Section 9

Lower Granite Dam

Lower Granite Dam

1. Fish Passage Information. The locations of fish passage facilities at Lower Granite Lock and Dam are shown in Figure LWG-1. Dates of project operations for fish purposes and special operations are listed in Table LWG-1.

1.1. Juvenile Fish Passage.

1.1.1. Facilities Description. The Lower Granite juvenile facilities consist of a bypass system and juvenile transportation facilities. The bypass system contains extended length submersible bar screens with flow vanes, improved modified balanced flow vertical barrier screens, gatewell orifices, a bypass channel running the length of the powerhouse, and a bypass pipe to transport the fish to the transportation facilities or to the river. The transportation facilities include an upwell and separator structure to separate the juveniles from the excess water and adult fish, raceways for holding fish, a distribution system for distributing the fish among the raceways or to the barge or back to the river, a sampling and marking building, truck and barge loading facilities, and PIT tag detection and deflection systems.

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

1.2. Adult Fish Passage.

1.2.1. Facilities Description. The adult fish passage facilities at Lower Granite are made up of one fish ladder on the south shore, two south shore entrances, a powerhouse collection system, north shore entrances with a transportation channel underneath the spillway to the powerhouse collection system, and an auxiliary water supply system. The powerhouse collection system is comprised of four operating floating orifices, two downstream entrances and one side entrance into the spillway basin on the north end of the powerhouse, and a common transportation channel. Four of the floating orifices and the two downstream entrances at the north end of the collection system are operated. The north shore entrances are made up of two downstream entrances and a side entrance into the spillway basin with the two downstream entrances normally used. The

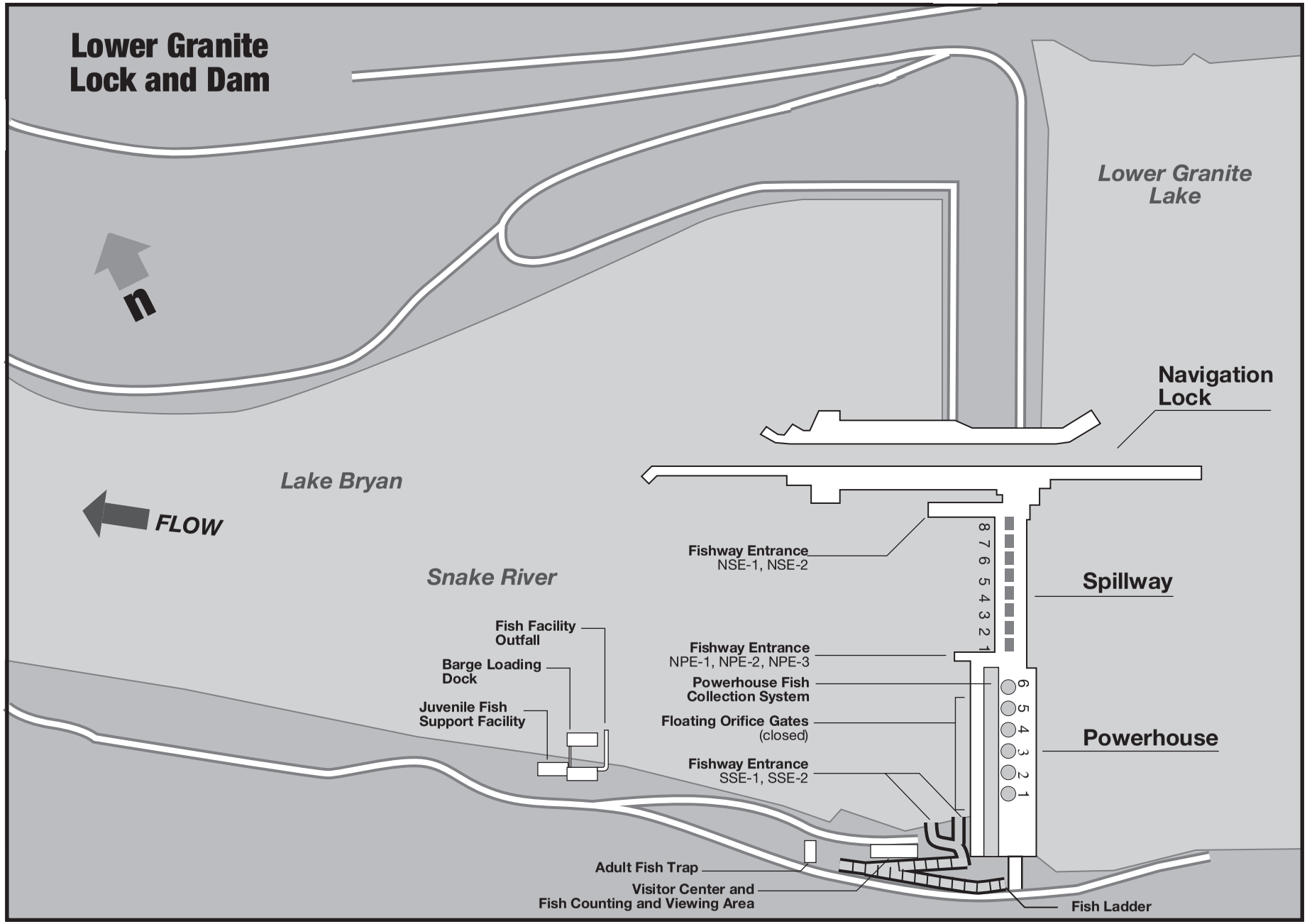

Figure LWG-1 Lower Granite Lock and Dam general site plan.

Table LWG-1. Dates of project operations for fish purposes at Lower Granite Dam, 2005

