



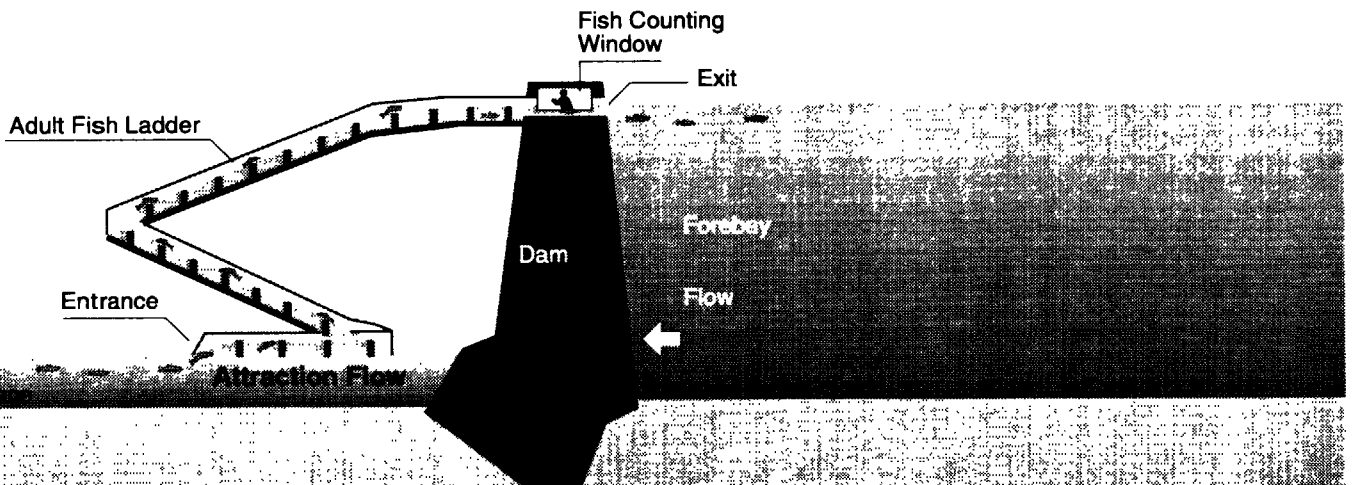
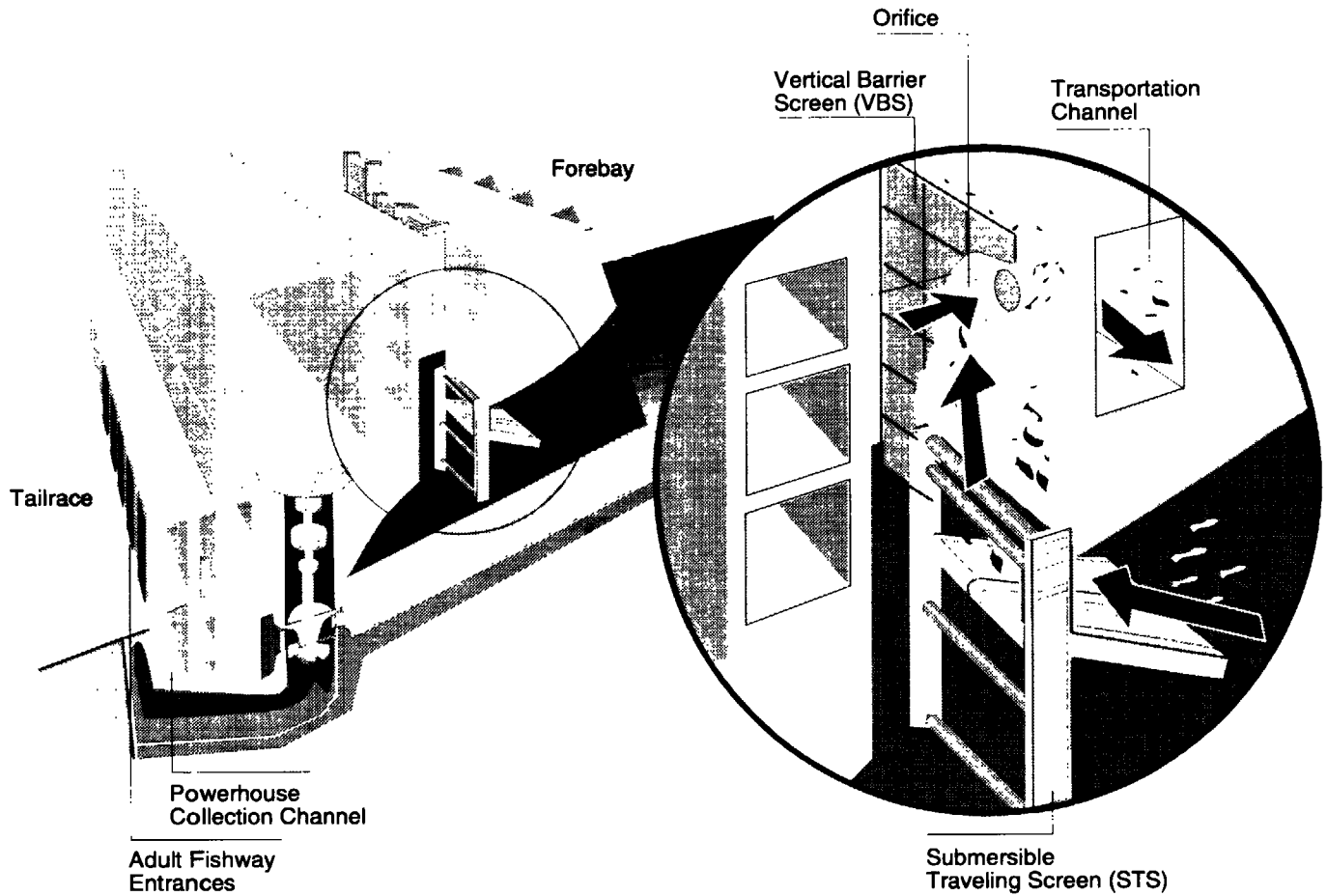
**US Army Corps
of Engineers**

North Pacific Division

Fish Passage Plan

Corps of Engineers Projects

CENPD-PE-ER



February 1994

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FISH PASSAGE PLAN
FOR CORPS OF ENGINEERS PROJECTS

U.S. ARMY CORPS OF ENGINEERS
NORTH PACIFIC DIVISION
PORTLAND, OREGON

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FISH PASSAGE PLAN

1. **General.** The Corps' Fish Passage Plan (FPP) is developed in coordination with the region's fish agencies, Indian tribes, and the Bonneville Power Administration (BPA) through the Fish Facilities O&M Subcommittee of the Fish Passage Development and Evaluation Program Technical Coordinating Committee (FPDEP-TCC). It is revised when 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 consultation with the National Marine Fisheries Service (NMFS) as part of the Endangered Species Act (ESA) Section 7 consultation process. This is due to the listing of Snake River sockeye and chinook salmon as endangered and threatened species.

FPP revisions are provided to the Northwest Power Planning Council (NPPC)-sponsored 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 are conducted to minimize fish impacts and are coordinated with fish agencies and tribes.

The NPPC's guideline of at least 70% fish passage efficiency (FPE) for yearling fish (spring outmigrants) and 50% FPE for subyearling fish (summer outmigrants) is utilized as an interim target at projects with bypasses installed, until either project or system survival goals are developed. The Corps considers the following factors in implementing the interim standard:

1. Spill provisions contained in the amended NPPC Fish and Wildlife Program (Appendix F) and the Corps Juvenile Fish Transportation Program (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.

Regarding fish spill, Corps mainstem projects provide spill according to the amended NPPC Fish and Wildlife Program, which reflects the regional spill agreement (specifications in Appendix F), and to protect ESA-listed salmon species. Spill levels for improving juvenile fish passage conditions for listed species are developed through consultation with NMFS. Nightly spill is provided at The Dalles, John Day, and Ice Harbor Dams for spring and summer outmigrations (summer only at John Day, summer spill is continuous at Ice Harbor) to meet requirements of NMFS Biological Opinion. Spill may also be provided under special circumstances, if requested by the fish agencies and tribes, and if the requests are consistent with regional operational agreements (i.e., Spring Creek Hatchery release).

In order to maximize fish transportation at dams with collection and loading facilities, voluntary spill will not occur at McNary, Lower Monumental, Little Goose, or Lower

Granite Dams. Spill may occur at Bonneville Dam, if appropriate, to provide juvenile fish passage according to the interim 70/50 FPE guidelines, subject to the above considerations for implementation.

Total dissolved gas (TDG) saturation levels are monitored at each 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, insofar as physically possible, is a goal of fish spill management by the Corps. Implementation of fish spill in the past has resulted in higher TDG levels (120% or greater). Therefore, fish spill is subject to further ESA consultation with NMFS, if excessive TDG levels occur, or if evidence of gas bubble disease is observed in fish.

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 FPDEP Fish Facilities O&M Subcommittee or the Corps' North Pacific Division, Environmental Resources Division, 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 the fish agencies and tribes recommendations are highlighted within Appendix A.

3. **Juvenile Fish Transportation Plan.** The Juvenile Fish Transportation Plan (JFTP) is contained in 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 is contained in Appendix A. Additional criteria may be developed as part of the Section

10 permit ESA consultation process with NMFS.

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 bi-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 control during the fish passage season when operating projects 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, pending consultation with NMFS, to meet ESA requirements for threatened and 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.

- Spill criteria is contained in Appendix B.

(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 (including

extended-length screens) is operational (1998) or NMFS requests a different operation during ESA consultation.

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

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

- Spill criteria is contained in Appendix B.

(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.

- Spill criteria is contained in Appendix B.

(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 expected to be installed and operating by March 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.

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

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

(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. Approximately 2,000 cfs is discharged through the ice and trash sluiceway for 24 hours per day during the juvenile passage season. This is an interim operation until a new juvenile bypass system is operational (1996) or NMFS requests a different operation during ESA consultation.

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

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

- Spill criteria is contained in appendix B.

(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.

(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 are screened. Extended-length screens are expected to be installed and operating by March 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.

(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 expected to be installed and operating by March 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.

(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.

(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 consultation with NMFS and coordination with

BPA, Indian tribes, other Federal and state fish agencies, and the FOEC. 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 fish agencies and tribes on other project-specific operations that do not have system impacts. The Fish Passage Center (FPC) coordinates, with the fish agencies and tribes, project operation requests not covered in the Biological Opinion and transmits the requests to RCC.

RCC daily briefings are held at 1300 hours, Monday through Friday, in the U.S. Custom House, Portland, Oregon. Immediately following these briefings, RCC representatives are available to meet with interested parties to discuss the latest weather and runoff forecasts, as well as fish, hydrologic, and power information to assist in the planning of operations for fish passage for the next few days. Fish operations or requests are evaluated to determine impact on overall system operations and how they fit with the NMFS Biological Opinion. The Corps also consults with NMFS when necessary to meet ESA requirements for endangered or threatened salmon species.

a. **Responsibilities of Parties.**

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

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

(b) Prepare a Plan of Action for In-Season Management for implementing 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, described in Appendix E.

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

(a) Request spill for fish in accordance with the amended NPPC Fish and Wildlife Program and through NMFS to protect endangered species. Requests not in accordance with the Program or the current Biological Opinion will only be considered on a case by case basis, and after consultation with NMFS.

(b) Provide RCC with a spill priority list and updates.

(c) Provide monitoring and surveillance throughout the migration period at 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. 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, and the fish agencies and tribes, the BPA estimate of power market impacts of requested spill operations.

(c) Utilize available flexibility of the Federal Columbia River Power System to shape flow requirements, spill priorities, and plant generation consistent with BPA'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 procedures specified in Section III, Paragraphs A.1, B.1 - B.17 (except B.5, B.6, and B.14), of the regional spill agreement, as modified to provide for nonpower uses (Appendix F).

(e) Implement spill priorities on a real-time, hourly basis.

(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 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 FPDEP-TCC Fish Facilities O&M Subcommittee, and in consultation with NMFS. Different pieces of the FPP may be revised at different times. Suggested revisions should be submitted to the Subcommittee 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 the FOEC as part of the Corps' overall river operation plan.

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

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

Procedures described in the Plan of Action for In-Season Management will be used in making and implementing fish operations requests. These include requirements and schedules for coordination meetings, in-season briefings, water use accounting, providing information, and making and implementing requests.

(b) Spill amendment requests.

The Corps will implement the NPPC Fish & Wildlife Program spill amendments' project spill provisions to the fullest extent practicable. In this regard, procedures specified in Section III, Paragraphs A.1, B.1 - B.17 (except B.5, B.6, and B.14), of the regional spill agreement (Appendix F) will be followed by the fish agencies and tribes, NMFS, and RCC in submitting and implementing fish spill requests for The Dalles and John Day. The fish agencies and tribes will submit daily spill requests, including reiterations of existing requests, if there are no changes in project spill. Requests are to be submitted by the deadlines specified in Appendix F, which require specific lead times for requests prior to implementation.

RCC will coordinate with BPA on project spill requests, and will implement a request if the following conditions are met:

- (1) BPA agrees to the power loss.
- (2) The request is consistent with dates, hours, and percentage criteria shown in Appendix F.
- (3) Spill does not cause adverse nonpower, environmental, or safety impacts.

(c) Special operations requests (fish-related requests and Corps O&M activities).

Requests for special operations for fish needs outside the Plan of Action for In-Season Management will be considered by RCC. Prior coordination of these requests 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 implementation decision. Modifications to requests will be coordinated

with BPA, Bureau of Reclamation, fish agencies and tribes, and NMFS prior to implementation.

Corps project requests related to O&M activities will be evaluated for impacts on fish migration, including coordination with the fish agencies and tribes and consultation 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 emergency actions. After-action coordination will occur when advance notice is not possible.

(d) Other operational requests.

As with Corps O&M requests, all other operational requests will be evaluated for impacts on fish migration, including coordination with the fish agencies and tribes and consultation with NMFS. 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.

Disputes which cannot be resolved between the Corps and the fish agencies and tribes, or other interests, will be brought before the FOEC for discussion and resolution. If the FOEC is unable to resolve an issue, it will be forwarded, with alternative solutions proposed, to the NPPC. The NPPC will provide a recommendation to the Corps. This recommendation will be fully considered by the North Pacific Division Engineer for final decision and implementation.

February 24, 1994

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 (Figure 1 through Figure 3).

1. Juvenile Fish Passage

a. Facilities Description

(1) First Powerhouse.

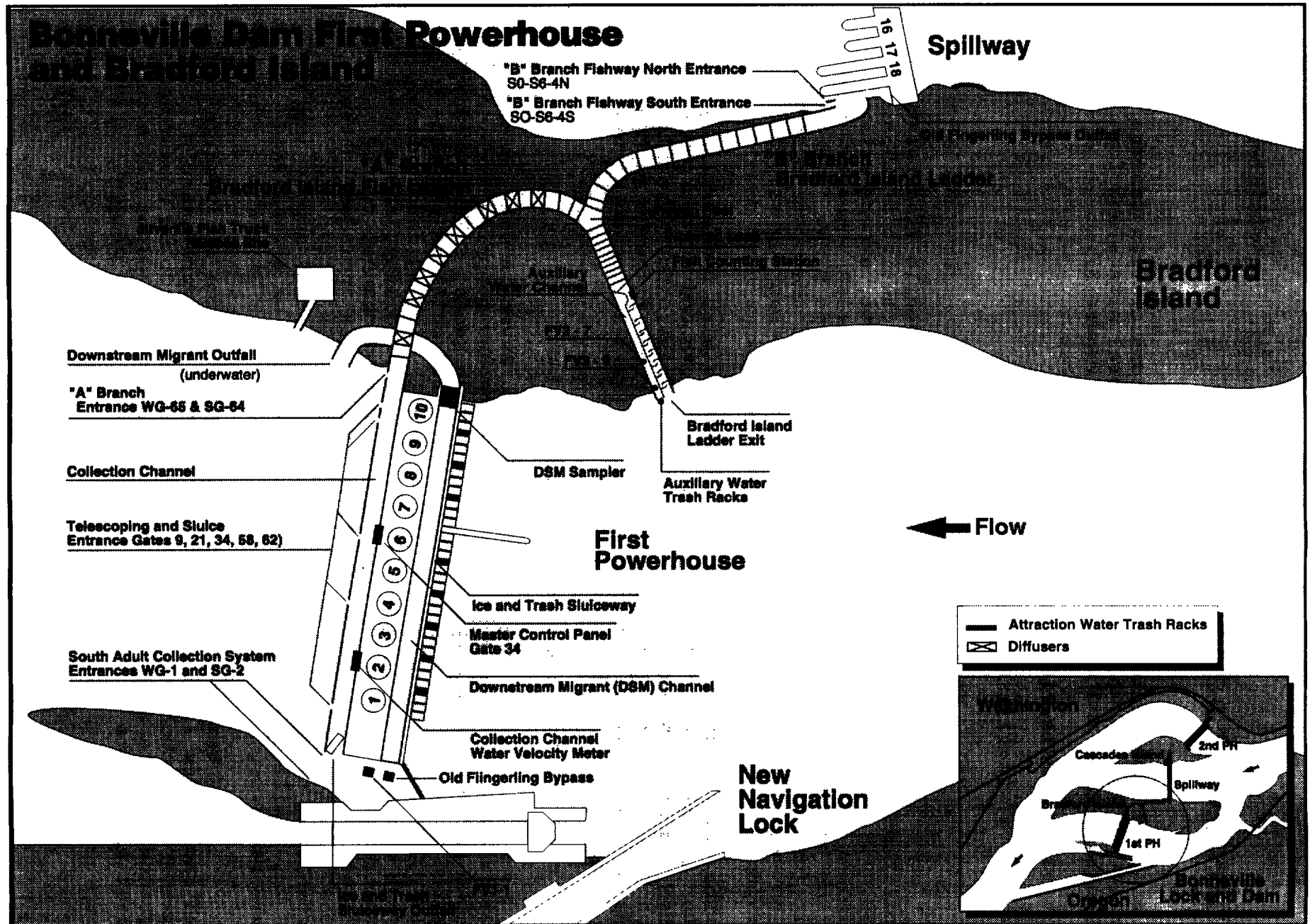
(a) Facilities Description. Juvenile fish passage facilities at the Bonneville first powerhouse consist of STSs, VBSSs, 12" gatewell orifices, fish bypass channel, excess water elimination facility, fish sampler, and a 24" fish transport pipe to the tailrace. All 10 main turbine units have STSs. A small 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 auxiliary water intakes for adult fishways at the south end of the powerhouse and at both ends of the spillway. These older juvenile fish passage channels discharge into the adult fishways at the ends of the spillway and into the ice & trash sluiceway at the south end of the powerhouse.

(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), VBSSs, 2-12" 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 trash racks. Two smaller turbines that supply adult fishway auxiliary water do not have STSs, TIEs or streamlined trash racks.

b. Juvenile Migration Timing. Maintenance of juvenile fish facilities is scheduled for the period of approximately December 1 through February 28 to reduce the impact on downstream migrants: maintenance activities will be coordinated to minimize potential impacts on juvenile migrants that may be present during



BON-2

Figure 1 Bonneville Dam First Powerhouse and Bradford Island Fish Ladder

BON-3

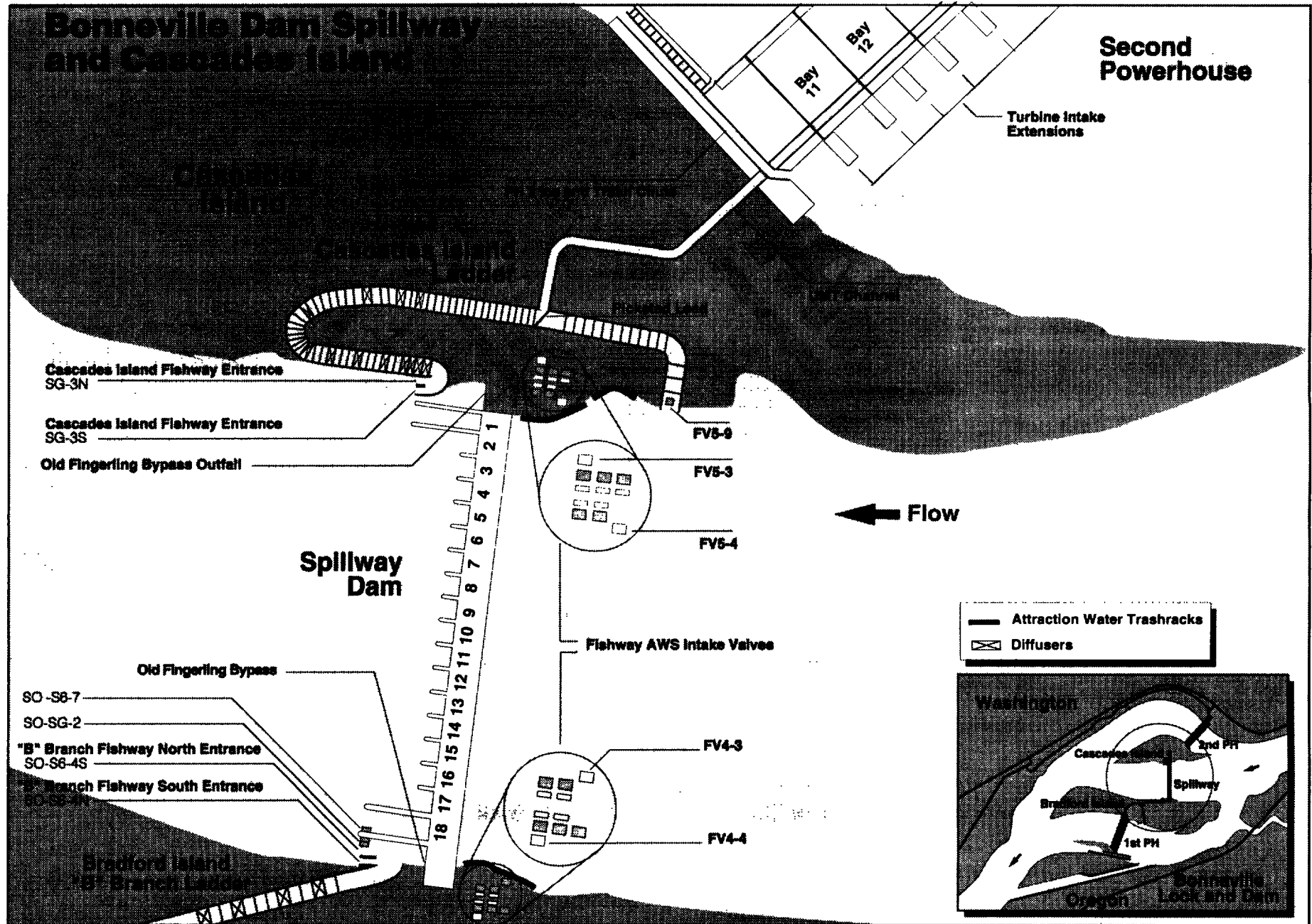


Figure 2 Bonneville Dam Spillway, Cascades Island Fish Ladder and Upstream Migrant Transportation Channel (UMT)

BON-4

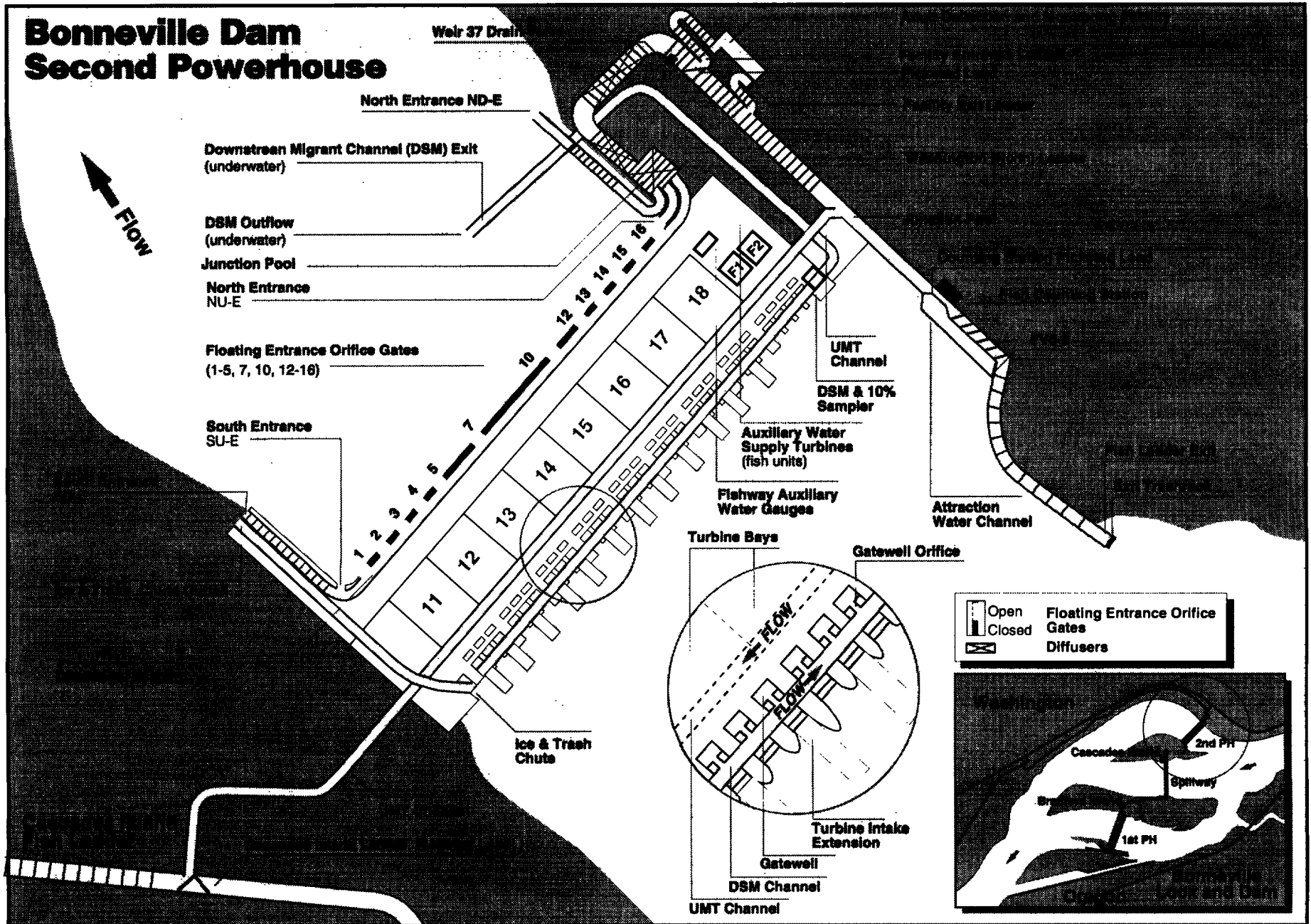


Figure 3 Bonneville Dam Second Powerhouse and Washington (North) Fish Ladder.

