2017 Fish Passage Plan

Chapter 3 – The Dalles Dam

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The Dalles Dam

Project Acronym	TDA
River Mile (RM)	Columbia River – RM 191.5
Reservoir	Lake Celilo
Minimum Instantaneous Flow (kcfs)	Dec–Feb: 12.5 kcfs \ Mar–Nov: 50 kcfs
Forebay Normal Operating Range (ft)	155.0’ – 160.0’
Tailrace Rate of Change Limit (ft)	3’/hr
Powerhouse Length (ft)	2,089’
Powerhouse Hydraulic Capacity (kcfs)	375 kcfs
Turbine Units	22 (BLH Kaplan) + 2 Fish Units
Turbine Generating Capacity (MW)	Rated: 1,808 MW (Units 1-14 @ 78 MW/unit + Units 15-22 @ 86 MW/unit) Maximum: 2,080 MW (Units 1-14 @ 90 MW/unit + Units 15-22 @ 99 MW/unit)
Gatewell Orifice Diameter (in)	One 6” orifice per gatewell
Spillway Length (ft)	1,447’
Spillway Hydraulic Capacity (kcfs)	2,290 kcfs
Spillbays (#)	23
Spillway Weirs (#)	0
Navigation Lock Length x Width (ft)	650’ x 86’
Navigation Lock Max. Lift (ft)	90’

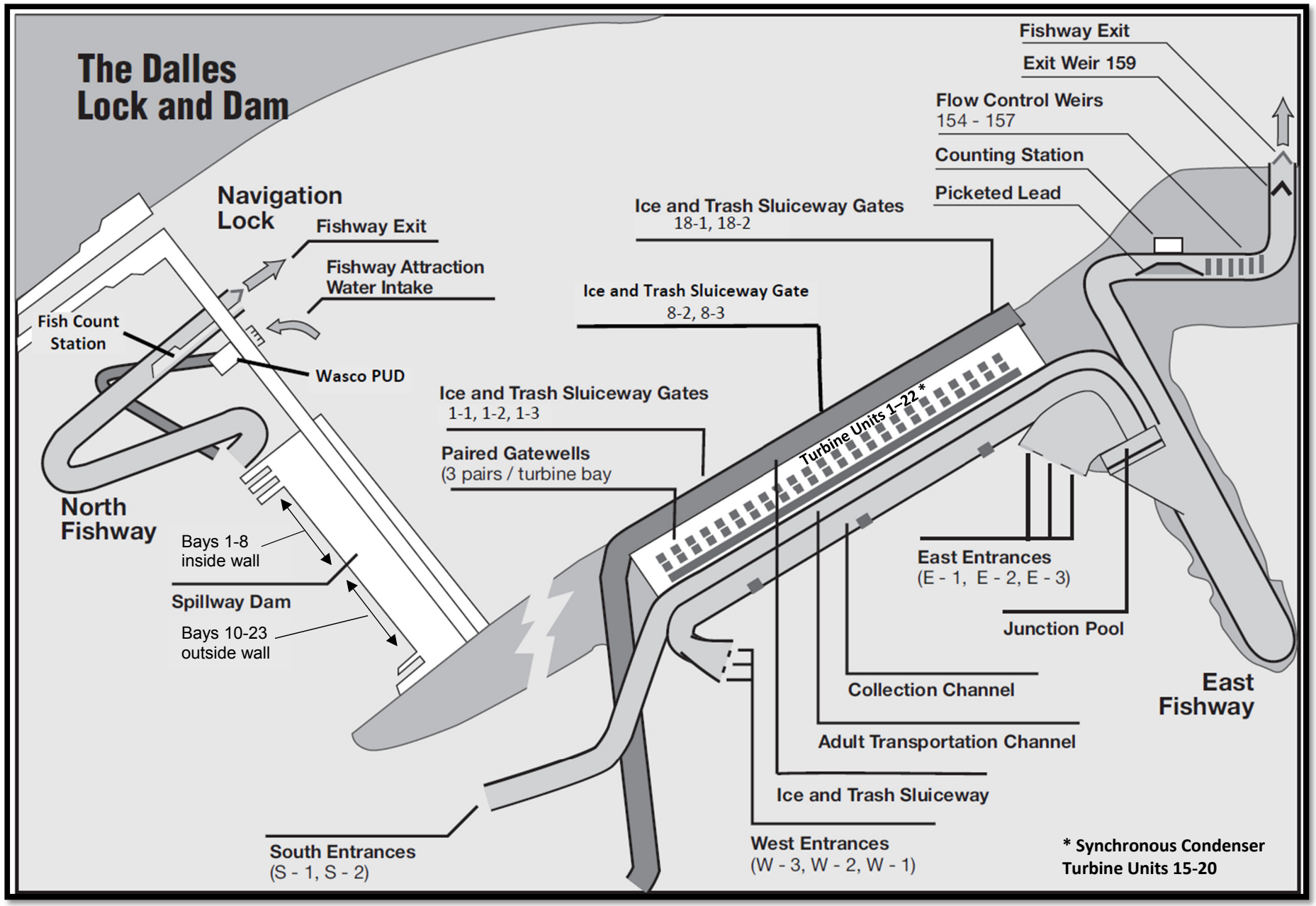


Figure TDA-1. The Dalles Dam General Site Plan.

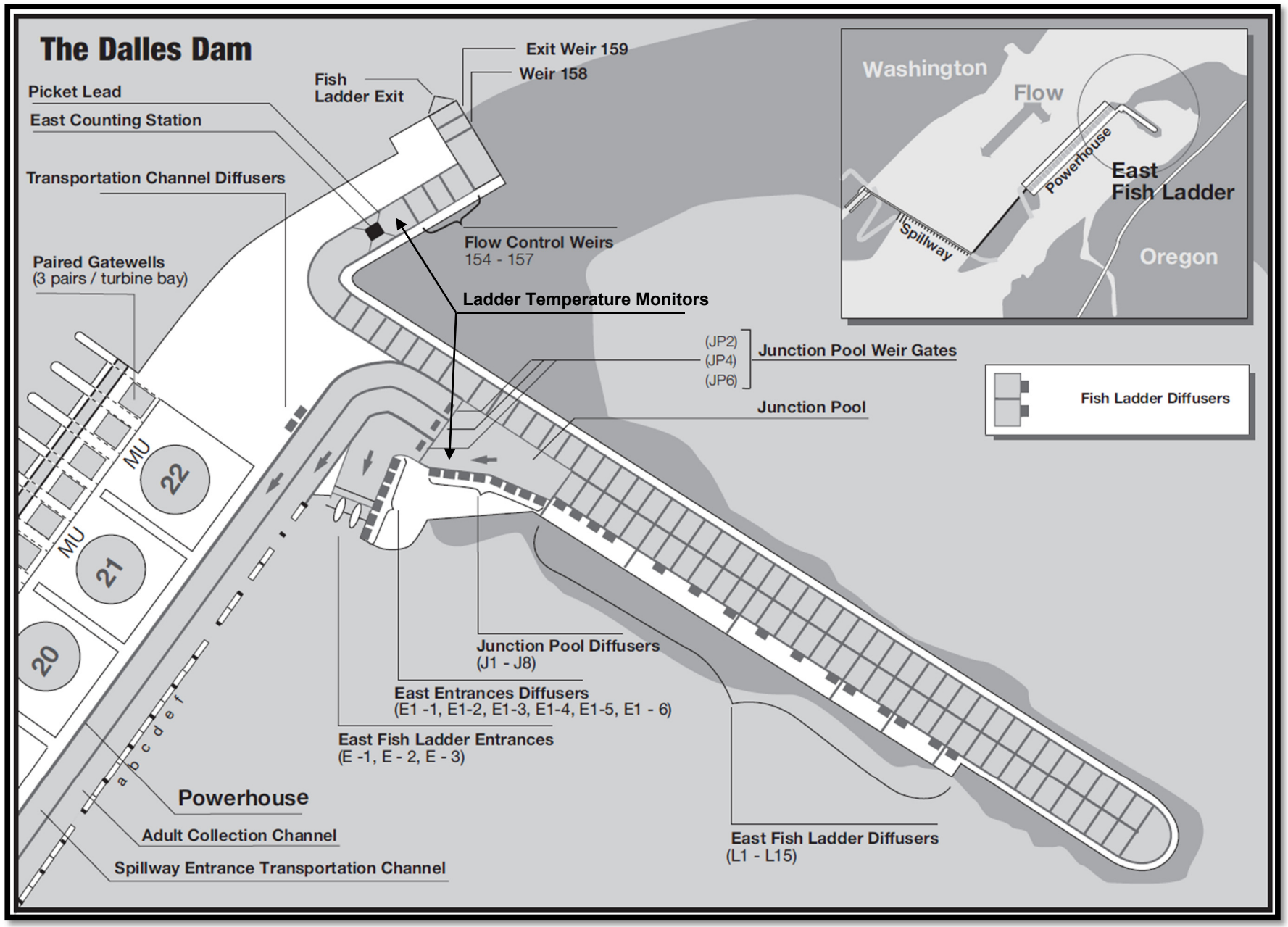


Figure TDA-2. The Dalles Dam East Fish Ladder.

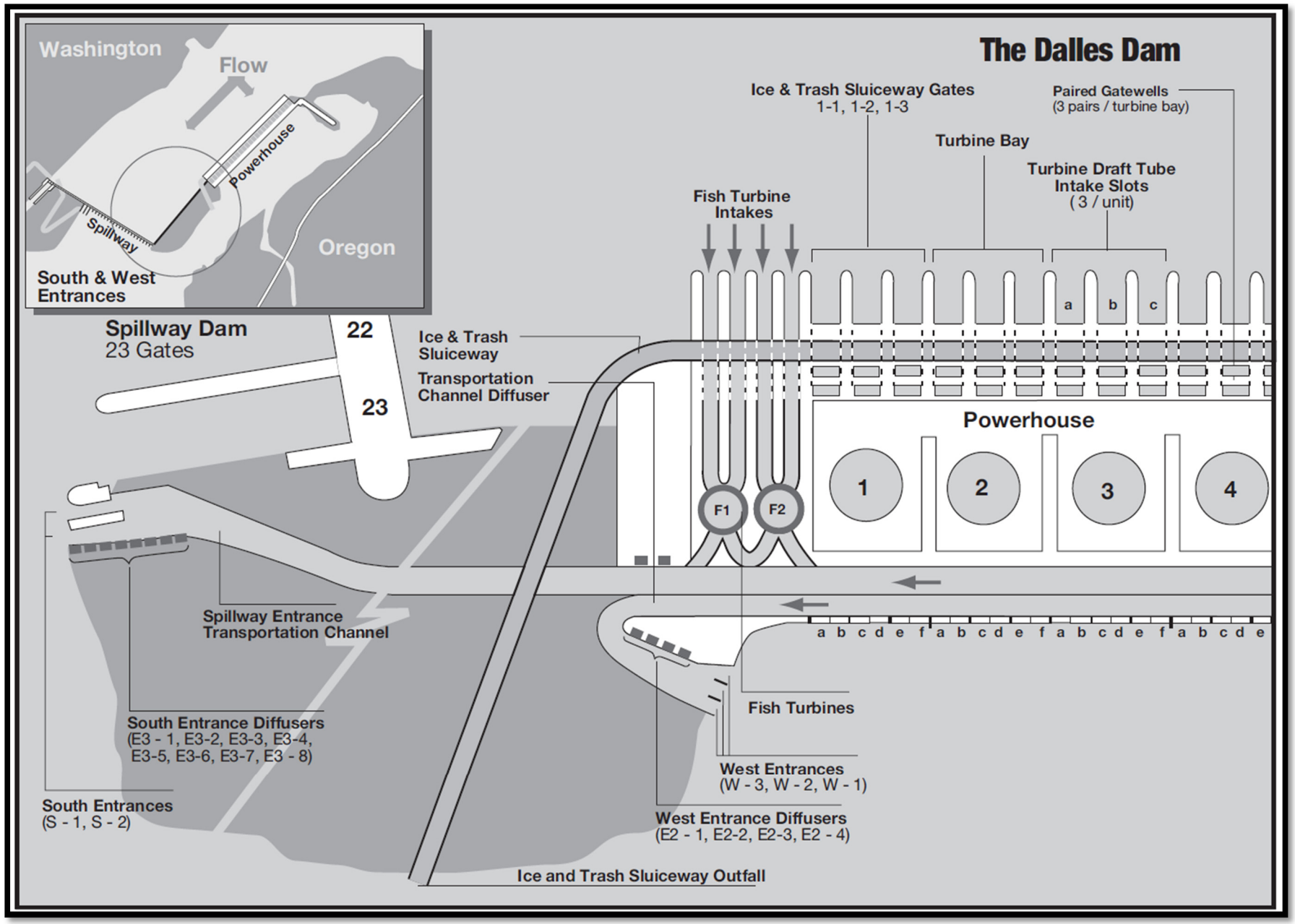


Figure TDA-3. The Dalles Dam South and West Fish Ladder Entrances.

