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-2**.

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 diversion systems.

1.1.2. Juvenile Migration Timing. Juvenile migration timing at Lower Granite Dam is indicated in **Table LWG-1**. The dates in the table are based on juvenile fish collection numbers and do not reflect FGE or spill passage. Salmon, steelhead, bull trout, lamprey, and other species are routinely counted. Maintenance of juvenile fish passage facilities that may impact juvenile fish passage or facility operations should be conducted during the winter maintenance season.

Table LWG-1. Juvenile Migration Timing at Lower Granite Dam, 2001 – 2010.[1]

Yearling Chinook				
	10 %	50%	90 %	# of Days
2001	26-Apr	5-May	18-May	27
2002	17-Apr	6-May	21-May	34
2003	21-Apr	6-May	20-May	29
2004	24-Apr	5-May	12-May	18
2005	24-Apr	5-May	10-May	16
2006	20-Apr	5-May	15-May	25
2007	19-Apr	4-May	14-May	25
2008	26-Apr	9-May	18-May	22
2009	22-Apr	7-May	20-May	28
2010	24-Apr	4-May	21-May	27
MEDIAN	22-Apr	5-May	16-May	25
MIN	17-Apr	4-May	10-May	16
MAX	26-Apr	9-May	21-May	34

Subyearling Chinook				
	10 %	50%	90 %	# of Days
2001	11-Jun	4-Jul	10-Aug	60
2002	23-Jun	15-Jul	9-Aug	47
2003	4-Jun	22-Jun	16-Jul	42
2004	8-Jun	21-Jun	14-Jul	36
2005	29-May	3-Jun	17-Jun	19
2006	26-May	5-Jun	3-Jul	38
2007	3-Jun	9-Jun	12-Jul	39
2008	31-May	20-Jun	28-Jul	58
2009	29-May	11-Jun	2-Jul	34
2010	2-Jun	9-Jun	14-Jul	42
MEDIAN	4-Jun	17-Jun	15-Jul	42
MIN	26-May	3-Jun	17-Jun	19
MAX	23-Jun	15-Jul	10-Aug	60

Unclipped Steelhead				
	10 %	50%	90 %	# of Days
2001	29-Apr	8-May	27-May	28
2002	17-Apr	19-May	1-Jun	45
2003	19-Apr	17-May	30-May	41
2004	29-Apr	9-May	24-May	25
2005	27-Apr	9-May	20-May	23
2006	19-Apr	5-May	21-May	32
2007	1-May	10-May	21-May	20
2008	20-Apr	11-May	27-May	37
2009	22-Apr	6-May	29-May	37
2010	26-Apr	19-May	5-Jun	40
MEDIAN	23-Apr	11-May	26-May	33
MIN	17-Apr	5-May	20-May	20
MAX	1-May	19-May	5-Jun	45

Clipped Steelhead				
	10 %	50%	90 %	# of Days
2001	29-Apr	11-May	27-May	28
2002	21-Apr	10-May	29-May	38
2003	25-Apr	14-May	28-May	33
2004	27-Apr	9-May	24-May	27
2005	26-Apr	8-May	16-May	20
2006	21-Apr	4-May	19-May	28
2007	28-Apr	7-May	20-May	22
2008	28-Apr	8-May	21-May	23
2009	21-Apr	1-May	21-May	30
2010	25-Apr	11-May	4-Jun	40
MEDIAN	25-Apr	8-May	24-May	29
MIN	21-Apr	1-May	16-May	20
MAX	29-Apr	14-May	4-Jun	40

Coho				
	10 %	50%	90 %	# of Days
2001	18-May	4-Jun	13-Jul	56
2002	18-May	23-May	8-Jun	21
2003	18-May	27-May	15-Jun	28
2004	8-May	21-May	28-May	20
2005	30-Apr	10-May	17-May	17
2006	2-May	18-May	1-Jun	30
2007	5-May	15-May	23-May	18
2008	6-May	10-May	22-May	16
2009	13-May	21-May	23-Jun	41
2010	6-Jun	21-May	5-Jul	29
MEDIAN	12-May	20-May	9-Jun	28
MIN	30-Apr	10-May	17-May	16
MAX	6-Jun	4-Jun	13-Jul	56