Table 1. Juvenile Fish Migration Timing at Bonneville Dam.

<u>% PAST PROJECT^a</u>	1989	1990	1991	1992	1993
Yrlg. Chinook					
10%	4/21	4/16	4/22	4/16	
90%	5/21	5/22	5/31	5/15	
Subyrlg. Chinook ^b					
10%	6/6	6/7	3/24	4/19	
90%	7/29	7/12	7/23	7/8	
Steelhead					
10%	4/22	5/1	5/9	4/25	
90%	5/29	6/4	5/31	5/29	
Coho					
10%	4/21	4/23	5/3	4/25	
90%	5/29	6/9	6/1	6/3	
Sockeye					
10%	5/10	5/8	5/19	5/11	
90%	6/4	6/5	5/31	5/31	

^a Measured at the first powerhouse bypass trap.

^b Large spring releases of tule stock subyearling chinook in Bonneville pool overshadow the summer upriver stock migration. To avoid this, these dates are for the middle 80 percent of the subyearling chinook run which occurs after this June 1.

this time period.

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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 effect fish passage. The weekly reports shall cover a Sunday through Saturday time period and shall be sent to CENPP-OP by noon the following Tuesday via electronic mail. The Project biologist shall prepare an annual report by January 31, summarizing the operation of the project fish passage facilities for the previous year. The report will cover from the beginning of an adult fish facility winter maintenance period to the beginning of the next.

2. Adult Fish Passage

a. Facilities Description. Adult fish passage facilities at Bonneville Dam are composed of two main fishway segments. The first powerhouse collection system with A-branch ladder and the south spillway collection system with B-branch ladder join together at The Bradford Island ladder to form the Bradford Island fishway segment. The second powerhouse collection system/ladder and the Cascades Island collection system/ladder join together at the Washington shore to form the Washington Shore fishway segment. Both the Bradford Island and the Washington Shore fishways have counting stations. The second powerhouse ladder has an adult fish sampling facility. All four collection systems have auxiliary water supplies for fish attraction.

b. Adult Migration Timing. Upstream migrants are present at the project 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. Normal and special annual fish counting is described in appendix B.

Adult migration count data for Bonneville Dam have been collected since 1938. Table 2 summarizes adult fish passage timing through the most recent count year. The primary passage period and the earliest and latest peaks of migration recorded are listed for each species, from fish counts compiled by the Corps.

Table 2. Adult Migration Timing from Fish Counts 1938-1993.

Species	Passage Period	Earliest Peak	Latest Peak
Spring Chinook	3/14 - 5/31	4/15	5/27
Summer Chinook	6/1 - 7/31	6/5	8/15
Fall Chinook	8/1 - 11/15	9/1	9/17
Steelhead	3/15 - 11/15	7/16	9/12
Coho	7/ - 11/15	8/29	9/20
Sockeye	5/ - 8/	6/22	7/13

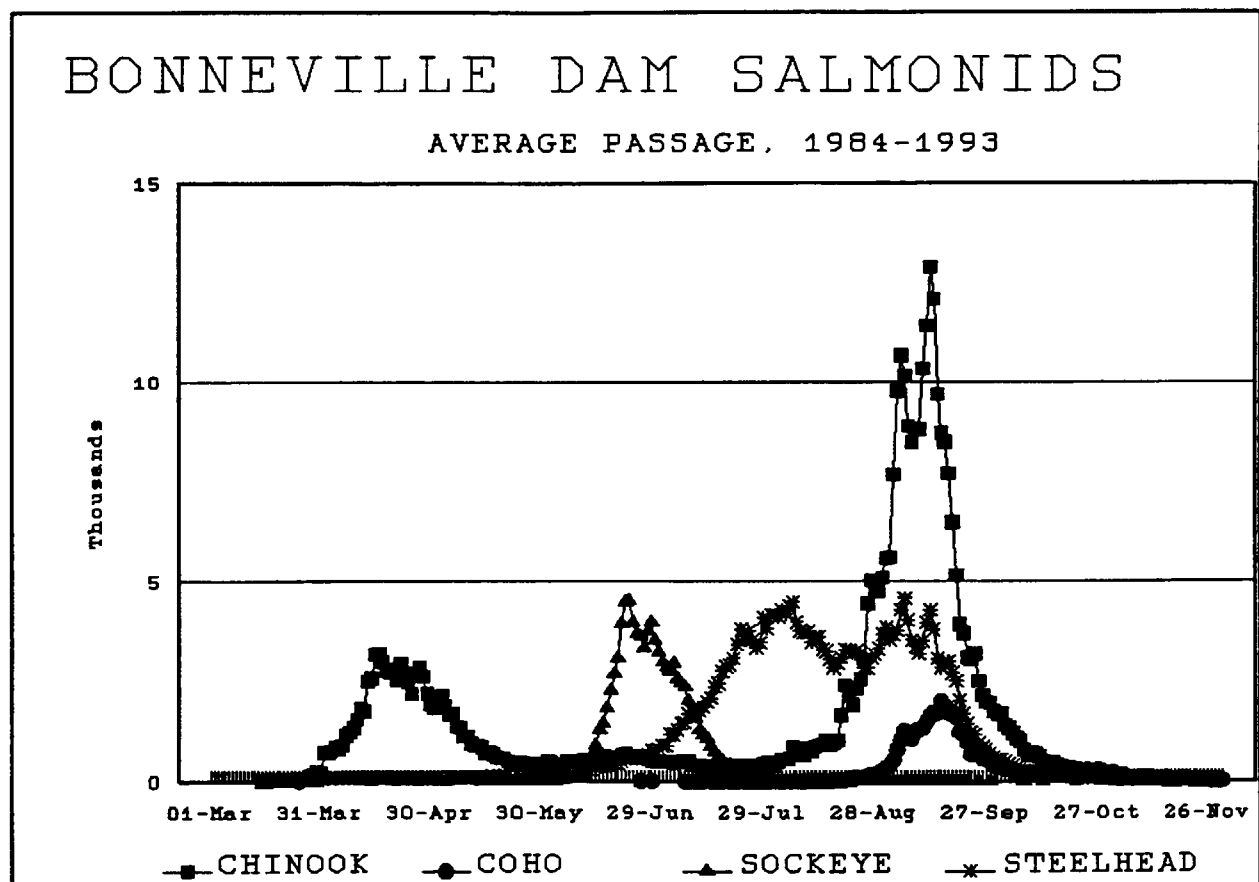


Figure 4. Adult Salmonid Passage at Bonneville Dam.

B. Project Operation

1. General

a. Low FGE at the second powerhouse has been improved by implementation of three measures: 1) full installation of turbine intake extensions 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).

2. Spill Management.

a. General.

(1) Regardless of time of day, only one spill schedule will be used at Bonneville Dam. See Table 3, page BON-11.

(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 appendix B. Special operations will end no later than 0500 on August 23.

(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 1 hour before sunrise to $\frac{1}{2}$ hour before sunset. However, during the sockeye passage season, June 1 through August 15, the cap will apply until 1 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' | |

3. Dissolved Gas Management and Control. Implementation of spill requests will take into account dissolved gas monitoring data and the observed condition of migrant juveniles and adults, along with juvenile migration monitoring data. Total dissolved gas monitoring will be conducted by the Corps from a station in the Bonneville forebay and from four stations located below Bonneville Dam (Warrendale, Camas, Kalama and Wauna Mill). Dissolved gas data will be reported every four hours starting prior to an early Spring Creek NFH fish release, but not later than 1 March for stations below Bonneville and on 1 April for the station at Bonneville and those further upriver. Collection will continue until Labor Day. Related data for Bonneville Dam 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.

4. Juvenile Fish Passage Facilities

a. First Powerhouse

(1) Operating Criteria

(a) Prior to the Juvenile Fish Passage Season:

i) Remove debris from forebay, trashracks and gatewell slots such that these areas are free of debris.

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

iii) Inspect each STS and operate on trial run (dogged off at deck level). Install STS in each slot of operational turbine units by the end of the last work day in the work week closest to March 1. However, see I.B.4.a.(1)(b), about accommodations when there is an early fish release from Spring Creek NFH.

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

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

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

vii) Inspect and where necessary repair or install avian predator control lines.

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

ix) The results of all inspections and the readiness of the facilities for operation will be verbally reported to a FPDEP-TCC or fish facility O&M sub-committee meeting immediately prior to the fish passage season.

(b) Juvenile Fish Passage Season. The passage season begins on the date of a work week end which is closest to 1 March, and ends on the Monday which is closest to 30 November, (see appendix B). Bonneville project's current work week is Monday through Thursday. When possible, the first powerhouse juvenile fish protection facilities (STSS, etc.) will be in place for an early fish release from Spring Creek NFH, if scheduled to occur before the juvenile fish passage season.

i) 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 total draw-down in gatewell, as indicated by fish condition (e.g., higher than expected descaling), or as determined by the Project Biologist. STSS in units being raked will be run in continuous mode during raking operation. Gatewell orifices of the unit being raked must be closed during the procedure.

ii) Operate STSS at 55° angle from vertical.

iii) 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 May 1, mid-July and September 1. Inspections will be concentrated on the priority units and others with the longer operating time. More frequent inspections may be required by the Project Biologist or under the following condi-

tions: 1) deterioration of fish conditions; 2) increased debris load in bypass system; and 3) other indications of STS or VBS malfunctions or failure.

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

The Corps is currently attempting to resolve this conflict through an element of the Project Improvements for Endangered Species (PIES) program. The intent is to increase inspection frequency by developing a faster inspection system, and implement as quickly as it is approved and developed.

Records of inspections or summary of such records will be made available to the FPC by January 1.

iv) Operate all gatewell orifice systems. Inspect each daily to assure that the orifice valves and lights are operating correctly. Back-flush at least every day or more often if indicated by debris accumulations. Replace all burned out orifice lights within 24 hours.

v) In the DSM downwell area¹:

a) Maintain between 0.9 and 1.3 feet of depth, 1 foot preferred, over the end of the DSM inclined dewatering screen.

b) Maintain differential between forebay and dewatering screen between 5.3 and 5.7 feet.

c) Maintain drop from dewatering screen to water surface in down-well between 3.0 and 4.5 feet.

d) Operate dewatering screen trash sweep 1 revolution at 20 minute intervals. The interval between operations may be doubled when the amount of debris passing is light.

vi) Inspect each STS amp gauge readings at least once each shift and record readings once per day. If an STS failure occurs, then follow procedures in the Fish Facilities Maintenance Plan, see page BON-27.

¹. Standards listed are for normal operation. During smolt sampling, depth of water over the inclined screen and elevation of the water surface in the downwell are lowered.

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. 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.

viii) A slight oily sheen is commonly found in many gate-wells. 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) Inspect and maintain the avian predator control lines strung over the tailrace and juvenile fish release areas.

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

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

xii) During the juvenile fish passage season, open sluice gate 7A to a depth of 3.5 feet and 10C to a depth of 2.5 feet below the daily expected forebay elevation (see end-notes, page BON-41). Whenever the old juvenile fish bypass located at the south end of the powerhouse operates, some flow must be maintained through the ice & trash sluiceway, since the bypass flows into the sluiceway.

xiii) Operate the three fingerling bypass gates so that the 2' x 4' orifice at the top of each gate is at least

half submerged, but not so deep that the beam above the orifice is submerged.

xiv) Inspect juvenile fish passage facilities twice per day, except where other guidance is provided elsewhere within this plan for specific facilities.

(c) **Winter Maintenance Season.** The winter maintenance season begins on the Monday which is closest to 30 November and ends on the date of the work week end which is closest to 1 March (see appendix B). Bonneville project's current work week is Monday through Thursday.

i) All STSs removed.

ii) DSM channel may be dewatered throughout most of this period if STSs must be stored beneath the intake deck, which places the STSs directly in front of the gatewell orifices (see Dewatering Procedures, page BON-38).

b. Second Powerhouse

(1) Operating Criteria

(a) Prior to the Juvenile Fish Passage Season

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

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

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

iv) Install STS in each intake of operational units. Second powerhouse STSs are to be installed by the date of a work week end which is closest to 1 March. When possible, however, the juvenile fish protection facilities (STSSs, TIEs, etc.) will be in place for an early fish release from Spring Creek NFH, if scheduled to occur before the juvenile fish passage season.

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

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

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

viii) Install, inspect and maintain avian predation control lines in the tailrace area, except when fish research precludes the installation.

(b) Juvenile Fish Passage Season. The juvenile fish passage season begins on the date of a work week end which is closest to 1 March, and ends on the Monday which is closest to 30 November (see appendix B). Bonneville project's current work week is Monday through Thursday.

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 (e.g., 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 gate-well draw-down 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 draw-down. 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° 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 May 1, mid-July and September 1. Inspections will be concentrated on the priority units and others with the longer operating time. More frequent inspections may be required by the Project Biologist or under the following condi-

tions: 1) deterioration of fish conditions; 2) increased debris load in bypass system; and 3) other indications of STS or VBS malfunctions or failure.

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

The Corps is currently attempting to resolve this conflict through an element of the Project Improvements for Endangered Species (PIES) program. The intent is to increase inspection frequency by developing a faster inspection system.

If STS or VBS damage or plugging is detected, follow procedures in Fish Facilities Maintenance Plan. Records of inspections or summary of such records will be made available to the FPC by January 1 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. As the effectiveness of darkening the DSM in speeding the passage of juvenile fish continues to be investigated, gallery and orifice lights may be turned off temporarily according to coordinated study plans.

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 (page BON-27).

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.

viii) A slight oily sheen is commonly found in many gate-wells. 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

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 better way to remove fish and reduce impact on fish is being studied.

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) Inspect and maintain avian predation control lines in the tailrace area, except when ongoing fish research precludes the installation.

xi) Turbine units without full complements 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.

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 58.0 under the automatic control system.

xv) Inspect facilities twice per day.

(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 March 1.

However, the end of the season may be shortened for an early fish release from Spring Creek National Fish Hatchery.

All STSs removed. DSM dewatered (see Dewatering Procedures) 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.

5. Adult Fish Passage Facilities

a. Operating Criteria

(1) Prior to March 1

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

(a) All Adult Facilities

i) Water depth over fish ladder weirs: 1.3' ± 0.1.

ii) Measure water temperature within each ladder system 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 (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 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 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) At the end of each fish counting day, fully open counting station crowders and leave fish passage slot lighted over night.

viii) Inspect facilities twice per day.

(b) Spillway Ladders

i) Spill bay gates 1 and 18 shall be open 4 inches 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, both gates shall be open. When the tailwater is between 9 and 17 feet, the south sluice gate shall close. When the tailwater exceeds 17 feet, both sluice gates shall close.

(c) First Powerhouse

i) Entrance gate 65 operates as an adjustable height submerged weir with crest elevation 8 feet or greater below tailwater for tailwater elevations above 17.0. For tailwater elevations below 17.0, the weir is fully lowered with crest at elevation 8.5.

ii) Entrance gate 64 is a submerged orifice entrance which operates according to tailwater elevation. The gate fully closes when tailwater exceeds 17'. It fully opens when tailwater is below 8'. Between these elevations, the gate positions to compensate for limited flow through gate 65.

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

Orifice A (lower sluice gate) operates (opens) from tailwater elevation 7 to 16 on a rising tailwater and elevation 15 to 7 on a falling tailwater.

Orifice B (upper telescoping gate) operates from tailwater elevation 16 to 38 on a rising tailwater and 38 to 15 when tailwater drops.

iv) Powerhouse entrance gate 1 operates as an adjustable height submerged weir which acts as the primary control to regulate head between the collection channel and tailrace (head on all entrances). Entrance gate 2 is a submerged orifice entrance which operates only when entrance gate 1 is completely lowered to regulate the head between the collection channel and tailrace at lower tailwater elevations. Gate 1 is fully lowered when the tailwater is below 22.0; then gate 2 takes over fishway head regulation.

(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 feet or greater below tailwater.

ii) Operate all 12 powerhouse floating gate fishway entrances.

(e) Spillway Operations

Bonneville Dam uses a single spill schedule for use both day and night (Table 3).

b. December 1 through February (Winter Operating 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 to 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 specially 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 crowdiers at fish counting stations to full open at the end of the counting season.

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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 be initiated this year. These organisms have become a serious problem elsewhere in the country and are expected to eventually become introduced to the Columbia.

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 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. 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 gateway 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 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. Gateway 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 Plan). The maintenance schedules for these turbines and spillways will be coordinated with the agencies through the Fish Passage Center representative on the Fish Passage Development and Evaluation Program (FPDEP) Operations and Maintenance Subcommittee. 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 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 resource agencies.

Some types of maintenance on turbines will result in the requirement to operate the turbine throughout it's 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 draw-down.

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. The intent is to facilitate more frequent gatewell cleaning by developing a more efficient debris removal system.

(c) Bonneville First Powerhouse - If any part of the dewatering screen, downwell or juvenile release conduit fails, making this portion of the system unsafe for juvenile fish, the juveniles will be diverted to the ice and trash sluiceway. This operating mode will require the gate at the south end of the 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 feet² (see endnotes, page BON-41), 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.

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.

(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 diffusion gratings, leads and entrance gates, will be scheduled at least once every ten years with at least one underwater inspection in between 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 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, page BON-38).

(3) **Adult Fish Ladders and Counting Stations.** The adult fish ladders will be dewatered (see Dewatering Plan, page BON-38) 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.

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 gates fails to achieve a minimum fishway head of 1.0 feet when tailwater is greater than 17 feet, then raise gate 65 weir in one-foot increments up to 6 feet of depth below the tailwater surface until a head of 1.0 feet is achieved. If this fails to achieve the proper fishway head, then raise gate 1 weir in one foot increments to 6 feet below the tailwater surface until a head of 1.0 feet is achieved.

When tailwater elevation is less than 17 feet and the gate 65 weir crest is at least 6 feet below tailwater, close gate 64 in one-foot increments until the proper head is achieved or the gate is fully closed, then raise gate 65 in one-foot increments up to 6 feet below tailwater. If the gate 65 weir crest is less than 6 feet below tailwater, then fully open gate 64 and close gate 65. If this fails to achieve the proper fishway head and the gate 1 weir crest is at least 6 feet below tailwater, then close gate 2 in one-foot increments until fully closed, then raise gate 1 in one foot increments up to 6 feet below tailwater. If the gate 1 weir crest is less than 6 feet below tailwater, then fully open gate 2 and close gate 1. At this point maintain the gates' positions regardless of whether criteria are met or not, until the auxiliary water system is repaired.

(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, stop-logs are to be added to the entrance slots until the desired head or a weir depth of not less than 6 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 April 1 and August 31, raise the North Upstream Entrance (NUE) in one-foot increments until the weir crest is 6 feet below the tailwater or a fishway head of a least 1.0 feet 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 three entrances will not be raised above 6 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 September 1 and March 31, during a time when tailwater is high enough that normal operation can't be maintained using the remaining fish unit, and repairs can't be made within 24 hours, then the ice and trash sluiceway will be used to supplement discharge to allow operation of the fishway according to the above standards. 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 September 1 and March 31, 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 eight 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 eight 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 six 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 insure 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 project biologist and CBFWA.

D. Turbine Unit Operation and Maintenance

1. Unit operating priority during the fish passage seasons.

Table 4. Bonneville Dam Fish Passage Season Unit Operating Priority.

1st POWERHOUSE		2nd POWERHOUSE	
UNIT OPERATING PRIORITY	TIMES	UNIT OPERATING PRIORITY	
1, 2, 10, 9, 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-PE-WM.

Unit 16 will follow unit 17 in priority if unit 18 is out of 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 cavitation limits at various head ranges are provided in Table 5²:

4. To the extent technically feasible, turbines will be operated within $\pm 1\%$ of peak turbine efficiency, unless operation

² The guidance provided is based on an assumption of greater control and gauging accuracy than is actually currently possible. Elements of the Passage Improvements for Endangered Species (PIES) program are working toward achieving greater actual turbine efficiency.

BONNEVILLE DAM PEAK TURBINE EFFICIENCY RANGES

Head (ft)	FIRST POWERHOUSE				SECOND POWERHOUSE			
	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	11,238	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	12,094	47	16,777
41	18	6,371	33	11,464	35	12,022	48	16,826
42	19	6,424	34	11,506	36	11,980	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	11,780	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	30	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	48	11,844	53	12,050	77	17,343
60	33	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

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 (appendix D) apply between March 15 and October 31. 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.

The Corps is currently attempting to resolve this conflict through elements of the Project Improvements for Endangered Species (PIES) program. Developments are being made in the areas of operational control and in defining operating criteria.

(These comments apply to the following item, also.)

5. If it is necessary to operate units outside the $\pm 1\%$ 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 the following prioritized 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. Attempts will be made to avoid long-term unit outages after the beginning of the juvenile fish passage season, particularly the first Spring Creek NFH fish release, until after the fall chinook and coho adult runs diminish at the end of October.

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

juvenile fish downstream, also. When not needed for juvenile fish passage, long-term outages will be avoided between March 4 and the end of the fall chinook and coho adult runs at the end of October.

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 described³ in a memorandum from the project operations superintendent.³

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

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 CBFWA will be represented at all ladder dewaterings by the WDW fish counting program supervisor or an alternate.

4. **Juvenile bypass systems** Key elements of the fish salvage plan for JBS draining and PH1 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 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 orifice flow for at least 24 hours but no more than 48 hours prior to dewatering.

(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 will invite fishery agency and/or Indian tribal biologists participation in the dewatering and will try to be available to oversee fish rescue when ladders are dewatered. Rescue personnel will walk the inside of the ladder from the head gates down to tailwater salvaging all fish either by moving fish to tailwater within the ladder flow or capturing and placing the fish in a large water filled tank which is then transported to the forebay or tailwater, whichever is closest, 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 insure 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 on 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 gate-well(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 turbine unit draft tube is to be dewatered and 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 insure 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 invite CBFWA 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 insure 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 Movement of Salmonids at Bonneville Dam. Gauley, Anas, and Schlotterbeck, BCF, USFWS. Special Scientific Report, Fisheries No. 236 (January 1958).

The Dalles Dam

II. 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 (Figure 4 through Figure 6).

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.