Task Name	Start	Finish	FPP Reference
Adult Fish Counting	**3/1/05**	**12/15/05**	**Lwg 1.2.2**
Video 0600 - 1600 PST	3/1/05	3/31/05	Lwg 1.2.2
Visual 0400 - 1600 PST	4/1/05	10/31/05	Lwg 1.2.2
Video 2000 - 0400 PST	6/15/05	8/31/05	Lwg 1.2.2
Video 0600 - 1600 PST	11/1/05	12/15/05	Lwg 1.2.2
TDG Monitoring	3/1/05	2/28/06	App D Phase 2
Winter Maintenance Period Juvenile	3/1/05	3/24/05	Lwg 2.3.1.1.
Adult Fish Passage Period	3/1/05	12/31/05	Lwg 2.3.2.2
Weekly Reports	3/1/05	12/31/05	Lwg 2.3.3
Operate Turbines for Fish Passage	3/1/05	12/15/05	Lwg 4.1
Unit 1 Repair	3/1/05	7/31/05	App A Lwg 1.3
Relocation of BGS	3/1/05	3/31/05	App A Lwg 1.6
1% limitations	**3/1/05**	**2/28/06**	**Lwg 4.1**
1% Soft	3/1/05	3/31/05	Lwg 4.1
1% Hard	4/1/05	10/31/05	Lwg 4.1
1% Soft	11/1/05	2/28/06	Lwg 4.1
Final Report	3/15/05	3/16/05	Lwg 2.3.3
ESBS Installed in 4 units	3/24/05	3/25/05	Lwg 2.3.1.1.b.6
Transport vs. In-River Study	3/25/05	10/31/05	App A Lwg 2.5
Juvenile Fish Transportation	3/25/05	10/31/05	App B 3
Operate juvenile facilities	**3/25/05**	**12/15/05**	**Lwg 2.3.1**
Operate for Juvenile Fish Passage	3/25/05	10/31/05	Lwg 2.3.1
Operate for Adult Fallback	11/1/05	12/15/05	Lwg 2.3.1
Juvenile Passage Period	3/25/05	12/15/05	Lwg 2.3.1.2
Transport vs. In-River Study	3/25/05	10/31/05	App A Lwg 2.5
Backflush orifices once per shift	4/1/05	8/15/05	Lwg 2.3.1.2.c.6
Adult Fishway Evaluation	4/1/05	10/31/05	App A Lwg 2.3
Measure Head Differentials Weekly	4/1/05	6/30/05	Lwg 2.3.1.2 b 8
Adult Migration Study	4/1/05	10/31/05	App A Lwg 2.1
Spill for fish	4/3/05	6/20/05	Lwg 2.1
Prototype Separator Eval	4/3/05	6/20/05	App A Lwg 2.3
Removable Spillway Weir Operation	**4/15/05**	**7/30/05**	**App A Lwg 2.2**
Removable Spillway Weir Operation	4/15/05	6/10/05	App A Lwg 2.2
Removable Spillway Weir Operation	6/15/05	7/30/05	App A Lwg 2.2
1/2 ESBS may be pulled	10/1/05	10/2/05	Lwg 2.3.1.2. b.6
Winter Maintenance Period Juvenile	12/16/05	2/28/06	Lwg 2.3.1.1.
Maintenance of Adult Facilities	1/1/06	2/28/06	Lwg 1.2.2
Draft Final Report	2/10/06	2/10/06	Lwg 2.3.3

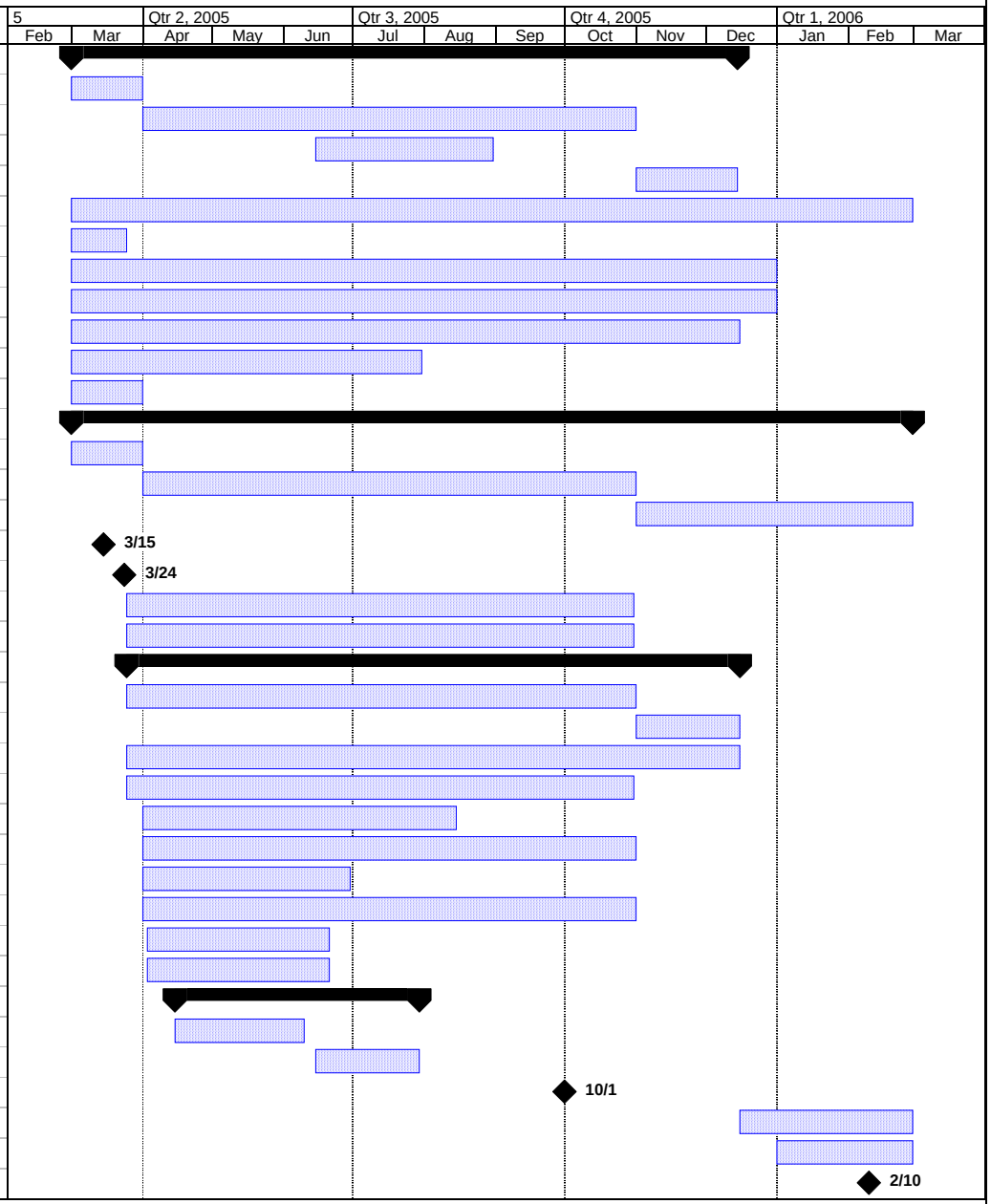

Table LWG-2. Juvenile migration timing at Lower Granite Dam based on juvenile fish collection numbers.

% Collection	2000	2001	2002	2003	2004
Yearling Hatchery Chinook					
10%	4/22	4/27	4/18	4/23	4/25
90%	5/13	5/17	5/19	5/18	5/10
Yearling Wild Chinook					
10%	4/11	4/24	4/16	4/14	4/18
90%	4/18	5/25	5/24	5/26	5/22
Subyearling Chinook					
10%	6/18	6/11	6/23	6/4	6/8
90%	8/26	8/10	8/9	7/16	7/14
Hatchery Steelhead					
10%	4/23	4/29	4/21	4/25	4/27
90%	5/24	5/27	5/29	5/28	5/24
Wild Steelhead					
10%	4/13	4/29	4/17	4/19	4/29
90%	5/24	5/27	6/1	5/30	5/24

auxiliary water is supplied by three electric pumps that pump water from the tailrace. Two pumps are normally used to provide the required flows. Four weirs in the upper end of the ladder were outfitted with PIT tag detectors in early 2003.

1.2.2. Adult Migration Timing. Upstream migrants are present at Lower Granite Dam all year. Maintenance of adult fish facilities is scheduled for January and February to minimize impacts on upstream migrants. Table LWG-3 lists primary passage periods by species and the earliest and latest dates of peak passage based on fish count data compiled by the Corps of Engineers. Adult fish (salmon, steelhead, bull trout, and lamprey) are normally counted from March 1 through December 15. Fish are counted in March for 10 hours per day (0600 to 1600 hours Pacific Standard Time), from April 1 through October 31 for 16 hours per day (0400 to 2000 hours PST), and from November 1 through December 15 for 10 hours per day (0600 to 1600 hours PST). Nighttime fish counts (2000 to 0400 hours PST) also occur from June 15 through August 31.

