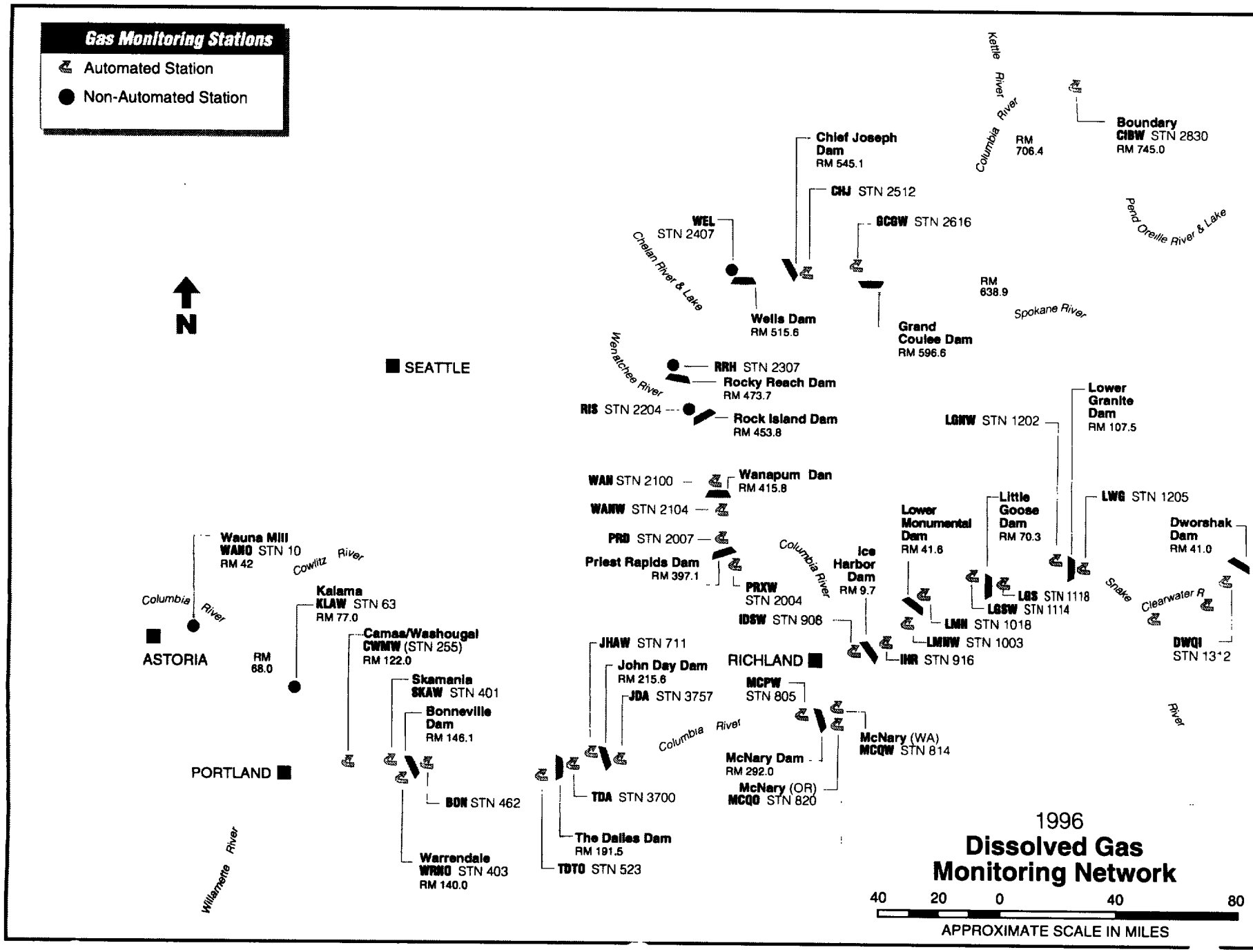
TABLE 1. List of Contact Persons

Projects	Names	Position	Phone Nos.
Int'l Boundary			
	Dave Zimmer	Limnologist	(208) 378-5088
Grand Coulee			
	Dave Zimmer	Limnologist	(208) 334-9035
Chief Joseph		Chief of Operations	(509) 686-5501
	Marian Valentine	Hydraulic Engineer	(206) 764-3529
Wells	Rick Klinge	Biologist	(509) 884-7191
Rocky Reach	Steve Hays	Biologist	(509) 663-8121
Rock Island	Steve Hays	Biologist	(509) 663-8121
Wanapum	Stuart Hammond	Biologist	(509) 754-3541
	Mike Taylor	Telecom.Engr.	(509) 754-2138
Priest Rapids	Stuart Hammond	Biologist	(509) 754-3541
	Mike Taylor	Telecom.Engr.	(509) 754-2138
Dworshak	Tom Miller	Limnologist	(509) 527-7279
Clearwater	Tom Miller	Limnologist	(509) 527-7279
Clearwater	Tom Miller	Limnologist	(509) 527-7279
Lower Granite	Tom Miller	Limnologist	(509) 527-7279
Little Goose	Tom Miller	Limnologist	(509) 527-7279
Lo.Monumental	Tom Miller	Limnologist	(509) 527-7279
Ice Harbor	Tom Miller	Limnologist	(509) 527-7279
McNary	Tom Miller	Limnologist	(509) 527-7279
John Day	Faith Ruffing	Biologist.	(503) 362-6184
The Dalles	Faith Ruffing	Biologist.	(503) 326-6184
Bonneville	Faith Ruffing	Biologist.	(503) 326-6184
Warrendale	Faith Ruffing	Biologist	(503) 326-6184
Skamania	Faith Ruffing	Biologist	(503) 326-6184
Camas/Washougal	Faith Ruffing	Biologist	(503) 326-6184
Kalama	Faith Ruffing	Biologist	(503) 326-6184
Wauna Mill	Faith Ruffing	Biologist	(503) 326-6184

TABLE 2 1996 Dissolved Gas Monitoring Network

Sta. ID	Location	Owners/Operators
CIBW	Boundary	USBR
GCGWD/s	GCL	USBR
CHJ	Forebay	NPS
WEL	Forebay	Douglas County PUD
RRH	Forebay	Chelan County PUD
RIS	Forebay	Chelan County PUD
WAN	Forebay	Grant County PUD
WAN	Tailwater	Grant County PUD
PRD	Forebay	Grant County PUD
PRXW	Tailwater	Grant County PUD
DWQI	Tailwater	NPW
(*)	Clearwater 1	NPW
(*)	Clearwater 2	NPW
LWG	Forebay	NPW