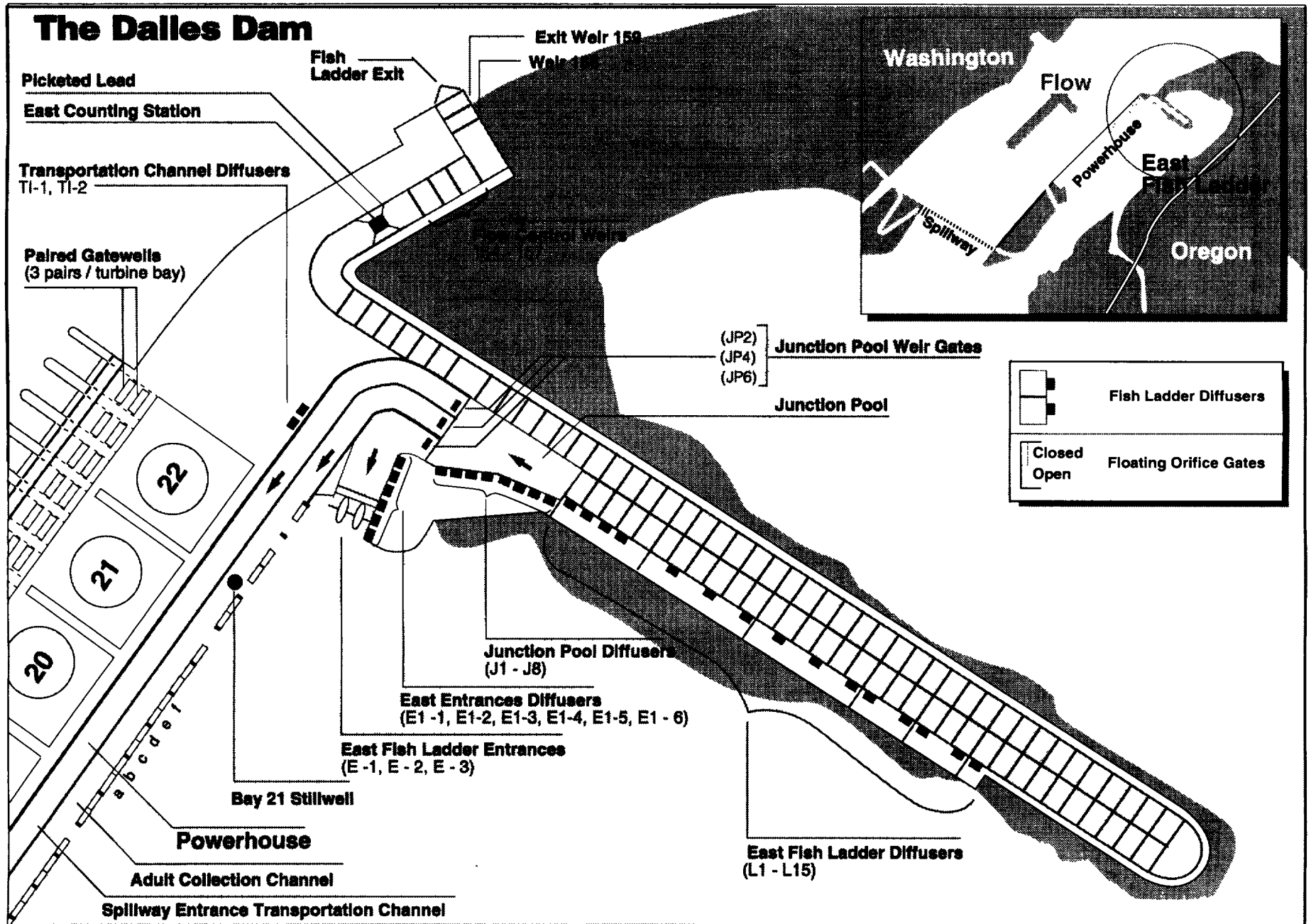


Figure 4 The Dalles Dam East Fish Ladder

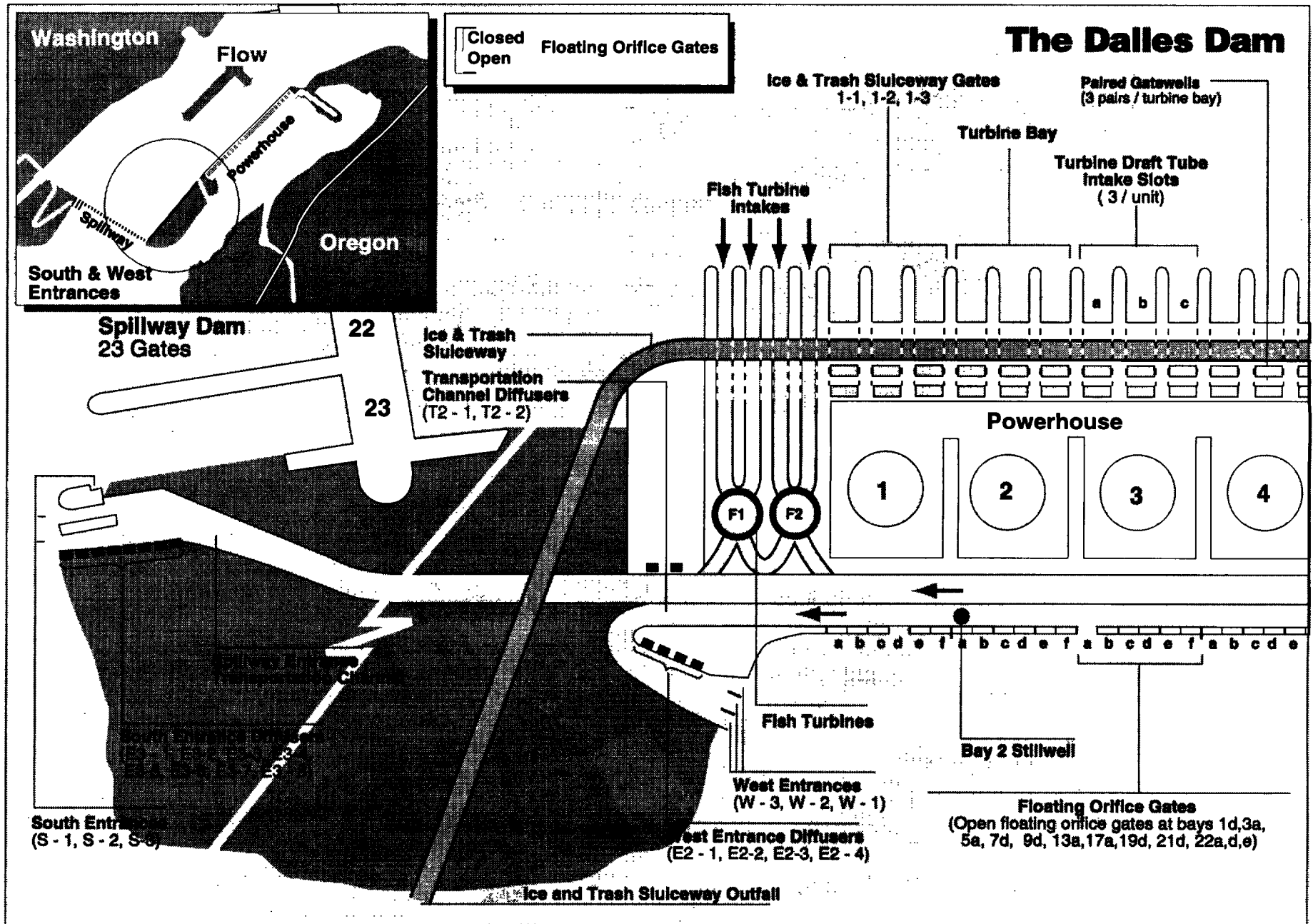


Figure 5 The Dalles Dam South and West Fish Ladder Entrances

TDA-4

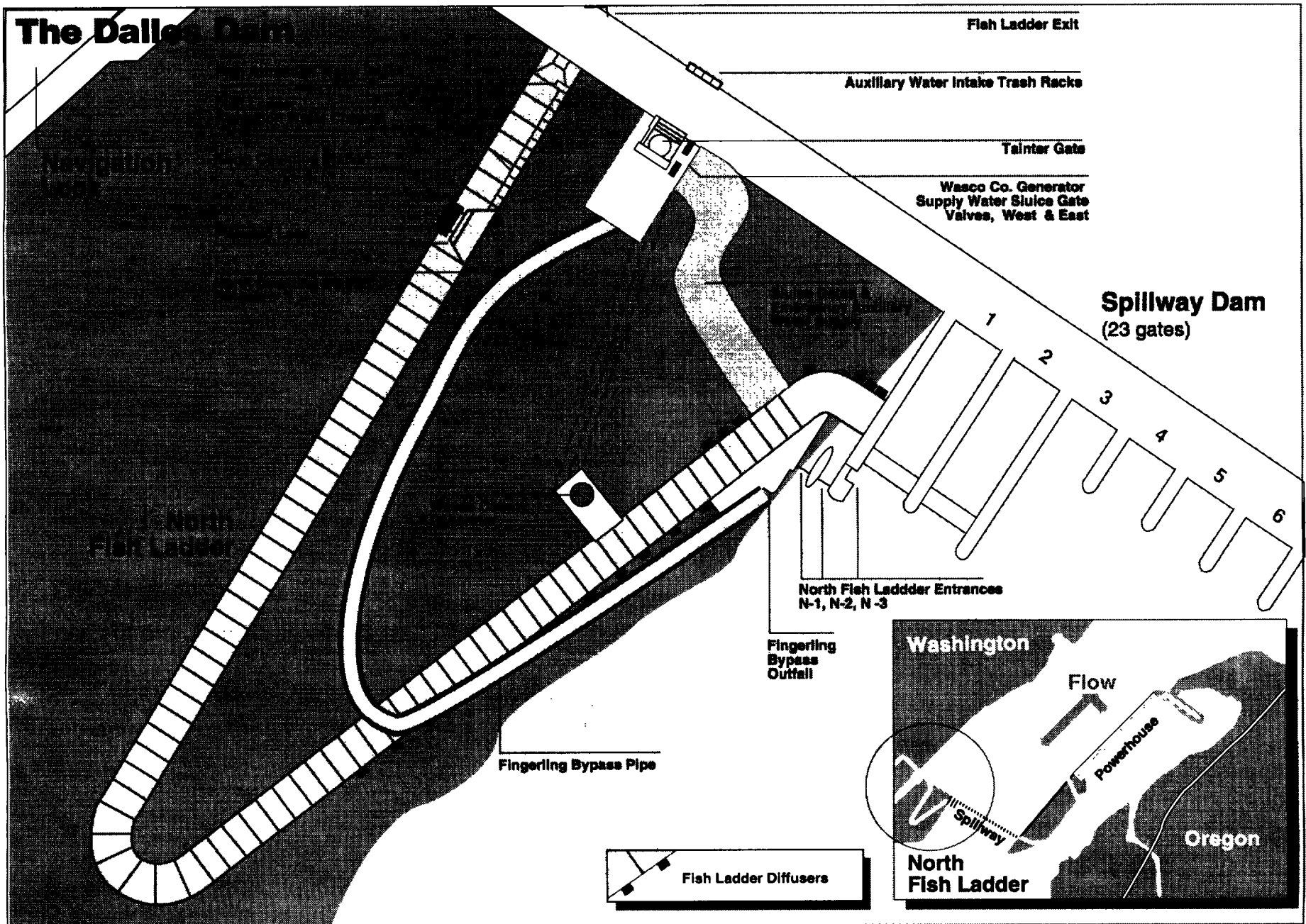


Figure 6 The Dalles Dam North Fish Ladder and Spillway

b. Juvenile Migration Timing. The dates of peak passage of Snake River steelhead at The Dalles Dam have ranged from May 11 in 1978 to June 21 in 1977. Peak passage of Snake River spring chinook at The Dalles Dam ranged from May 8 in 1976 to June 17 in 1977. Travel time from the upper Snake River to The Dalles Dam ranges from 12 to 39 days for yearling chinook and 10 to 40 days for steelhead.¹ 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; 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 effect fish passage. The weekly reports shall cover a Sunday through Saturday time period and shall be sent to CENPP-OP by noon the following Tuesday via electronic mail. The Project biologist shall prepare an annual report by January 31 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.

Table 6 Juvenile Fish Passage Timing at The Dalles Dam.

PERCENT OF MIGRATION	1978	1979	1981	1982	1989 ^a	1990 ^b	1991
Yearling Chinook							
10%	5/6	5/6	5/2	5/2	---	4/17	4/23
90%	6/11	6/11	5/31	5/30	---	5/28	6/19
Sub-yearling Chinook							
10%	---	---	---	---	6/13	---	4/17
90%	---	---	---	---	8/01	---	8/1
Sockeye							
10%	5/1	5/7	5/8	5/2	---	---	5/22
90%	6/5	6/5	6/6	5/30	---	---	6/5
Steelhead							
10%	4/27	4/15	5/1	5/1	---	4/26	5/10
90%	5/30	5/26	5/31	5/30	---	6/2	6/7

No monitoring in 1992.

Fall chinook are not included due to incomplete sampling.

Source: ODFW sluiceway passage research 1977, 1978, 1979, 1981 and 1982. NMFS smolt monitoring, 1989, 1990 and 1991.

^a NMFS gate-well sampling terminated on 9/1 in 1989; gatewell and airlift operations terminated on 8/31/90.

^b Recapture of Corps barge release fish on 5/29 is not included in determination of 10 and 90% migration timing for yearling chinook and steelhead.

2. Adult Fish Passage

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

A small hydropower facility utilizing the north fishway ladder auxiliary water supply was constructed in 1991 and is monitored by the North Wasco PUD. Possible impacts of this facility on

operation of the fish passage facilities are monitored closely by The Dalles project personnel.

b. **Adult Migration Timing.** Upstream migrants are present at The Dalles Dam throughout the year. However, passage through the winter months is relatively light and there is no regular fish counting. The fish counting schedule at The Dalles Dam is described in appendix B. Maintenance of upstream migrant passage facilities is scheduled to take place between December 1 and February 28 to minimize impacts on upstream migrants. The following table shows the passage period by species and the earliest and latest recorded dates of peak passage since 1957.³

Table 7. The Dalles Dam Adult Fish Passage Timing.

<u>MIGRATION TIMING</u>			
<u>1957-1993</u>			
<u>Species</u>	<u>Counting Period</u>	<u>Earliest Peak</u>	<u>Latest Peak</u>
Spring Chinook	4/1 - 6/3	4/17	5/13
Summer Chinook	6/4 - 8/3	6/6	8/1
Fall Chinook	8/4 -10/31	9/3	9/16
Sockeye	4/1 -10/31	6/20	7/10
Steelhead	4/1 -10/31	7/9	9/22
Coho	4/1 -10/31	9/3	9/27

B. Project Operation

1. Spill Management

a. The spill schedule at Table 8 will be used for juvenile fish passage during 2000-0500 hours (Juvenile Passage Period).

b. The spill schedule at Table 9 will be used for adult fish passage during 0500-2000 hours (Adult Passage Period).

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	3	2	2	1											34	51.0
2	3	4	3	3	3	3	3	3	3	3	2	2	1											35	52.5
3	3	4	3	3	3	3	3	3	3	3	2	2	1											36	54.0
3	3	4	3	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	3	2	1	1										38	57.0
3	3	4	4	3	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	3	1	1										40	60.0
3	3	4	4	4	3	3	3	3	3	3	3	3	1	1										41	61.5
3	3	4	4	4	3	3	3	3	3	3	3	3	2	1										42	63.0
3	3	4	4	4	4	3	3	3	3	3	3	3	2	1										43	64.5
3	3	4	4	4	4	4	3	3	3	3	3	3	2	1										44	66.0
3	3	4	4	4	4	4	4	3	3	3	3	3	2	1										45	67.5
3	3	4	5	4	4	4	4	4	3	3	3	3	2	1										46	69.0
3	3	4	5	5	4	4	4	4	3	3	3	3	2	1										47	70.5
3	3	4	5	5	4	4	4	4	4	3	3	3	2	1										48	72.0
3	3	4	5	5	4	4	4	4	4	3	3	3	2	2										49	73.5
3	3	4	5	5	5	4	4	4	4	3	3	3	2	2										50	75.0
3	3	5	5	5	5	4	4	4	4	3	3	3	2	2										51	76.5
3	3	5	5	5	5	4	4	4	4	3	3	3	2	2	1									52	78.0
3	4	5	5	5	5	4	4	4	4	3	3	3	2	2	1									53	79.5
4	4	5	5	5	5	4	4	4	4	3	3	3	2	2	1									54	81.0
4	4	5	5	5	5	4	4	4	4	4	3	3	2	2	1									55	82.5
4	4	5	5	5	5	5	4	4	4	4	3	3	2	2	1									56	84.0
4	4	5	5	5	5	5	4	4	4	4	4	3	2	2	1									57	85.5
4	4	5	6	5	5	5	4	4	4	4	4	3	2	2	1									58	87.0
4	4	5	6	5	5	5	4	4	4	4	4	3	3	2	1									59	88.5
4	4	5	6	5	5	5	5	4	4	4	4	3	3	2	1									60	90.0
4	4	5	6	6	5	5	5	4	4	4	4	3	3	2	1									61	91.5
4	5	5	6	6	5	5	5	4	4	4	4	3	3	2	1									62	93.0
5	5	5	6	6	5	5	5	4	4	4	4	3	3	2	1									63	94.5
5	5	5	6	6	6	5	5	4	4	4	4	3	3	2	1									64	96.0
5	5	5	6	6	6	5	5	4	4	4	4	3	3	2	2									65	97.5
5	5	5	6	6	6	5	5	5	4	4	4	3	3	2	2									66	99.0
5	5	5	6	6	6	5	5	5	4	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

**SPIEL 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	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	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	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	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	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	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	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	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	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	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	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	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	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	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	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	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	1	54	81.0
1	1	2	2	2	2	3	2	3	3	3	3	4	3	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	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	1	57	85.5
1	1	2	3	2	3	3	2	3	3	4	3	4	3	3	3	3	3	2	2	1	1	1	1	58	87.0
1	1	2	3	2	3	3	2	3	3	4	3	4	3	4	3	3	3	2	2	1	1	1	1	59	88.5
1	1	2	3	2	3	3	2	4	3	4	3	4	3	4	3	3	3	2	2	1	1	1	1	60	90.0
1	1	2	3	2	3	3	3	4	3	4	3	4	3	4	3	3	3	2	2	1	1	1	1	61	91.5
1	1	2	3	2	3	4	3	4	3	4	3	4	3	4	3	3	3	2	2	1	1	1	1	62	93.0
1	1	2	3	2	3	4	3	4	3	4	3	4	3	4	3	3	3	2	2	2	1	1	1	63	94.5
1	1	2	3	2	3	4	3	4	3	4	4	4	3	4	3	3	3	2	2	2	1	1	1	64	96.0
1	1	2	3	2	3	4	3	4	4	4	4	4	4	4	3	3	3	2	2	2	1	1	1	65	97.5
1	1	2	3	2	3	4	3	4	4	4	4	4	4	4	3	3	3	2	2	2	1	1	1	66	99.0
1	2	2	3	2	3	4	3	4	4	4	4	4	4	4	3	3	3	2	2	2	1	1	1	67	100.5
1	2	2	3	2	3	4	3	4	4	4	4	4	4	4	3	3	3	2	3	2	1	1	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	5	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	5	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	5	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	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	5	5	4	2	128	192.0	
1	2	5	5	6	6	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	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	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	6	6	5	5	4	2	132	198.0		
1	3	5	6	6	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	6	6	5	5	4	2	134	201.0		
1	3	5	6	6	7	7	7	7	7	8	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	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	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	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	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	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	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	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	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.

2. Dissolved Gas Management and Control. Additional spill management will be based on dissolved gas monitoring data and the observed condition of migrant juvenile and adult fish, along with juvenile migration monitoring data. Total dissolved gas monitoring will be conducted by the Corps at the The Dalles Dam forebay automated station and reported every four hours from 1 April until Labor Day. 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.

3. Juvenile Fish Passage Facilities

a. Operating Criteria

(1) Prior to April 1 Each Year:

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

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

(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 April 1.

(f) Install or repair avian predator control lines at the ice and trash sluiceway outfall such that the lines are in good condition on April 1.

(g) The results of all inspections and the readiness of the facility for operation will be verbally reported to the FPDEP-TCC or Fish Facility O&M subcommittee immediately prior to the fish passage season.

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

(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).

(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 by debris.

The Corps is currently attempting to resolve this conflict through an element of the Project Improvements for Endangered Species (PIES) program. The intent is to facilitate more frequent gatewell cleaning by developing a more efficient debris removal system.

(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), through August 31, and at least sunrise to sunset from September 1 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 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 gate-wells. 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.

(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 Table 8 for nighttime spill (2000 - 0500). This schedule was developed for juvenile fish passage.

(4) December 1 through March 31:

(a) Maintain orifices clear of debris.

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

(c) Inspect facilities once per day.

4. Adult Fish Passage Facilities

a. Operating Criteria

(1) Prior to March 1

(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 to the FPDEP-TCC or the Fish Facility O&M committee immediately prior to the passage season.

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

(a) All Adult Facilities

i) Water depth over fish ladder weirs: 1.3' ± .1.

ii) Measure water temperature within each ladder system 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 1.3 to 1.5). 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.

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) 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 will be lowered to bottom when 8.0 feet depth is not possible.

viii) Inspect facilities twice each day.

ix) At the end of each fish counting day, move count station crowdiers back and leave fish passage slot lighted over night.

(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' ± .1'.

ii) Telescoping weir #159 will adjust to maintain 1.3' ± .1' depth over the weir, measured below the counting station.

iii) Telescoping weir #158 will track 1.3' ± .1' below weir #159.

(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.

ii) Spill through bay 1 as follows. Continuing testing in 1994, spill at 1,500 cfs will be called for as required by study design. In the summer (June 1 through August 15), spill 1,500 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' or greater below tailwater. Set E1 with gate crest at 78'.

iii) Operate east ladder junction pool weirs at the following depths in relation to east entrance tailwater

surface elevation, $\pm .5'$. 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.

vi) South Spillway Entrance: Operate both downstream entrances (S1 and S2).

(3) December 1 through February 28 (Winter Operating Period)

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

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

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

(d) Inspect 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 be initiated this year. These organisms have become a serious problem elsewhere in the country and are expected to eventually become introduced to the Columbia.

2. Juvenile Fish Passage Facilities

a. Scheduled Maintenance

(1) **Collection and Transportation Systems.** The Dalles Dam ice and trash sluiceway 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 are dewatered downstream of the gatewell orifices. The system is then visually inspected in all accessible areas for damaged equipment and areas that may cause problems to the juvenile fish. Any problem areas identified are repaired and modifications to the channel and general maintenance are completed. The trash racks are raked just prior to the juvenile fish passage season (April 1), whenever trash accumulations are suspected because of increased head across the trash racks, or increased descaling of juvenile fish is noted at The Dalles or Bonneville dams and that Bonneville's trash racks are clean.

(2) **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 Plan). The schedule for this maintenance is reviewed by the Project and Operations biologists and coordinated within NPP, NPD, BPA and FPC. Certain turbine and spillway discharges at the projects are secondarily used to attract adult fish to the area of fishway entrances. The maintenance schedules for these turbines and spillways will reflect equal weighting given to fish, power and water management and will be coordinated with the appropriate resource agencies. No other fish related restrictions regarding maintenance will be placed on any units at this project, except to coordinate research activities.

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

b. Unscheduled Maintenance

(1) **Collection and Transportation Systems.** The ice and trash sluiceway is now being used as a juvenile bypass system.

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

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

(c) Inspect all gatewells daily. The project will clean 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 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.

CBFNA 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. The intent is to facilitate more frequent gatewell cleaning by developing a more efficient debris removal system.

(d) If a gate hoist fails, it will be repaired promptly. The gate will be removed when there are problems with the seal and the difficulty cannot be repaired promptly. If the epoxy lined section of the sluiceway is found to be damaged, it will be repaired.

(2) Turbines and Spillways.

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

3. Adult Fish Passage Facilities

a. Scheduled Maintenance

(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.

(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 diffusion gratings, picket leads and entrance gates, will be scheduled at least once every five years 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. 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 plan) 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 damage fish, stability of the weirs, damaged picket leads, exit gate problems, loose diffusion valves, ladder orifice reduction plates 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 are then repaired.

b. Unscheduled Maintenance

(1) **Fishway Auxiliary Water Systems.** Most fishway auxiliary water systems operate automatically. If the automatic system fails, the system will be manually operated by the project personnel to maintain criteria. This will allow the fish facility to operate according to criteria while the 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) **Powerhouse** - If one of the two fishway auxiliary water turbines fails or malfunctions during the spring/summer adult migration season (March 1 - July 31) use the following sequential procedure until a fishway head of 1.0 feet is achieved:

- 1: Raise the open West Powerhouse Entrance weirs W1 and W2 (W3 stationary at 78') in one-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 78 feet) in one-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 one-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 (August 1-February 28) 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 eight feet below tailwater surface elevation.
- 4: Raise entrance weir W1 to 6.0' depth below tailwater surface elevation.
- 5: Raise entrance weir E3 to seven feet below tailwater. If one foot of head is still not achieved, then raise it an additional foot to a six 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 feet 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 back-up auxiliary water system will be started and the system operated at criteria. If the back-up 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 picketed 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 representative on the FPDEP Operations and Maintenance Subcommittee.

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 Operations Division biologists for fishery impacts.