2. Project Operation.

2.1. Spill Management. Involuntary spill at Lower Granite is the result of river flow exceeding powerhouse capacity, insufficient generation loads to pass the river flow, turbine unit outages (forced or scheduled), or the failure of a key component of the juvenile fish passage facility which forces the

Table LWG-3. Adult migration timing at Lower Granite Dam from 1975-2002 based on fish counts.

Species	Counting Period	Date of Peak Passage	
		Earliest	Latest
Spring Chinook	3/1 - 6/17	4/26	5/27
Summer Chinook	6/18 - 8/17	6/18	7/17
Fall Chinook	8/18 - 12/15	9/5	10/6
Steelhead	3/1 - 12/15	9/3	10/16
Sockeye	3/1 - 12/15	7/1	7/19

project to spill to provide juvenile fish passage. Spill at Lower Granite shall be distributed in accordance with the spill patterns included at the end of this section, Tables LWG-9 and LWG-10. Special spills for juvenile fish passage may be provided as detailed in Appendix A (Special Project Operations and Research). Spills for juvenile fish passage normally take place during the spring, from approximately April 3 through June 20.

2.2. Dissolved Gas Management and Control. Total dissolved gas (TDG) levels at Lower Granite are monitored in accordance with the Dissolved Gas Monitoring Program, Appendix D. The TDG levels will be monitored at the Lower Granite forebay and tailrace automated stations year-round. Data will be collected every half-hour and transmitted via computer every hour. Data on spill volume and total project flow will be reported at the same time. Implementation of spill management requests will be based in part upon TDG monitoring data and the observed condition of migrant juveniles and adults, along with juvenile migration monitoring data. Requests for spill will be coordinated through the Technical Management Team (TMT).

2.3. Operating Criteria.

2.3.1. Juvenile Fish Passage Facilities. Operate from March 25 through October 31 for juvenile fish bypass, collection, and transportation and from November 1 through December 15 for bypassing adult fallbacks. Operate the juvenile facilities according to the criteria listed below and in Appendix B (Corps' Juvenile Fish Transportation Program Operating Criteria) for the bypassing, collection, and transportation of juvenile salmonids. The transportation program may be revised in accordance with the ESA Section 10 permit and the NOAA Fisheries biological opinion.

2.3.1.1. Winter Maintenance Period (December 16 through March 24). Check and perform maintenance as required on the items listed below.

a. Forebay Area and Intakes.

1. Remove debris from forebay and gatewell slots.

2. Rake trashracks just prior to the operating season.

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

b. Extended-Length Submersible Bar Screens, Flow Vanes, and Vertical Barrier Screens.

1. Maintenance completed on all screens.

2. Inspect ESBSs prior to installation and operate debris cleaner (dogged off on deck) to ensure proper operation.

3. Log results of trial run.

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

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

6. ESBSs installed in at least 4 turbine units by March 24 (all 6 turbine units if possible). Remaining ESBSs installed prior to April 1.

c. Collection Channel.

1. Makeup water valves and float control equipment maintained and ready for operation.

2. Orifice lights are operational.

3. Orifices clean and valves operating correctly.

4. Orifice cycling and air backflush system works correctly.

d. Transportation Facilities.

1. 42" and 72" sluice gates maintained and operating correctly.

2. Inclined screen clean and in good condition with no holes in or damage to screen mesh, gaps around screen, or missing silicone.

3. Perforated plate smooth with no rough edges.

4. Wet separator and fish distribution system maintained and ready for operation as designed.

5. Brushes and screens on crowders in good condition with no holes in screens or rough edges.

6. Crowders maintained, tested, and operating correctly.

7. All valves, slide gates, and switch gates maintained and in good operating condition.

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

9. Barge and truck loading pipes should be free of debris, cracks, or blockages and barge loading boom maintained and tested.

10. All sampling equipment should be maintained and in good operating condition prior to watering up the facilities.

e. Barges.

1. All engines and pumps maintained and in good operating condition.

2. Fish release openings and related equipment in good operating condition.

3. No rough edges or support beams protruding into compartments.

4. No brass or galvanized fittings in circulation lines.

5. All loading hoses properly installed so fish will not hit sides of compartments or support beams when loading.

6. Loading hoses in good shape with rubber gaskets in cam lock fittings.

7. Inside edges of cam lock joints should be beveled to avoid sharp edges.

8. Warning systems tested and operational.

9. Provide net and/or deck covers.

10. Net pens maintained and installed in barge holds for transport of steelhead kelts as required.

f. Avian Predation Areas (Forebay and Tailrace). Inspect bird wires, water cannon, and other deterrent devices and repair or replace as needed. Where possible, add additional bird wires or other deterrent devices to cover areas of known avian predation activity.

g. Maintenance Records. Record all maintenance and inspections.

2.3.1.2. Fish Passage Period (March 25 through December 15).

a. Forebay Area and Intakes.

1. Remove debris from forebay.

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

3. If a visible accumulation of contaminating substances (such as oil) is detected in a gatewell and it cannot be removed within 24 hours, the gatewell orifices shall be closed immediately and the turbine unit shut down within one hour until the material has been removed and any problems corrected. A preferred method for removing oil from the water surface is to install absorbent (not adsorbent) socks, booms, or pads capable of encapsulating the material, tied off with a rope for later disposal. Action should be taken as soon as possible to remove

the oil from the gatewell so the orifice can be reopened to allow the fish to exit the gatewell. Orifices shall not be closed for longer than 48 hours.

4. Log drawdown differentials in bulkhead slots at least once per week.

5. Remove debris from forebay and trashracks as required to maintain less than 1' of additional drawdown in gate slots. Additional raking may be required when heavy debris loads are present in the river or if fish condition requires it.

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

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

b. Extended-Length Submersible Bar Screens, Vertical Barrier Screens, and Operating Gates.

1. ESBSs and flow vanes installed in all operating turbine units by March 24.

2. Operate ESBSs with flow vanes attached to screen.

3. Operate ESBSs with debris cleaners in automatic mode. Set cleaning frequency as required to maintain clean screens and good fish condition. Change cleaning frequency as needed.

4. Inspect each ESBS once per month by means of underwater video in April, May, and June. Conduct similar inspections in August and October, focusing on at least three turbine units as the judgment of project personnel dictates. Spot check VBSs at the same time.

5. If an ESBS is damaged or fails during the juvenile fish passage season, follow procedures detailed under unscheduled maintenance of ESBSs (see section 3.1.2.1). In no case should a turbine unit be operated with a missing or a known non-operating or damaged ESBS, except as noted.

6. One-half of the ESBSs may be pulled after October 1 for maintenance as long as unscreened turbine units are not operated.

7. Make formal determination at end of season as to adequacy of ESBS bar screen panels and debris cleaner brush and

replace components as necessary.

