

SECTION 7

LOWER MONUMENTAL DAM

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Lower Monumental Dam

1. Fish Passage Information. The locations of fish passage facilities at Lower Monumental Lock and Dam are shown on Figure LMN-1. Dates of project operations for fish purposes and special operations are listed in Table LMN-2.

1.1. Juvenile Fish Passage.

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

1.1.2. Juvenile Migration Timing. Juvenile migration timing at Lower Monumental Dam is indicated in Table LMN-1. 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 which may impact juvenile fish passage or facility operations should be conducted during the maintenance season.

Table LMN-1. Juvenile migration timing at Lower Monumental Dam based on juvenile fish collection numbers.

% Collection	1995	1996	1997	1998	1999
Yearling Hatchery Chinook					
10%	5/2	4/16	4/23	4/24	4/24
90%	5/21	5/25	5/19	5/17	5/25
Yearling Wild Chinook					
10%	4/26	4/22	4/21	4/24	4/21
90%	6/8	5/28	5/20	5/27	5/31
Subyearling Chinook					
10%	7/10	6/7	7/4	6/16	6/24
90%	9/1	8/11	9/1	8/3	8/4
Hatchery Steelhead					
10%	5/7	4/25	4/28	5/1	5/2
90%	5/26	5/23	5/27	5/27	5/29
Wild Steelhead					
10%	5/5	4/17	4/22	5/1	4/28
90%	5/22	5/22	5/21	5/28	5/29

Insert Figure LMN-1

Table LMN-2. Dates of project operations for fish purposes at Lower Monumental Dam, 2000.

1.2. Adult Fish Passage.

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

1.2.2. Adult Migration Timing. Upstream migrants are present at Lower Monumental dam all year. Maintenance of adult fish facilities is scheduled in January and February to minimize impacts to adult migrants. Facilities are usually shut down one shore at a time for maintenance to minimize impacts on adult fish passage. Table LMN-3 shows the primary passage periods by species and shows the latest and earliest recorded dates of peak passage from fish count records compiled by the Corps. Adult fish are normally counted 16-hours per day (0400 to 2000 Pacific Standard Time) from April 1 through October 31. Adult fish passage is video taped with later interrogation and counting done by fish counters.

2. Project Operation.

2.1. Spill Management. Involuntary spill at Lower Monumental is the result of river flow exceeding powerhouse capacity, insufficient generation loads to pass the river flow, turbine unit outages (forced or scheduled), 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

Table LMN-3. Adult migration timing at Lower Monumental Dam from 1969-1999 based on fish counts.

Species	Counting Period	Date of Peak Passage	
		Earliest	Latest
Spring Chinook	4/1 - 6/13	4/20	5/27
Summer Chinook	6/14 - 8/13	6/14	7/12
Fall Chinook	8/14 - 10/31	9/13	9/30
Steelhead	4/1 - 10/31	9/15	10/13
Sockeye	4/1 - 10/31	6/24	7/25

provide juvenile fish passage. Spill at Lower Monumental will be distributed across the spillway in accordance with the spill pattern in Table LMN-9. Special spills for juvenile fish passage will be provided as detailed in Appendix A. Spills for juvenile fish passage normally take place during the spring, from April 3 through June 20.

2.2. Total Dissolved Gas Management and Control. Total dissolved gas (TDG) levels at Lower Monumental are monitored in accordance with the Dissolved Gas Monitoring Program, Appendix D. The TDG levels are monitored in the Lower Monumental Dam forebay and tailrace from April 1 through September 30. Data will be collected every half-hour and transmitted via computer every hour. Implementation of spill management requests will be based upon TDG monitoring and juvenile migration 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 April 1 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 for bypassing, collection, and transportation of juvenile salmonids.

2.3.1.1. Winter Maintenance Period (December 16 through March 31). 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 trash racks just prior to the operating season.
3. Measure drawdown in gatewell slots after cleaning trashracks and with STSs in place.

b. Submersible Traveling Screens and Vertical Barrier Screens.