Sockeye (Wild & Hatchery)				
	10 %	50%	90 %	# of Days
2001	21-Apr	23-May	16-Jun	56
2002	25-Apr	19-May	31-May	36
2003	15-May	31-May	6-Jun	22
2004	12-May	22-May	19-Jun	38
2005	9-May	20-May	1-Jun	23
2006	11-Apr	12-May	28-May	47
2007	11-May	16-May	21-May	10
2008	17-May	20-May	8-Jun	22
2009	21-Apr	20-May	28-May	37
2010	19-May	30-May	5-Jun	17
MEDIAN	4-May	21-May	3-Jun	31
MIN	11-Apr	12-May	21-May	10
MAX	19-May	31-May	19-Jun	56

1. Dates are derived from daily and yearly facility collection numbers.

Figure LWG-1 Lower Granite Lock and Dam General Site Plan

Table LWG-2. Dates of fish project operations at Lower Granite Dam, 2010-11.

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 auxiliary water is supplied by three electric pumps that pump water from the tailrace. Two pumps are normally used to provide the required flows. In addition, auxiliary water is also provided through diffuser 14, from the forebay. 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 throughout the year and adult passage facilities are operated year round. Maintenance of adult fish facilities is scheduled for January and February to minimize impacts on upstream migrants. Adult fish (salmon, steelhead, shad, and lamprey) are counted as per **Table LWG-3;** these data appear daily on the Corps adult count website. Salmon migration timing data appear in **Table LWG-4**. Sturgeon and bull trout are also counted and recorded on the WDFW fish counters' daily summary sheet comments section; but do not appear on the Corps daily website total due to relative infrequency of passage. These data are posted in the Miscellaneous Fish Counts report during the passage season (updated periodically during the season) found on the Corps' web site, and summarized in the Annual Fish Passage Report.

Table LWG-3. Adult fish counting schedule at Lower Granite Dam.

Period	Counting Method
March 1 to March 31	Video 0600-1600 PST
April 1 to October 31	Visual count 0400 - 2000 PST
June 15 to August 31	Night video counts for sockeye 2000-0400 PST
July 1 to September 30	Night video counts for lamprey 2000 – 0400 PST
November 1 to December 30	Video count 0600-1600 PST

Table LWG-4. Adult count period and peak migration timing at Lower Granite Dam from 1975-2010 based on fish counts.

Species	Counting Period	Date of Peak Passage	
		Earliest	Latest
Spring Chinook	3/1 - 6/17	4/26	6/17
Summer Chinook	6/18 - 8/17	6/18	7/17
Fall Chinook	8/18 - 12/30	9/5	10/6
Steelhead	3/1 - 12/30	9/1	10/16
Sockeye	3/1 - 10/31	7/1	7/19
Lamprey	4/1 – 10/31	7/18	7/25

2. Project Operation.

2.1. Spill Management. See Fish Operations Plan (**Appendix E**) for more information.

2.1.1. 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 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-10** and **LWG-11**, and summer **LWG-12**. Special spills for juvenile fish passage will be provided as detailed in **Appendixes A and E**.

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**.

2.3. Operating Criteria.

2.3.1. Juvenile Fish Passage Facilities. Operate from March 24 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. Project personnel shall retain the authority to dewater the juvenile fish collection system to the extent necessary to prevent frost damage to pipes and other structures during late fall and extended winter operations.

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 gatewell drawdown after cleaning trashracks and with ESBSs in.

4. Inspect and repair gatewell dipnet as needed.

b. Extended-Length Submersible Bar Screens (ESBSs), Flow Vanes, and Vertical Barrier Screens (VBSs).

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 (all 6 if possible) by March 24. 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.

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

6. Crowders maintained, tested, and operating correctly.

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

11. Maintain juvenile PIT tag system as required (see “Columbia Basin PIT Tag Information System, General Gate Maintenance and Inspection, Walla Walla District”, February 2003). Coordinate with PSMFC.

12. Mini- and midi-tanks maintained and in good operating condition.

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 or juveniles as required.

11. Deck wash systems fully operational.

12. Oxygen monitoring probes installed and tested; monitoring system operational.

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. Prepare avian abatement contract as needed.

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 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 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 (relative to the drawdown with a clean screen). 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. ESBSs, VBSs, 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 two VBSs in two 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.