8. Measure head differentials across VBSs at least once per week from April 1 through June 30 (more frequently if required) and biweekly for the remainder of the operating season. Clean VBS when head differentials reach 1.5'. When a head differential of 1.5' is reached, the respective turbine unit should be operated at a reduced loading, not more than 110 MW, to minimize loading on the VBS and potential fish impingement. Clean VBSs as soon as possible after a 1.5' head differential is reached.

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

10. Turbine units are to be operated with *raised* operating gates to improve fish guidance efficiency when ESBSs are installed (March 25 through December 15), except as provided for in Section 4.3., Turbine Unit Maintenance.

c. Collection Channel.

1. Orifices clean and operating. Operate at least one orifice per gatewell slot (preferably the north orifice). If the project is operating at MOP, additional orifices may be operated to maintain a full collection channel. *If orifices must be closed to repair any part of the facility, do not close orifices in operating turbine units with ESBSs in place for longer than 5 hours. If possible, keep to less than 3 hours.* Monitor fish conditions in gatewells hourly or more frequently during orifice closure periods.

2. Orifice lights operational and operating on open orifices. Orifice lights and area lights may be turned off the evening before the channel is dewatered at the end of the season (dewatering occurs on December 16 or later) to encourage fish to exit the channel volitionally. Area lights can be turned on briefly for personnel access if necessary.

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

4. Rotate orifices in fish screens slots (6 open).

5. Orifice valves are either fully open or closed.

6. Backflush orifices in the bulkhead slots every four hours and more frequently if required. During periods of high fish and debris passage, April 1 through August 15, orifices should be inspected and backflushed more frequently as determined by the project biologist, to keep orifices clean. If debris is causing continual orifice plugging problems in a particular turbine unit gatewell, the respective turbine unit generation may be restricted to the lower end of the 1% turbine efficiency range to minimize orifice plugging problems.

7. If utilizing the automatic orifice backflush system, inspect as determined by the project biologist (but at least once per 8-hour shift unless coordinated differently) to ensure that the orifices are opening and closing correctly and are clear of debris. The project biologist will determine the frequency of automatic orifice cycling and backflushing to maintain clear orifices.

8. Makeup water valves and associated float controls operational and maintaining stable channel flow.

d. Transportation Facilities.

1. 42" and 72" sluice gates operational.

2. Maintain stable water conditions in upwell and separator. No holes, broken wires, or gaps in inclined screen. Operate separator and fish distribution system as designed.

3. Crowder screen brushes should be maintained in good operating condition, with no holes or sharp edges on crowder screens. Crowders in good operating condition.

4. All valves, slide gates, and switch gates in and around separator and raceways operational.

5. Inspect raceway and tank retainer screens to make sure they are clean with no holes or protruding wire.

6. Barge and truck loading pipes and related equipment free of debris, cracks, or blockages and in good condition. Barge loading boom in good operating condition

e. Avian Predation Areas (Forebay and Tailrace).

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

wires or devices should be replaced as soon as possible.

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

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

f. Removable Spillway Weir (RSW).

1. When the RSW is in operation, the spillgate shall be raised to where it does not touch flow passing down the RSW (about 9 stops).

2. When the NWS forecasts Lower Granite inflows to exceed 200,000 cfs, initiate aggressive forebay debris removal so that RSW operation will not be impeded and coordinate with RCC.

3. Initiate partial RSW stow (rotate down to 30-degree position) when Lower Granite inflows exceed 200,000 and when NWS forecasts inflows to exceed 240,000 cfs.

4. Complete RSW stow (complete rotation to the landing pad) when inflows exceed 260,000 cfs, upstream river gage flows are increasing, and the NWS forecasts Lower Granite inflow to exceed 300,000 cfs.

5. Operation of the RSW for short periods of time may be requested by the project biologist during low flow years if it appears the juvenile fish transportation facility and barge holding capacities will be exceeded (refer to Appendix B, Juvenile Fish Transportation Plan).

g. Inspection and Record Keeping.

1. Inspect fish facilities at least once every 8 hours. Inspect facilities according to fish facilities monitoring program.

2. Record all maintenance and inspections.

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

2.3.2.1. Winter Maintenance Period (January 1 through February 28).

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

b. Dewater the ladder and inspect all dewatered sections of fish facilities for projections, debris, or plugged orifices which could injure fish or impede fish passage up the ladder. The fish ladder exit trashrack must have smooth surfaces where fish pass, and must have downstream edges that are adequately rounded or padded. A spare trashrack should be on hand for use as necessary. Inspect all diffuser gratings and chambers, and the fallout fence, annually by dewatering or by using divers or video inspection techniques. All diffuser gratings and chambers are to be dewatered and physically inspected at least every 3 years. Repair deficiencies.

c. Inspect for and clean debris from the fish ladder exit. The trashrack and picketed leads must be clean and installed correctly.

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

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

f. Fish pumps maintained and ready for operation.

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

h. Maintain the adult fish trap as required.

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

Note: Little Goose pool may be operated at minimum operating pool (MOP), between elevations 633' and 634' msl, as part of the Corps' efforts to improve migration conditions for juvenile salmonids. This may result in some of the adult fishway entrances at 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 supplied by the pumps.

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

b. Counting Window. The counting window should be operated as far out as possible while maintaining adequate counting conditions. When possible, the minimum counting slot width should be 18". All equipment should be maintained and in good condition.

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

d. North Shore Entrances (NSE 1 & 2). Elevation of top of gates when on sill = 625'.

1. Operate both downstream gates.

2. Weir depth: 7' or greater below tailwater.

e. North Powerhouse Entrances (NPE 1 & 2). Elevation of top of gates when on sill = 628'.

1. Operate both downstream gates.

2. Weir depth: 8' or greater below tailwater. At tailwaters below elevation 636', weirs should be on sill.

f. Floating Orifice Gates. Operate 4 floating orifices (numbers 1, 4, 7, and 10). Inspect fish fallout fence for debris buildup.

g. South Shore Entrances (SSE 1 & 2). Elevation of top of gates when on sill = 625'.

1. Operate both gates.

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

h. Channel Velocity. 1.5' to 4' per second.

i. Tunnel Lights. Lights in the tunnel section under the spillway shall be on during fish passage period.

j. Head on Trashracks.

1. Maximum head of 0.5' on ladder exit.

2. Maximum head on picketed leads shall be 0.3'.

3. Trashrack and picketed leads installed correctly.

k. Staff Gages and Water Level Indicators. All staff gages should be readable at all water levels encountered during the fish passage period. Repair or clean as necessary.

l. Facility Inspections.

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

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

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

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

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

6. Record all inspections.

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

year. The annual report shall also include a description of all actions taken to discourage avian predation at the project, with an overview of the effectiveness of the activities in discouraging avian predation. Project biologists also inspect project facilities once per month and during dewaterings for the presence of zebra mussels. Biologists shall provide a report to CENWW-OD-M on a monthly basis summarizing zebra mussel inspections.

3. Project Maintenance.

Project biologists should be present to provide technical guidance at all project activities that may involve fish handling. All dewaterings shall be accomplished in accordance with approved project dewatering and fish handling plans. **When river temperatures reach 70 degrees Fahrenheit or greater, all adult fish handling will be coordinated through CENWW-OD-M.** Dewatering and fish handling plans were reviewed and revised in 2000 to ensure that they comply with Appendix F, Guidelines for Dewatering and Fish Handling Plans.