3. Guidelines for operation of the turbine units within 1% peak efficiency at various head ranges are shown in Table 10⁴:

4. To the extent technically feasible, turbines will be operated within $\pm 1\%$ 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

⁴. Reference, CENPD-PE-HD.

THE DALLES DAM PEAK TURBINE EFFICIENCY RANGES

Head (ft)	UNITS 1-14				UNITS 15-22			
	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	8,973	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	15,306	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	15,780
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

between March 15 and October 31. 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.

The Corps is currently attempting to resolve this conflict through elements of the Project Improvements for Endangered Species (PIES) program. Developments are being made in the areas of operational control and in defining operating criteria.

(These comments apply to the following item, also.)

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.

E. Dewatering Plans.

1. Detailed plans have been developed 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 WDW 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, do not operate the ladder at orifice flow for more than 48 hours prior to dewatering. Reduced flow is defined as less than criterion operation, but more than orifice flow.

(2) The Project Biologist will invite fisheries agencies and tribes biologists to participate in the dewatering and he will assure that fish rescue equipment is available. He will coordinate with the project to ensure adequate numbers of personnel will be available to move fish out of the dewatered ladder.

(3) Project personnel will install head gates to shut down ladder flow.

(4) The Project Biologist or alternate Corps fisheries personnel will attend all ladder dewaterings and oversee fish rescue. 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, whichever is closest, 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.

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 insure 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 gate-wells 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 insure 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 it will not be necessary to remove fish from draft tubes as long as an adequate "safety pool" is maintained. Adequate inspections will need to be conducted to insure 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 - 1988. Columbia and Snake River Projects. US COE.

John Day Dam

III. 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 (Figure 7 and Figure 8).

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

JDA-2

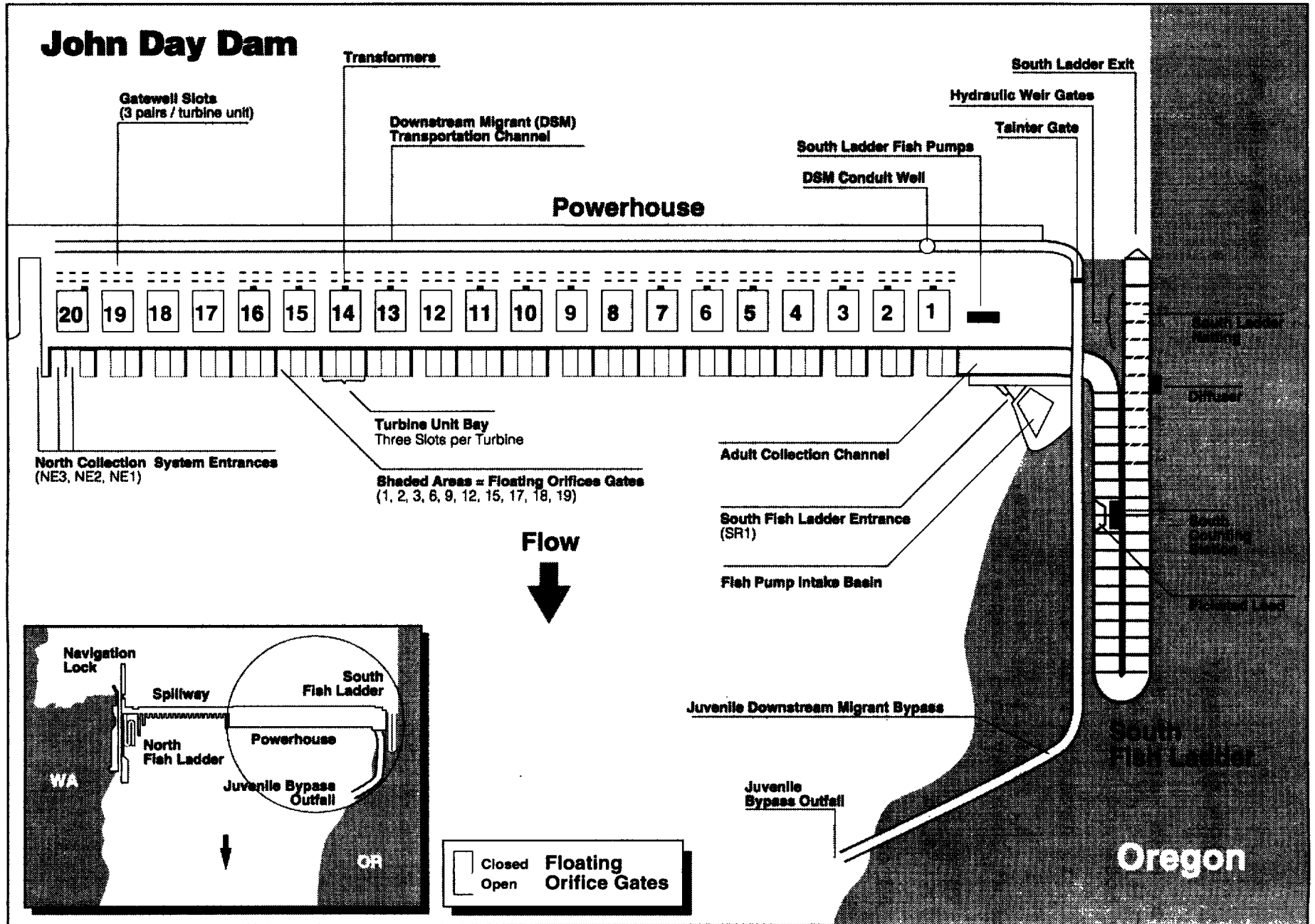


Figure 7 John Day South Fish Ladder and Powerhouse Collection System.

JDA-3

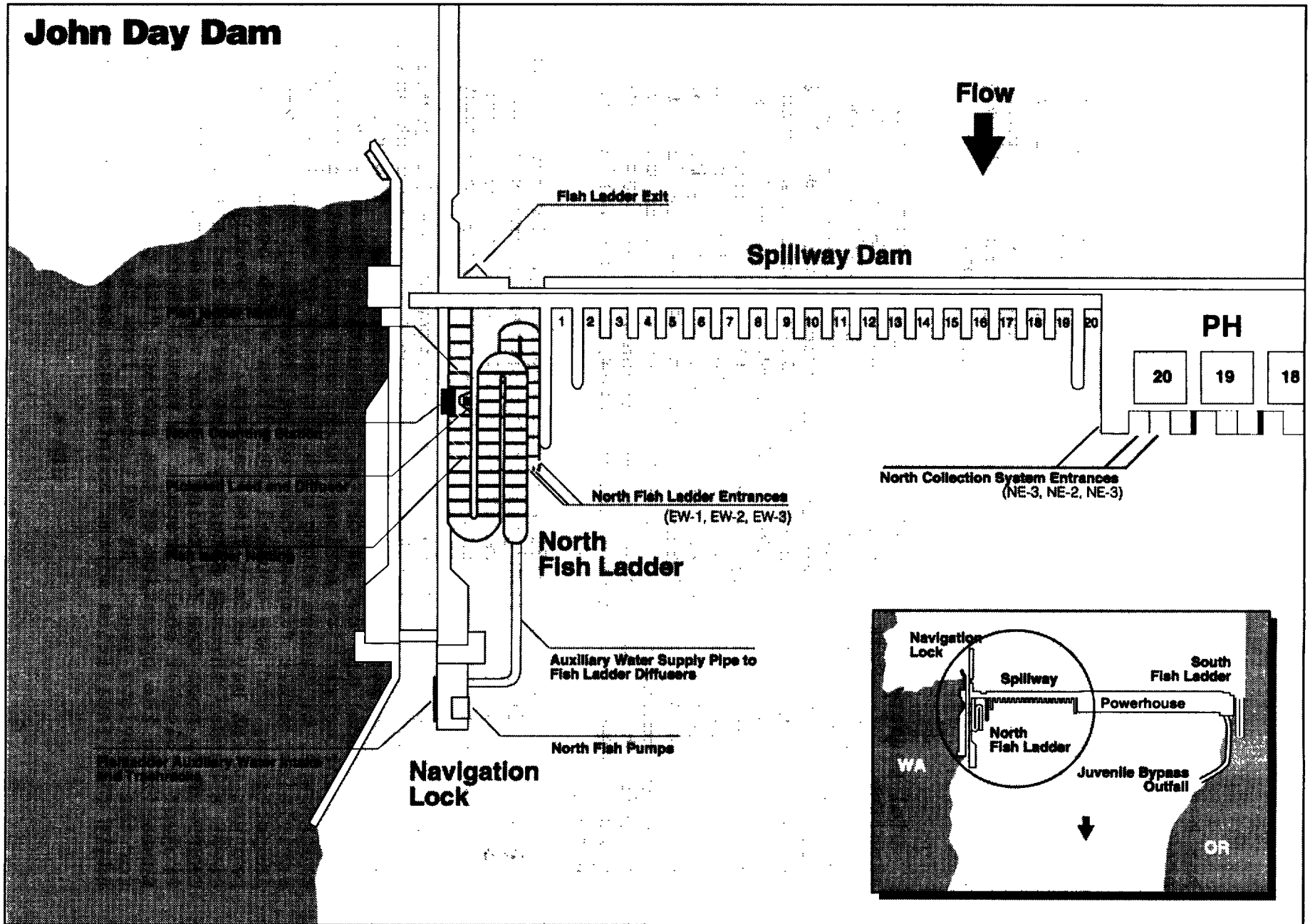


Figure 8 John Day Dam Spillway and North Fish Ladder.

b. Juvenile Migration Timing. Juvenile passage timing has been determined by gatewell sampling at John Day Dam. Hydro-acoustic monitoring has been conducted but has generally been concentrated on peak days and hours of passage, and therefore, cannot 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 October 31. As a result, smolt monitoring under the Water Budget Measures Program is now discontinued on October 31. Maintenance of juvenile fish facilities is scheduled for approximately December 1 through March 31 to minimize impact on downstream migrants.

Diel passage was monitored by hydroacoustics and gatewell sampling. ^{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 sub-yearling 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 May 23. During the peak of the spring juvenile migration period at John Day Dam, 40% of the spring chinook and steelhead daily passage occurred between 0700 and 2200. Unit 3 gatewell sampling and hydroacoustic sampling confirmed the diel pattern.

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 effect fish passage. The weekly reports shall cover a Sunday through Saturday time period and shall be sent to CENPP-OP by noon the following Tuesday via electronic mail. The Project biologist shall prepare an annual report by January 31 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

Table 11. John Day Dam Juvenile Fish Migration Timing.

	<u>% PAST PROJECT</u>		<u>YEAR/DATE</u>						
	1984	1985 ^b	1986	1987	1988	1989	1990 ^c	1991	1992
Yrlg. Chin.									
10%	4/18		4/18	5/2	4/24	5/2	4/25	4/26	5/2
90%	5/27		5/28	5/31	6/1	5/27	NA	6/7	6/10
Suby. Chin.									
10%	6/12	7/12 ^a	6/8	6/7	6/22	6/7	NA	6/6	6/24
90%	8/19	8/5	8/24	9/18	9/7	8/16	NA	8/15	8/15
Steelhead									
10%	4/23		4/25	5/1	4/26	4/24	4/29	5/4	5/3
90%	6/2		6/3	5/29	6/2	5/27	NA	5/29	5/28
Coho									
10%	5/22	no	5/22	5/6	5/6	4/28	4/27	5/11	5/2
90%	6/5	data	6/7	5/30	5/31	5/29	NA	6/4	5/27
Sockeye									
10%		no	5/3	5/14	5/12	5/8	5/4	5/16	5/8
90%		data	6/4	6/6	6/3	6/3	NA	6/1	5/27

^a It appeared in 1985 that hatchery releases of upriver bright fall chinook salmon either delayed or failed to migrate.

^b Consistent sampling in 1985 did not start until May 11.

^c 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".

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 April 1 through October 31. The schedule is described in appendix B. Maintenance of adult fish facilities is scheduled from December 1 through March 31 to minimize the impact on downstream migrants and adult fall chinook and steelhead fallback. Table 12 shows fish counting periods by species and earliest and latest recorded dates of peak passage, from fish count data compiled by the Corps.

Table 12. John Day Dam Adult Fish Migration Timing.

Species	1968-1993		
	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. Spill Management

a. The spill schedule at Table 13 will be used for juvenile fish passage during 2000-0500 hours.

b. The spill schedule at Table 14 will be used for adult fish passage during 0500-2000 hours.

2. 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 April 1 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	46	73.6
															7	8	8	8	8	47	75.2
															8	8	8	8	8	48	76.8
															8	8	8	8	9	49	78.4
															8	8	8	8	9	50	80.0
1															8	8	8	8	9	51	81.6
1	1														8	8	8	8	9	52	83.2
1	1	1													8	8	8	8	9	53	84.8
1	1	1	1												8	8	8	8	9	54	86.4
1	1	1	2												8	8	8	8	9	55	88.0
1	1	2	2												8	8	8	8	9	56	89.6
1	2	2	2												8	8	8	8	9	57	91.2
2	2	2	2												8	8	8	8	9	58	92.8
2	2	2	3												8	8	8	8	9	59	94.4
2	2	3	3												8	8	8	8	9	60	96.0
2	3	3	3												8	8	8	8	9	61	97.6
3	3	3	3												8	8	8	8	9	62	99.2
3	3	3	3	1											8	8	8	8	9	63	100.8
3	3	3	3	1											8	8	8	9	9	64	102.4
3	3	3	3	1											8	8	9	9	9	65	104.0
3	3	3	3	1											8	9	9	9	9	66	105.6
3	3	3	3	1											9	9	9	9	9	67	107.2
3	3	3	3	2											9	9	9	9	9	68	108.8
3	3	3	3	2										7	8	8	8	8	8	69	110.4
3	3	3	3	2										8	8	8	8	8	8	70	112.0
3	3	3	3	2										8	8	8	8	8	9	71	113.6
3	3	3	3	2										8	8	8	8	8	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	9	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	9	9	102	163.2
3	3	3	3	3	3	3					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	9	9	9	104	166.4
3	3	3	3	3	3	3					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	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	8	9	9	114	182.4	
3	3	3	3	3	3	3	2		8	8	8	8	8	8	8	8	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	9	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	2	1	17	27.2
1	2	2	2	2											2	2	2	2	2	1	18	28.8
1	2	2	2	2	1										2	2	2	2	2	1	19	30.4
1	2	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	1	25	40.0
1	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	1	27	43.2
1	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	1	29	46.4
1	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	1	31	49.6
1	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	1	33	52.8
1	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	4	4	4	4	4	4	4	3	3	3	3	3	2	1	60	96.0
1	2	3	3	3	3	4	4	4	4	4	4	4	4	3	3	3	3	2	1	61	97.6
1	2	3	3	3	4	4	4	4	4	4	4	4	4	3	3	3	3	2	1	62	99.2
1	2	3	3	3	4	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	3	3	3	2	1	65	104.0
1	2	3	3	4	4	4	4	4	4	4	4	4	4	4	3	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	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	8	7	7	7	7	6	4	2	126	201.6
2	4	6	7	7	7	7	7	8	8	8	8	8	8	7	7	7	6	4	2	127	203.2
2	4	6	7	7	7	7	8	8	8	8	8	8	8	7	7	7	6	4	2	128	204.8
2	4	6	7	7	7	7	8	8	8	8	8	8	8	8	7	7	6	4	2	129	206.4
2	4	6	7	7	7	8	8	8	8	8	8	8	8	8	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	8	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	10	9	9	9	8	6	4	2	153	244.8	
2	4	6	9	9	9	9	9	10	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	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	10	9	9	8	6	4	2	156	249.6
2	4	6	9	9	9	10	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	11	10	10	10	9	6	4	2	167	267.2	
2	5	6	9	10	10	10	10	11	11	11	11	11	11	10	10	9	6	4	2	168	268.8	
2	5	6	9	10	10	10	11	11	11	11	11	11	11	10	10	9	6	4	2	169	270.4	
2	5	6	9	10	10	10	11	11	11	11	11	11	11	11	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 April 1 Each Year:

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

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

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

(d) By April 1, place 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 April 1.

(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 DSM conduit, raceway, and outfall.

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

(j) The results of all inspections and the readiness of the facility for operation will be verbally reported to the FPDEP-TCC or Fish Facility O&M subcommittee immediately prior to the fish passage season.

(2) April 1 through November 30

(a) Measure gatewell draw-down 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. The

trash racks for at least units 1 through 5 will be raked once per month from April 1 through July 30. Trash racks for the full powerhouse will be raked prior to April 1 and prior to the summer migrant season (about June 15). 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.

(b) 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. 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 January 1.

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

The Corps is currently attempting to resolve this conflict through an element of the Project Improvements for Endangered Species (PIES) program. The intent is to increase inspection frequency by developing a faster inspection system, and implement as quickly as it is approved and developed.

(c) 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.

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

(e) 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 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. 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 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. The intent is to facilitate more frequent gatewell cleaning by developing a more efficient debris removal system.

i) A slight oily sheen is commonly found in many gate-wells. 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.

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

(g) 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 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.

(h) Provide measures to reduce avian predation in the tailrace. Avian predator control lines will remain in place.

(i) 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.

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

(3) August 16 through November 30

STSs may be removed from the powerhouse turbine units designated by the Project Biologist with no more than eight of the sixteen units unscreened to reduce wear and facilitate early winter maintenance. Enough units will remain screened to allow the average expected daily peak river flow, (as estimated by RCC in coordination with BPA) for the remainder of the fish passage season to pass through screened units. STSs will be removed from lower priority units. 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.

(4) December 1 through March 31

(a) Remove all STSs.

(b) Dewater DSM channel (see Dewatering Plans, page JDA-34) 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

a. Operating Criteria

(1) Prior to March 1

(a) Inspect and calibrate all staff gauges and 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 to the FPDEP-TCC or Fish Facility O&M subcommittee immediately prior to the fish passage season.

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

(a) Adult Fish Facilities

i) Water depth over fish ladder weirs: 1.0'±
.1.

ii) Measure water temperature within each ladder system 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 on page JDA-25 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 depth is not possible.

vii) Inspect facilities twice each day.

(b) North Fishway

i) Operate two downstream gates (EW-1 and EW-3). Use staff gauge located around the first ladder bend to calculate entrance head. Doing so helps account for the velocity head associated with these entrances.

ii) At the end of each fish counting day, fully open counting station crowder and leave fish passage slot lighted over night.

iii) Spill through bay 1 as follows. Continuing testing in 1994, spill at 1,800 cfs will be called for as required by study design (see appendix B). In the summer and fall (June 1 through October 31), spill 1,800 cfs from 0400 to 2000 hours.

(c) 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, 19 (open associated auxiliary water diffusers).

iii) Operate SE-1.

iv) At the south ladder counting station, leave the fish passage slot lighted overnight after counting ends each day.

v) From 0400-2000 P.S.T. operate powerhouse turbine unit #1 near 100 megawatts (± 10 MW) 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) **December 1 through February (Winter Operating 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 Fish Passage Center representative on the FPDEP O&M subcommittee. However, operation of unit 2 may be substituted for unit 1 without special coordination.

iii) Pull picket leads at counting stations and have crowdors 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.

vii) 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 be continued this year. These organisms have become a serious problem elsewhere in the country and are expected to eventually be introduced into the Columbia.

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 gateway 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.

The trash racks for at least units 1 through 5 will be raked once per month from April 1 through July 30. Trash racks for the full powerhouse will be raked prior to April 1 and prior to the summer migrant season (about June 15). Additional raking will occur whenever trash accumulations are suspected because of increased differential (1') across the trash racks, or as deter-

mined 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 Plan). The maintenance schedules for these turbines and spillways will be coordinated with the agencies through the Fish Passage Center representative on the Fish Passage Development and Evaluation Program (FPDEP) Operations and Maintenance subcommittee. 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 resource agencies.

Some types of maintenance on turbines will result in the requirement to test operate the turbine 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 April 16 and August 31, 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 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. The intent is to facilitate more frequent gatewell cleaning by developing a more efficient debris removal system.

(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 consultation with the FPC representative on the FPDEP O&M subcommittee. 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 the 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 Fish Passage Facilities

a. Scheduled Maintenance

(1) **Fishway Auxiliary Water Systems.** The John Day Project has pump style auxiliary water systems. Preventive maintenance and normal repair are carried out throughout the year.

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 FPDEP O&M subcommittee. 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 every ten years with at least one underwater inspection in between unless a channel must be dewatered for fishway modifications or to correct observed problems (see Dewatering Plan). 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 Plan). 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.

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 facility 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 discharge 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 (NE1, NE2) in one-foot increments to 6 feet of depth below the tail water surface.
- 2: Close NE1.
- 3: Raise the south powerhouse entrance weir (SE1) in one-foot increments to 6 feet of depth below the tail water surface;
- 4: Close the center five floating gate submerged orifice entrances starting at the north end (17, 15, 12, 9, 6);
- 5: If the above criteria are still not achieved, then leave in this configuration until more auxiliary water becomes available. Then reverse the above procedure.

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

1: SE1 will be open with the weir crest 6 feet below the tail water 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.

(a) **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 one-foot increments until a fishway head of 1.0 foot is met or until the weir crest reaches a depth of 6 feet below the tail water surface. If this fishway criterion is still not met, EW-1 will be raised in one-foot increments until that criterion is met or the weir crest reaches a depth of 6 feet below the tail water surface. If the criterion is still not achieved close EW-2 and the EW-1 weir will be maintained at the 8 foot level. If head of 1.0 is not met, then raise EW-1 in one-foot increments until the weir crest reaches a depth of 6 feet below tail water 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 Project contains several types of fishway entrances. In most cases if failures occur the entrance can and will be operated manually by project personnel until repairs are made. 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 in-

stances of picket lead failure or concrete erosion, the timing and method of repair will depend upon the severity of the problem. The decision of whether or not to dewater the fishway and repair any problem will be made in consultation with the FPC representative on the FPDEP O&M subcommittee, 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 Operations Division 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 15⁵:

3. To the extent technically feasible, turbines will be operated within $\pm 1\%$ 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 March 15 and October 31. 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.

The Corps is currently attempting to resolve this conflict through elements of the Project Improvements for Endangered Species (PIES) program. Developments are being made in the areas of operational control and in defining operating criteria.

(These comments apply to the following item, also.)

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.

⁵. Reference, CENPD-PE-HD.

JOHN DAY DAM PEAK TURBINE EFFICIENCY RANGES

Head (ft)	Lower MW Limit	Lower Limit cfs	Upper MW Limit	Upper Limit cfs
85	73	12,079	111	18,273
86	74	12,050	112	18,210
87	75	12,021	113	18,147
88	76	11,992	114	18,084
89	77	11,963	115	18,021
90	77	11,934	116	17,958
91	78	11,905	118	17,895
92	79	11,918	118	17,864
93	80	11,934	120	17,826
94	81	11,951	121	17,788
95	82	11,967	122	17,750
96	83	11,984	123	17,712
97	84	12,000	124	17,673
98	85	11,973	126	17,707
99	86	11,943	128	17,745
100	86	11,913	129	17,783
101	87	11,883	131	17,821
102	88	11,853	133	17,858
103	89	11,823	134	17,896
104	89	11,793	136	17,934
105	90	11,775	137	17,898
106	91	11,758	138	17,862
107	92	11,740	139	17,826
108	92	11,722	140	17,790
109	93	11,705	141	17,755
110	94	11,687	143	17,719
111	95	11,669	144	17,683
112	95	11,605	147	17,890
113	95	11,541	150	18,097
114	96	11,476	153	18,304

E. Dewatering Plans

1. Detailed plans have been developed 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 WDW 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 prior to dewatering. But, do not operate the ladder at orifice flow for more than 48 hours before dewatering.

(2) The Project Biologist will assure that fish rescue equipment is available and will coordinate to ensure adequate numbers of personnel will be available to move fish out of the dewatered ladder.

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

(4) The Project Biologist or alternate Corps fisheries personnel will oversee fish rescue when the ladders are dewatered. Rescue personnel will walk the inside of the ladder from the head gates down to tail water salvaging all fish either by moving fish to tail water within the ladder flow or capturing and placing the fish in a large water filled tank which is then transported to the forebay or tail water, whichever is closest, for release.

b. Unscheduled Maintenance

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

(2) Follow steps 2-4 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 insure 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 on fish safety and will assist in rescue operations as required.

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 gate-wells will be dipped in advance to minimize the number of fish contained in this flushing water.

7. Turbines

a. Immediately before setting the head gates, remove juvenile fish from the gate-well(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 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 longer than three hours 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 insure 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 as needed.

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 will not be necessary as long as an adequate "safety pool" is maintained. Adequate inspections will need to be conducted to insure 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; 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.