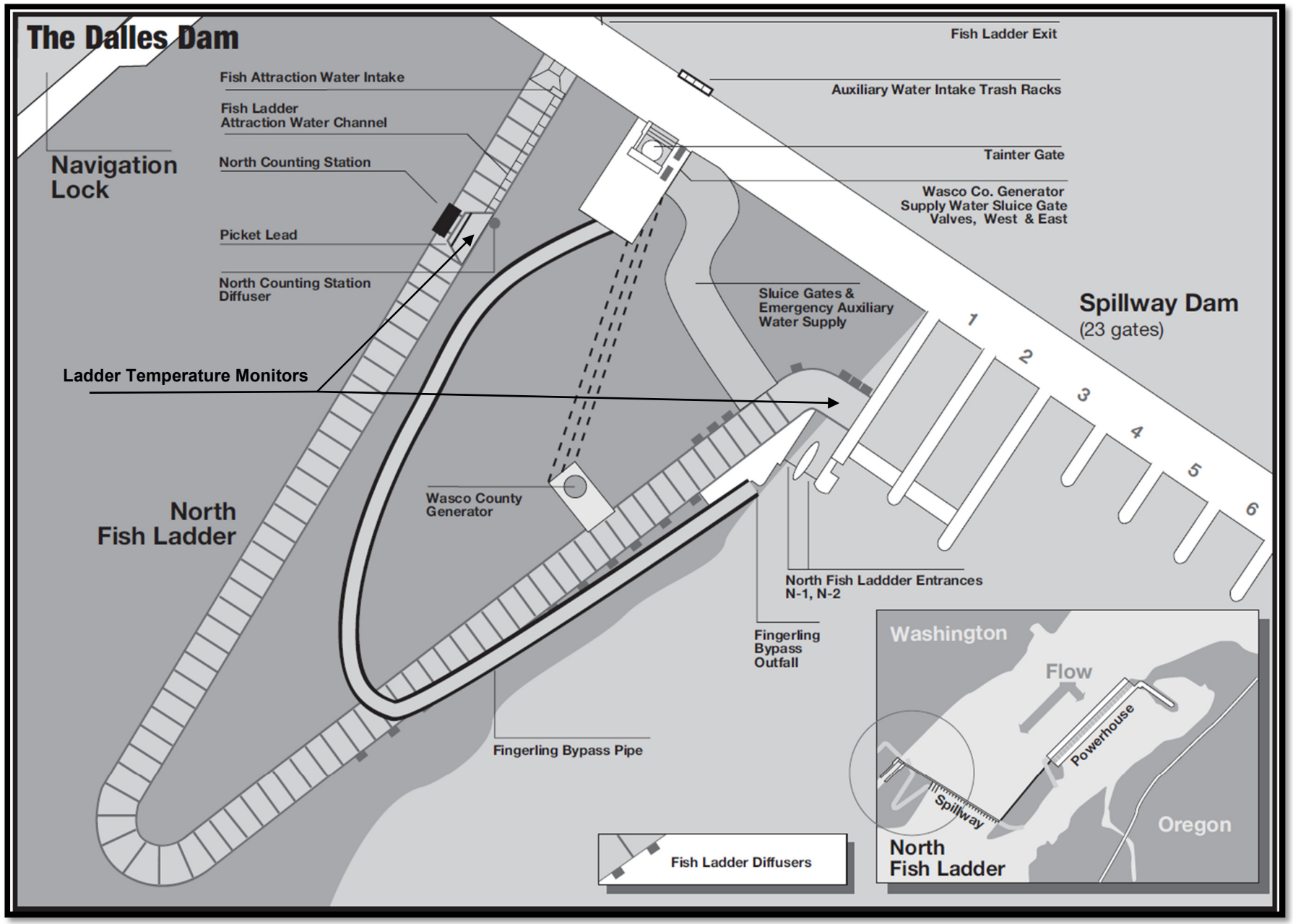
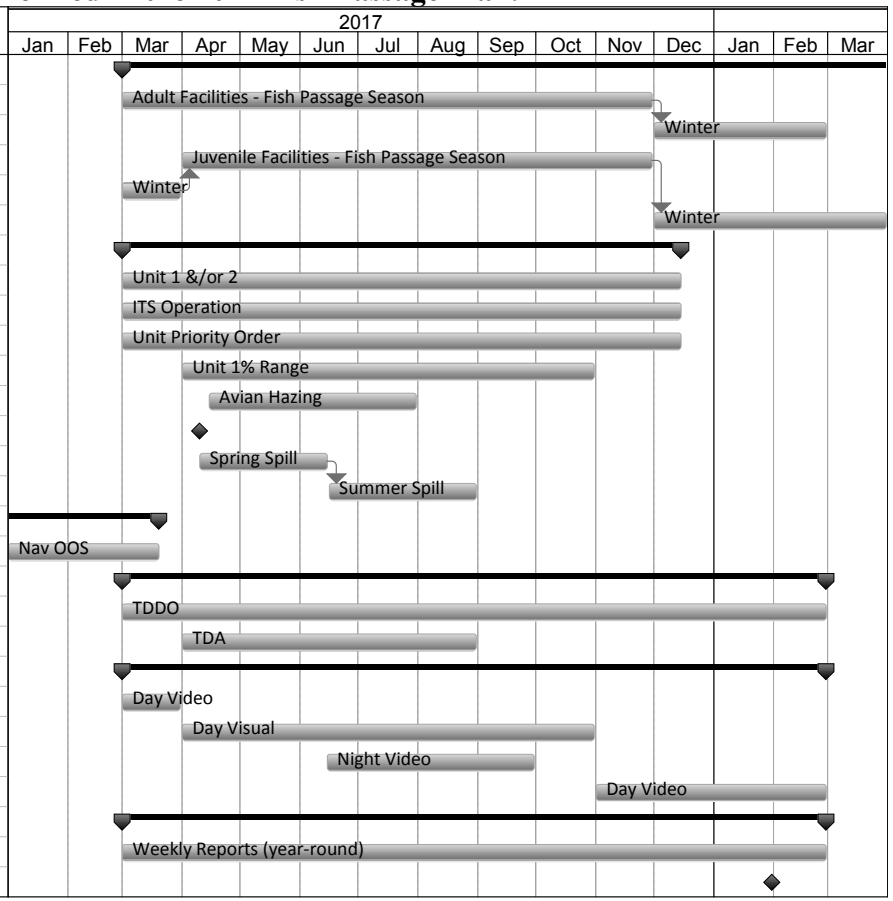


Figure TDA-4. The Dalles Dam North Fish Ladder and Spillway.

Table TDA-1. The Dalles Dam Schedule of Operations and Actions Defined in the 2017 Fish Passage Plan.

Task Name	Start	End	FPP Section
FISH PASSAGE FACILITIES	**3/1/17**	**3/31/18**	
Fish Passage Season - Adult Facilities	3/1/17	11/30/17	2.4.2
Winter Maintenance - Adult Facilities	12/1/17	2/28/18	2.4.1
Fish Passage Season - Juvenile Facilities	4/1/17	11/30/17	2.3.2
Winter Maintenance - Juvenile Facilities	3/1/17	3/31/17	2.3.1
Winter Maintenance - Juvenile Facilities	12/1/17	3/31/18	2.3.1
PROJECT OPERATIONS FOR FISH PASSAGE	**3/1/17**	**12/15/17**	
Unit 1 &/or 2 operate for fish passage	3/1/17	12/15/17	5.1.1
ITS Operation	3/1/17	12/15/17	Table TDA-4
Turbine unit priority order	3/1/17	12/15/17	Table TDA-5
Turbine unit 1% operating range	4/1/17	10/31/17	5.2
Avian Hazing	4/15/17	7/31/17	Appendix L
Avian Wires installed NLT April 10	4/10/17	4/10/17	Appendix L
Spring Spill	4/10/17	6/15/17	Appendix E
Summer Spill	6/16/17	8/31/17	Appendix E
SPECIAL OPS & STUDIES (Appendix A)	**1/1/17**	**3/20/17**	**Appendix A**
Navigation Lock annual outage	1/1/17	3/20/17	
TDG MONITORING	**3/1/17**	**2/28/18**	**2.2.3**
TDG Monitoring - Tailrace (year-round)	3/1/17	2/28/18	station TDDO
TDG Monitoring - Forebay	4/1/17	8/31/17	station TDA
ADULT FISH COUNTING	**3/1/17**	**2/28/18**	**Table TDA-2**
Day Video 0400-2000 PST	3/1/17	3/31/17	
Day Visual 0500-2100 DST	4/1/17	10/31/17	
Night Video 2100-0500 DST	6/15/17	9/30/17	
Day Video 0400-2000 PST	11/1/17	2/28/18	
REPORTS	**3/1/17**	**2/28/18**	**3.3**
Weekly Reports (year-round)	3/1/17	2/28/18	
Annual Report due NLT Jan 31	1/31/18	1/31/18	



1. FISH PASSAGE INFORMATION

Fish passage facilities at The Dalles Lock & Dam are shown in **Figure TDA-1** through **TDA-4** and described below. The schedule for project operations described in the Fish Passage Plan (FPP) and Appendices is included in **Table TDA-1**.

1.1. Juvenile Fish Passage.

1.1.1. Juvenile Fish Facilities. Turbine units at The Dalles Dam are not screened. Juvenile fish passage consists of the Ice & Trash Sluiceway (ITS) and one 6"orifice in each gatewell. All 6" orifices will be closed as units are dewatered. The ITS is a rectangular channel extending along the total length of the 22-unit powerhouse and is located in the forebay side of the powerhouse. When any of the sluiceway gates (located in the forebay side of the sluiceway) are opened, water and juvenile migrants are skimmed from the forebay into the sluiceway and deposited in the tailrace downstream of the project.

1.1.2. Juvenile Fish Migration Timing. The primary juvenile fish passage period at The Dalles Dam is April–November. Juvenile migration timing is monitored at the John Day Dam Smolt Monitoring Facility (SMF), and the 10-year passage timing data are reported in **FPP Chapter 4 - John Day Dam, Table JDA-2**. No juvenile monitoring is done at The Dalles Dam. To estimate juvenile fish arrival at The Dalles Dam, refer to **Table JDA-2** and add approximately one day.