11. When extreme cold weather is forecasted (as defined as: anticipated temperatures below 20^{o} Fahrenheit for 24 hours) to occur for an extended period of time between Thanksgiving and December 15, ESBSs and STSs may be removed. The project will first request special permission from CENWW-OD-T. CENWW-OD-T will inform NOAA Fisheries and other FPOM participants of the action.

c. Collection Channel.

1. Orifices clean and operating. Operate at least one orifice per gatewell slot (preferably the north orifice) unless a unit is scheduled out of service with non-operational fish screens. 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. Reduce turbine unit loading to the lower end of the 1% efficiency range if deemed necessary by the project biologist. 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. Replace all burned out orifice lights within 24 hours of notification. Orifice

lights shall remain lighted 24 hours/day.

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

5. Rotate orifices in fish screens slots weekly (6 open).

6. Orifice valves are either fully open or closed.

7. 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.

8. 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.

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

d. Transportation Facilities.

1. 42" and 72" sluice gates operational; 42-inch separator remote controller switch fully 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 should be 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, hoses, and related equipment free of debris, cracks, or blockages and in good condition. Barge loading boom in good operating condition. Barge loading boom remote control system fully operational.

7. Inform PSMFC, in advance if possible, of situations that cause the PIT tag

system to become inoperable (e.g., power outages) or that could result in confounding the interpretation of PIT tag data (e.g., bypassing fish from raceways to the river, operating in primary bypass mode without an operational full-flow detector, emergency dewatering).

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 (at least nine stops).

2. When the National Weather Service 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 and CENWW-OD-T.

3. 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.

4. Operation of the RSW for short periods of time may be requested by the project biologist through CENWW 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, Section 4.d.(4)).

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.

i. Clean debris from the diffuser 14 trashrack (entrance). Check under the diffuser 14 ladder grating for debris accumulation and remove – if necessary. Check limit switch settings on diffuser 14 controller and ensure full operation.

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. Fish pump 1 may be run at the "slow speed" setting to avoid frequent tripping from an overload condition while operating under MOP.

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

b. Counting Window. The minimum counting slot width should be 18". All equipment should be maintained and in good condition. The counting window and backboard should be cleaned as needed to maintain good visibility.

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

d. North Shore Entrances (NSE 1 & 2). Elevation at 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 at top of gates, on sill = 628'.

1. Operate both downstream gates.

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

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

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.

3. At tailwater below elevation 633' weirs should be on sill.

h. Channel Velocity. 1.5' to 4' per second. The velocity is measured by means of a "Stevens Programmable Monitor" which is connected to a flow meter located in the junction pool area. The meter and monitor were installed, and are serviced every few years, by Dale Fraser (Dale R. Fraser, Sales and Service, P.O. Box 785, Gresham, OR 97030, ph no: 503-658-2649).

1. To take an actual reading, we turn the monitor on and allow it to warm up for a few seconds. We then record six separate velocity readings and average them. This information is recorded on the daily adult fishway inspection form. At the end of the inspection week, all readings are averaged and we note the maximum and minimum velocity from the various inspections. This information is included in the weekly adult fishway report.

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. Inform PSMFC, in advance if possible, of situations that cause the PIT tag system to become inoperable (e.g. power outages) or that could result in confounding the interpretation of PIT tag data (e.g. emergency dewatering).

m. Facility Inspections.

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

2. Project biologists shall inspect adult facilities at least 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. Deviations in readings should be reported to the electrical crew foreman for corrective action.

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

6. Record all inspections.

n. Adult Trap Holding Tanks. Protocols for operating the adult trap for research and other activities are covered in **Appendix G**. This criterion supplements that appendix and governs use of the holding tanks for research or broodstock collection and the water supply for the tanks. The water supply for the trap comes from the diffuser water supply at the top of the ladder and trap operations can affect the amount of water in the ladder proper. Operating all six holding tanks may require that modifications be made to the auxiliary water supply to diffuser #14.

1. Prior to and during the period of use of any holding tanks at the Adult Trap, the COE should inspect and clean if necessary the intake to the diffuser #14 auxiliary water supply. Additionally, the COE should inspect and repair potential sources of leakage in the diffuser #14 water supply.

2. No holding tanks can be used prior to September 1 of each year if their usage affects the amount of water passing down the fish ladder and a water depth of less than 12 inches of water is maintained over the ladder weirs.