LWG	Tailwater	NPW
LGS	Forebay	NPW
LGS	Tailwater	NPW (.7 mi RB)
LMN	Forebay	NPW
LMN	Tailwater	NPW (.8 mi LB)
IHR	Forebay	NPW
IHR	Tailwater	NPW (3.6 mi RB)
MCQW	Forebay-WA	NPW
MCQO	Forebay-OR	NPW
MCN	Tailwater	NPW (1.4 mi RB)
JDA	Forebay	NPP
JDA	Tailwater	NPP
TDA	Forebay	NPP
TDA	Tailwater	NPP
BON	Forebay	NPP
WRNO	Warrendale	NPP
SKAW	Skamania	NPP
CWMW	Camas	NPP
KLAW	Kalama	NPP
WANO	Wauna Mill	NPP

USBR= U.S. Bureau of Reclamation NPP= Portland District NPS= Seattle District
NPW= Walla Walla District LB=Left bank RB=Right bank
MC=mid-channel (*) Station IDs to be provided later


Gas Monitoring Stations
Automated Station
Non-Automated Station
N
SEATTLE
PORTLAND
ASTORIA
RICHLAND
Columbia River
Kettle River
Boundary
CIBW STN 2830
RM 745.0
RM 706.4
Chief Joseph Dam
RM 545.1
CHJ STN 2512
WEL
STN 2407
Chelan River & Lake
Wells Dam
RM 515.6
GCGW STN 2616
Grand Coulee Dam
RM 596.6
RM 638.9
Spokane River
Pend Oreille River & Lake
Wenatchee River
RRH STN 2307
Rocky Reach Dam
RM 473.7
RIS STN 2204
Rock Island Dam
RM 453.8
LGNW STN 1202
Lower Granite Dam
RM 107.5
WAN STN 2100
Wanapum Dan
RM 415.8
WANW STN 2104
PRD STN 2007
Priest Rapids Dam
RM 397.1
PRXW
STN 2004
IDSW STN 908
Ice Harbor Dam
RM 9.7
IHR STN 916
Lower Monumental Dam
RM 41.6
LMNW STN 1003
LMN STN 1018
Little Goose Dam
RM 70.3
LGSW STN 1114
LGS STN 1118
LWG STN 1205
Dworshak Dam
RM 41.0
DWQI
STN 1342
Snake River
Clearwater R
Wauna Mill
WAMO STN 10
RM 42
Cowlitz River
Kalama
KLAW STN 63
RM 77.0
RM 68.0
Camas/Washougal
CWMW (STN 255)
RM 122.0
Skamania
SKAW STN 401
Bonneville Dam
RM 146.1
BON STN 462
Warrendale
WRNO STN 403
RM 140.0
Willamette River
JHAW STN 711
John Day Dam
RM 215.6
JDA STN 3757
TDA STN 3700
The Dalles Dam
RM 191.5
TDTO STN 523
MCPW
STN 805
McNary Dam
RM 292.0
McNary (OR)
MCQO STN 820
McNary (WA)
MCQW STN 814
1996
Dissolved Gas Monitoring Network
40 20 0 40 80
APPROXIMATE SCALE IN MILES