1.1.3. Diel passage of juvenile fish at The Dalles Dam sluiceway is affected by spill and flow conditions. In years of consistently high flow and spill, fish may be distributed higher in the water column and daytime passage may increase.

1.2. Adult Fish Passage.

1.2.1. Adult Fish Facilities. Adult fish passage facilities at The Dalles Dam are composed of a north shore fish ladder that passes fish collected at the north end of the spillway, and an east fish ladder that passes fish collected at the south end of the spillway and across the downstream face of the powerhouse.

1.2.1.1. North Wasco PUD operates a small hydropower facility constructed in 1991 that utilizes the north fishway ladder auxiliary water supply. Adult fishway criteria associated with this facility are monitored and maintained during daily fishway inspections. A backup auxiliary water supply system, unscreened for juveniles, has been upgraded to facilitate its use if required.

1.2.1.2. Annual maintenance of adult facilities is scheduled December 1 through the end of February (winter maintenance period) to minimize impacts on upstream migrants. One ladder is dewatered at a time unless otherwise coordinated through FPOM.

1.2.2. Adult Fish Migration Timing & Counting. Upstream migrants are present throughout the year and adult passage facilities are operated year-round.

1.2.2.1. Adult salmon, steelhead, lamprey, and shad are typically counted April 1–October 31 (**Table TDA-2**) and data are posted daily at: http://www.fpc.org/adultsalmon_home.html. Sturgeon and bull trout are relatively infrequent and counts are reported in *Miscellaneous Fish Counts* and summarized in the *Annual Fish Passage Report*.

1.2.2.2. Yearly counts through the most recent passage year are used to determine the earliest and latest dates of peak adult fish passage (**Table TDA-3**). Time-of-day (diel) distributions of adult salmonid activity at The Dalles Dam fishway entrances and exits are summarized in **Figure TDA-5**.

Table TDA-2. The Dalles Dam Adult Fish Count Schedule, 3/1/2017 – 2/28/2018.

Count Period	Counting Method and Hours *
March 1–31	Day Video 0400–2000 (PST)
April 1 – October 31	Visual 0500–2100 hours (DST)
June 15 – September 30	Night Video 2100–0500 hours (DST)
November 1 – end of February	Day Video 0400–2000 (PST)

*In 2017, Daylight Saving Time (DST) is in effect March 12 – November 5, and hours are adjusted forward 1 hour from Pacific Standard Time (PST). DST = PST+1.

Table TDA-3. The Dalles Dam Adult Fish Count Period and Peak Passage Timing (based on yearly counts since 1957, except lamprey since 2000).

Species	Count Period	Earliest Peak	Latest Peak
Spring Chinook	Apr 1 – Jun 3	Apr 13	May 13
Summer Chinook	Jun 4 – Aug 3	Jun 6	Aug 1
Fall Chinook	Aug 4 – Oct 31	Sep 2	Sep 23
Sockeye	Apr 1 – Oct 31	Jun 20	Jul 10
Steelhead	Apr 1 – Oct 31	Jul 9	Sep 23
Coho	Apr 1 – Oct 31	Sep 3	Oct 25
Lamprey	Apr 1 – Oct 31	Jul 12	Aug 1

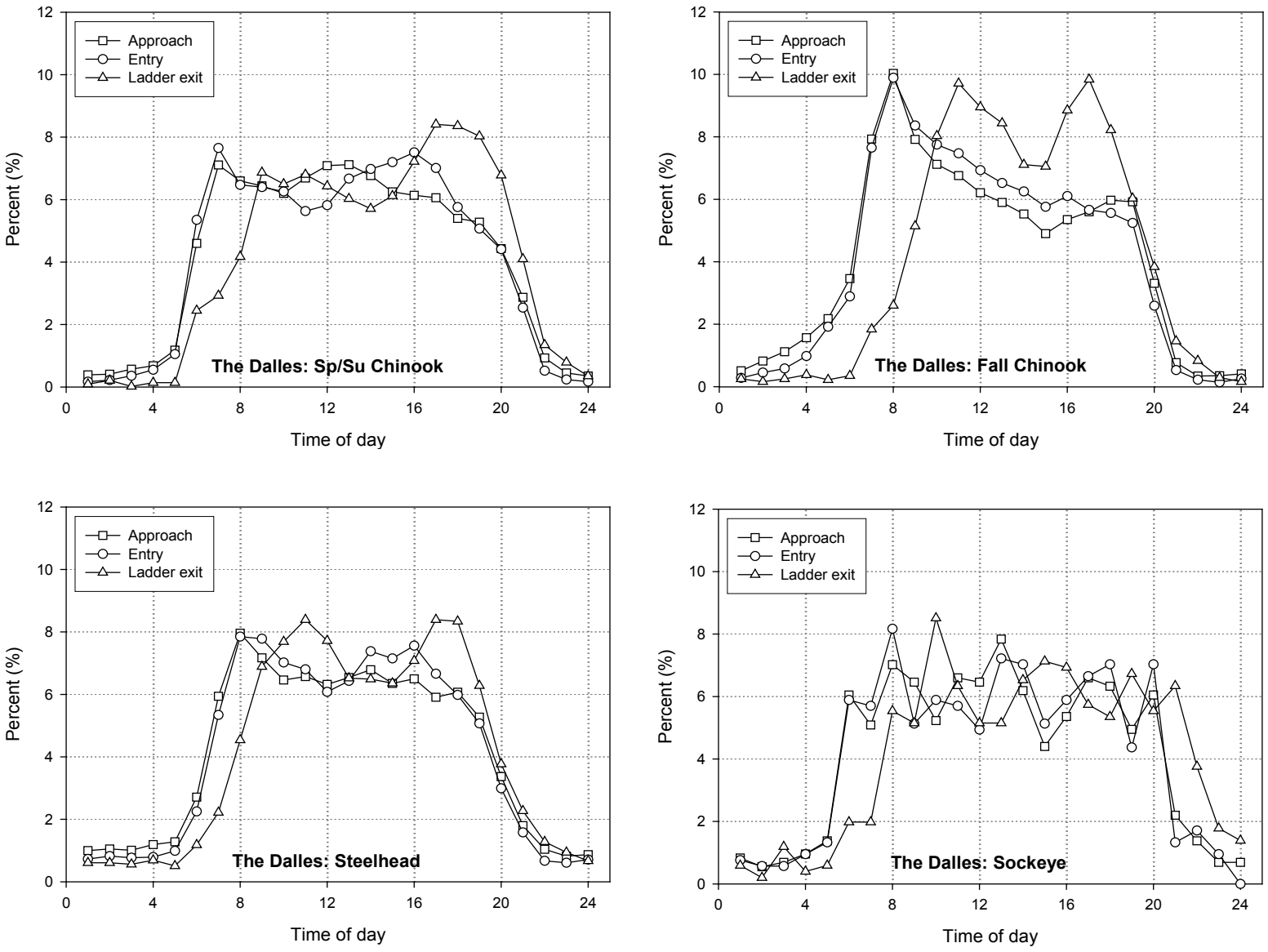


Figure TDA-5. Diel Distribution of Adult Salmonids at The Dalles Dam Fishway Entrances and Exits (*Keefer & Caudill 2008*).
www.nwd-wc.usace.army.mil/tmt/documents/FPOM/2010/2013_FPOM_MEET/2013_JUN/

2. FISH FACILITIES OPERATION

2.1. General.

2.1.1. Research, non-routine maintenance, fish-related activities, and construction will not be conducted within 100' of any fishway entrance or exit, within 50' of any other part of the adult fishway, or directly in, above, or adjacent to any fishway, unless coordinated with FPOM or FFDRWG by the Project, District Operations and/or Planning or Construction office. Alternate actions will be considered by District and Project biologists in conjunction with the Regional fish agencies on a case-by-case basis.

2.1.2. Currently coordinated special operations related to research are described in **Appendix A - Special Project Operations & Studies**.

2.1.3. Emergency situations should be dealt with immediately by the Project in coordination with the Project and/or District biologist. If unavailable, the biologists will be informed immediately following the incident of steps taken to correct the situation. On a monthly basis, as necessary, the project biologist will provide FPOM a summary of any emergency actions undertaken.

2.1.4. All activities within boat restricted zones (BRZ) will be coordinated with the Project at least two weeks in advance, unless it is deemed an emergency (see coordination guidance in **Chapter 1 - Overview**).

2.1.5. All fish passage related equipment and operations will be inspected twice daily. Additionally, entrance differential and weir depth 12-hour trends will be monitored daily from the data logging system to track operational changes and included in weekly status reports.

2.2. Spill Management.

2.2.1. Spring and summer spill operations for juvenile fish passage are defined in the *Fish Operations Plan* (FOP), included in the FPP as **Appendix E**. Spill patterns are defined in **Table TDA-7**.

2.2.2. During spill that occurs December 16 through the end of February, the Ice & Trash Sluiceway (ITS) will be operated if available to provide a surface passage route. Operate 3 gates on Unit 1 and 3 gates on Unit 18.

2.2.3. Total dissolved gas (TDG) is monitored at The Dalles Dam as defined in **Table TDA-1**, in accordance with the annual *TDG Monitoring Plan*[1] and the *Dissolved Gas Monitoring Plan of Action 2015-2018*.[2] Excessive TDG may harm fish and will be controlled to the extent possible, subject to river conditions. Management tools include system-wide spill distribution through the Spill Priority List issued by the Corps Northwestern Division Reservoir Control Center (RCC), night and/or day spill limits, and shaping of spill.

[1] Annual TDG Monitoring Plan (Appendix 4 of the WMP): www.nwd-wc.usace.army.mil/tmt/documents/wmp/
[2] 2015-2018 TDG Monitoring Plan: www.nwd-wc.usace.army.mil/tmt/wqnew/tdg_monitoring/2015-18.pdf

2.3. Operating Criteria - Juvenile Fish Facilities.

2.3.1. Juvenile Facilities - Winter Maintenance (December 1 – March 31).

2.3.1.1. An ROV will be used to inspect trashracks and main unit intakes. If necessary, remove debris from forebay, trashracks, gatewell slots, and gatewell orifices such that these areas are free of debris on April 1.

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

2.3.1.3. Inspect and correct any epoxy or concrete deficiencies on the Ice & Trash Sluiceway (ITS) walls and floors, where accessible.

2.3.1.4. Inspect and repair spill gates and control systems where necessary. Except for coordinated changes, the spillway must be able to achieve spill patterns on April 1.

2.3.1.5. Avian Lines. See the *Avian Monitoring & Deterrence Action Plans* for all projects in **Appendix L**. From August through mid-April, there will be no avian abatement measures other than avian lines. Avian lines will be repaired and/or reinstalled as soon as possible following damage or removal. New avian lines will be installed and maintained in locations determined to have significant avian predation. Avian abatement measures shall be in place by April 1 unless delayed by inclement weather, in which case work will be completed as soon as weather permits.

2.3.1.6. Ice & Trash Sluiceway (ITS). The ITS will be operated as defined in **Table TDA-4**.

Table TDA-4. The Dalles Dam Ice & Trash Sluiceway (ITS) Schedule of Operations.