1. Maintenance completed on all screens.
2. Inspect STSs prior to installation and operate one trial run (dogged off on deck) to ensure proper operation.
3. Log results of trial run.
4. Inspect all VBSs at least once per year. Repair as needed.

c. Collection Gallery.

1. Water-up valve operating correctly.
2. Orifice lights are operational.
3. Orifices clean and valves operating correctly.

d. Dewatering Structure and Flume.

1. Inclined screen clean and in good condition with no gaps between screen panels, damaged panels, or missing silicone.
2. Screen cleaning system (brush and air flush) maintained and operating correctly.
3. Overflow weirs should be maintained, tested and operating correctly.
4. All valves should be operating correctly.
5. Flume interior should be smooth with no rough edges.

e. Transportation Facilities.

1. Primary bypass flume switch gate maintained and in good operating condition.
2. Flume interior smooth with no rough edges.

3. Perforated plate edges smooth with no rough edges.
4. Wet separator and fish distribution system should be 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. Truck and barge loading hose couplings should have no rough edges and barge loading boom should be maintained and tested.
10. All sampling equipment should maintained and in good operating condition prior to watering up the facilities.

f. Avian Predation Areas (Forebay and Tailrace). Inspect bird wires and other deterrent devices and repair as needed. Where possible, install 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 (April 1 through December 15).

a. Forebay Area and Intakes.

1. Remove debris from forebay.
2. Log gatewell drawdown differentials in bulkhead slots at least once a week.
3. 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. Coordinate turbine unit outages with other project work activities, if possible, to minimize turbine unit outages during the spring.

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

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

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

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

b. Submersible Traveling Screens (STS) and Vertical Barrier Screens (VBS).

1. Operate STSs in cycling mode when average fork length of subyearling or sockeye is greater than 120 mm.

2. Operate STSs in continuous operational mode when average fork length of subyearling chinook or sockeye is less than 120 mm or if fish condition deteriorates.

3. Inspect each STS once per month.

4. Record STS amp readings daily.

5. If an STS is damaged or fails during the juvenile fish passage season, follow procedures detailed under unscheduled maintenance of STSs. In no case should a turbine unit be

operated with a missing or a known non-operating or damaged STS.

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

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

8. Inspect at least 2 VBSs at random across the powerhouse between the spring and summer migration periods. If a debris accumulation is noted, inspect other VBSs and clean debris as necessary.

c. Collection Gallery Checks.

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

2. Orifice lights operational and operating on open orifices.

3. Operate with bypass gallery full to ensure orifice jets are hitting in the middle of the channel.

4. Backflush orifices at least once per day, and more frequently if required. During periods of high debris, orifices should be inspected and backflushed several times per day (including swing and graveyard shifts), as determined by the project biologist, to keep orifices clean.

5. Water-up valve operational.

d. Dewatering Structure.

1. Trash sweep operating correctly. The frequency of the sweep should be set as necessary to maintain a clean screen, with a minimum operation of at least once per hour. Operate the air flush as specified by the project biologist to maintain a clean screen.

2. Hand clean trapezoidal section as often as required to maintain in clean condition, with a minimum of once per day.

3. Check overflow weirs to make sure they are operating correctly, perform maintenance as required.

4. There should be no gaps between screen panels or

damaged panels in the inclined screen.

e. Transportation Facilities.

1. All screens should be inspected to make sure there are no holes or sharp edges.

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

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

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

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

f. 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.

g. Inspection and Record Keeping.

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

2. Record all maintenance and inspections.

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 March 1).

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

b. Dewater all ladders and inspect all dewatered sections of fish facilities for projections, debris, or plugged orifices which could injure fish or impede fish passage up the ladder. Inspect all diffuser gratings and chambers annually by dewatering and physically inspecting the gratings and chambers 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, when necessary, clear debris in the ladder exits.

d. Calibrate all mechanical and electronic 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 debris cleaned out of turbine unit wicket gates.

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

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

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

b. Head on all Entrances. Head range: 1' to 2'

c. North Shore Entrances (NSE 1 & 2). Elevation of top of gate when on sill = 429'.