3. After September 1 of each year, the two smaller of the six holding tanks only may be used to hold adult fish, for hatchery broodstock or other research needs, if the use of more tanks will limit the ability of the LGR fish ladder to meet its depth over ladder weir criteria.

4. Additional holding tanks may be used if modifications are made to the diffuser #14 water supply that allow a water depth of 12 inches or greater over the ladder

weirs in addition to meeting the needs of the additional tanks.

5. Current configuration and operation of the adult fish trap are being reviewed during winter maintenance period 2009. Changes if needed to existing configurations will be completed prior to the fish passage season. If any changes in the Lower Granite reservoir elevation are needed, these will be coordinated through CENWW-OD-T, in consultation with NOAA Fisheries, and the regional members of FPOM. In-season operational changed that deviate from MOP will be coordinated through TMT.

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.

2.3.3.1. 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.

2.3.3.2. The reports shall include:

a. Any out-of-criteria situations observed and subsequent corrective actions taken;

b. Any equipment malfunctions, breakdowns, or damage along with a summary of resulting repair activities;

c. Adult fishway control calibrations;

d. ESBS and VBS inspections;

e. Any unusual activities which occurred at the project which may affect fish passage.

2.3.3.3. The weekly reports shall cover a Friday through Thursday time period and shall be sent to CENWW-OD-T by noon the following Monday via electronic mail.

2.3.3.4. Project biologists shall prepare a draft annual Adult and Juvenile Monitoring Report by February 10 and a final report by March 15 summarizing the operation of the adult project fish passage facilities for the previous year and giving a brief overview of the juvenile fish operations.. 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.

2.3.3.5. Project biologists also inspect project facilities once per month and during dewaterings for the presence of zebra and Quagga mussels. Biologists shall provide a report to CENWW-OD-T on a monthly basis summarizing mussel inspections.

2.4 Navigation Spill Operations. Short-term adjustments in spill are required for navigation safety. This may include changes in spill patterns, reduction in spill discharges rates, or short-term spill stoppages. These adjustments take approximately an hour but under some situations may take up to three hours. Listed below are two examples of the types of navigation situations that may occur that require short-term spill adjustments. Actual operations will vary due to

conditions such as spill patterns, turbine unit operations, experience of boat captains, etc. The Corps will make short-term adjustment in spill as appropriate in real-time to provide safe navigation conditions.

2.4.1. Fish Barge Transit Across the Tailrace
Spill may create hydraulic conditions that are unsafe for fish barges: crossing the tailrace, moorage at fish loading facilities, and navigation in and out of the barge storage area. If a tug boat operator determines hydraulic conditions are unsafe they will contact the Lower Granite Dam (LWG) control room and the project operator will reduce or stop spill temporarily when fish transport barges approach or leave the barge dock or are moored at loading facilities. If conditions warrant a spill adjustment, the Minimum Operating Pool (MOP) elevation range at Lower Granite may be exceeded temporarily to enable the barge to exit the tailrace safely. Spill reductions will utilize the existing spill pattern.

2.4.2. All Navigation (fish barges, commercial, non-commercial, etc.) Entering and Exiting the Tailrace Navigation Lock
When flows are less than 32 kcfs spill at Lower Granite Dam can create hydraulic conditions (eddies) that cause navigation safety concerns. Eddies cause boat and/or barge collisions with the guide wall as boats enter and or exit the tailrace navigation lock. Non-fish barge navigation does not involve traversing the tailrace, but eddies still cause collisions with the guide wall. If a boat captain has a navigation safety concern they will contact the Lower Granite operator and request a short-term adjustment in spill. This will occur when boats are traveling upstream to, or departing from, the tailrace navigation lock. The operator will shut off spill at the RSW and redistribute all scheduled spill evenly through the remaining bays. The operator will implement this operation for the shortest period of time necessary to allow safe navigation. After boats have safely passed the project the project will reverts back to normal spill operation.

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-T. Dewatering and fish handling plans were reviewed and revised in 2011 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 throughout the year. Long-term maintenance or modifications of facilities, which require extended out of service periods, 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-T 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-T. CENWW-OD-T 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-T when in his opinion delay of the work will result in an unsafe situation for people, property, or fish. Information required by CENWW-OD-T 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 four 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 one 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 six 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 much 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, and/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, and the outage is expected to be long-term, the floating orifices should be closed and monitored in the following order: OG-4, OG-7, OG-10, and OG-1. If fishway criteria still cannot be met, 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', then 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.