APPENDIX F

SECTION VIII.A.2. OF THE NMFS BIOLOGICAL OPINION ON FCRPS OPERATION -- SPILL AT SNAKE AND COLUMBIA RIVER PROJECTS

NMFS Biological Opinion on operation of the FCRPS in 1995 and future years

signed 2 March 1995

VIII. Reasonable and Prudent Alternative to the Proposed Action

Immediate Actions to Improve Survivals

2. The COE shall spill at the Snake and Columbia River projects in order to increase fish passage efficiency and survivals at the dams.

The COE, during the juvenile spring/summer chinook migration season (April 10 - June 20 in the Snake River and April 20 - June 30 in the Columbia River), shall spill at all projects, including collector projects, to achieve a fish passage efficiency target of 80%, except under the following low flow conditions: During any week in which unregulated weekly average flows at Lower Granite Dam are projected to be less than 100 kcfs, no spill shall occur at Lower Granite Dam; during any week in which unregulated weekly average flows at Lower Granite Dam are projected to be less than 85 kcfs, no spill shall occur at Lower Granite, Little Goose, and Lower Monumental dams, unless the TMT recommends that spill occur. During the fall chinook migration season (June 21 to August 31 in the Snake River and July 1 to August 31 in the Columbia River) the COE shall spill at all non-collector projects to achieve a fish passage efficiency target of 80%.

It is NMFS' view that the best condition for an evaluation of the effects and efficacy of spill to improve inriver survival would be for a single spill regime to prevail throughout the spring migration season. NMFS' first draft of the biological opinion used a volume runoff forecast in the Snake River to trigger spill operations, which would then remain constant during the season. In making recommendations to spill at collector projects when flows are below target levels, the TMT should take into consideration the objective of having a credible evaluation of the spill program. Accordingly, TMT recommendations to spill at the above projects in the Snake and Columbia rivers at flows

below the triggers specified should take into account past flow conditions and future flow projections, how close flows are to the trigger levels and how much augmentation is planned, the timing of the juvenile migration, and the need for a credible evaluation. If the use of weekly flow triggers compromises an evaluation, NMFS will consider returning to a volume runoff approach.

During low flow periods, spill at collector projects is reduced or eliminated in order to increase the proportion of fish transported. The discussion under measure 3 explains the rationale for increasing transportation under low flow conditions.

Spill levels calculated to obtain an 80 percent fish passage efficiency are listed below for each lower Snake and lower Columbia River dam. These levels are expressed in percent of instantaneous project flow during the spill period and were calculated with the best available information regarding spring and fall chinook salmon guidance efficiency, spill efficiency, fish passage diel and project operating conditions. Spill periods are 24 hours at Ice Harbor, The Dalles and Bonneville Dams and 12 hours (1800-0600) at all others.

DAM	LGR	LGS	LMN	IHR	MCN	JDA	TDA	BON
% Flow, Spring	80	80	81	27	50	33	64	*
% Flow, Summer	**	**	**	70	**	86	64	*

* An 80% FPE level is not obtainable at Bonneville Dam given a day time spill cap of 75 kcfs and the current low fish guidance efficiency levels. This spill cap (in place to reduce adult fallback) limits obtainable spring FPE to 74% and summer FPE to 59% at 100 percent nighttime spill.