3.1. Juvenile Fish Passage Facilities.

3.1.1. Scheduled Maintenance. Scheduled maintenance of the juvenile facilities is conducted during the entire year. Long-term maintenance or modifications of facilities that require them to be out of service for extended periods of time are conducted during the winter maintenance period from December 16 through March 24. During the fish passage season parts of the facilities are maintained on a daily, weekly, or longer interval to keep them in proper operating condition.

3.1.2. Unscheduled Maintenance. Unscheduled maintenance is the correction of any situation that prevents the facilities from operating according to criteria or that will impact fish passage or survival. Maintenance of facilities such as ESBSs, which sometimes break down during the fish passage season, will be carried out as described below. In these cases, repairs will be made as prescribed and CENWW-OD-M notified for further coordination. Unscheduled maintenance that will have a significant impact on juvenile fish passage shall be coordinated with NOAA Fisheries and other FPOM participants on a case-by-case basis by CENWW-OD-M. CENWW-OD-M will be notified as soon as possible after it becomes apparent that maintenance repairs are required. The Operations Manager has the authority to initiate work prior to notifying CENWW-OD-M when in his opinion delay of the work will result in an unsafe situation for people, property, or fish. Information required by CENWW-OD-M includes:

a. Description of the problem.

b. Type of outage required.

c. Impact on facility operation.

d. Length of time for repairs.

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

3.1.2.1. Extended-length Submersible Bar Screens. The ESBSs are inspected periodically throughout the juvenile migration season with a video monitoring system. If a screen is found to be damaged or malfunctions at any time it will be removed and either replaced with a spare ESBS or repaired and returned to service. A turbine unit shall not be operated during the juvenile bypass season with a missing, known damaged, or non-operating ESBS (except as detailed below). If an ESBS fails on a weekend or at night when maintenance crews are not available, the respective turbine unit will be shut down and generation switched to another fully screened unit. If all screened turbine units are in service, water may be spilled until the effected ESBS can be removed and repaired or replaced.

During the spring runoff when river flows are at the level where taking a unit out of service and spilling will exceed the TDG limits allowed by state standards, project personnel may operate a turbine unit at 110 MWs or less with a failed screen cleaner if there is evidence that the ESBS will not plug with debris. Evidence of this is a lack of debris in the gatewell and along the face of the powerhouse. This will only happen if an ESBS screen cleaner fails after 1400 hours on a regular workday or any time on a weekend. Project personnel will pull and replace the screen the next morning, weekday or weekend inclusive. If the screen cannot be pulled and repaired first thing the next morning, the turbine unit will be removed from service until the screen can be repaired. If there is evidence that fish are being injured under this operation, by either observing injured fish in the gatewells or injured fish appearing on the separator, the turbine unit will be removed from service immediately. This operation will not take place when daily average river flows are less than total powerhouse capacity and the turbine unit will not be operated during power peaking operations where turbine units are being turned on and off.

3.1.2.2. Gatewell Orifices. Each turbine intake has 4 orifices, two 10" orifices with air operated valves in the bulkhead slot and two 8" orifices with manually operated slide gates in the

fish screen slot, for allowing the fish to exit the slots. Under normal operation, a total of 24 orifices are operated with 18 being bulkhead slot orifices and 6 being fish screen slot orifices. At least 1 orifice is open in each bulkhead slot with the fish screen slot orifices rotated. If high flow conditions in the collection gallery prevent the operation of all 24 previously mentioned orifices, priority shall be given to operating the 18 bulkhead slot orifices. With the exception of the condition where a turbine unit is out of service for an indefinite period of time (with fish screens non-operational and no fish being diverted into bulkhead slots), the 6 fish screen slot orifices shall be closed (as needed) prior to closing any bulkhead slot orifices. If an orifice becomes blocked with debris it will normally be cleaned and remain in operation. If an orifice is damaged, it will be closed and the alternate orifice for that gatewell operated until repairs can be made. If both orifices are blocked with debris, damaged, or must be kept closed, the turbine unit will be taken out of service until repairs can be made. If repairs are to take longer than 48 hours, juvenile fish will be dipped from the gatewell with a gatewell dip basket.

3.1.2.3. Bypass Pipe. The bypass pipe goes from the end of the powerhouse bypass channel to the transportation facilities downstream of the dam. All juvenile fish in the bypass system must pass through this to the transportation facilities or to the tailrace. If any part of the bypass pipe is damaged, the gatewell orifices will be closed and the bypass system dewatered until repairs can be made. *Turbine units will not be operated for longer than 5 hours with ESBSs in place and orifices closed. If possible, keep to less than 3 hours.* If an outage takes longer than 5 hours, spill will be provided to bypass juvenile fish. During any orifice closure, gatewells shall be monitored by project personnel for signs of fish problems or mortality. During periods of high fish passage, orifice closure times may be less than 5 hours depending on fish numbers and condition.

3.1.2.4. Transportation Facilities. The transportation facilities can be operated to either collect and hold juveniles for the transportation program, or to bypass them back to the river. If part of the facility malfunctions or is damaged, efforts will first be made to bypass the fish around the damaged area. If this is not possible, the fish will be bypassed around the transportation facilities or the entire bypass system dewatered until repairs are made. Spill may be used as an alternative avenue for fish passage during a bypass system outage.

3.2. Adult Fish Passage Facilities.

3.2.1. Scheduled Maintenance. Scheduled maintenance of a facility that must be dewatered to work on or whose maintenance will have a significant effect on fish passage will be done during the January and February winter maintenance period. Maintenance of facilities that will have no effect on fish passage may be conducted at any time. When facilities are not being maintained during the winter maintenance period, they will be operated according to normal criteria unless otherwise coordinated with NOAA Fisheries and other FPOM participants.

3.2.2. Unscheduled Maintenance. Unscheduled maintenance that will significantly affect the operation of a facility will be coordinated with NOAA Fisheries and other FPOM participants. Coordination procedures for unscheduled maintenance of adult facilities are the same as for juvenile facilities (see section 3.1.2.). If part of a facility malfunctions or is damaged during the fish passage season and the facility can still be operated within criteria without any detrimental effects on fish passage, repairs may not be conducted until the winter maintenance period or until fewer numbers of fish are passing the project. If part of a facility is damaged or malfunctions that may significantly impact fish passage, it will be repaired as soon as possible.

3.2.2.1. Fish Ladder and Counting Station. The fish ladder contains fixed weirs, a counting station with picket leads, an adult fish trap, and a fish exit with trashrack. If any part of the ladder fails or is blocked with debris during the fish passage season, efforts will first be made to correct the problem without dewatering the ladder. Trashracks, picket leads, and counting stations can sometimes be repaired or maintained without dewatering the ladder. If the fish trap malfunctions or is damaged, fish may be passed around it until repairs are made. The decision to dewater the ladder and make repairs during the fish passage season or wait until the winter maintenance period will be made after coordination with the fish agencies and tribes.