3.2.2.4. Diffuser Gratings. Diffuser chambers for adding auxiliary water to fish ladders and collection channels are covered by gratings attached by several different methods. Diffuser gratings are normally checked during the winter maintenance period to make sure they are in place. These inspections are done by either dewatering 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.

3.2.2.5. Fallback Fence. The fallback fence located near the north powerhouse fishway entrances shall be inspected during the winter maintenance period. Loose mesh attached to the frame will be reattached. If any section of the netting is severely damaged, that section will be replaced.

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-5. 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, operate turbine units within 1% of best turbine efficiency. 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-5. 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)
December 16 – February 28	24 hours	Any Order

4.1.1. Turbine units will be operated within 1% of best efficiency 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**);

2) If the turbine unit draft tube is to be dewatered, operate unit with full load for a minimum of 15 minutes prior to installing tail logs. If not possible to load, run unit at speed-no-load for minimum of 15 minutes. This is to reduce the number of fish in the unit prior to installing stop logs;

3) Operating a turbine unit solely to provide station service; or

4) 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% 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-6 through LWG-9**.

4.1.2. All of the lower Snake River powerhouses may be required to keep one generating turbine

unit on line at all times to maintain power system reliability. During low flows, there may not be enough river flow to meet this generation requirement and required minimum spill. Under these circumstances the power generation requirement will take precedence over the minimum spill requirement. At Lower Granite Dam, minimum generation requirements are 11 - 12 kcfs for turbine units 1 – 3 and 12.5 – 13.5 kcfs for turbine units 4-6.

Table LWG-6. Units 1-3 1% turbine operating range with ESBSs installed.

Head (ft)	Lower Generator Limits		Upper Generator Limits	
	(MW)	(CFS)	(MW)	(CFS)
85	**69.9**	**11,938**	**116.2**	**19,863**
86	70.6	11,922	118.5	20,007
87	71.4	11,906	120.8	20,146
88	72.2	11,890	123.1	20,282
89	73.0	11,875	125.4	20,415
90	**73.7**	**11,859**	**127.7**	**20,544**
91	74.6	11,849	128.1	20,346
92	75.5	11,839	128.5	20,152
93	76.3	11,829	128.8	19,963
94	77.2	11,818	129.2	19,777
95	**78.1**	**11,808**	**129.5**	**19,596**
96	79.1	11,825	129.7	19,385
97	80.2	11,841	129.8	19,179
98	81.2	11,857	130.0	18,978
99	82.3	11,872	130.1	18,780
100	**83.3**	**11,887**	**130.3**	**18,586**
101	84.2	11,890	132.0	18,637
102	85.1	11,892	133.7	18,687
103	86.0	11,895	135.4	18,736
104	86.9	11,897	137.2	18,784
105	**87.8**	**11,899**	**138.9**	**18,830**

Table LWG-7. Unit 1-3 1% turbine operating range without ESBSs installed.

Head (ft)	Lower Generator Limits		Upper Generator Limits	
	(MW)	(CFS)	(MW)	(CFS)
85	**65.7**	**10,897**	**120.6**	**20,010**
86	66.4	10,882	123.0	20,155
87	67.2	10,868	125.4	20,296
88	67.9	10,853	127.8	20,434
89	68.6	10,839	130.2	20,568
90	**69.3**	**10,826**	**132.6**	**20,698**
91	70.2	10,817	133.0	20,500
92	71.0	10,808	133.3	20,305
93	71.8	10,799	133.7	20,115
94	72.6	10,790	134.1	19,929
95	**73.4**	**10,781**	**134.4**	**19,747**
96	74.4	10,797	134.6	19,536
97	75.4	10,813	134.7	19,329
98	76.4	10,827	134.9	19,126
99	77.4	10,842	135.0	18,928
100	**78.3**	**10,855**	**135.2**	**18,734**
101	79.2	10,858	137.0	18,785
102	80.0	10,860	138.8	18,836
103	80.9	10,863	140.6	18,885
104	81.7	10,865	142.4	18,934
105	**82.5**	**10,867**	**144.2**	**18,981**

NOTE: The turbine efficiency tables are being revised to reflect new information using a 2004 Unit 3 NS index test and a 1962 model test regarding extended-length submersible bar screens.