** Spill is not recommended at these projects for summer migrants.

The spill levels necessary to obtain this FPE may be limited by total dissolved gas (TDG) in the river between each project. Specific monitoring sites for the purposes of in-season dissolved gas management should be selected on the basis of data consistency and relationship to fish exposure. Until it can be

determined how tailrace monitoring stations relate to the river reaches between monitoring sites and how TDG data collected at these sites relate to fish experience, forebay monitoring data will be used for in-season management. Water quality and other fishery management agencies have recommended that monitoring sites be located below mixing areas, the forebay monitors are the only presently established monitors that consistently provide mixed flow data. Tailrace monitors are of limited usefulness at this time, however, they probably best estimate maximum acute exposure, particularly for adults.

Spill will be reduced as necessary when the 12 hour average TDG concentration exceeds 115% of saturation (or as limited by state water quality standard modifications) at the forebay monitor of any Snake or lower Columbia river dam or at the Camas/Washougal station below Bonneville Dam or another suitable location to measure accurately chronic exposure levels. Spill will also be reduced when 12 hour average TDG levels exceed 120% of saturation (or as limited by state water quality standard modifications) at the tailrace monitor at any Snake or lower Columbia River dams. Average concentrations of dissolved gas will be calculated using the 12 highest hourly measurements per calendar day. The use of 12-hour averages, rather than 24-hour averages, is an attempt to set a more conservative standard, and to relate the measured concentrations of dissolved gas to the 12-hour spill cycles. Spill will also be reduced when instantaneous TDG levels exceed 125% of saturation (or as limited by state water quality standard modifications) for any two hours during the 12 highest hourly measurements per calendar day at any Snake or lower Columbia River monitor.

The intent of these gas caps is to ensure that the long term exposure of adult and juvenile migrants is to TDG levels that do not exceed 115%. NMFS concludes this operation accomplishes that goal for several reasons. Radio telemetry studies indicate that juvenile salmonids tend to move out of tailrace areas within a few hours (Snelling and Schreck unpublished) and that adults tend to move about laterally in tailraces prior to ascending ladders (Johnson et al. 1982, Turner et al. 1983). These movement patterns limit exposure to high spill basin TDG levels. As spilled water moves out of the tailrace the TDG level decreases at some point below the project (depending on ratio of these flows and river topography) because the spilled water mixes with water from the powerhouse. For instance, Blahm (1974) found that, given moderate spill levels, the river was well mixed within 2.5 miles of The Dalles Dam and 15 miles below Bonneville Dam. The requirement that TDG levels in the forebay be limited

to 115% will help ensure that areas where migrating juveniles may spend long periods of time do not have TDG levels in excess of 115%. Radio tag studies have indicated that some spring migrating juvenile salmon may be delayed from several hours to several days in these areas (Snelling and Schreck unpublished, D. Rondorf, NBS, February 24, 1995, pers. comm.). Finally, the fact that spill is intermittent at many projects will help limit dissolved gas exposure of fish holding in the forebays and other areas between the projects. This is particularly true for adult migrants.

After reviewing available information on dissolved gas exposure as well as information and recommendations submitted by the parties during the IDFG v. NMFS discussions, NMFS concluded that 115% TDG measured in the forebays was a reasonable interim measure to adopt. Several commenters argued that the Environmental Protection Agency's recommended water quality limit of 110% represented an appropriate level and should not be varied. State and tribal entities developed a risk assessment that suggested that long term exposure to 120% did not pose significant risks to migrating fish and that the benefits of improved dam passage outweighed these minimal risks of TDG exposure at 120%. Still other commenters noted the spill at collector projects reduced the numbers of fish transported and that any risk assessment had to consider the benefits of transportation. The issue of transportation is addressed more fully in measure 3 below.

NMFS concluded that it was appropriate to seek an operation that would result in the EPA criteria of 110% being exceeded primarily because of: 1) the ability of fish in a river environment to compensate hydrostatically for the effects of dissolved gas supersaturation, and 2) the daily fluctuation in levels of dissolved gas throughout most of the river. In a river environment, depth of migration reduces TDG effects on migrants. Each meter of depth provides pressure compensation equal to a 10% reduction in TDG. Shew et al. (Undated) and Turner et al. (1984b) noted through tunnel studies that net entry rates through McNary and Bonneville dam ladder entrance tunnels were highest for the deepest (3.4m) tunnels. Other studies indicate that adult and juvenile salmon tend to spend most of their time at or below one meter of depth (Smith 1974). Blahm (1975) concluded that shallow water tests were "not representative of all river conditions that directly relate to mortality of juvenile salmon and trout in the Columbia River." In deep tank tests, salmonids exposed to 115% TDG levels did not experience significant

mortality until exposure time exceeded approximately 60 days (Dawley et al. 1976).