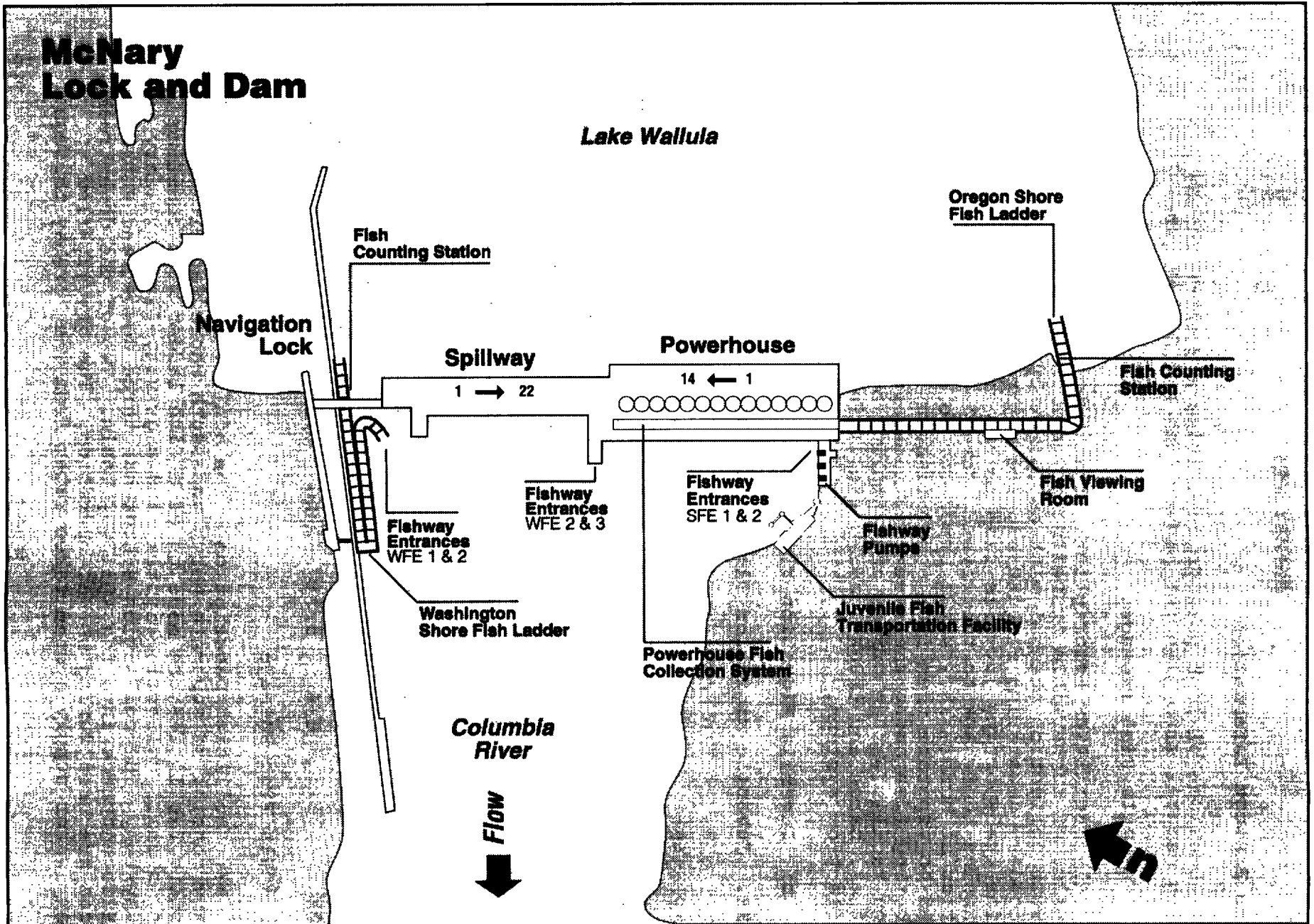
b) Juvenile Migration Timing.

Table 23. Juvenile Migration Timing at McNary Dam.

% Past Project	1986	1987	1988	1989	1990	1991	1992
<hr/>							
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
<hr/>							
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
<hr/>							
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
<hr/>							
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

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



MCN-2

Figure 9 McNary Lock and Dam General Site Plan

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.

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.

3. Operating Criteria

a) Juvenile Fish Passage Facilities: April 1 to December 31 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. To accommodate the extended bypass and transportation season, October 1 through December 31, McNary project may remove STS's from 4 turbine units on August 1 for maintenance, which will restrict McNary project to a 10 unit powerhouse. Two of the 4 turbine units out of service may be made available for short-term use in the event of a BPA declared power emergency. Turbine units without a full compliment of operating STS's shall not be operated (except as stated above). 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:

- 1> Maintenance completed on all STS's.
- 2> Inspect STS's for good running order and operate one trial run (dogged off at deck level).

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 crowdors in good order.
- 6> Crowdors 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 31:

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 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 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:

- 1> Operate STS's in continuous mode when the average fork length of chinook salmon in the daily sample is less than 112 millimeters (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> Inspect STS's in at least 3 operating turbine units per week.
- 3> Conduct additional STS inspections if fish condition warrants it.
- 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, except as listed above under operating criteria.
- 7> Make formal determination at end of season as to adequacy of screen mesh and replacement if necessary.

c> Collection Gallery :

- 1> Operate at least one orifice per gate slot (preferably the south orifice).
- 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.

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.

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> 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 CENPE-OP-PO 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 0.3 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. All inspections shall be recorded.
- 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.

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 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 January 1 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-PO. CENPW-OP-PO 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-PO when in his opinion delay of the work will result in an unsafe situation for people, property, or fish. Information required by CENPW-OP-PO 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 VBS, or without a full compliment of STS's and VBS'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 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 there is a major failure with the bypass system which prevents the gatewell orifices from operating, traveling screens will remain in operation. 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. Spill may occur to provide an alternate avenue for fish passage.

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 either discharged into the adult fish facility auxiliary water supply system or 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.

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, WFE 2 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 sluiceways. 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 sluiceways in diffusers 3 through 7 will be opened more to provide the required transportation flows. If any sluiceways fail, the sluiceways 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 as deep as possible and to maintain the 1.0 to 2.0 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.

To the extent technically feasible, turbine units will be operated within 1% of peak efficiency from March 15 through October 31 (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 November 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		Upper Generator Limits	
	(MW)	(CFS)	(MW)	(CFS)
67	37		61	12,785
68	38		62	12,776
69	38		64	12,995
70	39		65	12,980
71	39		66	12,971
72	39		67	12,958
73	40	7,697	68	12,960
74	41	7,725	69	12,957
75	41	7,631	70	12,946
76	42	7,664	71	12,927
77	43	7,704	72	12,920
78	43	7,607	73	12,908
79	44	7,660	74	12,895
80	45	7,707	75	12,875
81	45	7,632	76	12,875
82	46	7,677	77	12,873
83	47	7,738	78	12,857

[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.

KCFS Spill	Discharges in KCFS at Forebay Elevation 339																					Total Stops
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	
1.4	1																					1
4.2	1	<u>1</u>																			1	3
7.6	1	1	<u>1</u>																		1	5
11.6	1	1	1	<u>1</u>															1	1	1	7
13.8	1	<u>2</u>	1	1															1	1	2	9
17.8	1	2	1	1	<u>1</u>													1	1	1	2	11
21.8	1	2	1	1	1	<u>1</u>											1	1	1	1	2	13
25.8	1	2	1	1	1	1	<u>1</u>									1	1	1	1	1	2	15
29.8	1	2	1	1	1	1	1	<u>1</u>								1	1	1	1	1	2	17
33.8	1	2	1	1	1	1	1	1	1					<u>1</u>	1	1	1	1	1	1	2	19
34.9	<u>2</u>	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				<u>1</u>	1	1	1	1	1	1	2	22
42.9	2	2	1	1	1	1	1	1	1	1				<u>1</u>	1	1	1	1	1	1	2	24
46.5	2	2	1	1	1	1	1	1	1	1	1			<u>2</u>	1	1	1	1	1	1	2	26
51.9	2	2	1	1	1	1	1	2	1	1	1	2		<u>2</u>	1	<u>2</u>	1	1	1	1	2	28
55.5	2	2	1	1	1	2	1	2	1	1	1	2	2	1	2	1	<u>2</u>	1	1	1	2	30
57.7	2	<u>3</u>	1	1	1	2	1	2	1	1	1	2	2	1	2	1	2	1	1	1	3	32
61.3	2	<u>3</u>	1	2	1	2	1	2	1	1	1	2	2	1	2	1	2	1	<u>2</u>	1	3	34
64.9	2	<u>3</u>	1	2	1	2	1	2	1	2	<u>2</u>	2	2	1	2	1	2	1	2	1	3	36
66.7	2	<u>3</u>	1	2	1	2	1	2	2	2	<u>2</u>	2	2	<u>2</u>	2	1	2	1	2	1	3	38
68.8	<u>3</u>	3	1	2	1	2	1	2	2	2	2	2	2	2	2	1	2	1	2	1	3	39
71.4	<u>3</u>	<u>3</u>	1	2	1	2	2	2	2	2	2	2	2	2	2	<u>2</u>	2	1	2	1	3	41
73.6	<u>3</u>	<u>4</u>	1	2	1	2	2	2	2	2	2	2	2	2	2	2	2	1	2	1	4	43
76.8	<u>3</u>	<u>4</u>	1	2	1	2	2	2	2	2	2	<u>3</u>	<u>3</u>	2	2	2	2	1	2	1	4	45
80.3	<u>3</u>	<u>4</u>	2	2	1	2	2	2	2	2	2	<u>3</u>	<u>3</u>	<u>3</u>	2	2	2	1	2	1	4	47
83.4	<u>3</u>	<u>4</u>	2	2	1	2	2	2	2	3	<u>3</u>	<u>3</u>	<u>3</u>	<u>3</u>	2	2	2	1	2	1	4	49
87.0	<u>3</u>	<u>4</u>	2	2	2	2	2	2	2	3	<u>3</u>	<u>3</u>	<u>3</u>	<u>3</u>	2	2	<u>2</u>	2	1	4	51	
90.2	<u>3</u>	<u>4</u>	2	2	2	2	2	3	2	3	<u>3</u>	<u>3</u>	<u>3</u>	<u>3</u>	2	2	<u>3</u>	2	1	4	53	
93.4	<u>3</u>	<u>4</u>	2	2	2	2	2	3	3	3	<u>3</u>	<u>3</u>	<u>3</u>	<u>3</u>	<u>3</u>	2	<u>3</u>	2	2	1	4	55
96.6	<u>3</u>	<u>4</u>	2	2	2	3	2	3	3	3	<u>3</u>	<u>3</u>	<u>3</u>	<u>3</u>	<u>3</u>	<u>3</u>	<u>3</u>	2	2	1	4	57
99.9	<u>3</u>	<u>4</u>	2	2	2	3	<u>3</u>	3	3	3	<u>3</u>	<u>3</u>	<u>3</u>	<u>3</u>	4	3	3	2	2	1	4	59
102.1	<u>3</u>	<u>5</u>	2	2	2	3	<u>3</u>	3	3	3	<u>3</u>	<u>3</u>	<u>3</u>	<u>3</u>	4	3	3	2	2	2	4	61
105.4	<u>3</u>	<u>5</u>	2	2	<u>3</u>	<u>3</u>	<u>3</u>	<u>3</u>	<u>3</u>	<u>3</u>	4	<u>3</u>	<u>3</u>	<u>3</u>	4	3	3	2	2	2	4	63
108.2	<u>4</u>	<u>5</u>	2	2	<u>3</u>	<u>3</u>	<u>3</u>	<u>3</u>	<u>3</u>	<u>3</u>	4	<u>3</u>	<u>3</u>	4	4	3	3	2	2	2	4	65
109.8	<u>4</u>	<u>5</u>	2	2	<u>3</u>	<u>3</u>	<u>3</u>	<u>3</u>	<u>3</u>	<u>3</u>	4	<u>3</u>	<u>3</u>	4	4	3	<u>3</u>	<u>3</u>	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	4	5	4	4	4	4	4	3	4	4	6	88
144.4	6	7	3	4	3	4	3	4	4	4	4	5	4	5	4	4	4	3	4	4	7	90
147.7	6	7	3	4	3	4	4	4	4	4	4	5	4	5	5	4	4	3	4	4	7	92
148.8	7	7	3	4	3	4	4	4	4	4	4	5	4	5	5	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	7	99	
161.3	7	8	4	4	3	4	4	5	4	5	5	5	6	5	5	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	7	103	
167.9	7	8	4	4	4	4	4	5	5	5	6	5	6	5	5	4	5	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	7	108	
173.9	8	8	4	4	4	5	4	5	5	6	6	6	6	5	5	4	5	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	7	111	
179.9	8	8	4	4	4	5	4	5	6	6	6	7	6	6	5	4	5	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	8	115	
186.3	8	8	4	4	4	5	5	5	6	6	7	7	7	6	5	5	5	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	8	119	
192.2	8	9	4	4	4	5	5	6	6	7	7	7	7	6	6	5	5	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	8	123	
198.6	8	9	4	5	4	5	5	6	7	7	7	8	7	6	6	5	5	4	5	8	125	
198.5	9	9	4	5	4	5	5	6	7	7	7	8	7	6	6	5	5	4	5	8	126	
222.4	9	10	4	5	5	6	5	6	7	8	8	9	9	9	7	6	5	5	5	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

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, 14-inch orifices drilled through the concrete leading from each gatewell slot to the ice and trash sluiceway, and electric hoists attached to the A-slot gates of the ice and trash sluiceway to allow operation of the sluiceway as a surface bypass system. As an interim system until the new juvenile bypass facility is constructed, the sluiceway will operate with approximately 2,000 cfs total flow. A new juvenile collection channel, dewatering facility, low velocity flume, and sampling facilities are being designed and are scheduled to be completed for the 1996 juvenile fish outmigration.

b) **Juvenile Migration Timing.** Table 26 shows dates of 10 and 90 percent passage. Data from 1964-1968 were compiled from gatewell dipping during the completion of the Snake River projects.

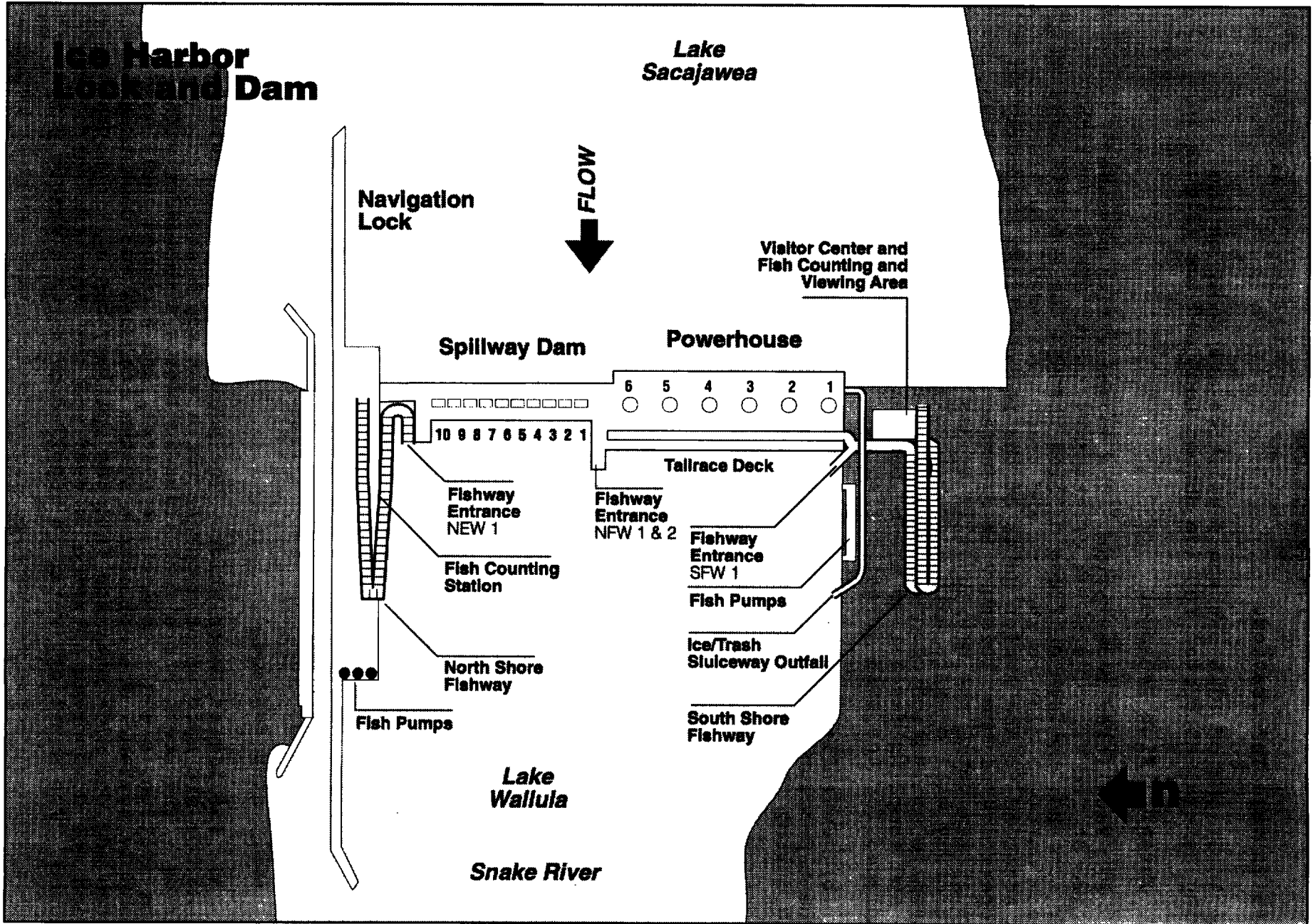
Table 26. Juvenile Migration timing at Ice Harbor Dam.

1964 - 1968	Yearling Chinook	Steelhead
-----	-----	-----
Earliest date of 10% past project	4/10/65	4/20/65
Average date of 10% past project	4/15	5/5
Latest date of 10% past project	4/16/66	5/6/66
Earliest date of 90% past project	5/25/64	5/25/64
Average date of 90% past project	5/30	5/30
Latest date of 90% past project	6/5/66	6/5/66

*no data on sub-yearlings

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



IHR-2

Figure 10 Ice Harbor Lock and Dam General Site Plan

with either two or three pumps operated at any one time, depending on tailwater. 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 five to seven are normally used to provide the required flows.

d) 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 27 shows primary passage periods for each species and shows earliest and latest date of peak passage on record from fish count data compiled by the Corps of Engineers. Adult fish are normally counted 16-hours per day (0400 to 2000 Pacific Standard Time) from April 1 through October 31.

Table 27. 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 will be managed according to the Fish Spill MOA and consultation with NMFS under ESA. Other problems may supersede spill requests such as high concentrations of dissolved gas, poor adult passage, or extreme low flows. When spill occurs during the daytime hours, that spill shall be shaped in accordance with the current spill schedule, Table 28.

2. Dissolved Gas Management and Control. Dissolved gasses at Ice Harbor are monitored in accordance with the Dissolved Gas Monitoring Program, Appendix E. Implementation of spill management requests will be based in part upon dissolved gas monitoring data along with juvenile migration data. 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.

3. Operating Criteria.

a) **Juvenile Fish Passage Facilities.** Operate from April 1 to August 31 for juvenile fish passage and from September 1 through November 30 for protecting adult fallbacks. Operate the facilities according to the following criteria:

1) **Prior to April 1 each year:**

- a> Remove debris from forebay and gatewell slots.
- b> Rake trash racks.
- c> Inspect and clean orifices of debris. Video inspection permitted.
- d> Test that chain gates are operational.
- e> Run gates on manual and automatic operation.
- f> Inspect bird wires and replace as needed.
- g> Inspect STS's for good running order and operate one trial run (dogged off on deck).
- h> Inspect VBS's once per year. Repair as needed.

2) **April 1 to November 30:**

- a> Remove debris from forebay.
- b> 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.
- c> Inspect orifices daily and clean as required.
- d> 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, efforts should be made as soon as possible to remove the obstruction. If the obstruction becomes plugged with debris, the turbine unit will not be operated until the effected gatewell and orifice are cleared of debris.
- e> 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 than 48 hours.

- e> Operate chain gates to maintain total sluiceway flow at 2,000 cfs 24 hours a day.
- f> Inspect all facilities according to fish facilities monitoring plan. Record all maintenance and inspections.
- g> 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.
- h> 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.
- i> Inspect each STS once per month.
- j> Record STS amp readings daily.
- k> 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.
- l> 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.
- m> Make formal determination at end of season as to adequacy of screen mesh and replacement if necessary.
- n> Dip bulkhead gatewell slots to remove fish prior to installing bulkhead for unwatering bulkhead slot.

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 CENPE-OP-PO 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 (NPE 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 may bottom out and 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 may bottom out and 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 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 September 1 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-PO 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-PO. CENPW-OP-PO 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-PO when in his opinion delay of the work will result in an unsafe situation for people, property, or fish. Information required by CENPW-OP-PO 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) **Sluiceway Operation:** If orifices become blocked with debris, they will be cleared by project personnel as soon as possible. If a sluiceway gate hoist fails, the gate will be closed and an alternate gate opened until repairs can be made.

2) **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. 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. Fluctuating tailwater levels require from five to seven 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 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.

To the extent technically feasible, turbine units will be operated within 1% of peak efficiency from March 15 through October 31 (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 November 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:

Head Feet	Lower Generator Limits		Upper Generator Limits	
	(MW)	(CFS)	(MW)	(CFS)
85	49	7,530	85	13,046
86	50	7,618	86	13,019
87	51	7,610	87	13,087
88	52	7,694	88	13,051
89	52	7,636	89	13,069
90	53	7,723	90	13,036
91	54	7,667	92	13,109
92	54	7,705	93	13,124
93	55	7,743	93	13,088
94	56	7,734	95	13,108
95	57	7,775	95	13,076
96	57	7,761	97	13,087
97	58	7,750	98	13,155
98	59	7,790	99	13,171
99	59	7,774	100	13,180
100	60	7,865	101	13,091
101	61	7,852	102	13,104
102	62	7,939	102	13,005
103	64	8,078	102	12,852
104	65	8,069	104	12,974
105	65	8,055	104	12,930

Turbine Units 4 - 6:

Head Feet	Lower Generator Limits		Upper Generator Limits	
	(MW)	(CFS)	(MW)	(CFS)
85	58	9,174	83	13,113
86	59	9,222	85	13,183
87	60	9,157	86	13,195
88	60	9,132	87	13,127
89	61	9,121	89	13,252
90	62	9,167	90	13,261
91	63	9,155	91	13,269
92	64	9,258	92	13,335
93	64	9,128	93	13,341
94	65	9,172	93	13,170
95	66	9,151	95	13,225
96	67	9,189	96	13,221
97	67	9,058	97	13,289
98	68	9,225	98	13,238
99	69	9,201	99	13,291
100	70	9,248	101	13,358
101	70	9,167	102	13,295
102	71	9,207	103	13,354
103	72	9,191	104	13,297
104	73	9,241	107	13,553
105	73	9,166	109	13,749

[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 28. 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

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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 29. 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 29. Juvenile Migration Timing at Lower Monumental Dam.