Table LWG-8. 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	**83.9**	**13,761**	**107.2**	**17,586**
86	85.0	13,769	108.9	17,652
87	86.1	13,777	110.7	17,717
88	87.1	13,784	112.4	17,780
89	88.2	13,791	114.2	17,841
90	**89.3**	**13,798**	**115.9**	**17,900**
91	90.3	13,778	117.1	17,878
92	91.2	13,759	118.4	17,857
93	92.1	13,740	119.6	17,836
94	93.1	13,722	120.8	17,815
95	**94.0**	**13,703**	**122.0**	**17,795**
96	95.1	13,707	122.6	17,676
97	96.1	13,711	123.1	17,560
98	97.2	13,714	123.7	17,446
99	98.3	13,717	124.2	17,335
100	**99.4**	**13,720**	**124.8**	**17,225**
101	100.4	13,724	126.0	17,227
102	101.4	13,728	127.3	17,229
103	102.5	13,731	128.6	17,230
104	103.5	13,735	129.8	17,232
105	**104.5**	**13,739**	**131.1**	**17,233**

Table LWG-9. 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**	**13,602**	**116.0**	**18,546**
86	86.1	13,600	117.9	18,616
87	87.2	13,597	119.8	18,685
88	88.2	13,595	121.7	18,751
89	89.2	13,592	123.5	18,816
90	**90.3**	**13,589**	**125.4**	**18,879**
91	91.4	13,598	126.8	18,856
92	92.5	13,607	128.1	18,834
93	93.7	13,615	129.4	18,812
94	94.8	13,623	130.8	18,791
95	**95.9**	**13,630**	**132.1**	**18,769**
96	96.9	13,620	132.7	18,645
97	97.9	13,609	133.3	18,523
98	98.9	13,599	133.9	18,403
99	99.9	13,589	134.5	18,285
100	**100.9**	**13,579**	**135.0**	**18,170**
101	101.9	13,579	136.4	18,172
102	102.9	13,580	137.8	18,174
103	104.0	13,580	139.1	18,175
104	105.0	13,581	140.5	18,177
105	**106.0**	**13,581**	**141.9**	**18,179**

NOTE: The turbine efficiency tables were revised to reflect new information using a 2004 unit 3 NS index test and the 1975 model test and extended-length submersible bar screens.

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 are 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-T 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 CBT 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 cannot wait for the above process to be implemented, project personnel shall notify CENWW-OD-T 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 normally take 2 to 5 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 3 to 5 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.

4.3.1. 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). On the completion of maintenance, the turbine unit can be operated with one operating gate in the standard operating position 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 four other turbine units are available for service. No more than one turbine unit at a time shall be operated with operating gates in the standard operating position.

4.3.2. Dewatering turbine units should be accomplished in accordance with project dewatering plans. If the turbine unit draft tube is to be dewatered, operate unit with full load for a minimum of 15 minutes prior to installing tail logs. If not possible to load, run unit at speed-no-load for minimum of 15 minutes. This is to reduce the number of fish in the scroll case prior to installing stop logs. If a turbine unit is out of service for maintenance for an extended period of time without tailrace stop logs 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.

4.3.3. Units may be operationally tested for up to 30 minutes before going into maintenance status by running the unit at speed no load and various loads within the 1% criteria to allow pre-maintenance measurements and testing AND TO ALLOW ALL FISH TO MOVE THROUGH THE UNIT. Units may be operationally tested after maintenance or repair while remaining in maintenance or forced outage status. Operational testing may consist of running the unit for up to a cumulative time of 30 minutes (within 1% criteria) before it is returned to operational status. Operational testing OF UNIT UNDER MAINTENANCE is in addition to a unit in run status (E.G. MINIMUM GENERATION) required for power plant reliability. Operational testing may deviate from fish priority units and may require water that would otherwise be used for spill if the running unit for reliability is at its 1% minimum load. Water will be used from the powerhouse allocation if possible, and water diverted from spill for operational testing will be minimized to that necessary to maintain and assure generation system reliability.

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. Normally, the Project shall contact CENWW-OD-T at least two workdays prior to the day the special operation is required. Using information provided by the Project, CENWW-OD-T will notify FPOM and RCC will issue a teletype detailing the special operations.