3.2.2.2. Auxiliary Water Supply System. Three electric pumps supply the auxiliary water for the fish ladder and the powerhouse collection system. During normal operations and most flow conditions, two pumps are capable of providing the required flows. If a pump fails during the two-pump operation, the pump on standby will be operated to make up the flows. If two pumps fail, NSE 2 and NPE 2 will be closed and NPE 1 raised in 1' increments to provide the required 1' to 2' head differential. If the head cannot be maintained by the time the top of the weir reaches 5', the floating orifices should be closed in the

following order: OG-4, OG-7, OG-10, and OG-1. If the head in the system still cannot be maintained at this point, SSE 1 and SSE 2 should be raised in 1' increments until 5' below tailwater is reached. If all three pumps fail, NSE 1 and NPE 1 should be closed, the powerhouse collection channel bulkheaded off at the junction pool, and SSE 1 and SSE 2 operated at 6' below tailwater regardless of the head.

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

3.2.2.5. Diffuser Gratings. Diffuser chambers for adding auxiliary water to fish ladders and collection channels are covered by gratings attached by several different methods. Diffuser gratings are normally checked during the winter maintenance period to make sure they are in place. These inspections are done by either dewatering and physically inspecting the diffuser gratings, or by using underwater video cameras, divers, or other methods. Diffuser gratings may come loose during the fish passage season due to a variety of reasons. Daily inspections of fish ladders and collection systems should include looking for any flow changes that may indicate problems with diffuser gratings. If a diffuser grating is known or suspected to have moved, creating an opening into a diffuser chamber, efforts must immediately be taken to correct the situation and minimize impacts on adult fish in the fishway. Coordination of the problems should begin immediately through the established unscheduled maintenance coordination procedure (see section 3.1.2). If possible, a video inspection should be made as soon as possible to determine the extent of the problem. If diffuser gratings are found to be missing or displaced, creating openings into the diffuser chambers, a method of repair shall be developed and coordinated with the fish agencies and tribes through the established coordination procedure. Repairs shall be made as quickly as possible unless coordinated differently.

4. Turbine Unit Operation and Maintenance.

4.1. Turbine Unit Operation. When in operation, turbine units will be operated to enhance adult and juvenile fish passage from March 1 through December 15. During this time period turbine units will be operated as needed to meet generation requirements in the priority order shown in Table LWG-4. Unit operating priority may be coordinated differently to allow for fish research, construction, or project maintenance activities. To minimize mortality to juvenile fish passing through the turbine units from April 1 through October 31 (or as long as there is sufficient river flow and/or generation requests to operate turbine units 4, 5, or 6 within 1% of best turbine efficiency), operating priority during nighttime hours from 2000 to 0400 hours shall be units 4, 5, and 6 (in any order) and then units 1, 2, and 3 as needed (Table LWG-4). If a turbine unit is taken out of service for maintenance or repair, the next unit in the priority list shall be operated.

Table LWG-4. Turbine unit operating priority for Lower Granite Dam.

Season	Time of Day	Unit Priority
March 1 – December 15	24 hours	1, 2, 3, then 4-6 (any order)
April 1 – October 31 (If there is enough flow to run priority units)	Nighttime (2000 to 0400 hours)	4-6 (in any order, then 1-3 (as needed)
December 16 – February 28	24 hours	Any Order

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

Guidelines for operation of the turbine units within the 1% efficiency range at various heads are shown in Tables LWG-5

through LWG-8. The 1% efficiency ranges were calculated using results from 1994 index testing of turbine unit 3 at Little Goose Dam. Maximum generation of units 1 through 6 at 115% overload is 155 MW.

Table LWG-5. The 1% turbine operating range at Lower Granite Dam for units 1-3 with extended-length submersible bar screens installed.

Head (ft)	Lower Generator Limits		Upper Generator Limits	
	(MW)	(CFS)	(MW)	(CFS)
85	**70**	**11,396**	**112**	**18,269**
86	70	11,381	114	18,402
87	71	11,366	116	18,531
88	72	11,351	118	18,657
89	73	11,336	120	18,779
90	**73**	**11,322**	**123**	**18,898**
91	74	11,313	123	18,717
92	75	11,304	123	18,540
93	76	11,295	124	18,367
94	77	11,285	124	18,197
95	**78**	**11,276**	**124**	**18,031**
96	79	11,294	124	17,841
97	80	11,312	125	17,654
98	81	11,329	125	17,472
99	82	11,346	125	17,293
100	**83**	**11,361**	**125**	**17,117**
101	84	11,363	127	17,163
102	85	11,364	128	17,207
103	86	11,365	130	17,250
104	87	11,367	131	17,293
105	**87**	**11,367**	**133**	**17,334**

NOTE: The turbine efficiency tables are being revised to reflect new information using a 2003 unit 3 ESBS index test and the 1962 model test regarding extended-length submersible bar screens. These tables are based on data from Little Goose Dam (Table LWG-5 revised, 2005).

Table LWG-6. The 1% turbine operating range at Lower Granite Dam for units 1-3 without extended-length submersible bar screens installed.

Head (ft)	Lower Generator Limits		Upper Generator Limits	
	(MW)	(CFS)	(MW)	(CFS)
85	**71**	**11,320**	**125**	**20,006**
86	71	11,305	127	20,152
87	72	11,290	130	20,293
88	73	11,276	132	20,431
89	74	11,262	134	20,566
90	**74**	**11,247**	**137**	**20,696**
91	75	11,239	137	20,499
92	76	11,230	138	20,306
93	77	11,221	138	20,116
94	78	11,212	138	19,931
95	**79**	**11,203**	**139**	**19,750**
96	80	11,222	139	19,541
97	81	11,240	139	19,338
98	82	11,257	139	19,138
99	83	11,274	139	18,942
100	**84**	**11,290**	**140**	**18,751**
101	85	11,291	141	18,801
102	86	11,293	143	18,850
103	87	11,294	145	18,897
104	88	11,295	147	18,944
105	**89**	**11,296**	**149**	**18,989**

NOTE: The turbine efficiency tables are being revised to reflect new information using a 2003 unit 3 NS index test and a 1962 model test regarding extended-length submersible bar screens. These tables are based on data from Little Goose Dam (Table LWG-6 revised 2005).

Table LWG-7. The 1% turbine operating range at Lower Granite Dam for units 4-6 with extended-length submersible bar screens installed.

Head (ft)	Lower Generator Limits		Upper Generator Limits	
	(MW)	(CFS)	(MW)	(CFS)
85	**83.3**	**13,505**	**105.8**	**17,152**
86	84.3	13,488	107.3	17,167
87	85.2	13,470	108.7	17,182
88	86.2	13,453	110.2	17,195
89	87.2	13,435	111.7	17,208
90	**88.1**	**13,418**	**113.1**	**17,220**
91	89.3	13,437	114.8	17,274
92	90.4	13,455	116.5	17,328
93	91.6	13,473	118.1	17,379
94	92.7	13,490	119.8	17,430
95	**93.9**	**13,507**	**121.5**	**17,479**
96	94.9	13,504	122.9	17,490
97	95.9	13,501	124.3	17,500
98	96.9	13,498	125.7	17,510
99	97.9	13,495	127.1	17,520
100	**98.9**	**13,492**	**128.5**	**17,529**
101	100.1	13,510	129.2	17,431
102	101.3	13,527	129.8	17,335
103	102.5	13,544	130.5	17,240
104	103.7	13,560	131.1	17,147
105	**104.9**	**13,576**	**131.8**	**17,056**

NOTE: The turbine efficiency tables were revised to reflect new information using a 1995 index test and the 1975 model test and extended-length submersible bar screens. These tables are based on data from Lower Granite Dam.