% Migration past project	Year/Date				
	1987	1988	1989	1990	1991
<hr/>					
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	
<hr style="border-top: 1px dashed black;"/>					
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	
<hr style="border-top: 1px dashed black;"/>					
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	

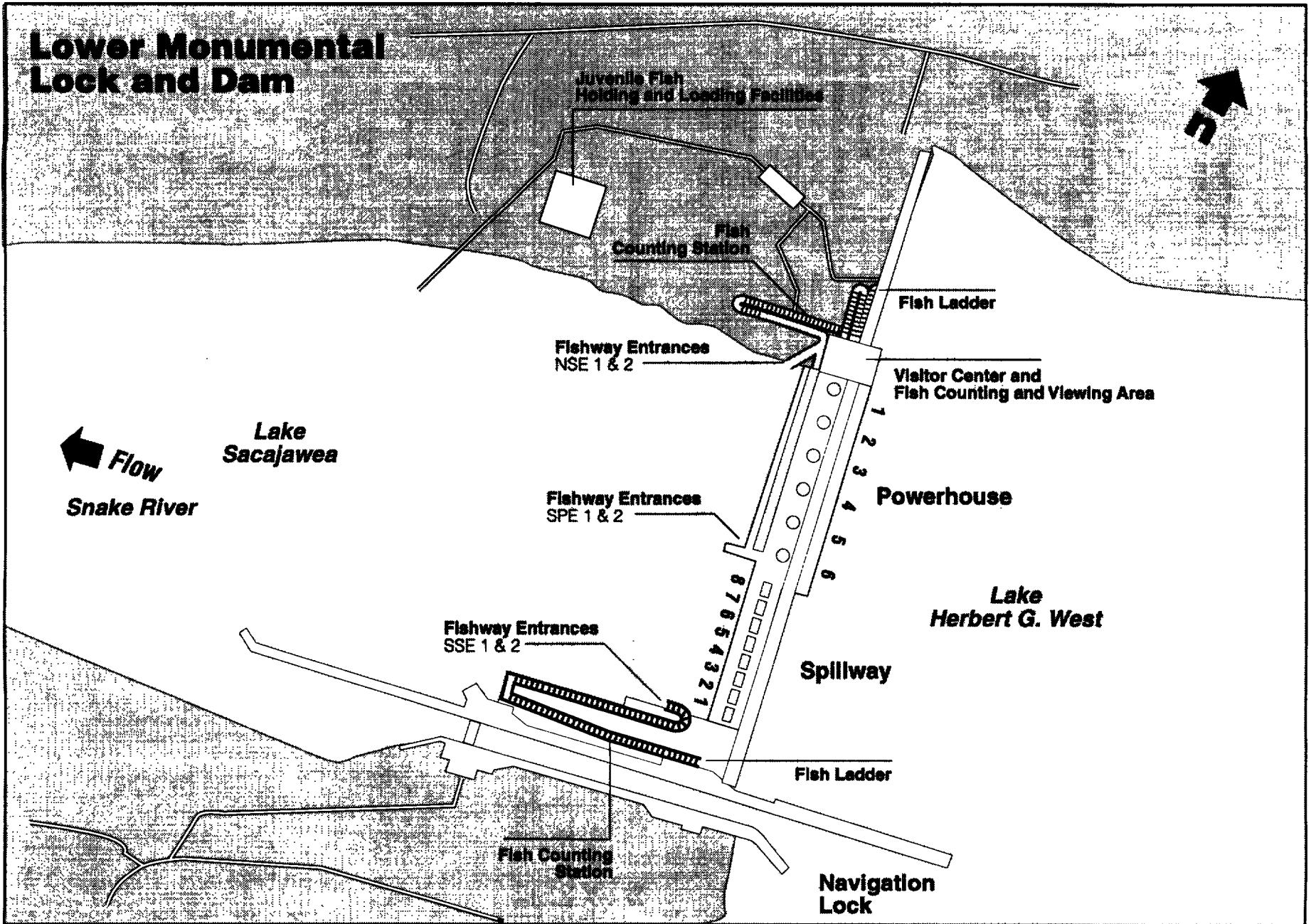


Figure 11 Lower Monumental Lock and Dam General Site Plan

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 30 shows the primary passage periods by species and shows the latest and earliest recorded dates of peak passage from fish count records compiled 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 30. 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 31.

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.

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 November 30 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 November 30:

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 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):

- 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 screen mesh and replacement if necessary.

d> 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.

e> 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.

f> 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.

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 CENPE-OP-PO 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): (See special note under scheduled maintenance)

***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 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 1 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-PO 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-PO. CENPW-OP-PO 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-PO when in his opinion delay of the work will result in an unsafe situation for people, property, or fish. Information required by CENPW-OP-PO 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.

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.

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.

**** Special Note:** In 1994, and 1995, a contractor will be rebuilding the auxiliary water supply fish pump turbines at Lower Monumental Dam. The maintenance period for the fish pumps has been extended during the 1994 and 1995 winter maintenance period from January and February time frame to November 21 through March 31. During the November 21 through December 31 and March 1 through March 31 periods, Lower Monumental will have one fish pump out of service for repairs. The fish pump will be bulkheaded off and the other 2 pumps run at high RPM to provide at or very near fishway criteria. During the January and

February normal fish facility maintenance period, all three pumps may be off for maintenance.

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.

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 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. 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 October 31 (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 November 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:

Head Feet	Lower Generator Limits		Upper Generator Limits	
	(MW)	(CFS)	(MW)	(CFS)
85	75	11,932	108	17,315
86	76	11,932	110	17,411
87	76	11,777	111	17,326
88	77	11,776	112	17,254
89	78	11,773	113	17,186
90	79	11,770	114	17,121
91	79	11,642	115	17,055
92	80	11,644	117	17,151
93	81	11,648	118	17,087
94	82	11,656	119	17,025
95	83	11,666	120	16,965
96	83	11,561	121	16,908
97	84	11,574	122	16,855
98	85	11,584	124	16,950
99	86	11,585	126	17,041
100	86	11,486	129	17,275
101	87	11,490	131	17,361
102	88	11,493	131	17,165
103	89	11,496	132	17,114
104	89	11,402	134	17,202
105	90	11,505	136	17,478

Turbine Units 4 - 6:

Head Feet	Lower Generator Limits		Upper Generator Limits	
	(MW)	(CFS)	(MW)	(CFS)
85	86	13,364	123	19,216
86	87	13,355	125	19,286
87	88	13,348	127	19,353
88	89	13,341	129	19,416
89	90	13,334	131	19,475
90	91	13,326	133	19,530
91	92	13,320	135	19,586
92	93	13,317	137	19,641
93	94	13,315	138	19,530
94	95	13,312	140	19,581
95	96	13,309	141	19,478
96	98	13,398	143	19,540
97	99	13,393	144	19,454
98	100	13,386	145	19,375
99	102	13,470	146	19,299
100	104	13,557	147	19,227
101	106	13,644	147	19,014
102	107	13,637	147	18,807
103	108	13,632	147	18,604
104	109	13,627	149	18,682
105	110		151	

[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 double 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 double tests are normally scheduled for the August time period to minimize impacts on adult and juvenile fish passage.

Table 31. 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	4	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 31. 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 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 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 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.

b) Adult Migration Timing. Upstream migrants are present at the project year around. Maintenance of upstream passage facilities is scheduled for January through February to minimize the impact on upstream migrants. Table 32 lists primary passage periods by species and shows the earliest and latest dates of peak passage which have been recorded from compilation of fish counts by the Corps.

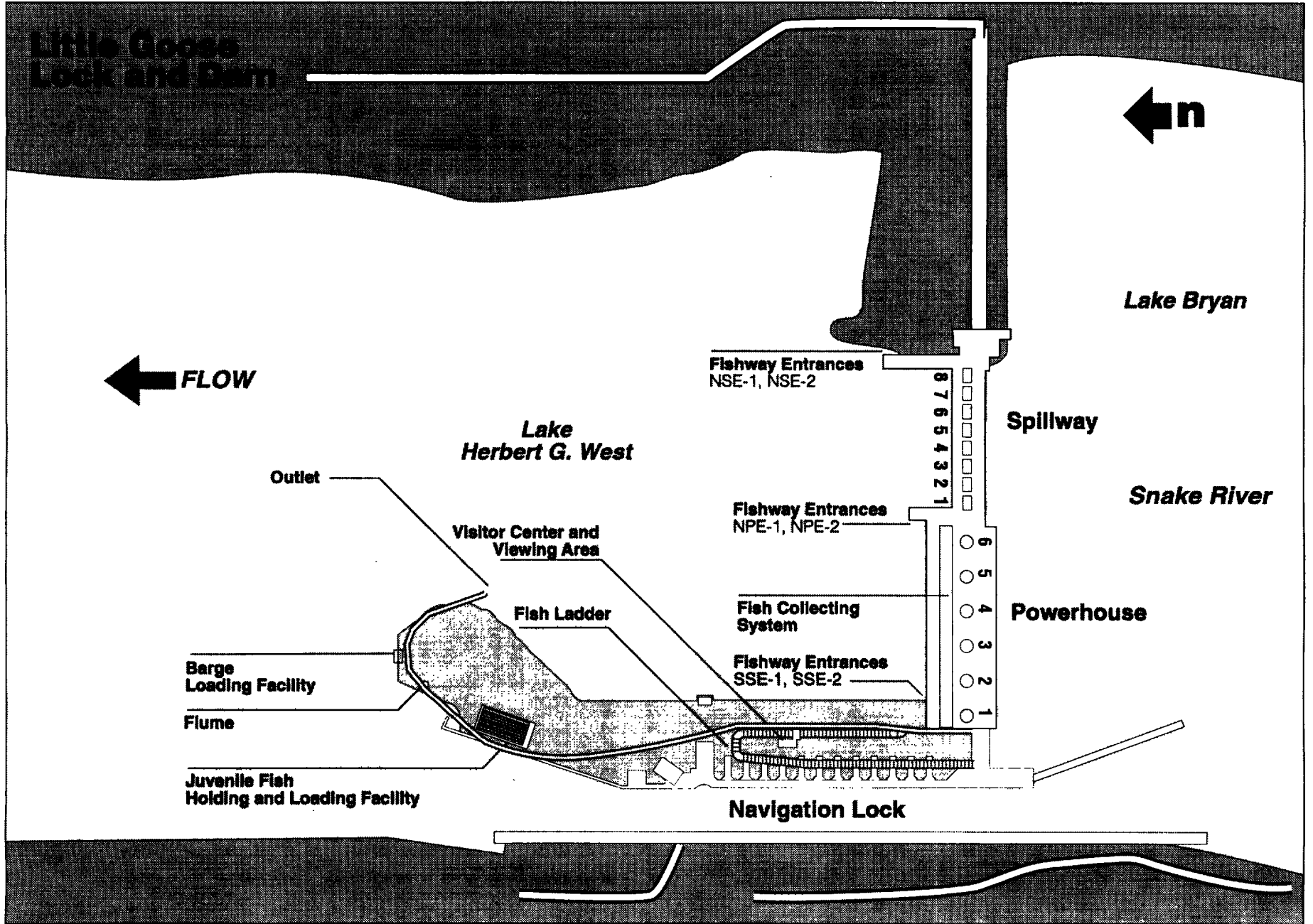


Figure 12 Little Goose Lock and Dam General Site Plan

Table 32. Adult Migration Timing at Little Goose Dam From 1969 - 1983.

SPECIES	PASSAGE PERIOD	EARLIEST PEAK	LATEST PEAK
Spring Chinook	4/1 - 6/15	4/20	5/27
Summer Chinook	6/16 - 8/15	6/14	7/12
Fall Chinook	8/16 - 10/31	9/14	9/30
Steelhead	4/1 - 10/31	9/15	10/10
Sockeye	6/15 - 10/31	6/24	7/25

B. Project Operations.

1. **Spill Management.** Spill at Little Goose 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 Little Goose shall be distributed in accordance with the adult fish passage spill pattern listed on Table 33.

2. **Dissolved Gas Management and Control.** Dissolved gasses at Little Goose are monitored in accordance with the Dissolved Gas Monitoring Program, Appendix E. Total dissolved gas will be monitored hourly in the Little Goose forebay and reported every 4 to 6 hours from April 1 through September 30. Total dissolved gas will also be monitored hourly in the Little Goose tailwaters 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.

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 November 30 for bypassing adult fallbacks. Operate 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 :**

a> **Forebay Area and Intakes:**

- 1> Remove debris from forebay and gatewell slots.
- 2> Rake trashracks.
- 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> Makeup water gate operational.
- 2> Orifice lights operational.
- 3> Orifices clean and operational.

d> Dewatering Structure:

- 1> Inclined screen clean and in good condition with no holes.
- 2> Cleaning brush system maintained and operational.
- 3> Overflow weirs maintained and tested.

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.

f> Maintenance Records:

Record all maintenance and inspections.

g> Powerhouse Tailrace Area:

Inspect birdwires and replace as needed.

2) April 1 to November 30 :

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 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 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):

- 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 screen mesh and replacement if 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 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 CENPE-OP-PO 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): (See special note under scheduled maintenance)

***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 will 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.

[CBFWA recommends that weir depths be operated at 8 feet or greater below tailwater at all times]

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 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 1 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-PO 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-PO. CENPW-OP-PO 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-PO when in his opinion delay of the work will result in an unsafe situation for people, property, or fish. Information required by CENPW-OP-PO 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 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.

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 either discharged into the river or 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.

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.

**** Special Note:** In 1994, and 1995, a contractor will be rebuilding the auxiliary water supply fish pump turbines at Little Goose Dam. The maintenance period for the fish pumps has been extended during the 1994 and 1995 winter maintenance period from January and February time frame to November 21 through March 31. During the November 21 through December 31 and March 1 through March 31 periods, Little Goose will have one fish pump out of service for repairs. The fish pump will be bulkheaded off and the other 2 pumps run at high RPM to provide at or very near fishway criteria. During the January and February normal fish facility maintenance period, all three pumps may be off for maintenance.

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) Fishladder and Counting Station: The fishladder 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 October 31 (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 November 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:

Head Feet	Lower Generator Limits		Upper Generator Limits	
	(MW)	(CFS)	(MW)	(CFS)
85	75	11,932	108	17,315
86	76	11,932	110	17,411
87	76	11,777	111	17,326
88	77	11,776	112	17,254
89	78	11,773	113	17,186
90	79	11,770	114	17,121
91	79	11,642	115	17,055
92	80	11,644	117	17,151
93	81	11,648	118	17,087
94	82	11,656	119	17,025
95	83	11,666	120	16,965
96	83	11,561	121	16,908
97	84	11,574	122	16,855
98	85	11,584	124	16,950
99	86	11,585	126	17,041
100	86	11,486	129	17,275
101	87	11,490	131	17,361
102	88	11,493	131	17,165
103	89	11,496	132	17,114
104	89	11,402	134	17,202
105	90	11,505	136	17,478

Turbine Units 4 - 6:

Head Feet	Lower Generator Limits		Upper Generator Limits	
	(MW)	(CFS)	(MW)	(CFS)
85	86	13,364	123	19,216
86	87	13,355	125	19,286
87	88	13,348	127	19,353
88	89	13,341	129	19,416
89	90	13,334	131	19,475
90	91	13,326	133	19,530
91	92	13,320	135	19,586
92	93	13,317	137	19,641
93	94	13,315	138	19,530
94	95	13,312	140	19,581
95	96	13,309	141	19,478
96	98	13,398	143	19,540
97	99	13,393	144	19,454
98	100	13,386	145	19,375
99	102	13,470	146	19,299
100	104	13,557	147	19,227
101	106	13,644	147	19,014
102	107	13,637	147	18,807
103	108	13,632	147	18,604
104	109	13,627	149	18,682

[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, excitors, 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 double 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 double tests are normally scheduled for the August time period to minimize impacts on adult and juvenile fish passage.

Table 33. Little Goose Dam Spillway Pattern for Adult Fish Passage.

Gate Numbers								Totals	
1	2	3	4	5	6	7	8	Increments	Kcfs
(1)							1		
1	(1)					1	1		
1	1	(1)			1	1	1		
1	1	1	(1)	1	1	1	1		
1	1	(2)	1	1	2	1	1	10	19
1	1	2	(2)	2	2	1	1		
(2)	1	2	2	2	2	1	1		
2	2	2	2	2	2	(2)	3		
(3)	2	2	2	2	2	2	(3)		
3	2	(3)	(3)	2	2	2	3	20	39
3	3	3	3	2	(3)	2	3		
3	3	3	3	2	3	(3)	4		
3	3	3	(4)	3	3	3	4		
4	3	(4)	4	3	3	3	4		
4	4	4	4	3	3	(4)	4	30	60
5	(5)	4	4	3	3	4	4		
5	5	(5)	4	4	3	4	4		
5	5	5	4	4	(4)	4	5		
5	(6)	5	5	4	4	4	5		
5	6	5	5	4	4	(5)	6	40	80
(6)	6	5	5	4	5	5	6		
6	6	5	5	(5)	5	6	6		
(7)	6	5	5	5	5	(6)	7		
7	6	5	(6)	6	5	6	7		
7	6	(6)	6	6	6	6	7	50	100
7	6	6	(7)	7	6	6	7		
7	(7)	6	7	7	7	6	7		
7	7	(7)	7	7	7	7	7		
8	7	7	7	7	7	7	(8)		
8	7	(8)	7	8	7	7	8	60	120
8	7	8	(8)	8	8	7	8		
8	(8)	8	8	8	8	8	8		
(9)	8	8	8	8	8	8	9		
9	8	(9)	8	9	8	8	9		
9	8	9	(9)	9	9	8	9	70	140

Values in parenthesis may be 1 increment less than indicated.
 For example: (2) means 2 or 1 increments
 (3) means 3 or 2 increments

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 traveling screens, 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 34. Juvenile Migration Timing at Lower Granite Dam.

% Migration Past Project	1986	1987*	1988*	1989*	1990*	1991	1992
<hr/>							
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 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

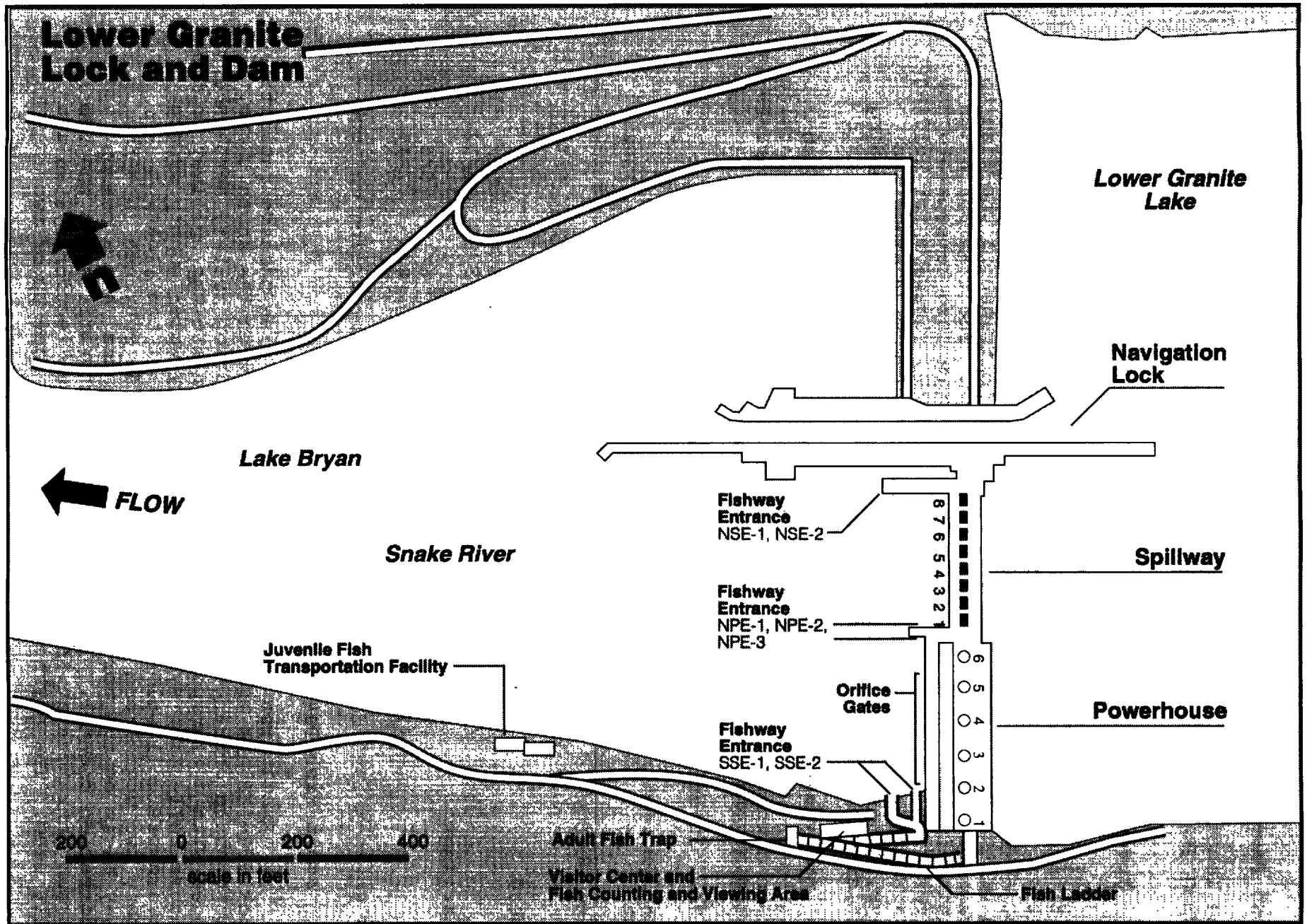


Figure 13 Lower Granite Lock and Dam General Site Plan

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). Primary passage periods by species and earliest and latest date of peak passage follow.

Table 35. 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 36.

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 October 1. 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.

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 November 30 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.

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

- 1> Maintenance completed on all STS's.
- 2> Inspect STS's for good running order and operate on one trial run (dogged off on deck).
- 3> Log results of trial run.
- 4> Inspect VBS's once per year.

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 Lock 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 November 30 :

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 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 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> 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.
- 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 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 screen mesh and replacement if necessary.

d> Collection Gallery Checks:

- 1> Orifices clean and operating.
- 2> Orifice lights operating on open orifices.
- 3> Orifice jets not hitting backwall, 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.
- 5> Alternate orifices in fish screens slots daily (6 open).
- 6> Backflush orifices 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> Barges and Trucks:

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

g> Towboats:

Capable of making turn-around trip in less than 84 hours.

h> 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 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 CENPE-OP-PO 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 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 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 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 1 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-PO 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-PO. CENPW-OP-PO 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-PO when in his opinion delay of the work will result in an unsafe situation for people, property, or fish. Information required by CENPW-OP-PO 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 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 fish passage season with a missing, damaged, or non-operating STS. 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 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 be cleaned; however, a damaged orifice will be closed and the alternate orifice for that gatewell operated until repairs can be made.

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. Traveling screens will remain in operation and the juveniles allowed to accumulate in the gatewells for up to two days. If repairs are to take longer than two days, a salvage program will be initiated to remove the juveniles from the gatewells until repairs are made and the system watered up again.

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.

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) Fishladder and Counting Station: The fishladder 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 October 31 (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 November 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:

Head Feet	Lower Generator Limits		Upper Generator Limits	
	(MW)	(CFS)	(MW)	(CFS)
85	75	11,932	108	17,315
86	76	11,932	110	17,411
87	76	11,777	111	17,326
88	77	11,776	112	17,254
89	78	11,773	113	17,186
90	79	11,770	114	17,121
91	79	11,642	115	17,055
92	80	11,644	117	17,151
93	81	11,648	118	17,087
94	82	11,656	119	17,025
95	83	11,666	120	16,965
96	83	11,561	121	16,908
97	84	11,574	122	16,855
98	85	11,584	124	16,950
99	86	11,585	126	17,041
100	86	11,486	129	17,275
101	87	11,490	131	17,361
102	88	11,493	131	17,165
103	89	11,496	132	17,114
104	89	11,402	134	17,202
105	90	11,505	136	17,478

Turbine Units 4 - 6:

Head Feet	Lower Generator Limits		Upper Generator Limits	
	(MW)	(CFS)	(MW)	(CFS)
85	86	13,364	123	19,216
86	87	13,355	125	19,286
87	88	13,348	127	19,353
88	89	13,341	129	19,416
89	90	13,334	131	19,475
90	91	13,326	133	19,530
91	92	13,320	135	19,586
92	93	13,317	137	19,641
93	94	13,315	138	19,530
94	95	13,312	140	19,581
95	96	13,309	141	19,478
96	98	13,398	143	19,540
97	99	13,393	144	19,454
98	100	13,386	145	19,375
99	102	13,470	146	19,299
100	104	13,557	147	19,227
101	106	13,644	147	19,014
102	107	13,637	147	18,807
103	108	13,632	147	18,604
104	109	13,627	149	18,682
105	110		151	

[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 double 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 double tests are normally scheduled for the August time period to minimize impacts on adult and juvenile fish passage.

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Table 36. 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.

February 24, 1994

APPENDIX B

SPECIAL PROJECT OPERATIONS AND RESEARCH

This appendix summarizes, by project, special project operations (including spill), fish passage research, and Project Improvements for Endangered Species.

Bonneville Dam

Bonneville Dam

1. **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. Operations to achieve 70 percent FPE for spring operations will begin after the first 10 percent of the spring migration has passed the project, but no later than 2000 hours 15 April. The latest sockeye fish guidance efficiency (FGE) (Table 1) will be used to calculate the project FPE (thus spill). Operation of unit 4 will precede operation of the second powerhouse units.

b. **Summer Operations.**

The first powerhouse will operate as first priority during the summer juvenile salmon outmigration season. Operations to achieve 50 percent FPE for summer operations will begin approximately 15 June. The specific day to begin the summer operating period will be determined by NMFS, depending on the status of the Snake River spring outmigration, and end at 0500 hours August 23. The latest subyearling chinook (after 6/15) FGE data will be used to calculate project FPE.

c. **Special Project Operations.**

The following priorities are in effect from the beginning of the fish passage season (end of the work week closest to March 1). If needed to achieve FPE, the first powerhouse flows can be reduced below 60,000 cfs to a minimum of four operating units (1, 2, 9, and 10). Normally, when flows are less than 200,000 cfs, the second powerhouse will not operate. If the second powerhouse is operating, and if needed to achieve FPE, second powerhouse flows can be reduced below 60,000 cfs to a minimum of three operating units (11, 17, and 18). Each powerhouse, once started, will remain operating with at least the minimum operating units throughout the day.