Table LWG-10. Lower Granite Spring 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 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. Note: Spillbay discharge at pool elevation 734:

Stops	Discharge (kcfs) (without RSW)	Stops	Discharge (kcfs) (without RSW)
1	1.7	5	9.1
2	3.5	6	11.0
3	5.4	7	12.8
4	7.2	8	14.7

RSW Discharge (Bay 1) = 6.7 kcfs (equivalent to about 3.5 stops on a gated spillbay)

Table LWG-11. 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.

Table LWG-12. Lower Granite Summer 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	0	0	0	0	0	0	3.5	6.1
3.5	0	1	0	0	0	0	0	4.5	7.9
3.5	0	2	0	0	0	0	0	5.5	9.6
3.5	0	3	0	0	0	0	0	6.5	11.4
3.5	0	4	0	0	0	0	0	7.5	13.1
3.5	0	4	0	0	0	1	0	8.5	14.9
3.5	0	4	0	0	1	1	0	9.5	16.6
3.5	0	4	0	0	1	1	1	10.5	18.4
3.5	0	4	0	1	1	1	1	11.5	20.1
3.5	1	4	0	1	1	1	1	12.5	21.9
3.5	1	4	1	1	1	1	1	13.5	23.6
3.5	1	5	1	1	1	1	1	14.5	25.4
3.5	1	5	1	2	1	1	1	15.5	27.1
3.5	1	5	1	3	1	1	1	16.5	28.9
3.5	1	5	1	4	1	1	1	17.5	30.6
3.5	1	5	1	5	1	1	1	18.5	32.4
3.5	1	5	1	5	1	2	1	19.5	34.1
3.5	1	5	1	5	1	3	1	20.5	35.9
3.5	1	5	1	5	1	4	1	21.5	37.6
3.5	1	5	1	5	1	5	1	22.5	39.4
3.5	1	5	2	5	1	5	1	23.5	41.1
3.5	1	5	3	5	1	5	1	24.5	42.9
3.5	1	5	4	5	1	5	1	25.5	44.6
3.5	1	5	5	5	1	5	1	26.5	46.4
3.5	1	5	5	5	2	5	1	27.5	48.1
3.5	1	5	5	5	3	5	1	28.5	49.9
3.5	1	5	5	5	4	5	1	29.5	51.6
3.5	1	5	5	5	5	5	1	30.5	53.4
3.5	1	5	5	5	5	5	2	31.5	55.1
3.5	1	5	5	5	5	5	3	32.5	56.9
3.5	1	5	5	5	5	5	4	33.5	58.6
3.5	1	5	5	5	5	5	5	34.5	60.4
3.5	2	5	5	5	5	5	5	35.5	62.1
3.5	3	5	5	5	5	5	5	36.5	63.9
3.5	4	5	5	5	5	5	5	37.5	65.6
3.5	5	5	5	5	5	5	5	38.5	67.4
3.5	5	5	6	5	5	5	5	39.5	69.1
3.5	5	5	6	6	5	5	5	40.5	70.9
3.5	5	6	6	6	5	5	5	41.5	72.6
3.5	5	6	6	6	6	5	5	42.5	74.4
3.5	5	6	6	6	6	6	5	43.5	76.1

Table LWG-12 (continued). Lower Granite Summer 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	5	6	6	6	6	6	6	44.5	77.9
3.5	6	6	6	6	6	6	6	45.5	79.6
3.5	6	6	7	6	6	6	6	46.5	81.4
3.5	6	6	7	7	6	6	6	47.5	83.1
3.5	6	7	7	7	6	6	6	48.5	84.9
3.5	6	7	7	7	7	6	6	49.5	86.6
3.5	6	7	7	7	7	7	6	50.5	88.4
3.5	6	7	7	7	7	7	7	51.5	90.1
3.5	7	7	7	7	7	7	7	52.5	91.9
3.5	7	7	8	7	7	7	7	53.5	93.6

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. Note: Spillbay discharge at pool elevation 734:

Stops	Discharge (kcfs) (without RSW)	Stops	Discharge (kcfs) (without RSW)
1	1.7	5	9.1
2	3.5	6	11.0
3	5.4	7	12.8
4	7.2	8	14.7

RSW Discharge (Bay 1) = 6.7 kcfs (equivalent to about 3.5 stops on a gated spillbay)