1. Operate both gates.

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

d. Powerhouse Collection System. Operate 5 floating orifices (O.G numbers 1, 3, 5, 7, 9). All floating orifices will be closed for the 2000 operating season as part of an adult fish passage study.

e. South Powerhouse Entrances (SPE 1 & 2). Elevation of top of gate when on sill = 432'.

1. Operate both downstream gates.

2. Weir depth: 8' or greater below tailwater. At tailwaters below elevation 440', weirs should be on sill.

f. South Shore Entrances (SSE 1 & 2). Elevation of top of gate when on sill = 431'.

1. Operate both downstream gates.

2. Weir depth: SSE 1 operate 8' or greater below tailwater. SSE 2 raised 6' above sill. At tailwaters below elevation 439', SSE 1 weir should be on sill.

g. Transportation Velocity. 1.5' to 4' per second.

h. Head on Trashracks.

1. Maximum head of 0.5' on ladder exits.

2. Maximum head on south shore picket leads shall be 0.3'. Maximum head on north shore picket leads shall be 0.4'.

i. Staff Gages and Water Level Indicators. Gages shall be readable at all water levels encountered during fish passage period.

j. Facility Inspections.

1. Powerhouse operators shall inspect facilities once per day.

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

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

calibration.

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

5. Record all inspections.

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; STS and VBS inspections; and any unusual activities that occurred at the project that may effect fish passage. The weekly reports shall cover a Friday through Thursday time period and shall be sent to CENWW-OD-TF 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-TF on a monthly basis summarizing zebra mussel inspections.

3. Project Maintenance.

Project biologist 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 plans. Dewatering and fish handling plans were reviewed and revised in 1997 to ensure that they comply with Appendix G, 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 to the 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 31. During the fish passage season, parts of the facilities are maintained on a daily, weekly, or longer interval to keep them in proper operating condition.

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 and/or survival. Unscheduled maintenance of facilities such as submersible traveling screens, which sometimes break down during the fish passage season, will be carried out according to procedures described below. In these cases, repairs will be made as prescribed and CENWW-OD-TF notified for further coordination. Unscheduled maintenance that will have a significant effect on fish passage will be coordinated with NMFS and FPOM on a case-by-case basis by CENWW-OD-TF. The CENWW-OD-TF will be notified as soon as possible after it becomes apparent that maintenance repairs are required. The Project Manager has the authority to initiate work prior to notifying CENWW-OD-TF when in his opinion delay of the work will result in an unsafe situation for people, property, or fish. Information required by CENWW-OD-TF 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. Submersible Traveling Screens. The STSs are inspected periodically throughout the juvenile migration season with a video monitoring system. If a screen is found to be damaged it will be removed and either replaced with the spare STS or repaired and returned to service. A turbine unit shall not be operated with a known damaged or nonfunctioning STS or without a full compliment of STSs. If an STS fails on a weekend or at night when maintenance crews are not available, the respective turbine unit will be shut down and generation switched to another, fully screened unit. If all screened turbine units are in service, water may be spilled until the effected STS can be

removed and repaired or replaced.

3.1.2.2. Gatewell Orifices. Each gatewell has two 12" orifices with air operated valves to allow fish to exit the gatewell. Under normal operation, one orifice per gatewell is operated. To minimize blockage from debris, orifices are cycled and backflushed at least once per day, and more frequently if required by heavy debris loads. If an air-valve fails, the valve should be closed and the alternate orifice for that gatewell operated until repairs can be made. If both orifices are blocked with debris or damaged, the turbine unit will be taken out of service until repairs can be made. If repairs are to take longer than 48 hours, juvenile fish will be dipped from the gatewell with a gatewell dip basket. During any closure event of orifices in an operating turbine unit, gatewells will be checked hourly. During times of high fish passage or if there is evidence of any difficulty in holding fish in gatewells, fish are to be dipped from the gatewells at a more frequent interval.