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 70/50 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 1. FGE values for the first and second powerhouses used to calculate FPE.

	<u>Bonneville First</u>	<u>Bonneville Second</u>
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%

2. **Research.**

a. Second powerhouse: FGE tests will be conducted at units 12, 15, or 17, for up to 20 nights in May. Between 4 and 8 second powerhouse units will operate during each test. Test units will be off on test dates except during sampling (2000 - 2200 hours).

3. **Normal and Special Annual Fish Counting Program.**

a. 1 January - 14 March - Video count 16 hours per day (0400 - 2000 PST).

b. 15 March - 31 March - Video count 8 hours per day (0400 - 0800 PST and 1600 - 2000 PST).

c. 15 March - 31 March - Visual count 8 hours per day (0800 - 1600 PST).

d. 1 April - 31 October - Visual count 16 hours per day (0400 - 2000 PST).

e. 1 June - 15 August - Video count 8 hours per day (2000 - 0400 PST).

f. 1 November - 15 November - Visual count 8 hours per day (0800 - 1600 PST).

4. **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. Water Quality Improvements in Adult Fishways. This item is to identify where drains feed into adult fishways and determine ways to stop or redirect flows. Scheduled to be completed by November 1994.

c. 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. Scheduled to be completed by March 1995.

d. Gatewell Debris Removal System. This item is to enable debris removal from gatewells with minimum impact on fish. A modified basket has been developed and will be tested during the spring of 1994.

e. Modify PH2 DSM Elbow. This item is to modify the second powerhouse juvenile bypass system to improve hydraulic conditions and reduce negative impacts on fish. Scheduled to be completed by March 1995.

f. Direct Capture Net-frame. This item is to install a device at the first powerhouse to facilitate evaluation of fish passage through the bypass system outlet. The device will hold a net to the bypass outlet in a manner similar to the one earlier installed at the second powerhouse. Completed February 1993.

g. 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.

h. Powerhouse and Spillway Upstream Migrant Fishway Control Upgrade. This item is to provide better and more reliable automatic control systems for adult fishways. Scheduled to be completed by April 1996.

i. Operational Control Improvement of Turbine Units. This item is to allow more efficient operation of turbine units. Better turbine efficiency is related to better fish survival. Scheduled to be completed by April 1994.

j. Upgrade Juvenile Orifice Entrances. This item is to provide smoother internal surfaces on juvenile bypass system orifices. Scheduled to be completed by March 1995.

The Dalles Dam

The Dalles Dam

1. Special Project Operations.

a. Spill.

Spill may be requested by the fish agencies and tribes in accordance with spill criteria in Section III, Paragraphs A.1, B.1 - B.17 (except B.5, B.6, and B.14) of the regional spill agreement modified for nonpower use (Appendix F). The Corps will implement the spill requests if criteria in FPP Section 6.b.(2)(b) are met.

2. Research.

a. Extended-length juvenile fish screens will be evaluated in units 17 - 20 during spring and summer migration seasons, for approximately 20 test days per season. Test units will remain off line except for operation during fish sampling, beginning at 2000 hours and lasting 1 - 4 hours. Operating hours may be extended on nights when hydroacoustic or underwater video camera monitoring is underway. Spill and sluiceway operation will be curtailed on test dates from 1800 hours to conclusion of sampling. At the completion of the summer testing season, or between the spring and summer test periods, the turbine units may be operated as part of normal project operations, with the screens in place, if fish condition observed during the testing is at an acceptable level.

b. From April 1 to May 31, spillway one will provide approximately 1500 cfs from 0400 to 2000 hours to evaluate daytime adult fish attraction. Spill and non-spill days are randomized within a 2-day block during the specified time period.

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. Water Quality Improvements in Adult Fishways. This item is to identify where drains feed into adult fishways and determine ways to stop or redirect flows. Scheduled to be completed by November 1994.

b. Gatewell Debris Removal System. This item is to enable debris removal from gatewells with minimum impact on fish. A modified basket has been developed and will be tested at Bonneville Dam during the spring of 1994.

c. Spare Fish Unit Winding. This item is to provide a spare winding to shorten the repair time in case the existing winding fails in either of the small generating units which supply auxiliary water for the east fish ladder system. Scheduled to be completed by June 1994.

d. Spill Pattern Modification. This item is to develop the most effective spill patterns for passage of juvenile fish downstream and for adult fish going upstream. Testing has been completed for the juvenile pattern up to 200,000 cfs and the adult pattern up to 250,000 cfs.

e. Adult Fish Attraction Emergency Water Supply. This item is to reduce the dependency of the adult fishways on the two fishwater units. A new water supply is being developed which will provide back-up in case of a fish unit emergency. Scheduled to be completed by March 1996.

f. Operational Control Improvement of Turbine Units. This item is to allow more efficient operation of turbine units. Better turbine efficiency is related to better fish survival. Scheduled to be completed by April 1994.

John Day Dam

John Day Dam

1. **Special Project Operations.**

a. **Spill.**

(1) **Spring.**

Spill is not required for spring passage of juvenile fish as the bypass system achieves at least 70% fish guidance efficiency (i.e., 70% or greater FPE, with no spill).

(2) **Summer.**

Spill may be requested by the fish agencies and tribes during the summer passage period in accordance with spill criteria of Section III, Paragraphs A.1, B.1 - B.17 (except B.5, B.6, and B.14) of the regional spill agreement modified for nonpower uses (Appendix F). The Corps will implement the spill request if criteria in FPP Section 6.b.(2)(b) are met.

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. From April 1 to May 31, spillway one will provide approximately 1800 cfs from 0400 to 2000 to evaluate daytime adult fish attraction. Spill and non-spill days are randomized within a 2-day block during the specified time period.

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. Water Quality Improvements in Adult Fishways. This item is to identify where drains feed into adult fishways and determine ways to stop or redirect flows. Scheduled to be completed by November 1994.

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. Scheduled to be completed by April 1995.

c. Gatewell Debris Removal System. This item is to enable debris removal from gatewells with minimum impact on fish. A modified basket has been developed and will be tested at Bonneville Dam during the spring of 1994.

d. Modify South Ladder Diffuser. This item is to modify the upper part of the south ladder to reduce fish holding and leaping. Temporary modifications are being studied.

e. Auxiliary Water Supply Spare Parts. This item is to provide back-up parts for

the auxiliary water supply systems to limit downtime. The contract for this item has been awarded. Delivery is expected in September 1994.

f. Operational Control Improvement of Turbine Units. This item is to allow more efficient operation of turbine units. Better turbine efficiency is related to better fish survival. Scheduled to be completed by April 1994.

g. Upgrade Juvenile Orifice Entrances. This item is to provide smoother internal surfaces and enlarge the orifice openings in the juvenile bypass system. This was completed in February 1994.

h. Modify Counting Station. This item is to improve conditions at the south ladder counting station by reducing entrained air and increasing viewing window size. Modifications were completed in February 1994.

McNary Dam

McNary Dam

1. **Special Project Operations.** There are no special project operations currently scheduled for McNary Dam.

2. **Research.**

a. Tests of experimental extended-length fish screens and vertical barrier screens for the juvenile bypass facility will be conducted in 1994, from early April through August. This may require outages of units 5 and 6 as early as April 1. The units will operate for about 2 hours nightly, for approximately 30 nights in the spring and 30 nights in the summer. Unit outages may be extended if excessive fish injury is observed in association with test screen operation or if needed to accommodate underwater video camera operation. During the tests, turbine units may be operated outside of the one percent peak efficiency band to account for the flow variances caused by the fyke net frames, nets and head loss. No spill will take place during the FGE tests (approximately 1 - 4 hours nightly), if possible, to avoid biasing the tests. At the completion of the summer testing season, or between the spring and summer test periods, the turbine units may be operated as part of normal project operations, with the screens in place, if fish condition observed during the testing is at an acceptable level.

b. The new juvenile fish bypass and transportation facilities will be evaluated in 1994. Testing protocol may require some of the project operating criteria to be altered to allow test fish to be introduced into parts of the facilities or to allow for the recapture of fish at outfalls or other parts of the facilities. These will be short term alterations of facility criteria and will be coordinated with fishery agencies and tribes as necessary.

3. **Project Improvements for Endangered Species.**

a. Adult Fishway Control System. A new adult fishway control system was installed March 1, 1994. The system is controlled by a microprocessor with programming, instantaneous information readout, and data logging accomplished on a computer in the powerhouse control room.

b. Methodology for Operation of Turbine Units Within One Percent of Peak Efficiency. Hydroelectric Design Center is developing methods for determining and monitoring turbine unit operation within 1 percent of peak efficiency. This work is scheduled to be completed by mid-1994.

c. Replacement Fish Transport Trailers. A contract was awarded in spring of 1993 to obtain four new stainless steel 3,500 gallon fish transport trailers, with delivery of the trailers expected in 1994.

Ice Harbor Dam

Ice Harbor Dam

1. Special Project Operations.

a. Spill.

(1) Spring.

Spring spill to protect endangered salmon species will occur for 12 hours nightly (1800 - 0600 hours) from April 10 through June 20, at a level of up to 25 kcfs.

(2) Summer.

Summer spill to protect endangered salmon species will occur for 24 hours per day from June 21 through July 31, at a level of up to 100% of instantaneous project discharge or 25 kcfs (whichever is less), less flows needed through the powerhouse for adult attraction. Spill may be modified in-season if monitoring indicates adverse effects on migrating salmon or other project uses. Spill will be scheduled according to procedures described in Appendix F. This spill schedule will be modified once the new juvenile bypass is completed and tested.

2. Fish Counting Program.

a. 1 April - 31 October - Visual count 16 hours per day (0400 - 2000 PST).

b. 1 April - 31 October - Video count 8 hours per day (2000 - 0400 PST).

- c. 1 November - 15 December - Video count 24 hours per day.

3. **Research.**

- a. 1994 is the last year of a four-year Snake River adult fish passage study. The south shore ladder trap will operate periodically from mid-April through November to collect fish for tagging in the adult fish migration studies. Some aspects of project operations may be altered as part of this research study. The study will evaluate alternative spill patterns if river flows are high enough to require daytime spill in the spring. Other test design elements include reversing the daytime turbine unit operating priorities (alternating between north and south powerhouse turbine operations), and possibly opening or closing some of the powerhouse floating orifice gates.

4. **Project Improvements for Endangered Species.**

- a. Adult Fishway Control System. Ice Harbor project personnel installed a new fishway control system in 1992. The system is controlled by a microprocessor and linked to a computer in the powerhouse control room. The computer monitor displays real-time fishway settings and the computer records hourly fishway settings into a record keeping and reporting program. Final implementation of the control system was completed in October 1992.

- b. Methodology for Operation of Turbine Units Within One Percent of Peak Efficiency. Hydroelectric Design Center is developing methods for determining and monitoring turbine unit operation within 1 percent of peak efficiency. This work is scheduled to be completed by mid-1994.

Lower Monumental Dam

Lower Monumental Dam

1. **Special Project Operations.** A contractor will be conducting turbine blade cavitation repair on turbine units 3 through 6. The contractor will be allowed to work on one turbine unit at a time and is allowed 75 days per turbine unit. The contract work is scheduled to take place between June 25, 1994 and May 15, 1995.

2. **Research.**

a. Special tests on juvenile fish passage through the outfall pipe and holding and loading facilities will be conducted from April through June. This may require special unit operation during test periods. The new PIT tag deflector system in the transportation facility will be evaluated in April and May.

b. Juvenile fish survival studies will take place at Lower Monumental Dam in 1994. This will include releases of marked test fish groups through turbine units, spillbays, and the juvenile bypass system. The study will require special turbine, spill, or bypass operations during the test fish releases.

c. 1994 is the last year of a four-year Snake River adult fish passage study. The study will evaluate alternative spill patterns if river flows are high enough to require daytime spill. Other test design elements include reversing the daytime turbine unit operating priorities (alternating between north and south powerhouse turbine operations), alternating between south powerhouse downstream and side entrances, and possibly opening or closing some of the powerhouse floating orifice gates. Adult fish migration studies may require alternating two-week periods of nighttime zero flow (2300 - 0500 hours) and minimum flow

(at least 11.5 kcfs) from late August through November.

3. **Project Improvements for Endangered Species.**

a. **Adult Fishway Control System.** A new adult fishway control system is scheduled to be installed by March 1, 1995. The system will be controlled by a microprocessor and linked to a computer in the powerhouse control room. The computer will display real-time fishway settings and will record hourly fishway settings into a record keeping and reporting program.

b. **Rebuilding of Adult Fishway Auxiliary Water Supply Pump Turbines.** The turbines for driving the auxiliary water supply pumps at Lower Monumental and Little Goose dams will be rebuilt during the 1994 and 1995 winter maintenance periods. In 1993, new turbine runners and a spare turbine were procured. Rebuilding of the turbines will be accomplished during two extended fish pump maintenance periods from November 21, 1993, through March 31, 1994, and from November 21, 1994, through March 31, 1995. During the outage periods outside of the normal January and February maintenance period, two fish pumps will remain in operation at both projects.

c. **Methodology for Operation of Turbine Units Within One Percent of Peak Efficiency.** Hydroelectric Design Center is developing methods for determining and monitoring turbine unit operation within 1 percent of peak efficiency. This work is scheduled to be completed by mid-1994.

Little Goose Dam

Little Goose Dam

1. Special Project Operations.

a. A contract was awarded in 1993 for the rebuilding of turbine units 2 and 3. The work on turbine unit 2 started in early July 1993 and is estimated to be completed by June 30, 1994. When unit 2 is completed, the contractor will start work on turbine unit 3 with a contract work period of one year. The turbine units will be out of service the entire time period that they are being rebuilt.

b. The disconnects for transformer bank T1 are scheduled to be replaced in 1994.

2. Research.

a. Tests of extended-length traveling screens for the juvenile bypass system will be conducted in 1994, from approximately mid-April through July. This will require outages of units 4 and 5 from April 1 through possibly July, except for approximately 1-2 hours nightly (approximately 2000 - 2200 hours) while tests are underway. During testing, the test turbine units may be operated outside of the one percent peak efficiency band to account for the flow variances caused by the fyke net frames, nets and head loss. No spill will take place during the FGE tests, if possible, to avoiding biasing the tests. Unit outages may be extended if excessive descaling or mortality is observed in association with test screen operation or if needed for video camera operations. At the completion of the testing season, or during the testing season if needed to control river conditions, the turbine units may be operated as part of normal project operations, with the test screens in place, if fish condition observed during the testing is at an acceptable level.

b. Juvenile fish survival studies will take place at Little Goose Dam in 1994. This will include releases of marked test fish groups through turbine units, spillbays, and the juvenile bypass system. The study will require special turbine, spill, or bypass operations during the test fish releases.

c. 1994 is the last year of a four-year Snake River adult fish passage study. The study will evaluate alternative spill patterns if river flows are high enough to require daytime spill. Other test design elements include reversing the daytime turbine unit operating priorities (alternating between north and south powerhouse turbine operations), alternating between north powerhouse downstream and side entrances, possibly opening or closing some of the powerhouse floating orifice gates, and changes to the north powerhouse fallout fence. Adult fish migration studies may require alternating two-week periods of nighttime zero flow (2300 - 0500 hours) and minimum flow (11.5 kcfs or greater) from late August through November.

3. Project Improvements for Endangered Species.

a. Adult Fishway Control System. A new adult fishway control system was installed March 1, 1994. The system is controlled by a microprocessor and linked to a computer in the powerhouse control room. The computer displays real-time fishway settings and will record hourly fishway settings into a record keeping and reporting program.

b. Rebuilding Adult Fishway Auxiliary Water Supply Pump Turbines. The turbines for driving the auxiliary water supply pumps at Lower Monumental and Little Goose dams will be rebuilt during the 1994 and 1995 winter maintenance periods. In 1993, new turbine runners and a spare turbine were procured. The turbines will be rebuilt during two extended fish pump maintenance periods from November 21, 1993, through March 31, 1994, and from November 21, 1994, through March 31, 1995. During the outage periods outside

of the normal January and February maintenance periods, two fish pumps will remain in operation at both projects.

c. Routing Excess Juvenile Bypass System Water to the Adult Attraction Water System. Excess water from the juvenile fish bypass system primary dewatering structure will be routed to the adult fish collection auxiliary water supply system. This will add approximately 200 cfs to the auxiliary water supply system. Construction was completed during the winter maintenance period of January and February 1994.

d. Raceway Roofs. A roof to shade the juvenile fish transportation facility raceways was constructed in late 1993.

e. Methodology for Operation of Turbine Units Within One Percent of Peak Efficiency. Hydroelectric Design Center is developing methods for determining and monitoring turbine unit operation within 1 percent of peak efficiency. This work is scheduled to be completed by the mid-1994.

Lower Granite Dam

Lower Granite

1. **Special Project Operations.** There are no special operations currently scheduled for Lower Granite.

2. **Adult Fish Counting.**
 - a. 15 March - 31 March - Visual count 8 hours per day (0800 - 1600 PST).
 - b. 1 April - 31 October - Visual count 16 hours per day (0400 - 2000 PST).
 - c. 1 November - 15 December - Visual count 10 hours per day (0600 - 1600 PST).
 - d. 1 April - 31 October - Video count for 8 hours per day (2000 - 0400 PST).
 - e. 1 November - 15 December - Video count for 14 hours per day (1600 - 0600 PST).

3. **Research.**
 - a. Juvenile fish survival studies will take place at Lower Granite Dam in 1994. This will include releases of marked test fish groups through turbine units, spillbays, and the juvenile bypass system. The study will require special turbine, spill, or bypass operations during the test fish releases.

b. During June and July, a prototype gatewell dip tank system will be evaluated in turbine unit gatewell slot 6A. The tank system is being evaluated for use during possible future drawdown tests.

c. 1994 is the last year of a four-year Snake River adult fish passage study. The study will evaluate alternative spill patterns if river flows are high enough to require daytime spill. Other test design elements include reversing the daytime turbine unit operating priorities (alternating between north and south powerhouse turbine operations), alternating between powerhouse downstream and side entrances, and possibly opening or closing some of the powerhouse floating orifice gates. Adult fish migration studies may require alternating two-week periods of nighttime zero flow (2300 - 0500 hours) and minimum flow (at least 11.5 kcfs) from late August through November.

4. **Project Improvements for Endangered Species.**

a. Adult Fishway Control System. A new adult fishway control system is scheduled to be installed by March 31, 1994. The system will be controlled by a microprocessor and linked to a computer in the powerhouse control room. The computer will display real-time fishway settings and will record hourly fishway settings into a record keeping and reporting program.

b. Raceway Roofs. A roof to shade the juvenile fish transportation facilities truck loading raceways was completed late 1992.

c. Fish Barge Oxygen Monitoring System. Oxygen monitoring systems were connected to the alarm systems on the 4000 and 8000 series barges during the spring of 1992.

d. Forebay Debris Boom. A metal debris boom was designed and installed in the Lower Granite forebay in 1992, replacing the wooden debris boom that was deteriorating.

e. Small Fish Transport Tanks. Three 150-gallon insulated fiberglass tanks with chiller systems were procured in 1992 for transporting juvenile fish during the extended transportation program.

f. Methodology for Operation of Turbine Units Within One Percent of Peak Efficiency. Hydroelectric Design Center is developing methods for determining and monitoring turbine unit operation within 1 percent of peak efficiency. This work is scheduled to be completed by mid-1994.

February 24, 1994

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 Wildlife (WDW), Washington Department of Fisheries (WDF), and Oregon Department of Fish and Wildlife (ODFW). On-site quality control is provided by WDW at Lower Granite, ODFW at Little Goose, and WDF at Lower Monumental and McNary dams.

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 and McNary dams. Start-up at Lower Granite Dam will be triggered from fish counts at the FPC smolt monitoring traps on the Clearwater River above Lewiston, Idaho, and on the Snake River at Clarkston, Washington, in addition to information on flow and fish movement provided by the FPC. Start-up at McNary Dam will be based on information on flow and fish movement provided by FPC from the mid-Columbia smolt monitoring stations. 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.

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. 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 31 at McNary Dam.

d. Emergency Termination Criteria: When high water temperatures or other factors increase collection mortality of subyearling chinook to 10% or higher for three consecutive days, project personnel will promptly notify the CENPW transportation coordinator. 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 FPC, FPAC, and NMFS.

4. **Operating Criteria:**

a. Collection and Transportation: All fish collected at Lower Granite, Little Goose, Lower Monumental, and McNary dams will be transported according to the criteria listed below. During transport operations, if holding capacities are reached, additional fish collected will be bypassed back to the river until facility holding space is available. Maximum holding time and loading criteria will not be exceeded without CENPW review and approval. Marked or PIT tagged fish will be released, when transportation is being maximized, if they are part of an approved research study or smolt monitoring program travel time evaluation.

(1) Lower Granite Dam: All fish collected will be transported except those required to be released for approved fish research or monitoring activities.

(2) Little Goose and Lower Monumental dams: If average daily flow exceeds and is forecast to exceed 100 kcfs for 5 consecutive days, fish will be separated by size and smaller fish, predominantly yearling salmon, will be bypassed to the tailrace. Normally, if average daily flows are projected to drop below 100 kcfs for approximately 5 days, transportation will be maximized to prevent bypassing fish into deteriorating flow conditions. Because of the extended period expected for fish to move through the lower Snake River under low-flow conditions, it is desirable to anticipate sub-minimum flows as far in advance as practicable (approximately 3-5 days) and initiate transportation of all species at that time. If existing or projected conditions warrant a change in the criteria, CENPW will coordinate recommended deviations with the CBFWA, and FPC, and NMFS prior to implementation. Bypass will continue until approximately 80 percent of the yearling salmon migrants (as determined by the FPC) have passed and steelhead numbers predominate. When that happens, all fish collected will be transported.

(3) McNary Dam: If average daily project flows exceed and are projected to exceed 220 thousand cubic feet per second (kcfs) for 5 consecutive days based on Corps/National Weather Service Columbia River 7-day forecasts of regulated stream flow, fish will be separated by size and smaller fish (salmon) will be

bypassed and larger fish (steelhead) transported as long as yearling chinook salmon predominate in the collection. If average daily flows are projected to drop below 220 kcfs for 5 consecutive days, transportation will be maximized to prevent bypassing fish into deteriorating flow conditions. When subyearling chinook salmon predominate over yearling salmon in the collection sample, all collected fish will be transported. Sub-samples will be examined for marks or for use in research, then they will be released to the tailrace or transported. Maximum collection and transportation of all species will be implemented when average daily flows are at or below 220 kcfs.

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 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:

<u>Barge</u>	<u>Capacity (gal)</u>	<u>Inflow(gpm)</u>	<u>Fish Capacity(lbs)</u>
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.

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 all spring operations, barges will take on additional fish at Little Goose, Lower Monumental, and/or McNary Dam as barge capacity allows. When daily collection exceeds barge capacity, trucks may be used from Little Goose, Lower Monumental, or McNary Dam to supplement barge transport. 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. For research purposes, eight groups of fish will be transported to, and released at, Tongue Point (Oregon) at RM 8.

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 or culturists at each collector facility by Cooperative Agreements with WDW, ODFW, and WDF.

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.

February 24, 1994

APPENDIX D

SYSTEM LOAD SHAPING GUIDELINES TO ENABLE TURBINE OPERATION WITHIN 1% OF 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 the Corps, BPA, and the Fish Passage Development and Evaluation Program Fish Facility Operation and Maintenance Subcommittee (FPDEP-FFOMS) 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 LSN and LCOL 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, 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 FPDEP-FFOMS, 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, in a manner similar to the Surplus Spill Priority list. 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 management process, as described in the 1993 Biological Opinion on Operation of the Federal Columbia River Power System (FCRPS) through January, 31, 1994, p. 92).

Coordination is also intended to minimize frequent disruption of the Federal Columbia River Power System (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 1993 Biological Opinion on Operation of the Federal Columbia River Power system (FCRPS) through January, 31, 1994.

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 management team described above as soon as practical. Implementation of the change(s) will occur as soon as practical given operational, hydraulic and load conditions. The action agencies shall provide points of contact to allow such emergency coordination to occur.

C. Limitations for the period March 15 through October 31

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 Operations¹, the Northwest Power Pool Operating Manual², the Western Systems Coordinating Council Operations Committee Handbook³, and the North American Electric Reliability Council Operating Manual⁴ 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 Contract⁵ with the DSI's and

¹Section 4.

²Minimum Operating Reliability Criteria Sections I and II. 1.-3. and 8.

³Minimum Operating Reliability Criteria Section II 1.-4. and 8., and Section III 1.1 and 1.2.

⁴The entire manual has relevance. However, particularly concise portions are - Guide II.A. and the Reliability Criteria for Interconnected Systems Operation, especially the Preamble, Section I.A., B., and C., Section II.A. and B., and Section III.A.

⁵Section 8.(a).(1)

House Report 96-976⁶ 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. 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 above maximum peak efficient range.