DATES	SLUICEWAY OPERATION (24 hrs/day)	PURPOSE	FPP Section
March 1–31; December 1–15	OPEN End gate OPEN Sluice gates 1-2, 1-3 / 18-1, 18-2	Adult fallback; kelt passage	2.4.1.6; 2.4.2.9
April 1– November 30	OPEN End gate OPEN Sluice gates 1-1, 1-2, 1-3 / 8-2, 8-3 / 18-2	Juvenile passage	2.3.2.5
*December 16– end of February	*CLOSE End gate OPEN Sluice gates 1-1 / 18-3	*No passage; allows egress when equalized w/forebay	2.3.1.6, 2.4.1.6

*Except during periods of spill when the ITS will be operated if available, as defined in **section 2.2.2** (3 gates on Unit 1 and 3 gates on Unit 18).

2.3.2. Juvenile Fish Passage Season (April 1 – November 30).

2.3.2.1. Measure gatewell drawdown a minimum of once per week, and more frequently, three times per week or more, as needed during high debris periods. Clean trashracks as flow conditions dictate, or when drawdown in gatewell slots exceeds 1.5'. To determine if there is debris buildup on the trashracks between June 1 and June 15, inspect three units across the powerhouse that have the most prior operation and will not interfere with sluiceway operation. If so, trashracks will be raked. All trashracks can be raked using the Hammerhead crane.

2.3.2.2. Remove debris from the forebay as needed by operating sluiceway.

2.3.2.3. Inspect all gatewells daily. Clean gatewells before the gatewell water surface becomes 50% covered with debris. If due to the debris volume it is not possible to keep the gatewell surfaces at least 50% clear, they will be cleaned at least once daily. Turbines with a gatewell fully covered with debris will not be operated except to be in compliance with other coordinated fish measures, and then only on a last-on/first-off basis.

2.3.2.4. Project maintenance will permanently close the gate slot orifices as the unit intakes are serviced over the next few years, utilizing orifice plates as covers.

2.3.2.5. Ice & Trash Sluiceway (ITS).

2.3.2.5.a. April 1-November 30: operate ITS 24 hrs/day for juvenile fish passage (**Table TDA-4**). Open gates 1-1, 1-2, 1-3 over operating Main Unit (MU)-1; gates 8-2, 8-3 over operating MU-8; and gate 18-2 over operating MU-18. If any these MUs are out of service for more than 6 hours, operate the next available MU and associated gates adjacent to the unit (i.e., if MU-1 is OOS, then operate MU-2 w/gates; if MU-18 is OOS, then operate MU-17 w/gates or MU-19 w/gates).

2.3.2.6. When units are being dewatered, leave endgate open and close sluice gates to expose gatewell orifices, and then install orifice blocker. After orifice-sealing devices are installed, sluice gates should be returned to the open position. Installation time should be approximately 1 hour.

2.3.2.7. Efforts should be made to keep all petroleum out of gatewells. Project environmental section will determine cleanup efforts if needed. Regardless of unit operating status, oil accumulations will be dealt with promptly.

2.3.2.8. Avian Deterrence. See the *Avian Monitoring & Deterrence Action Plans* for all projects in **Appendix L**. Avian abatement measures shall be in place by April 1 unless delayed by inclement weather, in which case work will be completed as soon as weather permits. Avian hazing shall occur April 15–July 31. From August through mid-April, there will be no avian abatement measures other than avian lines. Avian lines will be repaired and/or reinstalled as soon as possible following damage or removal. New avian lines will be installed and maintained in locations determined to have significant avian predation.

2.3.2.9. Follow the spill patterns in **Table TDA-7** for juvenile fish passage.

2.4. Operating Criteria - Adult Fish Facilities.

2.4.1. Adult Fish Facilities - Winter Maintenance (December 1 – end of February).

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

2.4.1.2. Dewater all ladders and inspect for projections, debris, or plugged orifices that could injure fish or slow their progress up the ladder. Make necessary repairs and complete preventative maintenance.

2.4.1.3. Pull exit trashracks and/or inspect and clear debris from the ladder exits.

2.4.1.4. Inspect count station equipment and assure operational. Reinstall picket leads at counting stations prior to watering up ladders. Ensure the leads are properly seated.

2.4.1.5. Only one of the two adult fish facilities may be out of service at any one time unless coordinated through FPOM. The operating facility shall be operated at full fish passage season criteria unless specially coordinated. Outage periods will be minimized to the extent practicable.

2.4.1.6. Ice & Trash Sluiceway (ITS).

2.4.1.6.a. December 1–15: operate ITS 24 hrs/day for adult fallback and steelhead kelt passage (**Table TDA-4**). Open gates 1-2, 1-3 over operating MU-1, and gates 18-1, 18-2 over operating MU-18. If either of these MUs are out of service, operate the next available MU and associated adjacent gates (i.e., if MU-1 is OOS, then operate MU-2 w/gates; if MU-18 is OOS, then operate MU-17 w/gates or MU-19 w/gates).

2.4.1.6.b. December 16–end of February: discontinue ITS operation on a 24-hour basis, close the endgate and open sluice gates 1-1, 18-3 to allow fish egress from the ITS when equalized with the forebay (except during periods of spill when the ITS will be operated if available; see **section 2.2.2**).

2.4.2. Adult Fish Passage Season (March 1 – November 30).

2.4.2.1. Water depth over fish ladder weirs = 1.0’ ±0.1'. During shad passage season (>5,000 shad/day per at Bonneville Dam count station) = 1.3’ ±0.1’. See **section 2.4.2** for exceptions.

2.4.2.2. Temperature Monitoring.

2.4.2.2.a. Water temperatures will be measured in count station of each adult fishway and will be recorded in the fishway status report. When water temperature reaches 70°F, all fish handling activities will be coordinated through FPOM prior to any action to verify protocols that will be followed.

2.4.2.2.b. From June 1 through September 30, water temperature will be monitored at adult fishway entrances and exits.

b.1. Temperature monitors shall be placed within 10 meters of all shore-oriented entrances and exits.

b.2. If possible, the entrance monitor shall be within 1 meter above the ladder floor and at least 10 meters downstream of ladder diffusers to allow for sufficient mixing with surface water.

b.3. The exit monitor shall be within 1 meter above the ladder floor and above all diffusers to allow for sufficient mixing with surface water.

b.4. If an existing temperature monitoring location is proposed for either the exit or entrance, it shall be verified that the site accurately reflects water temperature within 10 meters of the entrance or exit.

b.5. Project Fisheries will submit temperature data to the Fish Passage Center (FPC) on a weekly basis for posting online at: http://www.fpc.org/river/Q_ladderwatertempgraph.php.

2.4.2.3. Head on all entrances: 1'–2' (1.5' optimum). Refer to **section 4.3.1** when unable to achieve head criteria.

2.4.2.4. Water velocity of 1.5–4.0 fps (2 fps optimum) shall be maintained for full length of the powerhouse collection channel and the lower ends of fish ladders that are below the tailwater. Fishway channel water velocities will be measured three times weekly, daily preferred, during adult fish passage (Mar 1 – Dec 1) part of the fishway inspection program. Floats will be timed through all fishway channels that are supplemented by auxiliary water. Results will be provided in the project weekly fishway status report.

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

2.4.2.6. Necessary staff gauges and water level indicators will be readable at all water levels encountered during the fish passage period and accuracy checked weekly. Instruments will be cleaned and/or recalibrated when necessary and ASAP.

2.4.2.7. Main entrance weir depths at 8' or greater below tailwater. Maintain a minimum tailwater at 70' msl to remain in entrance weir criteria operating range (regulated by RCC).

2.4.2.8. Adult Fish Counts. The current fish counting program schedule is in **Table TDA-2**. Count station crowders and picket leads shall remain in operating position while visual counting, videotaping and/or PIT-tag antenna operation is being conducted.

2.4.2.8.a. The crowder shall be opened to full count slot width when not counting. During counting, the crowder shall be open as far as possible to allow accurate counting and shall not be closed to less than 18". This will usually occur during high turbidity conditions to allow count accuracy criteria to be achieved. Crowder ranges are:

i. TDA-East = 20–34"

ii. TDA-North = 18–38"

2.4.2.8.b. If passage is impaired by this condition, the count slot may be widened until proper passage conditions are achieved, even though count accuracy may be compromised to some degree.

2.4.2.8.c. Project biologists, FFU, and the fish count supervisor shall coordinate to achieve optimum count slot passage and/or count accuracy conditions.

2.4.2.8.d. If counting is temporarily discontinued due to unscheduled events, the crowder shall be fully opened.

2.4.2.8.e. The crowder may remain in operating position during the counters' hourly ten-minute break period.

2.4.2.9. Ice & Trash Sluiceway (ITS). March 1–31: operate ITS 24 hrs/day for adult fallback and steelhead kelt passage (**Table TDA-4**). Open ITS gates 1-2, 1-3 over operating MU-1, and gates 18-1, 18-2 over operating MU-18. If either of these MUs are out of service, operate the next available MU and associated adjacent gates (i.e., if MU-1 is OOS, operate MU-2 w/gates; if MU-18 is OOS, operate MU-17 w/gates or MU-19 w/gates).

2.4.2.10. East Fishway.

2.4.2.10.a. Removable weirs #154 -#157 will drop into the ladder at a differential (water surface at respective weir location relative to the forebay) of 1.0' ±0.1'.

2.4.2.10.b. Telescoping weir #159 will adjust to maintain 1.1' ±0.1' depth over the weirs, measured below the counting station.

2.4.2.10.c. Telescoping weir #158 will track 1.0' ±0.1' below weir #159 at all times during fishway operation.

2.4.2.11. North Fishway Entrance. Operate one entrance weir, N1. Project biologists will work in conjunction with Wasco County to maintain fishway entrances within criteria.

2.4.2.12. Powerhouse.

2.4.2.12.a. West PH Entrance. Operate entrance weirs W1 and W2 to maintain a gate crest of 8' or greater below tailwater. W3 will be closed at 81'msl, but remain operational as backup to W1 and W2.

2.4.2.12.b. East PH Entrance. Operate entrance weirs E2 and E3 to maintain a gate crest of 8'or greater below tailwater, currently operated at 13'below tailwater. Weir E1 to be closed at 81' msl but will remain operational. At lower range of tailwater elevation, E1 may be operated manually at any depth to provide criteria entrance differential.

2.4.2.12.c. Operate east ladder junction pool weirs at the following minimum depths in relation to east entrance tailwater surface elevation: JP6..... >7'

2.4.2.12.d. South Spillway Entrance. Operate entrance weirs S1 and S2 to maintain a gate crest at 8' or greater below tailwater.

2.4.2.12.e. Discharge from the two operating fish units will be adjusted to maintain criteria at all associated fishway entrances. Discharge volume is dependent on criteria levels at entrances.

2.4.2.13. Ladder Crowding. Beginning September 1 (after spill for juvenile fish passage has ended), Project personnel should assess ladder crowding daily during peak seasonal passage periods. If daily East Fishway passage count exceeds 25,000 combined adult salmonids per day (20,000 if ladder temperatures are above 70°F), the following guidance will apply:

i. Inspectors shall walk entire East Fishway ladder, exit to east entrance, twice daily. Observations and picture recording will be made at the pool between 157 and 158, the pool downstream of count station, and the pool at the 180° bend in the ladder.

ii. During East Fishway passage exceeding 35,000 combined adult salmonids per day (30,000 if ladder temperatures are above 70°F), if Project Biologists identify a fish crowding emergency, or if any adult salmonid mortality is observed anywhere in the fishway, attempt to alleviate crowding by immediately notifying the control room to coordinate with BPA and implement an emergency spill operation as soon as possible: currently 15 kcfs total = 6 kcfs (4 stops) from bay 1 and 4.5 kcfs (3 stops) each from bays 7 and 8. This operation and daily coordination with FPOM will continue as long as fish passage counts are greater than or equal to project passage (both ladders) when the operation started, or unless otherwise determined by FPOM.

iii. If inspectors see crowding that is not an emergency but is cause for concern, FPOM will be consulted to evaluate the situation. If the team determines the crowding situation is severe enough, the spill operation will be implemented as defined above.

