
2020 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'

* More information for The Dalles Dam is available on the Corps Portland District website at: www.nwp.usace.army.mil/The-Dalles/

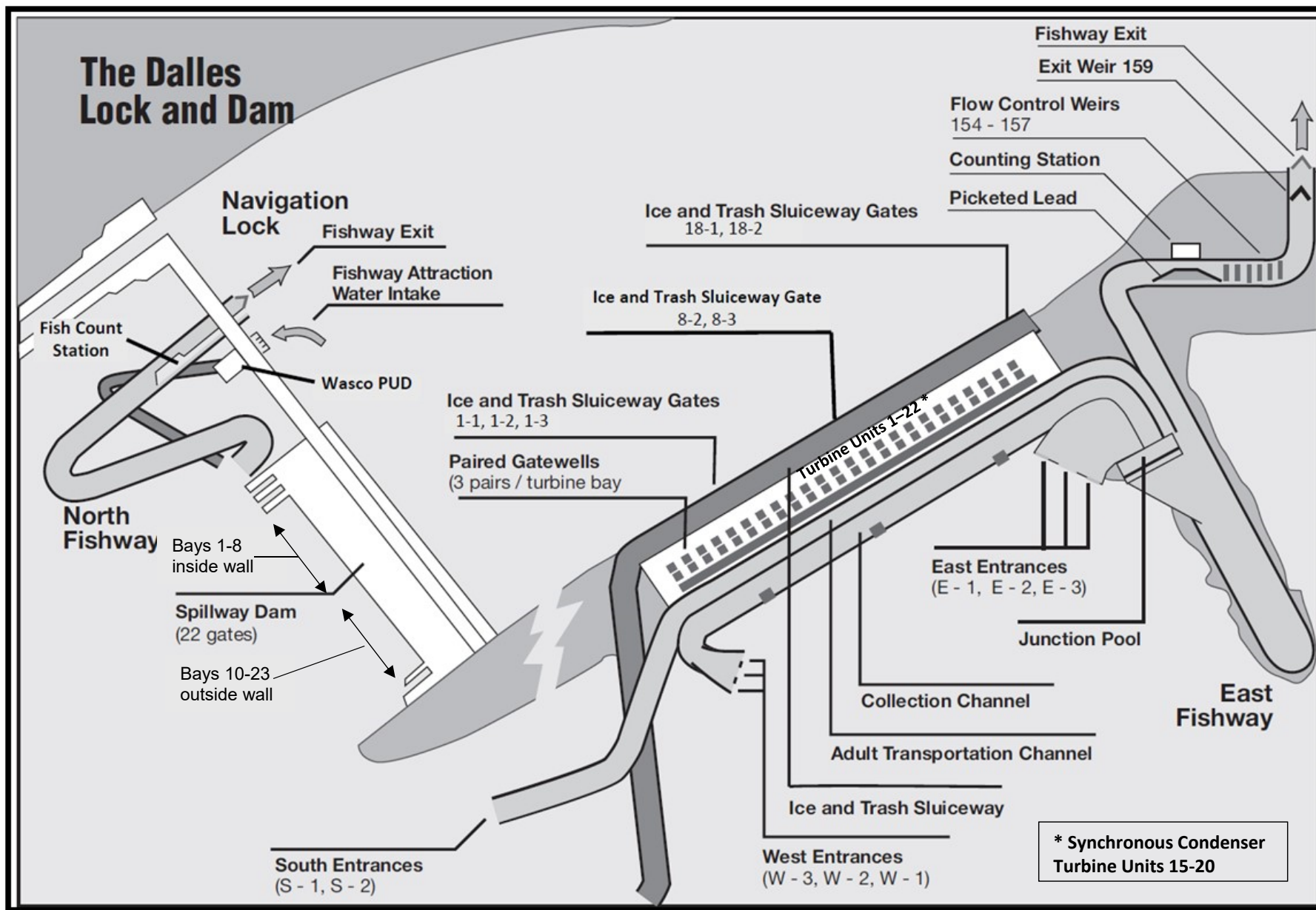


Figure TDA-1. The Dalles Dam General Site Plan.