3.1.2.3. Dewatering Structure. The dewatering structure acts as a transition from the collection channel to the corrugated metal flume. An inclined screen allows excess water to be bled off, with all fish and remaining water transitioning into the corrugated metal flume. The excess water is discharged into the adult fish facility auxiliary water supply system and is also used as the water supply for the transportation facilities. The dewatering structure contains a trash sweep and air burst system for cleaning the inclined screen of impinged debris. If the cleaning systems break and interfere with juvenile fish passage through the structure or if the inclined screen is damaged, an emergency bypass system at the upstream end of the dewatering structure will be used to bypass juveniles while repairs are made. Operation of the emergency bypass system requires the juvenile bypass system to be unwatered and stoplogs inserted at the upstream end of the inclined screen. The emergency bypass is then opened and the bypass system operated with 6 gatewell orifices open. Orifices will then need to be routinely rotated, every three hours, in order to let juveniles emigrate from all of the gatewells. While the facilities are in emergency bypass operation, project personnel shall monitor gatewells for signs of fish problems or mortality. Spill may be provided as an alternative avenue for fish passage during a collection channel outage.

3.1.2.4. Bypass Flume. The corrugated metal flume transports juveniles to either the transportation facilities or to the river below the project (primary bypass). If there is a problem with

the flume that interferes with its operation, the emergency bypass system at the upper end of the flume can be opened and all of the fish in the bypass system diverted to the river below the project through the emergency bypass pipe while repairs are made.

3.1.2.5. Transportation Facilities. The transportation facilities can be operated to collect and hold juveniles for the transportation program or to bypass them back to the river (secondary bypass). 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 to the river via the primary bypass pipe.

3.2. Adult fish Passage Facilities.

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

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

3.2.2.1. Fish Ladders and Counting Stations. The fish ladders contain fixed weirs, counting stations with picket leads,

and fish exits with trash racks. If any part of the ladder fails or is blocked with debris during the fish passage season, efforts will first be made to correct it without unwatering the ladder. Trash racks, picket leads, and counting stations can sometimes be repaired or maintained without unwatering the ladder. The decision on whether to dewater the ladder and make repairs during the fish passage season or wait until the winter maintenance period will be made after coordination with the fish agencies and tribes.

3.2.2.2. Auxiliary Water Supply System. The auxiliary water for the fish ladders and the collection systems is supplied by three turbine-driven pumps on the north shore, with all three pumps being required for normal operation. If one, two, or all three pumps fail, the fishway will be adjusted in the following manner until repairs can be made: SPE 2 and SSE 2 will be closed and SPE 1 raised to provide the required 1' to 2' head differential in the system. If the desired head differential cannot be reached by the time SPE 1 reaches 5' below tailwater, the floating orifices should be closed starting at OG-9 and working north across the powerhouse. (Note: The floating orifices will be closed during the 2000 operating season as part of an adult fish passage study.) If the head differential still cannot be maintained when all the floating orifices are closed, SPE 1 should be closed, the collection channel bulkheaded off at the junction pool, and NSE 1 and 2 and SSE 1 operated as deep as possible to maintain the head. If it cannot be maintained at a depth greater than 6', the weirs should be maintained at 6' regardless of the head differential.

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

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

inspections are done by either dewatering the fish passageway and physically inspecting the diffuser gratings, or by using underwater video cameras and divers or other methods to inspect the gratings. Diffuser gratings may come loose during the fish passage season due to a variety of reasons. Daily inspections of fish ladders and collection systems should include looking for any flow changes that may indicate problems with diffuser gratings. If a diffuser grating is known to or suspected of having moved, creating an opening into a diffuser chamber, efforts must immediately be taken to correct the situation and minimize impacts on adult fish in the fishway. Coordination of the problems should begin immediately through the established unscheduled maintenance coordination procedure (see paragraph 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 at Lower Monumental will be operated to enhance adult fish passage from March 1 through November 30. During this time period, turbine units will be operated as needed to meet generation requirements in the order shown in Table LMN-4. Unit operating priority may be coordinated differently to allow for fish research, construction, or project maintenance activities. If a turbine unit is taken out of service for maintenance or repair, the next unit on the priority list shall be operated.