3. FISH FACILITIES MONITORING & REPORTING

3.1. Inspections.

3.1.1. The results of all inspections and the readiness of the facilities for operation will be reported to the FPOM at the meeting immediately prior to the fish passage season.

3.1.2. During fish passage season, fish passage facilities will be inspected at least twice/day, seven days/week to assure operation according to established criteria. A third inspection will be made using the data logging system. Entrance conditions for the previous 24 hours will be checked daily for entrance criteria.

3.1.3. During winter maintenance, fish passage facilities will be inspected once/day, seven days/week.

3.1.4. More frequent inspections of some facility components will occur as noted in the text.

3.1.5. Additional fishway inspections may be performed by FFU and fish agencies.

3.2. Zebra Mussel Monitoring.

3.2.1. A zebra mussel monitoring program will continue. These organisms have become a serious problem elsewhere in the country and may become introduced into the Columbia River basin. Inspections should also be made when dewatering all project facilities.

3.3. Reporting.

3.3.1. Project biologists shall prepare weekly reports throughout the year summarizing project operations. The weekly reports will provide an overview of how the project and the fish passage facilities operated during the week and an evaluation of resulting fish passage conditions. The reports shall include:

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

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

iii. Adult fishway control calibrations;

iv. AWS closures (i.e. cleaning times);

v. Any unusual activities at the project that may affect fish passage.

3.3.2. The weekly reports shall cover Sunday through Saturday and they shall be e-mailed to CENWP-OD and other interested parties as soon as possible the following week, with a copy to CENWD-PDW-R (RCC).

3.3.3. ***Memorandum for the Record*** **(MFR)** shall be prepared by Project biologists for any adverse or negative impact to fish or fishways. See **FPP Chapter 1 – Overview** for the MFR template. The MFR will be sent to FPOM by the next working day and added to the next FPOM agenda for review.

3.3.4. The project biologists shall prepare an annual report by January 31, summarizing the operation of the project fish passage facilities for the previous year.

3.3.4.1. The report will cover from the beginning of one adult fish facility winter maintenance period to the beginning of the next.

3.3.4.2. The annual report also will 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.

3.3.4.3. The annual report will be provided to CENWP-OD in time for distribution to FPOM members at the February meeting.

4. FISH FACILITIES MAINTENANCE

4.1. General.

4.1.1. Routine Maintenance.

4.1.1.1. Staff gauges will be installed, cleaned, and/or repaired as required**.**

4.1.1.2. The zebra mussel monitoring program will continue. This includes veliger sampling, colonization sample units, and dewatering inspections. These organisms have become a serious problem elsewhere in the country and may become introduced into the Columbia River basin.

4.1.1.3. Routine fishway maintenance, to the extent practicable, will be conducted during periods when passage has been documented to be at its lowest to minimize impacts to migrating salmonids. Maintenance activities that occur during the fish passage period and that may affect fish passage will be reported in the weekly reports.

4.2. Maintenance - Juvenile Fish Facilities.

4.2.1. Routine Maintenance.

4.2.1.1. Collection and Transportation Systems. The Dalles Dam Ice & Trash Sluiceway (ITS) will receive preventive maintenance throughout the year. During the juvenile fish passage season, this will normally be above water work, such as maintenance of automatic systems, air lines, electrical systems, and monitoring equipment. The system is visually inspected in all accessible areas for damaged equipment and areas that may cause problems to the juvenile fish. Any problem areas identified are repaired and modifications to the channel and general maintenance are completed.

4.2.1.2. Turbines and Spillways. Maintenance and routine repair of project turbines and spillways is a regular and recurring process that requires units to be shut down for extended periods (see **Appendix F, Dewatering Plans**). Maintenance schedules are reviewed by Project and District biologists and coordinated within NWP, NWD, BPA, and among fish agencies and tribes through FPOM. Certain turbine and spillway discharges at the projects are secondarily used to attract adult fish to the fishway entrance areas, thus maintenance schedules for these turbines and spillways will reflect equal weight given to fish, power and water management, and will be coordinated with the appropriate resource agencies. No other fish-related restrictions regarding maintenance will be placed on any units at this project, except to coordinate research activities. Some types of turbine maintenance will require testing the turbine operation throughout its full range before returning it to normal service. Units which should receive low priority for scheduling maintenance during the fish passage season are: F1, F2, 1, 2, 3, 4, 8, and 18 (during ITS operation). The trash racks are raked if necessary as determined by ROV inspection just prior to the juvenile fish passage season (April 1), between June 1 and June 15, and whenever trash accumulations are suspected because of increased head across the trash racks.

4.2.2. Non-Routine Maintenance. Maintenance of all fish-related facilities will be carried out as described below. Unscheduled maintenance that will have a significant impact on juvenile fish passage shall be coordinated through FPOM on a case-by-case basis by Project and CENWP-OD biologists. See **FPP Chapter 1 - Overview** for *Memo of Coordination* (MOC) instructions and template. The CENWP-OD biologists will be notified as soon as possible after it becomes apparent that maintenance and/or repairs are required. The Operations Project Manager has the authority to initiate work prior to notifying CENWP-OD when delay of work will result in unsafe situations for people, property, or fish.

4.2.2.1. Collection and Transportation Systems. The Ice & Trash Sluiceway (ITS) is now being used as a juvenile surface passage route.

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

4.2.2.1.b. If a gate hoist fails, it will be repaired promptly. The gate will be removed when there are problems with the seal and the difficulty cannot be repaired promptly. If the epoxy- lined section of the sluiceway is damaged, it will be repaired.

4.2.2.1.c. To prepare a turbine for dewatering, the ice/trash sluiceway can be temporarily closed to install a gatewell orifice plug.

4.2.2.2. Turbines and Spillways - Spill Gate Failure. If a spill gate becomes inoperable, the operators will make necessary changes to accommodate spill and then immediately notify the Project Operations supervisor and the project biologist to determine the best pattern to follow until repairs can be made. This interim operation shall be coordinated with FPOM and FFDRWG through the CENWP-OD biologist, who will, depending on coordination, provide additional guidance to the project (see also section **2.2.**).

4.3. Maintenance - Adult Fish Facilities.

4.3.1. Routine Maintenance. Maintenance activities that occur during the fish passage period and that may affect fish passage will be reported in the weekly reports.

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

4.3.1.2. Powerhouse and Spillway Adult Collection Systems. Preventive maintenance and repair occurs throughout the year. During the adult fish passage season the maintenance will not involve any operations that will cause a failure to comply with the fishway criteria, unless specially coordinated. Inspection of those parts of the adult collection channel systems, such as diffusion gratings, picket leads, and entrance gates, will be scheduled once per year during the winter maintenance period while the system is dewatered. An inspection during the first week of August with the system watered up will also be conducted (see **section 5**). A diver

or underwater video system may be used for underwater inspections. Any non-routine maintenance and fishway modification will be handled on a case-by-case basis.

4.3.1.2.a. The project fish biologist or alternate Corps fish personnel will attend all dewatering activities potentially involving fish, as well as inspections to provide fish input.

4.3.1.3. Adult Fish Ladders and Counting Stations. The adult fish ladders will be dewatered once each year during the winter maintenance period. Unless specially coordinated, only one ladder will be dewatered at a time, with the other ladder capable of operating within criteria. During this time, the ladders are inspected for blocked orifices, projections into the fishway that may injure fish, stability of the weirs, damaged picket leads, exit gate problems, loose diffuser valves, ladder orifice reduction plates, malfunctioning equipment at the counting stations, and other potential problems. Problems identified throughout the passage year that do not affect fish passage, as well as those identified during the dewatered period are then repaired. Trashracks at the ladder exits and the north AWS intake will be raked when criteria are exceeded. Rake trashracks between 1100 and one hour prior to sunset. Fish count station windows will be cleaned when necessary, and when practicable.

4.3.2. Non-Routine Maintenance. Maintenance activities that occur during the fish passage period and that may affect fish passage will be reported in the weekly reports. Non-routine maintenance that will significantly affect the operation of a facility, such as repair of displaced diffuser gratings, will be coordinated with the Region, through FPOM. Coordination procedures for non-routine maintenance of adult facilities are the same as for juvenile facilities (**section 4.2.2** and **FPP Chapter 1 - Overview**).

4.3.2.1. Fishway Auxiliary Water Systems. Most fishway auxiliary water systems operate automatically. If the automatic system fails, the system will be manually operated by the project personnel until the system is repaired. When this operation becomes necessary, project personnel will increase surveillance on the adult system to ensure that criteria are being met. In the event of AWS failure, FPOM will work with the project to determine the best operating procedure.

4.3.2.1.a. Powerhouse. If one of the two fishway auxiliary water turbines fails or malfunctions for any duration, use the following sequential procedure until a fishway entrance head of 1' is achieved:

i. Increase discharge of remaining operating fish unit to maximum capacity.

ii. Close entrance weir S1.

iii. Set junction pool weirs 4 and 6 to no less than 4’ below junction pool elevation.

iv. Raise entrance weir E2 and E3 to 8’ depth below tailwater.

~~ii.~~**v.** Close 2 to 3 south entrance diffuser valves.

~~iii.~~**vi.** Close entrance weir S2 in 1’ increments.

~~iv.~~vii. Close entrance weir W2 in 1' increments.

~~v.~~viii. Close entrance weir W1 in 1' increments.

~~vi.~~ix. Differentials for open entrances should be checked between each of the steps above.

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

i. Raise the south entrance weirs to elevation 81'msl (closed position).

ii. Close west entrance.

iii. Close entrance weir E1 and E2 and keep E3 at 6' depth.

iv. Open two available fish lock valves and associated four diffusers to provide most possible water to the east auxiliary water system.

4.3.2.1.c. North Ladder. If the North Wasco County power unit auxiliary water system fails, the backup auxiliary water system will be started and the system operated at criteria. If the backup auxiliary water system fails, N1 will remain open with a weir depth of 6' below the tailwater surface.

4.3.2.2. Powerhouse and Spillway Adult Fish Collection Systems. The Dalles Dam contains several types of fishway entrances. In most cases, if failures occur, the entrance will be operated manually by project personnel until repairs are made. If this operation becomes necessary, project personnel will increase surveillance on the adult system to ensure criteria are being met. In those cases in which the failure will not allow the entrance to be operated manually, the gate will be maintained, to the extent possible, in an operational position. If this is not possible, the entrance will be repaired expediently, and it will be returned to manual or automatic control at the earliest possible date.

4.3.2.3. Adult Fish Ladders and Counting Stations. The ladder structures include picket leads, counting stations, fishway exits, and overflow weirs with orifices. Picket leads with excessive spacing (greater than 1") erosion of concrete around the picket leads, or missing pickets can allow fish into areas where escape is not likely. If picket lead failure or concrete erosion occurs, then the timing and method of repair will depend upon the severity of the problem. The decision of whether or not to dewater the fishway and repair any problem will be made in coordination with the fish agencies and tribes through the FPOM.