NMFS also concluded that it was not appropriate as an initial interim level to seek an operation that would result in chronic exposure to TDG level of 120%, as recommended by the states and tribes. In general, chronic exposure to TDG levels of 120% with hydrostatic compensation does not cause significant mortality until exposure time exceeds 40 days (Dawley et al. 1976). This is generally more time than it takes Snake River juvenile and adult migrants to travel between Lower Granite and Bonneville dam. Nevertheless, NMFS concluded that the more conservative level of 115% is appropriate because of concerns about the potential sublethal effects of gas bubble disease. The state and tribal report on "Spill and 1995 Risk Management" summarized the studies showing evidence that swimming performance, growth and blood chemistry are affected by high dissolved gas levels. The report correctly states that it is only inferential that these symptoms may result in susceptibility to predation, disease and delay. In fact, studies conducted in 1993 and 1994 by the National Biological Service indicated that juvenile chinook salmon that have been exposed for eight hours to high TDG (and exhibiting microscopic signs of gas bubble disease) are no more vulnerable to northern squawfish predation than control fish that had been held in equilibrated water (Mesa and Warren, in review). Ultimately the analysis in the state and tribal report did not assume any level of mortality as a result of these sublethal effects.

NMFS concludes that the impairments to migrating fish as a result of the sublethal effects of dissolved gas may be sufficiently grave to warrant caution in setting long term exposure levels above 110%. In particular, long term exposure to levels in excess of 110% decrease swimming ability (Dawley and Ebel, 1975); fish stressed with high levels of dissolved gas have been reported to have less swimming stamina (Dawley et al., 1975); and gas bubbles in the lateral line can impair sensory ability. In addition, although fish in deep tank studies are less affected by high levels of TDG than fish in shallow tanks, some mortalities still occur despite a water depth that is apparently adequate for protection. There is no evidence that fish can 'sense" TDG supersaturated water and deliberately sound to compensate.

At specific projects where specific levels of spill, particularly daytime spill have been shown to be detrimental to fish passage, timing and/or amounts of spill may have to be adjusted (for specific details see NMFS 1994b). Spill may also be limited at

projects where it can be demonstrated that spill may be detrimental to system spill allocation. One such project is John Day Dam, where very low amounts of spill result in very high TDG levels. These high TDG levels then limit the amount of spill possible at dams downstream. For instance, by reducing spill by 10 to 20 kcfs at John Day Dam, it may be possible to increase spill at The Dalles or Bonneville dams by 20 to 40 kcfs. The exact relationship will need to be developed through in-season spill/TDG testing. The limitation of spill may also apply at The Dalles Dam to minimize the passage of spilled flow and fish over the high predation risk area in the shoals below the dam (see specific details in NMFS (1994b). The details regarding this limitation will be decided in-season through consultation with predation experts and will likely depend on ambient flow and the spill levels obtainable under the TDG limitations. In 1995, spill at Ice Harbor, The Dalles, and John Day Dams may be modified to accommodate research activities if NMFS determines that the spill modifications will not affect the validity of the transport vs. in-river survival study. These spill operations should be treated as interim until the effects of TDG on migrating salmonids are more fully evaluated and until a spill/transport rule curve can be developed. The rationale for flow targets associated with spill at collector projects is related to transportation policy and discussed under measure 3 below.

Migration over the spillways or through the bypass systems are the safest routes of passage at the dams. Injury and mortality can occur through each route of passage (turbines, spillways, ice and trash sluiceways, juvenile fish bypass systems), but loss rates via the spillways and bypass systems are low relative to passage by the turbines. For both spring/summer and fall chinook salmon, mortality of fish passing over the spillways or through the bypass systems generally ranges from 0-3% (Schoeneman et al. 1961; Heinle 1981; Ledgerwood et al. 1990; Raymond and Sims 1980; Iwamoto et al. 1994). Direct turbine mortality can range from 8-19% for yearling chinook salmon and 5-15% for subyearling chinook salmon (Holmes 1952; Long 1968; Ledgerwood et al. 1990; Iwamoto et al. 1994). Values of turbine and spill mortality are not available for sockeye salmon. However, it is reasonable to assume that these values are similar to or greater than values for yearling chinook salmon due to size and timing of migration and due to the greater susceptibility of sockeye to physical injury and mortality in project passage and handling (Gessel et al. 1988; Johnsen et al. 1990; Koski et al. 1990; Parametrix 1990; Hawkes et al. 1991).