Table LMN-4. Turbine unit operating priority for Lower Monumental Dam.

Season	Time of Day	Unit Priority
March 1 - November 30	Daytime (0600-1800 hours)	1, 2, 3, then 4 through 6 (any order)
	Nighttime (1800-0600 hours)	1, 2, 3, 4, 5, then 6
December 1 - February 28	24 hours	Any Order

Turbine units will be operated within 1% of best efficiency

from March 15 through November 30 (or as specified in BPA's load shaping guidelines) unless operation outside of that range is necessary to: 1) meet the load requirements of the BPA administrator whose load requests will be made in accordance with BPA's policy, statutory requirements and load shaping guidelines (Appendix C); or 2) be in compliance with other coordinated fish measures. Project personnel shall record when turbine units are operated outside the 1% turbine efficiency range and shall provide the information to BPA on a weekly basis according to the load shaping guidelines. Between December 1 and March 15, turbine units will continue to be operated within the 1% 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% range at various heads are shown in Tables LMN-5 through LMN-8. These 1% turbine efficiency ranges were calculated using results from 1994 index testing of turbine unit 3 at Little Goose Dam. Maximum generation of turbine units at 115% overload is 155 MW.

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 Monumental, 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 the bottom of MOP and allowed to fill to 1' above the MOP operating range as the work is accomplished. After the work, reservoirs will be slowly 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.

Table LMN-5. Lower Monumental 1% operating efficiency range for turbine units 1-3 with standard length submersible traveling screens installed.

Head (ft)	Lower Generator Limits		Upper Generator Limits	
	(MW)	(CFS)	(MW)	(CFS)
85	80	12,966	137	22,317
86	81	12,966	140	22,441
87	81	12,797	141	22,331
88	82	12,796	142	22,239
89	83	12,793	144	22,151
90	84	12,790	145	22,067
91	84	12,651	146	21,982
92	85	12,653	149	22,106
93	87	12,657	150	22,023
94	88	12,666	151	21,943
95	89	12,677	152	21,866
96	89	12,563	154	21,793
97	90	12,577	155	21,724
98	91	12,588	155	21,478
99	92	12,589	155	21,237
100	92	12,481	155	21,024
101	93	12,486	155	20,816
102	94	12,489	155	20,588
103	95	12,492	155	20,365
104	95	12,390	155	20,146
105	96	12,502	155	19,954

NOTE: The turbine efficiency tables are being revised to reflect new information. These tables contain the best information currently available.

Table LMN-6. Lower Monumental 1% operating efficiency range for turbine units 1-3 without standard length submersible traveling screens.

Head (ft)	Lower Generator Limits		Upper Generator Limits	
	(MW)	(CFS)	(MW)	(CFS)
85	75	12,168	137	22,317
86	76	12,168	140	22,441
87	76	12,010	141	22,331
88	77	12,009	142	22,238
89	78	12,006	144	22,151
90	79	12,003	145	22,067
91	79	11,872	146	21,982
92	80	11,874	149	22,106
93	81	11,878	150	22,023
94	82	11,887	151	21,943
95	83	11,897	152	21,866
96	83	11,790	154	21,792
97	84	11,803	155	21,724
98	85	11,813	155	21,478
99	86	11,814	155	21,237
100	86	11,713	155	21,024
101	87	11,717	155	20,816
102	88	11,720	155	20,588
103	89	11,723	155	20,365
104	89	11,628	155	20,146
105	90	11,733	155	19,954

NOTE: The turbine efficiency tables are being revised to reflect new information. These tables contain the best information currently available.

Table LMN-7. Lower Monumental 1% operating efficiency range for turbine units 4-6 with standard length submersible traveling screens installed.