4.3.2.4. 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 passage system and physically inspecting the diffuser gratings, or 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. If a diffuser grating is known to or suspected of having moved, creating an opening into a diffuser chamber, close associated diffuser valve

ASAP. Efforts must immediately be taken to correct the situation and minimize impacts on adult fish in the fishway. 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 FPOM coordination procedure. Repairs shall be made as quickly as possible unless coordinated differently.

5. TURBINE UNIT OPERATION & MAINTENANCE

5.1. Turbine Unit Priority Order.

5.1.1. Through the juvenile fish passage season, April 1 – November 30, *and* from March 1–31 and December 1–15 to aid adult steelhead fallbacks or kelts, either turbine unit 1 and/or unit 2 will operate during daylight hours unless specially coordinated with FPOM. In order to provide favorable adult fish passage conditions while meeting transmission line needs, the main powerhouse turbine units will operate in the priority defined in **Table TDA-5** below (excluding synchronous condenser unit operation at units 15-20).

Table TDA-5. Turbine Unit Operating Priorities at The Dalles Dam.

PERIOD	PRIORITY
Fish Passage Season: April 1–November 30 If additional units needed, operate one unit from each block moving west to east. Repeat as necessary.	**1, 8, 18*** block 2-4, block 5-7, block 9-12, block 13-16, block 17-22
December 1 – December 15	1 and/or 18†
December 16 – end of February	1-22 in any order
March 1 – March 31	1 and/or 18†

*April-November (fish passage season): Units under open sluice gates 1, 8, 18 (**Table TDA-4**).

† March and December operation for adult fallbacks and kelt passage: Units 1 and 18 must be operated with two open sluice gates per unit (**Table TDA-4**).

5.2. Turbine Unit Operating Range.

5.2.1. From April 1 through October 31, turbine units will be operated within ±1% of peak turbine efficiency (1% range), as specified in the *BPA Load Shaping Guidelines* (**Appendix C**). Turbine unit flow and power output at the lower and upper limits of the 1% range for various heads are defined in **Table TDA-6.** While not required to do so in the off-season, units will normally be operated within the 1% range since it is the optimum point for maximizing energy output of a given unit of water over time. Operation outside the 1% range is allowed if needed for power generation or other needs.

5.2.2. When necessary to operate turbines outside of the 1% range, units will be selected according to the following guidance: Units 7 through 14 will be selected first, spacing by at least

one unit. For example, the following sequence might be used (assumes units are available): 7, 9, 11, 13, 15, 5, 2, 1, 8, etc. Since each successive unit in this order is thought to pass more fish, this outage priority order is intended to have a lower negative impact on fish during turbine unit passage, if units are taken out of service in this order.

5.3. Turbine Unit Maintenance

5.3.1. Maintenance Schedule. The project turbine unit maintenance schedules will be reviewed by project and district biologists for fish impacts and be coordinated with FPOM.

5.3.2. Operational Testing.

5.3.2.1. Pre-Maintenance: 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% range to allow pre-maintenance measurements and testing and to allow all fish to move through the unit.

5.3.2.2. Post-Maintenance: 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% range) before it is returned to operational status.

5.3.2.3. Operational testing of a unit under maintenance is in addition to a unit in run status required for power plant reliability. Operational testing may deviate from FPP priority order and may require water that would otherwise be used for spill if the unit running for reliability is at its 1% lower limit (i.e., minimum generation). Water for operational testing will be used from powerhouse allocation when possible, and diverted from spill only to the extent necessary to maintain generation system reliability.

5.3.3. To reduce the chance of debris washing onto the tail log sill during tail log installation in units 19 through 22, fish unit loading may be reduced to about 8 MW for 30-60 minutes. Entrance weir E1 may be closed for the same duration.

5.3.4. Wicket gate opening for functional testing on a watered-up unit will be no longer than 15 minutes total open time.

6. DEWATERING PLANS

6.1. General.

6.1.1. *Guidelines for Dewatering and Fish Handling* (**Appendix** F) have been developed by the projects and approved by FPOM, and are followed for most project facility dewaterings. The plans include consideration for fish safety and are consistent with the following general guidance. The appropriate plans are reviewed by participants before each salvage operation. *Dewatering Plans* are available online at:
www.nwd-wc.usace.army.mil/tmt/documents/FPOM/2010/

6.1.2. The project fish biologist and/or alternate Corps fish personnel will attend all project activities involving fish handling.

6.1.3. The fish agencies and tribes are encouraged to participate in all ladder dewaterings.

6.2. Dewatering - Juvenile Bypass Systems. [*not applicable for TDA*]

6.3. Dewatering - Adult Fish Ladder.

6.3.1. Routine Maintenance.

6.3.1.1. When possible, operate the ladder to be dewatered at orifice flow with the AWS off for at least 24 hours, but not more than 96 hours prior to dewatering.

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

6.3.1.3. Project personnel will install exit bulkheads to shut down ladder flow. Where possible, a minimum flow of 1"-2" will be maintained in the ladder until fish are rescued.

6.3.1.4. The project biologist or alternate Corps fish personnel will oversee fish rescue when the ladders are dewatered. The fish are then transported to the forebay or tailwater, depending on the fish life stage (adults to forebay, juveniles to tailrace), for release. If a ladder is dewatered in the spring or summer, identifiable steelhead kelts should be released into the tailrace.

6.3.1.5. Orifice blocking devices, with attachment ropes tied to handrails may be placed in the lower-most weirs to prevent fish from re-ascending the dewatered portion of the adult fishway. Use of orifice blocking devices will be at the discretion of the project biologist. The fishway return-to-service checklist is as follows:

i. Remove orifice blocking devices if used.

ii. Activate automation for systems.

iii. Assure all count station lighting is operational.

iv. Open count station crowder

v. Close picket leads.

vi. Remove all tools, equipment, and debris from inside ladder.

6.3.2. Non-Routine Maintenance.

6.3.2.1. Follow steps in **section 6.3.1** above. When possible, discontinue fishway auxiliary water and operate ladder at reduced flow as long as possible (prefer 3-24 hours) prior to dewatering.

6.4. Dewatering - Powerhouse Collection System Routine Maintenance.

6.4.1. During the pumping or draining operation to dewater a portion or the entire collection channel, the water level will not be allowed to drop so low it strands fish. Personnel shall remain present onsite during pumping operations to ensure stranding does not occur or a water level sensor that de-activates the dewatering process will be used.

6.4.2. The project biologist will ensure that rescue equipment is available if needed.

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

6.5. Dewatering – Turbine Units.

6.5.1. Gatewells need not be dipped as is required at other projects due to the lack of VBSs. Immediately before draining it will be operated at speed/no load briefly to flush fish out of the draft tube.

6.5.2. If the turbine unit draft tube is dewatered, operate unit with full load for a minimum 15 minutes prior to immediately installing tail logs. If not possible to load, run unit at speed-no-load for minimum 15 minutes. Install bottom two tail logs side-by-side first before stacking the remainder to minimize sturgeon from entering the draft tube before dewatering. This is necessary for both scheduled and unscheduled outages.

6.5.3. If a turbine unit is idle and partially dewatered, and tail logs are put into place, an adequate safety pool may be maintained for up to 4 days to accommodate fish trapped in the draft tube (If longer timeframes are needed for the safety pool, project fisheries will coordinate with FPOM on a case-by-case basis). The safety pool will be maintained at an appropriate level which will be determined by the project biologist.

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

6.6. Dewatering - Navigation Lock.

6.6.1. The navigation lock is frequently dewatered for routine maintenance in late February/early March, in conjunction with navigation lock outages at Bonneville and John Day dams.

6.6.2. The area between the upstream bulkhead and the upstream gate is surveyed for fish as water levels allow. The lateral and pool areas on the floor of the lock are surveyed for fish from above. Most of these areas remain full of water, precluding the ability to implement successful fish salvage operations. Areas where water levels slowly decrease are accessed via crane when pool levels reach a depth of approximately 3 feet. The fill conduits are accessed and checked for fish only if needed and can be done safely. All salvaged fish are removed, transported via bag or tank and released to the river.

7. FOREBAY DEBRIS REMOVAL

7.1.1. Debris at projects can impact fish passage conditions. It can plug or block trashracks, gatewell orifices, dewatering screens, separators, and facility piping resulting in impingement, injuries, and descaling of fish. 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.

7.1.2. Special spill operations that don't follow the normal spill schedule or volume limits will be coordinated prior to their execution. Normally, the project shall contact CENWP-OD at least two workdays prior to the day the special operation is required. Using information provided by the project, CENWP-OD will coordinate with FPOM and with RCC, as necessary. Once the coordination is complete, RCC will issue a teletype detailing the special operations.

8. RESPONSE TO HAZARDOUS MATERIALS SPILLS

8.1.1. The Dalles Project's guidance for responding to hazardous substance spills is contained in the Emergency Spill Response Plan.

8.1.2. In the event of a hazardous materials spill, the Project Biologist has the authority to make fishway adjustments outside of operating criteria as necessary to prevent contamination of the ladder until unified command is formed and consultation is established with FPOM. NOAA Fisheries will be notified within 24 hours of a ladder closure.

8.1.3. Project Fisheries will be contacted as soon as possible after a hazardous material release and prior to any modification to fishway operations. The project biologist will in turn contact the CENWP-OD biologist and FPOM. Attempts should be made to first contact the project biologist on duty. During fish passage season there is a project biologist on duty seven days a week. If a project biologist cannot be reached by radio or in the office, attempts to contact Project Fisheries will occur in the following order (home & mobile #s available in Control Room):

i. Bob Cordie

ii. Jeff Randall

iii. Gabriel Forrester

iv. Tammy Mackey

Table TDA-6. The Dalles Dam Turbine Unit Power (MW) and Flow (cfs) at Upper and Lower Limits of the ±1% Peak Efficiency Operating Range. [1]

Project Head (feet)	Turbine Units 1-14				Turbine Units 15-22			
	1% Lower Limit		1% Upper Limit		1% Lower Limit		1% Upper Limit	
	MW	cfs	MW	cfs	MW	cfs	MW	cfs
55	35.1	8,854	44.1	11,108	38.5	9,643	49.3	12,346
56	35.9	8,875	45.1	11,147	39.0	9,554	50.6	12,402
57	36.7	8,894	46.2	11,184	39.4	9,468	51.9	12,454
58	37.5	8,912	47.2	11,219	39.9	9,384	53.2	12,503
59	38.3	8,929	48.3	11,252	40.4	9,302	54.4	12,548
60	39.1	8,945	49.4	11,282	40.8	9,223	55.7	12,590
61	39.5	8,870	50.8	11,415	41.6	9,219	56.8	12,599
62	39.9	8,798	52.3	11,543	42.3	9,215	57.9	12,607
63	40.3	8,728	53.8	11,665	43.0	9,211	58.9	12,613
64	40.7	8,660	55.3	11,783	43.8	9,207	60.0	12,619
65	41.0	8,593	56.8	11,896	44.5	9,202	61.1	12,624
66	41.8	8,614	58.0	11,939	45.1	9,164	62.5	12,719
67	42.6	8,633	59.2	11,980	45.6	9,127	64.0	12,810
68	43.4	8,652	60.3	12,019	46.1	9,091	65.5	12,899
69	44.2	8,670	61.5	12,056	46.7	9,056	66.9	12,984
70	45.0	8,686	62.7	12,092	47.2	9,021	68.4	13,066
71	45.8	8,693	63.7	12,111	47.9	9,019	70.0	13,168
72	46.5	8,700	64.5	12,067	48.6	9,016	70.6	13,105
73	47.2	8,706	65.2	12,024	49.3	9,014	71.3	13,043
74	47.9	8,712	65.9	11,982	50.0	9,011	72.0	12,983
75	48.6	8,717	68.0	12,179	50.7	9,008	76.2	13,542
76	49.1	8,673	69.2	12,226	51.3	8,984	77.8	13,638
77	49.5	8,629	70.4	12,270	51.8	8,960	79.4	13,731
78	49.9	8,587	71.6	12,314	52.4	8,936	81.0	13,821
79	50.4	8,545	72.8	12,356	53.0	8,913	82.6	13,908
80	50.8	8,505	74.0	12,396	53.5	8,891	84.3	13,993
81	51.4	8,493	75.4	12,471	54.2	8,896	85.9	14,092
82	52.0	8,482	76.8	12,543	54.9	8,902	87.5	14,188
83	52.5	8,471	78.2	12,613	55.6	8,908	89.2	14,283
84	53.1	8,460	79.6	12,681	56.3	8,914	90.8	14,375
85	53.7	8,449	81.0	12,748	57.0	8,919	92.4	14,465
86	54.3	8,441	82.5	12,833	57.5	8,898	94.1	14,564
87	54.9	8,433	84.0	12,916	58.0	8,877	95.8	14,660
88	55.5	8,425	85.6	12,997	58.5	8,856	97.4	14,755
89	56.0	8,417	87.1	13,076	59.0	8,836	98.7	14,786
90	56.6	8,409	88.6	13,154	59.5	8,817	98.7	14,602
91	57.3	8,411	89.7	13,236	60.1	8,815	98.7	14,429
92	57.9	8,414	89.7	13,080	60.8	8,813	98.7	14,260
93	58.6	8,416	89.7	12,928	61.4	8,811	98.7	14,094
94	59.2	8,418	89.7	12,779	62.1	8,809	98.7	13,932
95	59.8	8,420	89.7	12,634	62.7	8,808	98.7	13,773