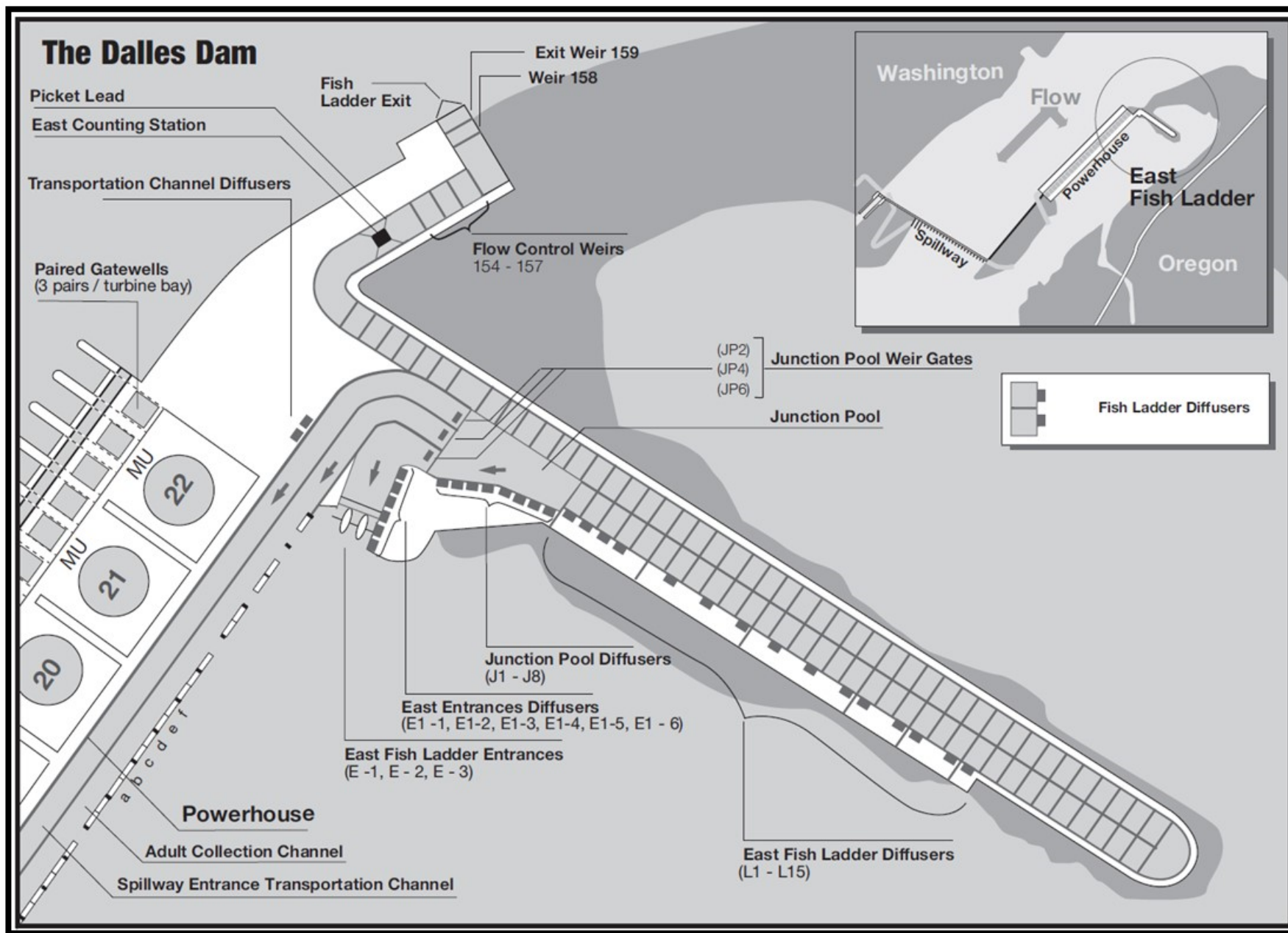


Figure TDA-2. The Dalles Dam East Fish Ladder.