6. Flow augmentation operations.

Flow augmentation requests for week average lower Columbia River (LCOL) flows at The Dalles (TDA) are primarily met by water releases from GCL. The decision on whether to use GCL flexibility to provide uniform daily average inflows to TDA 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 week-average flows may exceed the one percent peak efficient operation range at LCOL/LSN projects. Meeting this week-average flow request will take precedent over peak efficient operations. Coordination of the implementation of the week average 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.

⁶Part II, page 48

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.

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.

February 24, 1994

APPENDIX E

**DISSOLVED GAS MONITORING PROGRAM
PLAN OF ACTION**

DISSOLVED GAS MONITORING PROGRAM PLAN OF ACTION

The total dissolved gas (TDG) monitoring program consists of a range of activities designed to provide management information about dissolved gas and spill conditions. These activities include time-series measurements, data analysis, synthesis and interpretation, and calibration of numerical models. Four broad categories of objectives are involved: (1) data acquisition, to provide decision-makers with useful, synthesized, and relevant information to control dissolved gas supersaturation on a real-time basis, (2) compliance, to ascertain the extent to which existing state dissolved gas standards and federal criteria are being met; (3) trend monitoring, to identify longer-term changes in basinwide dissolved gas saturation levels resulting from water management decisions; and (4) model verification, to check the validity of assumptions and predictions used for evaluation of management objectives.

This Plan of Action summarizes the role and responsibilities of the Corps of Engineers (Corps) 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.

A two-way communication between those conducting the monitoring and the users of monitoring information is essential. 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 have been useful in establishing monitoring program priorities and defining areas requiring special attention.

The Plan of Action consists of seven phases:

- (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

Phase 1: Program Start-Up

Responsible parties (See Table 1) will be invited to a meeting in late September to discuss lessons learned during the past monitoring season and 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 a forum to objectively assess the adequacy of past, present and anticipated monitoring efforts; and consequently, to recommend commensurate program changes when needed.

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 three other Lower Columbia River locations below Bonneville Dam.

Phase 2: Instrument Installation

The list of the instruments to be installed and their assigned locations is given in Table 2. The Plan basically includes one forebay instrument at each Columbia/Snake River dam; one tailwater right shore-based instrument below Lower Granite and Little Goose; one tailwater left shore-based instrument below Lower Monumental; four tailwater instruments below Ice Harbor, two with telemetry equipment, and one attached to a U.S. Coast Guard (USCG) buoy; one tailwater right shore-based instrument below McNary; one tailwater instrument below Dworshak; and four instruments below Bonneville.

The Plan also includes the Bureau of Reclamation's (BoR) 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 left shore instrument located 2 miles downstream from Priest Rapids Dam. In addition, installation of a new tailwater monitoring station on the railroad bridge below Wanapum Dam has been budgeted in by Grant County PUD.

The instruments are scheduled for installation and, if applicable, interface with SUTRON Data Collection Platforms 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, but no later than 1 March. The Corps' staff hydrologist, together with maintenance and service contractors, will jointly perform the installation, calibration and testing of all equipment at those stations. Selected project personnel may also be requested to assist as needed.

Project staff familiarization with the Program details will be carried out at each project during the instrument installation trips. Each project will be instructed on how to dry the probe once a week.

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In an attempt to reduce instrument downtimes to no more than 48 hours during the peak of the fish migration season, duplicate probes and/or membranes will be furnished at selected critical locations so that the faulty components can be quickly replaced by local project personnel. Up to four redundant instruments are also available for deployment. Selection of the instrument sites will be made in consultation with all interested parties.

Ice Harbor tailwater monitoring has been revised to include the following actions:

- relocate the tailwater station (located 0.8 mile below the dam) from a shore-based site to a mid-channel site by deploying a self-contained wireless data logger station on an existing USCG navigation buoy;
- retain the right shore-base instrument located 3.6 miles below the dam and upgrade it from a data logger to a full telemetry station, complete with solar energy panel, data collection platform, and automatic data transmission capability;
- deploy a self-contained data logger on an existing USCG navigation buoy on the left side of the navigation channel in line with the 3.6 mile station mentioned above. The data will be manually retrieved once a week during the first part of the spill season. Data from the shore-based station will be compared with mid-channel data. If data from the shore-based station is found to be representative of data from the mid-channel station, logger download frequency will be reduced to bi-weekly;
- move and upgrade the instrument currently located at Shot Rock Island, immediately below the confluence of the Columbia with the Snake River, from a data logger to a full telemetry station. The plan is to install a full telemetry station, complete with solar energy panel, data collection platform, and automatic data transmission capability, 7.5 miles below Ice Harbor Dam on the left shore of the Snake River, near the Hood Park boat ramp.

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 1 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-PE-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 (°C)
- BH, Barometric Pressure (mm of Hg)
- NT, Total Dissolved Gas Pressure (mm of Hg)
- OP, Dissolved Oxygen Pressure (mm of Hg)

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- 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, BH will not be measured; BH forebay values will be used instead.

Data download from shore-based stations will be done monthly where spill does not occur and weekly where spill does occur. Data download from mid-channel stations will occur weekly until it is determined that this data is representative of shore-based data; at that point, logger download frequency will be reduced to bi-weekly.

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 CENPD-PE-WM(RCC) for data reconciliation purposes. Data transmission from automated stations interfaced with a SUTRON data collection platform (DCP) will be transmitted automatically every four hours, via the GOES Satellite, to the Corps' ground-receive station in Portland. After decoding, all data will be stored in the Columbia River Operational HydroMet System's (CROHMS) data base.

In-season instrument and operational problems should be reported to Mr. Bob Parker, CENPD-PW-WM(RCC), Tel. (503) 326-3747. Mr. Parker will arrange for the necessary repairs to be made as expeditiously as possible.

Daily reports summarizing Total Dissolved Gas (TDG) information will be prepared and posted by 1330 hours every day in 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, °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.

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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 CENPD-PE-WM(RCC) before the data are permanently stored in the Corps' Water Quality Data Base.

Phase 4: Instrument Removal and Storage

Tensionometers will be removed shortly after the end of the monitoring season (August/September) by the relevant Corps division/district/project personnel. They will be serviced by the maintenance and service contractor and stored at a convenient location (including CENPD-PE-WM) until the beginning of the next monitoring season. They may also 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 to 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. Data collected at and transmitted from all network stations will be ultimately stored at CENPD-PE-WM, where they can be accessed through a data management system such as CROHMS and HEC-DSS.

Phase 6: Program Evaluation and Summary Report

An office report will be prepared after the end of each 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.

Phase 7: Special Field Studies

Additional monitoring of dissolved gas saturation will be conducted on a as-needed basis. Current plan for additional monitoring includes transect measurements below Ice Harbor and, if time permits, at selected other 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. 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.

Revised: Jan.26, 1994

TABLE 1. List of Contact Persons

<u>Projects Numbers</u>	<u>Names</u>	<u>Position</u>	<u>P h o n e</u>
Int'l Boundary	Dan Lute	Hydrologist (USBR)	(208) 378-5272
	Dave Zimmer	Limnologist (USBR)	(208) 378-5088
Grand Coulee	Dan Lute	Hydrologist (USBR)	(208) 334-1970
	Dave Zimmer	Limnologist (USBR)	(208) 334-9035
Chief Joseph	Joe Munk	Ch. of Operations	(509) 686-5501
	Jim Hahermehl	Biologist	(509) 686-5501
	Bob Fisher	Biologist	(509) 686-5501
Wells	Rick Klings	Biologist (Douglas)	(509) 884-7191
Rocky Reach	Steve Hays	Biologist (Chelan)	(509) 663-8121
Rock Island	Steve Hays	Biologist (Chelan)	(509) 663-8121
Wanapum	Stuart Hammond	Biologist (Grant)	(509) 754-3541
	Mike Taylor	Telecom.Engr.(Grant)	(509) 754-2138
Priest Rapids	Stuart Hammond	Biologist (Grant)	(509) 754-3541
	Mike Taylor	Telecom.Engr.(Grant)	(509) 754-2138
Dworshak	Tom Miller	Limnologist (CENPW)	(509) 522-6379
Lower Granite	Jesse Smiley	Ch. of Operations	(509) 843-1493
	Tom Miller	Limnologist (CENPW)	(509) 522-6379
Little Goose	Ray Eakin	Ch. Of Operations	(509) 399-2233
	Tom Miller	Limnologist (CENPW)	(509) 522-6379
Lo.Monumental	Larry Walker	Ch. Of Operations	(509) 547-7781
	Tom Miller	Limnologist (CENPW)	(509) 522-6629
Ice Harbor	Larry Walker	Ch. Of Operations	(509) 547-7781
	Tom Miller	Limnologist (CENPW)	(509) 522-6629
McNary	Brad Eby	Reservoir Mgmt	(503) 922-3211
	Tom Miller	Limnologist (CENPW)	(509) 522-6629
John Day	Jim Williams	Power Proj.Supt.	(503) 298-7502
The Dalles	Jim Williams	Power Proj.Supt.	(503) 298-7535
Bonneville	Darrell Hunt	Power Proj.Supt.	(503) 374-8338
Warrendale	Bob Parker	Hydrologist (RCC)	(503) 326-3747

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Camas/Washougal	Bob Parker	Hydrologist (RCC)	(503) 326-3747
Kalama	Bob Parker	Hydrologist (RCC)	(503) 326-3747
Wauna Mill	Bob Parker	Hydrologist (RCC)	(503) 326-3747

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TABLE 2
Dissolved Gas Monitoring Network

<u>StaID</u>	<u>Location</u>	<u>Owner</u>	<u>Model of Tensionometer</u>	<u>Channels No.</u>
CIBW	Boundary	USBR	TGO-FT	4-auto
GCGW	D/s GCL	USBR	TGO-FT	4-auto
CHJ	Forebay	NPD/BPA	TBO-FTR-004	5-auto
WEL	Forebay	Douglas	FT	2-ch.
RRH	Forebay	Chelan	FT	2-ch.
RIS	Forebay	Chelan	FT	2-ch.
WAN	Forebay	Grant	TBL-O	5-auto
WAN (*)	Tailwater	Grant		
PRD	Forebay	Grant	TBO-FTR	4-auto
PRXW	Tailwater	Grant	TBL-O	5-auto
DWQI	Tailwater	NPD	TBL-O	5-auto
LWG	Forebay	NPD	TBL-O	5-auto
LWG	Tailwater	NPW (.8 mi Right Bank)		(H)
LGS	Forebay	NPD	TBL-O	5-auto
LGS	Tailwater	NPW (.7 mi Right Bank)		(H)
LMN	Forebay	NPW	TBL-O	5-auto
LMN	Tailwater	NPW (.8 mi Left Bank)		(H)
IHR	Forebay	NPW	TBL-O	5-auto
IHR	Tailwater	NPW (.8 mi mid-channel)		(W)
IHR	Tailwater	NPW (3.6 mi Right Bank)		(T)
IHR	Tailwater	NPW (3.6 mi mid-channel)		(W)
IHR	Tailwater	NPW (9.6 mi or 7.6 mi Left Bank)		(T)
MCQW	Forebay-WA	NPD/BPA	TBL-O	5-auto
MCQO	Forebay-OR	NPD/BPA	TBL-O	5-auto
MCN	Tailwater	NPW (1.4 mi Right Bank)		(H)
JDA	Forebay	NPD	TBL-O	5-auto
TDA	Forebay	NPD	TBL-O	3-auto
BON	Forebay	NPD	TBL-O	3-auto
WRNO	Warrendale	NPD	TBL-O	5-auto
CWMW	Camas	NPD	TBL-O	5-auto
KLAW	Kalama	NPD	TBL-O	5-auto
WANO	Wauna Mill	NPD	TBL-O	5-auto

USBR= U.S. Bureau of Reclamation * = New Instrument for 1994
 NPD= North Pacific Division (H) = Hynet Logger
 NPW= Walla Walla District (T) = Telemetry with Logger
 BPA= Bonneville Power Administr (W) = Wireless deployed on buoy (logger)

February 24, 1994

APPENDIX F

**SECTION III, Paras. A.2, B.1 - B.17
(except B.5, B.6, and B.14),
OF THE REGIONAL SPILL AGREEMENT:
FISH SPILL AT THE DALLES AND JOHN DAY DAMS
WHILE PROVIDING FOR NONPOWER USES (MODIFIED)**

SECTION III, Paras. A.2, B.1 - B.17
(except B.5, B.6, and B.14)
OF THE REGIONAL SPILL AGREEMENT:
FISH SPILL AT THE DALLES AND JOHN DAY DAMS
WHILE ALLOWING FOR NONPOWER USES (MODIFIED)

A. General Principles for Implementation

1. The operation of turbines at Federal hydroelectric projects causes mortality to juvenile migrating anadromous fish. Passage of water over spillways rather than through turbines during periods of juvenile anadromous fish migration can reduce turbine-related mortality of juvenile anadromous fish. This Agreement is intended to provide improved fish passage conditions through the commitment of spill for juvenile anadromous fish and avoidance of turbine impacts.

B. Specific Principles for Implementation

1. Spill for juvenile fish passage at the Federal Columbia River Hydroelectric Projects shall be provided in accordance with the terms of this agreement insofar as the spill does not impact nonpower uses. The following table sets forth fundamental principles of this agreement.

2. Spill Table

	Spill Season	Spill Percentages (a)
		--average (range)--
John Day		
	N/A	N/A
Spring		
Summer	6/7 -8/22	20% (15-25)
The Dalles(b)		
Spring	5/1 -6/6	10% (5-15)
Summer	6/7 -8/22	5% (0-10)

(a) Spill for 10 hours/day at JDA and up to 24 hours/day at TDA.

(b) During both the spring and summer the daily spill level at The Dalles Dam can be shaped on a seasonal basis by plus or minus 5% of the daily spill percentage indicated in the spill table.

3. Spill Requests

The agencies and tribes shall request that spill be provided in accordance with the Spill Table and other provisions of this agreement. Such requests shall be transmitted by the Fish Passage Center (FPC) to the Corps of Engineers' Reservoir Control Center (RCC) and BPA. The parties shall honor all requests by the Agencies and Tribes that are necessary for the

implementation of this agreement and consistent with this agreement as long as the request does not impact nonpower uses. The agencies and tribes may request adjustments or modifications to the dates, hours, and percentages of spill to be provided, in accordance with this agreement.

4. Spill Seasons

Dates for the initiation and cessation of spill for fish passage under this agreement shall be determined in the following manner. The agencies and tribes, using the best available data and sound scientific methods, shall estimate the 10 and 90 percent passage dates ("estimated dates") for the spring and summer migrations. Information and analyses employed by the fishery agency and tribes in developing the estimates of the 10 and 90 percent passage dates shall be provided to the parties.

a. Spring spill may be requested at TDA on the respective estimated dates of 10 percent passage at each dam, but not before the respective spring starting dates in the Spill Table.

b. The spring spill period shall end on the respective estimated dates of 90 percent passage but, except as provided in subsection d below, no later than the spring ending dates in the table.

c. The parties recognize that there may be considerable overlap between the spring 90% and summer 10% passage dates. In the event these dates do not overlap, no spill shall be requested between the estimated date of 90 percent spring passage and the estimated date of 10 percent summer passage.

d. The parties also recognize that the estimated 90% spring passage date may extend beyond the spring season ending dates in the Spill Table. If neither 90 percent of spring migrants nor 10 percent of summer migrants have passed TDA by June 6, then summer spill levels may be requested until 90 percent of spring migrants have passed.

e. Except as provided in subsection d above, summer spill may be requested at JDA and TDA on the estimated date of 10 percent passage, but not before the summer starting dates in the Spill Table.

f. The summer spill period shall end JDA and TDA on the estimated date of 90 percent passage, but not later than the summer ending dates in the Spill Table.

7. In-Season Adjustment to Spill Percentages at JDA

At JDA the instantaneous spill percentage requests by the agencies and tribes shall be based on the percentage and hours in the Spill Table and shall be calculated by the agencies and tribes in accordance with the following formula:

$$(10 \text{ Hrs} * \% \text{ Spill}) / N \text{ Hrs} = X$$

Where:

10 Hrs = the number of hours of spill prescribed by the Spill Table

% Spill = the percent of spill required by the Spill Table

N Hrs = the number of hours of spill requested by the agencies and tribes

X = the instantaneous spill percentage required during the requested hours of spill which shall in no event exceed 50%

For example, 20 percent spill for 10 hours could by request of the agencies and tribes be adjusted to 17 percent for 12 hours or 25 percent for 8 hours.

8. In-Season Adjustments to Spill Percentages at TDA

At TDA the instantaneous spill percentage requested by the agencies and tribes will be based on the percentages and hours in the spill table and the daily average flow, and will be calculated by the agencies and tribes in accordance with the following formula:

$$(Avg Q * \% Spill / Period Q) * (24 Hrs / N Hrs) = X$$

Where:

Avg Q = projected daily average flow at the project

% Spill = the percent spill required by the Spill Table

Period Q = total average river flow during the requested spill period

24 hours = the number of hours of spill prescribed by Spill Table

N hours = the requested number of hours of spill

X = the instantaneous spill percentage required during the requested hours of spill which shall in no event exceed 50%

For example, with a constant flow of 220 kcfs, the 10% spill rate listed in the Spill Table could provided an instantaneous spill level of 10% for 24 hours, or, on request of the agencies and tribes, 20 percent for 12 hours.

If, however, the daily average flow is 220 kcfs and the average river flow during the spill period is 165 kcfs, then the instantaneous spill percentage could be 27 percent for 12 hours or 32 percent for 10 hours at the discretion of the agencies and tribes:

$$(220 \text{ kcfs} * 10\% / 165 \text{ kcfs}) * (24 \text{ Hrs} / 12 \text{ Hrs}) = 27\%, \text{ or}$$

$$(220 \text{ kcfs} * 10\% / 165 \text{ kcfs}) * (24 \text{ Hrs} / 10 \text{ Hrs}) = 32\%$$

9. Seasonal Spill Shaping

a. The daily spill percentage may be adjusted at the request of the agencies and tribes within the ranges specified in the parentheses and footnote in the Spill Table. The purpose of this operational flexibility is to provide an increased level of spillway bypass for a greater number of smolt migrants. The agencies and tribes shall be allowed this operational flexibility, provided that each day of increased spill is balanced by a day of decreased spill.

b. The determination of when to request more or less spill shall be made by the agencies and tribes. For example, earned days of a higher percentage spill would not be considered used unless requested by the agencies and tribes, regardless of whether the project actually provides higher spill than requested.

c. The agencies and tribes shall use this flexibility to shape spill to the fish migration and shall provide information and rationale in support of their requests. The rationale for their requests shall be based on available data and sound scientific methods. For the purposes of the above discussion, no spill shall be shifted from one season to the other.

(1) ***[Not applicable except in reference to subsection b. below.]*** In the Snake River in spring and summer, the agencies and tribes may request low spill days at the beginning of the season. Each such low day requested shall entitle them to request two high spill days during the peak of the migration, and shall obligate them to request (i.e. repay) one low spill day after the peak of the migration. The low and high day figures are contained in the parentheses and footnote in the Spill Table. The number of low days that may be requested to earn high days is limited to 10 days, or 25 percent of the number of days between the estimated 10 percent passage date and the ending date in the Spill Table, whichever is less.

(2) At TDA in spring, the formula described above in subsection a. applies, except the limitation on the number of low days that may be requested is eight.

(3) At JDA and TDA in summer, the agencies and tribes may earn 1 high spill day for each low spill day requested and there is no limit on the number of low spill days that may be requested. The agencies and tribes may also request up to 14 unearned high days before requesting any low days provided that all unearned high days must be repaid with low days by July 15.

10. Spill Hours

Daily spill levels, determined by the agencies and tribes pursuant to this agreement, shall be spilled during hours requested by the agencies and tribes. No spill shall be requested to occur between 0600 and 1800 hours at JDA. Spill at TDA shall be provided during any hours requested by the agencies and tribes, subject to infrequent system reliability limitations imposed by BPA during the peak generating hours 0600-1000 and 1800-2000. Placement of limitations on spill at TDA during these peak generating periods shall be dealt with on a case-by-case basis. Notwithstanding these

limitations, spill at all projects may be requested for all hours from 1800 hours on Fridays through 0600 hours on Mondays ("weekends"). Holidays shall be treated the same as weekends.

11. Hourly Spill Shaping

a. The agencies and tribes may request daily shaping of spill for fish passage. The decision to provide a higher percentage for fewer hours or a lower percentage for more hours rests with the agencies and tribes. If spill is higher than requested due to project operations, no reduction in hours or accounting against future requests shall occur.

b. The agencies and tribes may request a pre-scheduled constant level of spill during the allowable spill hours. At TDA, however, spill requests may specify two different spill rates, one for daytime and one for nighttime. The two spill rates may not be used to obtain a greater volume of water than would be available with one spill rate. Spill shall be provided at the hourly rates requested by the agencies and tribes. This subsection shall apply whether spill percentages are determined using the Instantaneous or Daily Average methods.

12. Maximum Instantaneous Spill Levels

a. Summer spill requested at JDA shall be limited to 50 percent of the instantaneous flow at JDA, and spring and summer spill requested at TDA shall be limited to 50 percent of the instantaneous flow at TDA.

b. If BPA decides that any request consistent with this agreement for shaping prescheduled spill on any day cannot be implemented due to system reliability problems, then modifications to the shaping shall be made in consultation with the agencies and tribes. Such modifications shall affect only the shape of spill and shall not reduce the spill for that day.

c. Following such consultations, a complete description of the reasons that the request cannot be implemented shall be provided to the fishery agencies and tribes. This communication shall be followed by a written explanation within one week. The parties anticipate that the occurrence of such modifications shall be very infrequent. If such modifications occur more frequently and at a frequency unacceptable to the agencies and tribes, they may pursue such remedies available to them including withdrawal from this agreement.

13. Prescheduling

a. Spill requests shall be pre-scheduled by the agencies and tribes through the FPC. Spill requests shall be provided to the RCC by 1500 each Monday through Thursday. Spill requests for weekends, Mondays, and holidays shall be pre-scheduled on Thursday. Spill requests for Tuesday after 1800 through 1800 on Wednesday shall be pre-scheduled no later than 1500 hours on Monday. The same prescheduling procedure shall be followed on Tuesday and Wednesday of each week. Spill requests for all projects for Friday after 1800 through 0600 hours on Tuesday shall be prescheduled no later than 1500 on

Thursday. Spill requests at TDA for the 0600 through 1800 on Tuesday shall be prescheduled on Monday by 0900 through the RCC. See Appendix C. Allowance of prescheduling outside these specified times shall be at BPA's discretion.

b. BPA shall provide the Summary of Planned Daily Operation, 30-day version, to the FPC on a weekly basis. Upon request and as needed, BPA shall provide technical assistance to the agencies and tribes so that the FPC can estimate daily average flows and average flows for the daily spill period, in order to determine the instantaneous spill percentages in subsections 6, 7 and 8.

c. Modifications by the agencies and tribes to pre-scheduled spill requests are discouraged but may be allowed. Requests by the agencies and tribes for such modifications shall be dealt with by BPA on a case-by-case basis. The parties anticipate that the occurrence of such modifications shall be very infrequent.

15. Use of Surplus (Overgeneration) Spill

Any remaining spill available after meeting the requirements of this agreement will be allocated among Federal and non-Federal hydroelectric projects according to a spill priority list established by the FPC.

16. Special Operations

Special operations outside of this agreement may be sought by the agencies and tribes to protect fish. For example, if guidance for all species does not meet the FPE standard, special operations may be requested to provide protection to fish not meeting the standard. Such operations shall be considered by BPA on a case by case basis.

17. Continued Operation of Ice and Trash Sluiceways

The parties shall request operation of the ice and trash sluiceways at IHR and TDA as in recent years during the implementation of this agreement. Juvenile fish protection provided through spill shall be in addition to not in lieu of protection provided through such sluiceway operation.

APPENDIX C

Spill Request Deadlines

<u>Day and Hours That Spill Request is Implemented</u>	<u>Deadline for Providing Spill Request</u>	<u>Applicable Hydroelectric Projects</u>
Friday (after 1800 hrs)	Thursday by 1500 hrs	Both
Saturday (all hours)	Thursday by 1500 hrs	Both
Sunday (all hours)	Thursday by 1500 hrs	Both
Monday - Tuesday (0000 hrs) (1800 hrs)	Thursday by 1500 hrs	Both
Tuesday - Wednesday (1800 hrs) (1800 hrs)	Monday by 1500 hrs	Both
Wednesday - Thursday (1800 hrs) (1800 hrs)	Tuesday by 1500 hrs	Both
Thursday - Friday (1800 hrs) (1800 hrs)	Wednesday by 1500 hrs	Both
Tuesday (0600 - 1800 hrs)	Monday by 0900 hrs	TDA
Holidays	Thursday by 1500 hrs	Both