Table LWG-8. The 1% turbine operating range at Lower Granite Dam for units 4-6 without extended-length submersible bar screens installed.

Head (ft)	Lower Generator Limits		Upper Generator Limits	
	(MW)	(CFS)	(MW)	(CFS)
85	**85.1**	**13,532**	**113.0**	**17,972**
86	86.1	13,515	114.6	17,988
87	87.1	13,497	115.6	17,914
88	88.1	13,480	116.6	17,842
89	89.1	13,463	117.6	17,771
90	**90.0**	**13,446**	**120.8**	**18,045**
91	91.2	13,465	122.6	18,102
92	92.4	13,483	124.4	18,158
93	93.6	13,501	126.2	18,212
94	94.7	13,519	128.0	18,265
95	**95.9**	**13,535**	**129.8**	**18,317**
96	96.9	13,533	131.3	18,329
97	98.0	13,530	132.8	18,340
98	99.0	13,527	134.3	18,350
99	100.0	13,524	135.8	18,360
100	**101.1**	**13,521**	**137.3**	**18,370**
101	102.3	13,539	138.0	18,268
102	103.5	13,557	138.7	18,167
103	104.7	13,574	139.4	18,068
104	105.9	13,590	140.1	17,971
105	**107.1**	**13,606**	**140.8**	**17,876**

NOTE: The turbine efficiency tables were revised to reflect new information using a 1995 index test and the 1975 model test. These tables are based on data from Lower Granite Dam.

4.2. Turbine Unit Outages During High River Flow Periods. During high spring flows, turbine unit outages for inspecting fish screens, repairing research equipment such as hydroacoustic or radio telemetry equipment, and other fish items may cause increased spill at a project in order to maintain reservoir levels within operating levels. This may result in TDG levels exceeding standards. It is important that this work be conducted when scheduled to ensure that facilities are working correctly and not injuring migrating fish, and that important fish research data is collected. To facilitate this work, reservoir storage may be utilized to minimize impacts from taking turbine units out of service and increasing spill. At Lower Granite, this special operation shall take place when river flows are above 120 kcfs or when increasing spill levels will result in TDG levels exceeding standards. The activities covered under these operations will be

coordinated with and approved by the TMT whenever possible.

For scheduled inspection or repair of research equipment, reservoirs shall be drafted to MOP and allowed to fill to 1' above the 1’ MOP operating range as the work is accomplished. After the work, reservoirs will be drafted back to the MOP operating range. When inspection or repair work can be scheduled ahead of time, the following process will be followed:

a. Project personnel shall schedule turbine unit outages through the approved turbine outage scheduling procedure by noon of the Tuesday of the week prior to the outage.

b. Project personnel shall also contact CENWW-OD-M and RCC by the same time period and inform them of the intended work.

c. The RCC will coordinate the work activities through the TMT.

d. After coordination with the TMT, RCC shall issue a teletype through the CBTT issuing instructions to project and BPA personnel for the scheduled work.

e. Spill will be increased by one spillbay stop setting (about 1.7 kcfs) above passing inflow to lower the level of Lower Granite pool to MOP prior to the scheduled work taking place.

f. When the work takes place, additional spill will not be provided and the reservoir will be allowed to refill until the reservoir is 1' above the normal MOP range (a 2' pondage from where the pool was when the work started). At this point, screen inspections shall stop. (At Snake River projects, this should allow about one normal workday for the scheduled work.)

g. At the conclusion of the work, the reservoir shall be drafted back down to the MOP range utilizing a one spillbay stop increase in spill above passing inflow.

h. If work, such as screen inspections, is not finished, project personnel shall schedule another turbine unit outage for a date where it can be implemented again.

If the work that needs to be done is of an emergency nature that does not normally require the turbine unit to be taken out of service (such as a failed hydroacoustic transducer versus a failed fish screen), and can not wait for the above process to be implemented, project personnel shall notify CENWW-OD-M and RCC to get approval to do the work. If approval to do the work is given, the turbine unit shall be taken out of service and the

reservoir level allowed to increase until it reaches 1' above the MOP operating range. At this point, the turbine unit must be returned to service and the reservoir will be drafted back to the MOP range using one spillbay stop setting above passing inflows.

4.3. Turbine Unit Maintenance. The project turbine unit maintenance schedule will be reviewed annually by project and Operations Division biologists for fish impacts. If possible, maintenance of priority units will be scheduled for non-fish passage periods, or when there are low numbers of fish passing the project. Each turbine unit requires annual maintenance that may take from several days to two weeks. Annual maintenance of all turbine units is normally scheduled during the mid-July to late November time frame. The maintenance of priority units for adult passage is normally conducted during mid-August, when fewer adults are migrating, to minimize impacts on migrating adults. Turbine units may occasionally require overhauls to repair major problems with the turbine or generator. Overhauls may take over one year to accomplish. Turbine units, governors, exciters, and control systems require periodic maintenance, calibration, and testing which may take them outside of the 1% turbine efficiency range. This work will be scheduled in compliance with BPA load shaping guidelines (Appendix C) to minimize impacts on juvenile fish. Transformers are Doble tested every 3 years. Testing may need to be more frequent if there is a known problem with a transformer. These tests normally take 2 to 3 workdays. To conduct the testing, the transmission lines have to be disconnected from the transformers and normal generation stopped. One turbine unit will operate in a speed-no-load condition to provide project power and operation of fish passage facilities. Spill may be provided to meet minimum required project discharges during the testing hours. The Doble tests are normally scheduled for the August or early September time period to minimize impacts on adult and juvenile fish passage.

Turbine units are to be operated with raised operating gates to improve fish passage conditions when ESBSs are installed, except as provided below. To facilitate annual maintenance, operating gates are used to dewater the turbine units. To minimize turbine outage periods to the actual time required for maintenance (during the July 1 through December 15 time period), operating gates in one turbine unit may be lowered to the standard operating position and connected to hydraulic cylinders on the afternoon of the last regular workday (normally Thursday) prior to the start of the maintenance. With the operating gates in the standard operating position, the turbine unit may be operated until 0700 hours of the next regular workday (normally Monday) with generation loads restricted to 100 MWs or less. On the completion of maintenance, the turbine unit can be operated with the operating gates in the standard operating position at

100 MWs or less until 0700 hours of the first regular workday after the maintenance is completed. The project biologist will be notified when the operating gates are set in the standard operating position. The gatewells will be monitored 2 times per day to observe fish condition while the operating gates are in the standard operating position. If turbine maintenance or the raising of the operating gates to the raised operating position is delayed after the time periods stated above, the turbine unit shall be immediately taken out of service until the work can be accomplished. Operation of turbine units with operating gates in the standard operating position shall be restricted to the July 1 through December 15 time period, and shall not occur unless at least 4 other turbine units are available for service. No more than 1 turbine unit at a time shall be operated with operating gates in the standard operating position and the turbine unit will be operated on last on, first off operating priority.