1. Table values based on information provided by HDC in 2001, 2002 (table revised 2006).

Table TDA-7. [*pg 1 of 5*] The Dalles Dam Spill Patterns for Juvenile Fish Passage at 40% of Total Project Outflow. *See notes at end of table.*

PROJECT OUTFLOW			SPILL			TDA 40% Spill Patterns Vertical Gate Opening (ft) per Spillbay [a, b]																					Total	
Total	Range (kcfs)		Total	% Range [c]																							Open	
(kcfs)	Low	High	(kcfs)	Low	High	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	(ft)	Note
61.7	61.7	62.5	11.7	18.7%	19.0%							4	4																8	c, d
63.2	62.5	63.9	13.2	20.7%	21.1%							4.5	4.5																9	c, d
64.6	63.9	65.4	14.6	22.3%	22.8%							5	5																10	c, d
66.1	65.4	66.9	16.1	24.1%	24.6%							5.5	5.5																11	c, d
67.6	66.9	68.3	17.6	25.8%	26.3%							6	6																12	c, d
69.0	68.3	69.8	19.0	27.2%	27.8%							6.5	6.5																13	c, d
70.5	69.8	71.2	20.5	28.8%	29.4%							7	7																14	c, d
71.9	71.2	72.6	21.9	30.2%	30.8%							7.5	7.5																15	c, d
73.3	72.6	74.1	23.3	31.5%	32.1%							8	8																16	c, d
74.8	74.1	75.5	24.8	32.8%	33.5%							8.5	8.5																17	c, d
76.2	75.5	77.0	26.2	34.0%	34.7%							9	9																18	c, d
77.7	77.0	78.4	27.7	35.3%	36.0%							9.5	9.5																19	c, d
79.1	78.4	79.8	29.1	36.5%	37.1%							10	10																20	c, d
80.5	79.8	81.2	30.5	37.6%	38.2%							10.5	10.5																21	c, d
81.9	81.2	82.6	31.9	38.6%	39.3%							11	11																22	c, d
83.3	82.6	85.2	33.3	39.1%	40.3%							11.5	11.5																23	c, d
87.0	85.2	87.4	34.8	39.8%	40.9%							12	12																24	c
87.8	87.4	90.0	35.1	39.0%	40.2%			4	4	4	4	4	4																24	c
92.3	90.0	95.5	36.9	38.6%	41.0%			4.2	4.2	4.2	4.2	4.2	4.2																25.2	c, e
98.8	95.5	100.6	39.5	39.3%	41.4%			4.5	4.5	4.5	4.5	4.5	4.5																27	c, e
102.5	100.6	105.0	41.0	39.0%	40.7%		4	4	4	4	4	4	4																28	c
107.5	105.0	111.4	43.0	38.6%	41.0%		4.2	4.2	4.2	4.2	4.2	4.2	4.2																29.4	c, e
115.3	111.4	116.1	46.1	39.7%	41.4%		4.5	4.5	4.5	4.5	4.5	4.5	4.5																31.5	c, e
117.0	116.1	120.0	46.8	39.0%	40.3%	4	4	4	4	4	4	4	4																32	c
123.0	120.0	127.4	49.2	38.6%	41.0%	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2																33.6	c, e
131.8	127.4	134.8	52.7	39.1%	41.4%	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5																36	c, e
137.8	134.8	142.0	55.1	38.8%	40.9%	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7																37.6	c, e
146.3	142.0	149.3	58.5	39.2%	41.2%	5	5	5	5	5	5	5	5																40	c, e
152.3	149.3	156.6	60.9	38.9%	40.8%	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2																41.6	c, e
161.0	156.6	163.9	64.4	39.3%	41.1%	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5																44	c, e
166.8	163.9	171.1	66.7	39.0%	40.7%	5.7	5.7	5.7	5.7	5.7	5.7	5.7	5.7																45.6	c
175.5	171.1	178.4	70.2	39.4%	41.0%	6	6	6	6	6	6	6	6																48	c

PROJECT OUTFLOW			SPILL			TDA 40% Spill Patterns Vertical Gate Opening (ft) per Spillbay [a, b]																				Total Open	
Total	Range (kcfs)		Total	% Range [c]																							
(kcfs)	Low	High	(kcfs)	Low	High	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	(ft)	Note
181.3	178.4	185.6	72.5	39.1%	40.6%	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2																49.6	c
190.0	185.6	193.0	76.0	39.4%	40.9%	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5																52	c
196.0	193.0	200.4	78.4	39.1%	40.6%	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7																53.6	c
204.8	200.4	207.6	81.9	39.4%	40.9%	7	7	7	7	7	7	7	7																56	c
210.5	207.6	214.8	84.2	39.2%	40.6%	7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.2																57.6	c
219.0	214.8	221.9	87.6	39.5%	40.8%	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5																60	c
224.8	221.9	229.0	89.9	39.3%	40.5%	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7																61.6	c
233.3	229.0	236.1	93.3	39.5%	40.7%	8	8	8	8	8	8	8	8																64	c
239.0	236.1	243.4	95.6	39.3%	40.5%	8.2	8.2	8.2	8.2	8.2	8.2	8.2	8.2																65.6	c
247.8	243.4	250.6	99.1	39.5%	40.7%	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5																68	c
253.5	250.6	257.9	101.4	39.3%	40.5%	8.7	8.7	8.7	8.7	8.7	8.7	8.7	8.7																69.6	c
262.3	257.9	265.1	104.9	39.6%	40.7%	9	9	9	9	9	9	9	9																72	c
268.0	265.1	272.4	107.2	39.4%	40.4%	9.2	9.2	9.2	9.2	9.2	9.2	9.2	9.2																73.6	c
276.8	272.4	279.6	110.7	39.6%	40.6%	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5																76	c
282.5	279.6	286.6	113.0	39.4%	40.4%	9.7	9.7	9.7	9.7	9.7	9.7	9.7	9.7																77.6	c
290.8	286.6	293.6	116.3	39.6%	40.6%	10	10	10	10	10	10	10	10																80	c
296.5	293.6	300.6	118.6	39.5%	40.4%	10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2																81.6	c
304.8	300.6	307.6	121.9	39.6%	40.5%	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5																84	c
310.5	307.6	314.9	124.2	39.4%	40.4%	10.7	10.7	10.7	10.7	10.7	10.7	10.7	10.7																85.6	c
319.3	314.9	322.0	127.7	39.7%	40.6%	11	11	11	11	11	11	11	11																88	c
324.8	322.0	329.1	129.9	39.5%	40.3%	11.2	11.2	11.2	11.2	11.2	11.2	11.2	11.2																89.6	c
333.5	329.1	336.4	133.4	39.7%	40.5%	11.5	11.5	11.5	11.5	11.5	11.5	11.5	11.5																92	c
339.3	336.4	343.5	135.7	39.5%	40.3%	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7																93.6	c
347.8	343.5	350.5	139.1	39.7%	40.5%	12	12	12	12	12	12	12	12																96	c
353.3	350.5	357.4	141.3	39.5%	40.3%	12.2	12.2	12.2	12.2	12.2	12.2	12.2	12.2																97.6	c
361.5	357.4	364.3	144.6	39.7%	40.5%	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5																100	c
367.0	364.3	371.3	146.8	39.5%	40.3%	12.7	12.7	12.7	12.7	12.7	12.7	12.7	12.7																102	c
375.5	371.3	378.4	150.2	39.7%	40.5%	13	13	13	13	13	13	13	13																104	c
381.3	378.4	385.4	152.5	39.6%	40.3%	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2																106	c
389.5	385.4	392.3	155.8	39.7%	40.4%	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5																108	c
395.0	392.3	399.1	158.0	39.6%	40.3%	13.7	13.7	13.7	13.7	13.7	13.7	13.7	13.7																110	c
403.3	399.1	406.0	161.3	39.7%	40.4%	14	14	14	14	14	14	14	14																112	c, f
408.8	406.0	413.0	163.5	39.6%	40.3%	14.2	14.2	14.2	14.2	14.2	14.2	14.2	14.2																114	c

PROJECT OUTFLOW			SPILL			TDA 40% Spill Patterns Vertical Gate Opening (ft) per Spillbay [a, b]																				Total Open	
Total (kcfs)	Range (kcfs) Low	High	Total (kcfs)	% Range [c] Low	High	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	(ft)	Note
417.3	413.0	420.0	166.9	39.7%	40.4%	14.5	14.5	14.5	14.5	14.5	14.5	14.5	14.5																116	c
422.8	420.0	433.9	169.1	39.0%	40.3%	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7																118	c
445.0			175.0	39.3%		14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7				4												122	
450.8			180.8	40.1%		14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7				4		4										126	
456.7			186.7	40.9%		14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7				4		4	4									130	
462.5			192.5	41.6%		14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7				4		4	4		4							134	
468.4			198.4	42.4%		14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7				4		4	4		4			4				138	
474.2			204.2	43.1%		14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7				4		4	4		4			4	4			142	
480.1			210.1	43.8%		14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7				4		4	4		4			4	4	4		146	
485.9			215.9	44.4%		14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7				8		4	4		4			4	4	4		150	
491.7			221.7	45.1%		14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7				8		8	4		4			4	4	4		154	
497.5			227.5	45.7%		14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7				8		8	8		4			4	4	4		158	
503.3			233.3	46.4%		14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7				8		8	8		8			4	4	4		162	
509.1			239.1	47.0%		14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7				8		8	8		8			8	4	4		166	
515.0			245.0	47.6%		14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7				8		8	8		8			8	8	4		170	
520.8			250.8	48.2%		14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7				8		8	8		8			8	8	8		174	
526.5			256.5	48.7%		14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7				12		8	8		8			8	8	8		178	
532.2			262.2	49.3%		14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7				12		12	8		8			8	8	8		182	
537.9			267.9	49.8%		14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7				12		12	12		8			8	8	8		186	
543.7			273.7	50.3%		14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7				12		12	12		12			8	8	8		190	
549.4			279.4	50.9%		14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7				12		12	12		12			12	8	8		194	
555.1			285.1	51.4%		14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7				12		12	12		12			12	12	8		198	
563.3			293.3	52.1%		14.7	14.7	15	15	15	15	15	15				12		12	12		12			12	12	12		203	
568.2			298.2	52.5%		15	15	15.5	15.5	15.5	15.5	15.5	15.5				12		12	12		12			12	12	12		207	
572.5			302.5	52.8%		15	15	16	16	16	16	16	16				12		12	12		12			12	12	12		210	
576.7			306.7	53.2%		15	15	16.5	16.5	16.5	16.5	16.5	16.5				12		12	12		12			12	12	12		213	
580.6			310.6	53.5%		15	15	17	17	17	17	17	17				12		12	12		12			12	12	12		216	
590.5			320.5	54.3%		15	16	18	18	18	18	18	18				12		12	12		12			12	12	12		223	g
595.6			325.6	54.7%		15	16	18	18	18	18	18	18				16		12	12		12			12	12	12		227	
601.1			331.1	55.1%		15	16	18	18	18	18	18	18				16		16	12		12			12	12	12		231	
606.6			336.6	55.5%		15	16	18	18	18	18	18	18				16		16	16		12			12	12	12		235	
612.1			342.1	55.9%		15	16	18	18	18	18	18	18				16		16	16		16			12	12	12		239	
617.6			347.6	56.3%		15	16	18	18	18	18	18	18				16		16	16		16			16	12	12		243	