Head (ft)	Lower Generator Limits		Upper Generator Limits	
	(MW)	(CFS)	(MW)	(CFS)
85	86	13,525	120	18,945
86	87	13,516	122	19,014
87	88	13,509	124	19,080
88	89	13,502	126	19,142
89	90	13,495	128	19,200
90	91	13,487	130	19,255
91	92	13,480	132	19,310
92	93	13,477	134	19,364
93	94	13,475	135	19,255
94	95	13,472	137	19,305
95	96	13,469	138	19,203
96	98	13,559	139	19,264
97	99	13,554	140	19,180
98	100	13,547	141	19,102
99	102	13,632	142	19,027
100	104	13,720	143	18,956
101	106	13,808	143	18,746
102	107	13,801	143	18,542
103	108	13,796	143	18,342
104	109	13,791	145	18,418
105	110	13,785	147	18,434

NOTE: The turbine efficiency tables are being revised to reflect new information. These tables contain the best information currently available.

Table LMN-8. Lower Monumental 1% operating efficiency range for turbine units 4-6 without standard length submersible traveling screens.

Head (ft)	Lower Generator Limits		Upper Generator Limits	
	(MW)	(CFS)	MW)	(CFS)
85	98	15,421	126	19,896
86	99	15,410	128	19,968
87	100	15,402	131	20,037
88	102	15,394	133	20,103
89	103	15,386	135	20,164
90	104	15,377	137	20,221
91	105	15,370	139	20,279
92	106	15,366	141	20,336
93	107	15,364	142	20,221
94	108	15,361	144	20,273
95	110	15,357	145	20,167
96	112	15,460	147	20,231
97	113	15,454	148	20,142
98	114	15,446	149	20,060
99	116	15,543	150	19,982
100	119	15,643	151	19,907
101	121	15,744	151	19,686
102	122	15,736	151	19,472
103	123	15,730	151	19,262
104	124	15,724	153	19,343
105	126	15,717	155	19,359

NOTE: The turbine efficiency tables are being revised to reflect new information. These tables contain the best information currently available.

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

c. The RCC will coordinate the work activities with regional parties at the TMT meeting on the following Wednesday.

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 slowly lower the level of Lower Monumental pool to the bottom of the MOP range 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 work day 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 type 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-OP-TF 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 in mid-August, when fewer adults are migrating, to minimize impacts on migrating adults. Turbine units may occasionally require overhauls to repair major problems with the turbine or generator. Overhauls may take over one year to accomplish. Turbine units, governors, exciters, and control systems require periodic maintenance, calibration, and testing which may take them outside of the one percent best 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 work days. To conduct the testing, the distribution lines have to be disconnected from the transformers and normal generation stopped. One turbine unit will operate in a speed-no-load condition to provide project power and operation of fish passage facilities. Spill may be provided to meet minimum required project discharges during the testing hours. The Doble tests are normally scheduled for the August or early September time period to minimize impacts on adult and juvenile fish passage.

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, VBSSs, 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 debris 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 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-TF at least two work days prior to the day they want the special project operations for spilling to pass debris. The CENWW-OD-TF shall coordinate the special operations with RCC and NMFS. Project personnel shall provide CENWW-OD-TF 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 LMN-9. Lower Monumental Dam spill pattern for adult fish passage and for minimizing total dissolved gas levels.

1	Spill Bay						Total Stops	Total Spill
	2	3	4	5	6	7		
1							1	1.10
1	1						2	2.20
1	1	1					3	3.30
1	1	1	1				4	4.40
1	1	1	1	1			5	5.50
1	1	1	1	1	1		6	6.60
2	1	1	1	1	1	1	7	8.30
2	2	1	1	1	1	1	8	10.00
2	2	2	1	1	1	1	9	11.70
2	2	2	2	2	1	1	10	13.40
2	2	2	2	2	2	1	11	15.10
2	2	2	2	2	2	2	12	16.80
3	2	2	2	2	2	2	13	18.60
3	3	2	2	2	2	2	14	20.40
3	3	3	2	2	2	2	15	22.20
3	3	3	3	3	2	2	16	24.00
3	3	3	3	3	3	2	17	25.80
3	3	3	3	3	3	3	18	27.60
4	3	3	3	3	3	3	19	29.20
4	4	3	3	3	3	3	20	30.80
4	4	4	3	3	3	3	21	32.40
4	4	4	4	4	3	3	22	34.00
4	4	4	4	4	4	3	23	35.60
4	4	4	4	4	4	4	24	37.20
5	4	4	4	4	4	4	25	38.90
5	5	4	4	4	4	4	26	40.60
5	5	5	4	4	4	4	27	42.30
5	5	5	5	5	4	4	28	44.00
5	5	5	5	5	5	4	29	45.70
5	5	5	5	5	5	5	30	47.40
6	5	5	5	5	5	5	31	49.10
6	6	5	5	5	5	5	32	50.80
6	6	6	5	5	5	5	33	52.50
6	6	6	6	5	5	5	34	54.20
6	6	6	6	6	5	5	35	55.90
6	6	6	6	6	6	6	36	57.60
7	6	6	6	6	6	6	37	59.30
7	7	6	6	6	6	6	38	61.00
7	7	7	6	6	6	6	39	62.70