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

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

All special spills (other than normal spill patterns for ongoing spill operations) and project operations for passing debris will be coordinated prior to the operations taking place. Each project shall contact CENWW-OD-M at least two workdays prior

to the day they want the special project operations for spilling to pass debris. CENWW-OD-M shall coordinate the special operations with RCC, NOAA Fisheries, and other FPOM participants. Project personnel shall provide CENWW-OD-M the reason for the debris spill request including an explanation of project facilities being impacted by the debris, the date and time of the requested spill, and any special powerhouse or other operations required to move the debris to the spillway. When a debris spill is coordinated and approved, RCC shall issue a teletype detailing the specifics of the special operations.

Table LWG-9. Lower Granite spillway pattern for fish passage (with RSW operating at pool elevation 734).

Spill Bay								Total Stops	Total Spill
1	2	3	4	5	6	7	8		
3.5	0	1	0	1	1	1	1	8.5	15.2
3.5	0	1	1	1	1	1	1	9.5	16.9
3.5	1	1	1	1	1	1	1	10.5	18.6
3.5	1	1	2	1	1	1	1	11.5	20.4
3.5	1	1	2	1	1	1	2	12.5	22.2
3.5	1	1	2	2	1	1	2	13.5	24.0
3.5	1	1	2	2	2	1	2	14.5	25.8
3.5	1	2	2	2	2	1	2	15.5	27.7
3.5	2	2	2	2	2	1	2	16.5	29.5
3.5	2	2	2	2	2	2	2	17.5	31.3
3.5	2	2	3	2	2	2	2	18.5	36.6
3.5	2	2	3	3	2	2	2	19.5	35.0
3.5	2	2	3	3	3	2	2	20.5	36.9
3.5	2	3	3	3	3	2	2	21.5	38.7
3.5	3	3	3	3	3	2	2	22.5	40.6
3.5	3	3	4	3	3	2	2	23.5	42.4
3.5	3	3	4	4	3	2	2	24.5	44.3
3.5	3	3	4	4	4	2	2	25.5	46.2
3.5	3	4	4	4	4	2	2	26.5	48.0
3.5	4	4	4	4	4	2	2	27.5	49.9
3.5	4	4	4	4	4	2	3	28.5	51.7
3.5	4	4	4	4	4	3	3	29.5	53.6
3.5	4	4	5	4	4	3	3	30.5	55.5
3.5	4	4	5	5	4	3	3	31.5	57.3
3.5	4	4	5	5	5	3	3	32.5	59.2
3.5	4	5	5	5	5	3	3	33.5	61.0
3.5	5	5	5	5	5	3	3	34.5	62.9
3.5	5	5	5	5	5	3	4	35.5	64.8
3.5	5	5	5	5	5	4	4	36.5	66.6
3.5	5	5	6	5	5	4	4	37.5	68.5
3.5	5	5	6	6	5	4	4	38.5	70.3
3.5	5	5	6	6	6	4	4	39.5	72.2
3.5	5	6	6	6	6	4	4	40.5	74.1
3.5	6	6	6	6	6	4	4	41.5	75.9

Note: Minimum involuntary spill with RSW operating is 15.2 kcfs.
Note: At approximately 3.5 stops, the tainter gate no longer regulates flow through the RSW. The tainter gate should be raised at least 9 stops so the gate does not interfere with the spillbay flow.

NOTES ARE CONTINUED ON NEXT PAGE

Note: Spillbay discharge at pool elevation 734:

Stops	Discharge (kcfs)
(without RSW in place)	
1	1.7
2	3.5
3	5.4
4	7.2
5	9.1
6	11.0
7	12.8
8	14.7
(with RSW in place)	
RSW 3.5 stops or more	6.7

Table LWG-10. Lower Granite spillway pattern for fish passage (RSW NOT operating, pool elevation 734).

Spillbay Stops								Total Stops	Total Spill (kcfs)
1 (RSW)	2	3	4	5	6	7	8		
Closed	*1*	*1*			*1*	*1*	*2*	*6.0*	*10.3*
Closed	*1*	*1*			*1*	*2*	*2*	*7.0*	*12.1*
Closed	*2*	*1*			*1*	*2*	*2*	*8.0*	*13.9*
Closed	*2*	*2*			*1*	*2*	*2*	*9.0*	*15.7*
Closed	*2*	*2*	*1*		*1*	*2*	*2*	*10.0*	*17.4*
Closed	*2*	*2*	*1*	*1*	*1*	*2*	*2*	*11.0*	*19.1*
Closed	*2*	*2*	*2*	*1*	*1*	*2*	*2*	*12.0*	*20.9*
Closed	*2*	*2*	*2*	*1*	*2*	*2*	*2*	*13.0*	*22.7*
Closed	*2*	*2*	*2*	*2*	*2*	*2*	*2*	*14.0*	*24.5*
Closed	*2*	*2*	*2*	*2*	*2*	*2*	*3*	*15.0*	*26.4*
Closed	*2*	*2*	*2*	*2*	*2*	*3*	*3*	*16.0*	*28.3*
Closed	*3*	*2*	*2*	*2*	*2*	*3*	*3*	*17.0*	*30.2*
Closed	*3*	*3*	*2*	*2*	*2*	*3*	*3*	*18.0*	*32.1*
Closed	*3*	*3*	*3*	*2*	*2*	*3*	*3*	*19.0*	*34.0*
Closed	*3*	*3*	*3*	*2*	*3*	*3*	*3*	*20.0*	*35.9*
Closed	*3*	*3*	*3*	*3*	*3*	*3*	*3*	*21.0*	*37.8*
Closed	3	3	3	3	3	3	4	22.0	39.6
Closed	**3**	**3**	**3**	**3**	**3**	**4**	**4**	**23.0**	**41.4**
Closed	4	3	3	3	3	4	4	24.0	43.2
Closed	4	4	3	3	3	4	4	25.0	45.0
Closed	**4**	**4**	**4**	**3**	**3**	**4**	**4**	**26.0**	**46.8**
Closed	4	4	4	3	4	4	4	27.0	48.6
Closed	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**28.0**	**50.4**
Closed	4	4	4	4	4	4	5	29.0	52.3
Closed	**5**	**4**	**4**	**4**	**4**	**4**	**5**	**30.0**	**54.2**
Closed	5	4	4	4	4	5	5	31.0	56.1
Closed	5	5	4	4	4	5	5	32.0	58.0
Closed	**5**	**5**	**5**	**4**	**4**	**5**	**5**	**33.0**	**59.9**
Closed	*5*	*5*	*5*	*4*	*5*	*5*	*5*	*34.0*	*61.8*
Closed	*5*	*5*	*5*	*5*	*5*	*5*	*5*	*35.0*	*63.7*
Closed	*5*	*5*	*5*	*5*	*5*	*5*	*6*	*36.0*	*65.6*
Closed	*5*	*5*	*5*	*5*	*5*	*6*	*6*	*37.0*	*67.5*

Notes: Patterns in **bold** were evaluated with the Corps' Lower Granite 1:80 physical general model. These values match preliminary spill patterns for this test condition that were previously sent to RCC via e-mail message on 4/12/02. *Values shown in **italics** were added to this expanded table on 6/7/02.*