PROJECT OUTFLOW		SPILL		TDA 40% Spill Patterns																					Total	
Total	Range (kcfs)	Total	% Range [c]	Vertical Gate Opening (ft) per Spillbay [a, b]																					Open	
(kcfs)	Low High	(kcfs)	Low High	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	(ft)	Note
623.1		353.1	56.7%	15	16	18	18	18	18	18	18				16		16	16		16			16	16	12		247	
625.8		355.8	56.9%	15	16	18	18	18	18	18	18				18		16	16		16			16	16	12		249	
628.5		358.5	57.0%	15	16	18	18	18	18	18	18				18		18	16		16			16	16	12		251	
631.2		361.2	57.2%	15	16	18	18	18	18	18	18				18		18	18		16			16	16	12		253	
633.9		363.9	57.4%	15	16	18	18	18	18	18	18				18		18	18		18			16	16	12		255	
636.6		366.6	57.6%	15	16	18	18	18	18	18	18				18		18	18		18			18	16	12		257	
639.2		369.2	57.8%	15	16	18	18	18	18	18	18				20		18	18		18			18	16	12		259	
641.9		371.9	57.9%	15	16	18	18	18	18	18	18				20		20	18		18			18	16	12		261	
644.5		374.5	58.1%	15	16	18	18	18	18	18	18				20		20	20		18			18	16	12		263	
647.2		377.2	58.3%	15	16	18	18	18	18	18	18				20		20	20		20			18	16	12		265	
649.9		379.9	58.5%	15	16	18	18	18	18	18	18				20		20	20		20			20	16	12		267	
656.4		386.4	58.9%	15	16	18	18	18	18	18	18				21		21	21		21			21	16	12		272	
664.4		394.4	59.4%	15	16	19	19	19	19	19	19				21		21	21		21			21	16	12		278	
672.4		402.4	59.8%	15	16	20	20	20	20	20	20				21		21	21		21			21	16	12		284	
680.3		410.3	60.3%	15	16	21	21	21	21	21	21				21		21	21		21			21	16	12		290	
686.2		416.2	60.7%	15	16	21	21	21	21	21	21		4		21		21	21		21			21	16	12		294	
692.0		422.0	61.0%	15	16	21	21	21	21	21	21		8		21		21	21		21			21	16	12		298	
697.7		427.7	61.3%	15	16	21	21	21	21	21	21		12		21		21	21		21			21	16	12		302	
703.2		433.2	61.6%	15	16	21	21	21	21	21	21		16		21		21	21		21			21	16	12		306	
708.6		438.6	61.9%	15	16	21	21	21	21	21	21		20		21		21	21		21			21	16	12		310	
715.8		445.8	62.3%	15	16	21	21	21	21	21	21		21	4	21		21	21		21			21	16	12		315	
721.6		451.6	62.6%	15	16	21	21	21	21	21	21		21	8	21		21	21		21			21	16	12		319	
727.3		457.3	62.9%	15	16	21	21	21	21	21	21		21	12	21		21	21		21			21	16	12		323	
732.8		462.8	63.2%	15	16	21	21	21	21	21	21		21	16	21		21	21		21			21	16	12		327	
738.1		468.1	63.4%	15	16	21	21	21	21	21	21		21	20	21		21	21		21			21	16	12		331	
745.4		475.4	63.8%	15	16	21	21	21	21	21	21		21	21	21	4	21	21		21			21	16	12		336	
751.2		481.2	64.1%	15	16	21	21	21	21	21	21		21	21	21	8	21	21		21			21	16	12		340	
756.9		486.9	64.3%	15	16	21	21	21	21	21	21		21	21	21	12	21	21		21			21	16	12		344	
762.4		492.4	64.6%	15	16	21	21	21	21	21	21		21	21	21	16	21	21		21			21	16	12		348	
767.7		497.7	64.8%	15	16	21	21	21	21	21	21		21	21	21	20	21	21		21			21	16	12		352	
775.0		505.0	65.2%	15	16	21	21	21	21	21	21		21	21	21	21	21	21	4	21			21	16	12		357	
780.8		510.8	65.4%	15	16	21	21	21	21	21	21		21	21	21	21	21	21	8	21			21	16	12		361	
786.5		516.5	65.7%	15	16	21	21	21	21	21	21		21	21	21	21	21	21	12	21			21	16	12		365	

PROJECT OUTFLOW			SPILL			TDA 40% Spill Patterns Vertical Gate Opening (ft) per Spillbay [a, b]																					Total Open	
Total (kcfs)	Range (kcfs) Low	High	Total (kcfs)	% Range [c] Low	High	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	(ft)	Note
792.0			**522.0**	**65.9%**	15	16	21	21	21	21	21	21		21	21	21	21	21	21	16	21			21	16	12		**369**	
797.3			**527.3**	**66.1%**	15	16	21	21	21	21	21	21		21	21	21	21	21	21	20	21			21	16	12		**373**	
804.6			**534.6**	**66.4%**	15	16	21	21	21	21	21	21		21	21	21	21	21	21	21	21	4		21	16	12		**378**	
810.4			**540.4**	**66.7%**	15	16	21	21	21	21	21	21		21	21	21	21	21	21	21	21	8		21	16	12		**382**	
816.0			**546.0**	**66.9%**	15	16	21	21	21	21	21	21		21	21	21	21	21	21	21	21	12		21	16	12		**386**	
821.6			**551.6**	**67.1%**	15	16	21	21	21	21	21	21		21	21	21	21	21	21	21	21	16		21	16	12		**390**	
826.9			**556.9**	**67.3%**	15	16	21	21	21	21	21	21		21	21	21	21	21	21	21	21	20		21	16	12		**394**	
834.2			**564.2**	**67.6%**	15	16	21	21	21	21	21	21		21	21	21	21	21	21	21	21	21	4	21	16	12		**399**	
840.0			**570.0**	**67.9%**	15	16	21	21	21	21	21	21		21	21	21	21	21	21	21	21	21	8	21	16	12		**403**	
845.6			**575.6**	**68.1%**	15	16	21	21	21	21	21	21		21	21	21	21	21	21	21	21	21	12	21	16	12		**407**	
851.1			**581.1**	**68.3%**	15	16	21	21	21	21	21	21		21	21	21	21	21	21	21	21	21	16	21	16	12		**411**	
856.5			**586.5**	**68.5%**	15	16	21	21	21	21	21	21		21	21	21	21	21	21	21	21	21	20	21	16	12		**415**	
863.8			**593.8**	**68.7%**	15	16	21	21	21	21	21	21		21	21	21	21	21	21	21	21	21	21	21	16	12	4	**420**	
869.6			**599.6**	**69.0%**	15	16	21	21	21	21	21	21		21	21	21	21	21	21	21	21	21	21	21	16	12	8	**424**	
875.2			**605.2**	**69.1%**	15	16	21	21	21	21	21	21		21	21	21	21	21	21	21	21	21	21	21	16	12	12	**428**	

a. Spill (kcfs) is calculated as a function of total gate opening (ft) at forebay elevation 158.5 feet (revised July 2012).

b. Highlighted spillbays operationally restricted because of structural or wire rope issues, and will be used only if needed for dam safety.

c. Uniform spill patterns are critical to increasing juvenile fish survival through the tailrace. Uniform pattern fixed spill rates will result in hourly spill % within ranges in table.

d. TDA minimum generation requirement = 50 kcfs. Therefore, 40% spill is not achievable at total river flow <84 kcfs (i.e., minimum generation operation).

e. At certain flow ranges, spill could exceed ±1% of target spill of 40%. At total river flow 92,250–161,000 cfs, spill may range from 38.6–41.4% (up to ±1.4% of the 40% rate).

f. Minimum gate opening is 4 ft. At forebay elevation 160 ft, maximum gate opening through bays 1-8 is 14 ft, thus higher bays will be utilized prior to opening any of bays 1-8 more than 14.0 ft. At lower forebay elevations, gate openings can be increased up to 14.7 feet before utilizing higher bays.

g. If gate openings greater than shown in table are needed, to the extent feasible, incrementally increase gate openings. If all available spillbays are fully open and more flow is needed to limit pool surcharge, use restricted spillbays in following priority order: 10, 11, 13, 16, 18, 19, and 23. Fully open each bay as needed before moving to next.

Table TDA-8. Spillway Configuration at Various Flow Ranges.

Min Flow (cfs)	Max Flow (cfs)	Spillbay Gates	Gate Opening per Bay (ft)	Total Gate Opening (ft)	Total Spill (cfs)
62,000	65,000	7,8	4	8	12,000
65,000	71,000	7,8	6	12	18,000
71,000	77,000	7,8	8	16	24,000
77,000	85,000	7,8	10	20	30,000
85,000	97,500	7,8	12	24	36,000
85,000	97,500	1-8	4	24	36,000
97,500	112,500	1-8	4	28	42,000
112,500	127,500	1-8	4	32	48,000
127,500	142,500	1-8	4.5	36	54,000
142,500	157,500	1-8	5	40	60,000
157,500	172,500	1-8	5.5	44	66,000
172,500	187,500	1-8	6	48	72,000
187,500	202,500	1-8	6.5	52	78,000
202,500	217,500	1-8	7	56	84,000
217,500	232,500	1-8	7.5	60	90,000
232,500	247,500	1-8	8	64	96,000
247,500	262,500	1-8	8.5	68	102,000
262,500	277,500	1-8	9	72	108,000
277,500	292,500	1-8	9.5	76	114,000
292,500	307,500	1-8	10	80	120,000
307,500	322,500	1-8	10.5	84	126,000
322,500	337,500	1-8	11	88	132,000
337,500	352,500	1-8	11.5	92	138,000
352,500	367,500	1-8	12	96	144,000
367,500	382,500	1-8	12.5	100	150,000
382,500	397,500	1-8	13	104	156,000
397,500	412,500	1-8	13.5	108	162,000
412,500	438,000	1-8	14	112	168,000