Table LMN-9 (cont). Lower Monumental Dam spill pattern for adult fish passage and for minimizing total dissolved gas levels.

1	Spill Bay						8	Total Stops	Total Spill
	2	3	4	5	6	7			
	7	7	7	7	6	6		40	64.40
	7	7	7	7	7	6		41	66.10
	7	7	7	7	7	7		42	67.80
	8	7	7	7	7	7		43	69.60
	8	8	7	7	7	7		44	71.40
	8	8	8	7	7	7		45	73.20
	8	8	8	8	7	7		46	75.00
	8	8	8	8	8	7		47	76.80
	8	8	8	8	8	8		48	78.60
	9	8	8	8	8	8		49	80.30
	9	9	8	8	8	8		50	82.00
	9	9	9	8	8	8		51	83.70
	9	9	9	9	8	8		52	85.40
	9	9	9	9	9	8		53	87.10
	9	9	9	9	9	9		54	88.80
10	9	9	9	9	9	9		55	90.50
10	10	9	9	9	9	9		56	92.20
10	10	10	9	9	9	9		57	93.90
10	10	10	10	9	9	9		58	95.60
10	10	10	10	10	10	9		59	97.30
10	10	10	10	10	10	10		60	99.00
11	10	10	10	10	10	10		61	100.70
11	11	10	10	10	10	10		62	102.40
11	11	11	10	10	10	10		63	104.10
11	11	11	11	10	10	10		64	105.80
11	11	11	11	11	11	10		65	107.50
11	11	11	11	11	11	11		66	109.20
12	11	11	11	11	11	11		67	111.00
12	12	11	11	11	11	11		68	112.80
12	12	12	11	11	11	11		69	114.60
12	12	12	12	11	11	11		70	116.40
12	12	12	12	12	12	11		71	118.20
12	12	12	12	12	12	12		72	120.00
13	12	12	12	12	12	12		73	121.70
13	13	12	12	12	12	12		74	123.40
13	13	13	12	12	12	12		75	125.10
13	13	13	13	12	12	12		76	126.80
13	13	13	13	13	13	12		77	128.50
13	13	13	13	13	13	13		78	130.20

Table LMN-9 (cont). Lower Monumental Dam spill pattern for adult fish passage and for minimizing total dissolved gas levels.

Spill Bay								Total Stops	Total Spill
1	2	3	4	5	6	7	8		
	14	13	13	13	13	13		79	131.90
	14	14	13	13	13	13		80	133.60
	14	14	14	13	13	13		81	135.30
	14	14	14	14	13	13		82	137.00
	14	14	14	14	14	13		83	138.70
	14	14	14	14	14	14		84	140.40
	15	14	14	14	14	14		85	142.20
	15	15	14	14	14	14		86	144.00
	15	15	15	14	14	14		87	145.80
	15	15	15	15	14	14		88	147.60
	15	15	15	15	15	14		89	149.40
	15	15	15	15	15	15		90	151.20
	16	15	15	15	15	15		91	152.90
	16	16	15	15	15	15		92	154.60
	16	16	16	15	15	15		93	156.30
	16	16	16	16	15	15		94	158.00
	16	16	16	16	16	15		95	159.70
	16	16	16	16	16	16		96	161.40