This spill program is experimental due to uncertainties about benefits of transportation of smolts relative to in-river migration, as well as uncertainties about the effect of nitrogen supersaturation on free-swimming fish in the river. Gas supersaturation is a negative effect of spill and the precise relationship between spill levels and gas bubble disease in juvenile and adult salmon migrating in the Columbia and Snake Rivers is not known. The spill program will be accompanied by an extensive physical and biological dissolved gas monitoring effort (see measure 16) as well as studies to assess reach survival and to compare survival of transported versus in-river migrants, as well as studies that compare adult returns from transported fish versus fish that migrate in-river under improved in-river migration conditions (i.e., improved flows and improved passage survival at dams through spill). Ideally a spill program, rather than setting a gas cap across all projects, would be based on a project-by-project analysis, with the benefits of spill passage balanced against the risks of gas bubble disease at each project. Such an analysis will require more information about the TDG levels that result at different levels of spill at each project, in relation to spill at other projects, and more information about the lethal and sublethal effects of creating supersaturated conditions through the river.

APPENDIX G

LETTER FROM CENPD COMMANDER TO NMFS REGIONAL DIRECTOR REGARDING SPILL REQUESTS

DEPARTMENT OF THE ARMY
NORTH PACIFIC DIVISION, CORPS OF ENGINEERS
P.O. BOX 2870
PORTLAND, OREGON 97208-2870

Reply to
Attention of:

NOV 9 1994

Environmental Resources Division

Mr. William W. Stelle, Jr.
Regional Director
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Seattle, WA 98115-0070

Dear Mr. Stelle:

As you recall, last spring and summer I was faced with several controversial decisions concerning spill at dams operated by the Corps of Engineers in the Columbia River Basin. I anticipate similar requests in 1995; therefore, this letter is intended to explain in advance my position on this matter.

Spill for fish passage at Corps projects will be provided in 1995 according to the Fish Passage Plan (FPP) criteria, including any modifications agreed upon in consultation under the Endangered Species Act (ESA). Any additional requests for spills above those previously agreed to, and any spills that will produce total dissolved gas (TDG) levels that exceed state and Federal water quality standards must be evaluated prior to implementation. Therefore, any requests must be accompanied by a project-specific analysis of the TDG levels expected from the requested spills and expected biological benefits. Also, any necessary waivers of water quality standards must be obtained beforehand from appropriate state or Federal authorities, and a copy included with the request. Waivers from more than one state may be necessary and it will be the responsibility of the person or agency making the spill request to obtain all waivers. If more than one waiver is required, and one is more restrictive than another, I will consider the most restrictive one to apply when establishing operational changes. The Corps recognizes the existing TDG standards were established for protection of salmon and other aquatic species. As stated in the FPP, "Adherence to this standard, insofar as physically possible, is a goal of fish spill management by the Corps."

My first priority for consideration of spill requests will be those received from other Federal agencies to protect endangered species through the process identified during consultation. There was confusion and misconceptions created in 1994 over requests from other entities outside of this process and contrary to criteria agreed upon during ESA consultation, in particular from the Fish Passage Center. I will only consider separate requests from these other entities in the future for special operations outside of the normal period covered by consultation agreements (for example, the March operations at Bonneville Dam to protect early releases from Spring Creek Hatchery). These requests must be accompanied by the appropriate project-specific analyses and any necessary water quality waivers.

As you know, involuntary spill also occurs when river flows exceed powerhouse hydraulic capacity and during some power load situations. This spill may produce TDG levels that temporarily exceed water quality standards. Although we do not currently have much control over this, we are evaluating solutions to avoid causing high TDG levels during high spill periods. Potential solutions may include operational changes, facility modifications, or both. I will keep you apprised of the study progress.

I appreciate your cooperation in this matter. Spill programs carry potentially high risks to anadromous fish and other aquatic organisms which must be carefully weighed against potential benefits. Adequate time and thought must be allowed to accomplish this and avoid damaging the very resources we are trying to protect. I would welcome any additional thoughts you may have.

Yours truly,

Ernest J. Harrell
Major General, US Army
Division Engineer

CF:

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