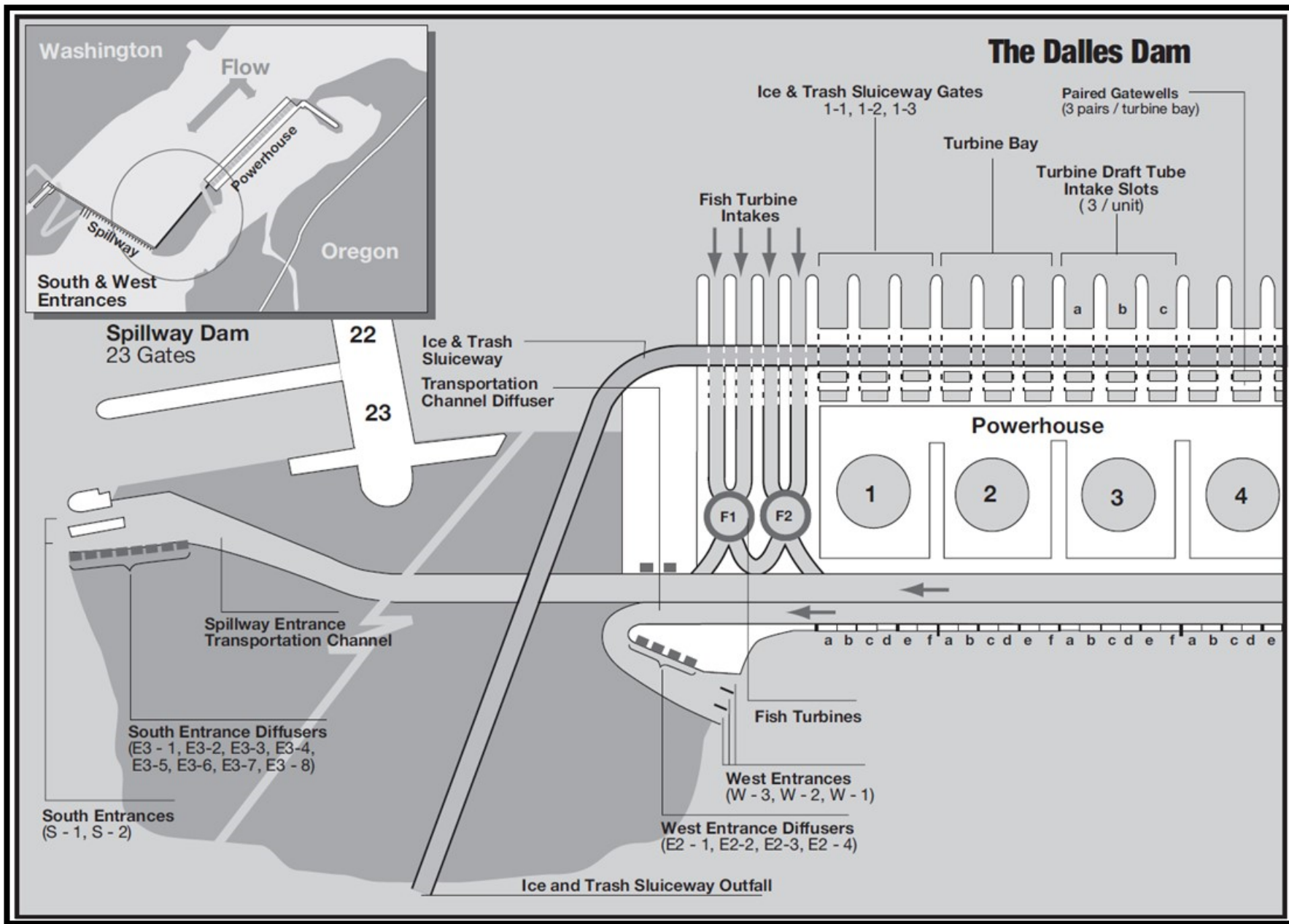


Figure TDA-3. The Dalles Dam South and West Fish Ladder Entrances.

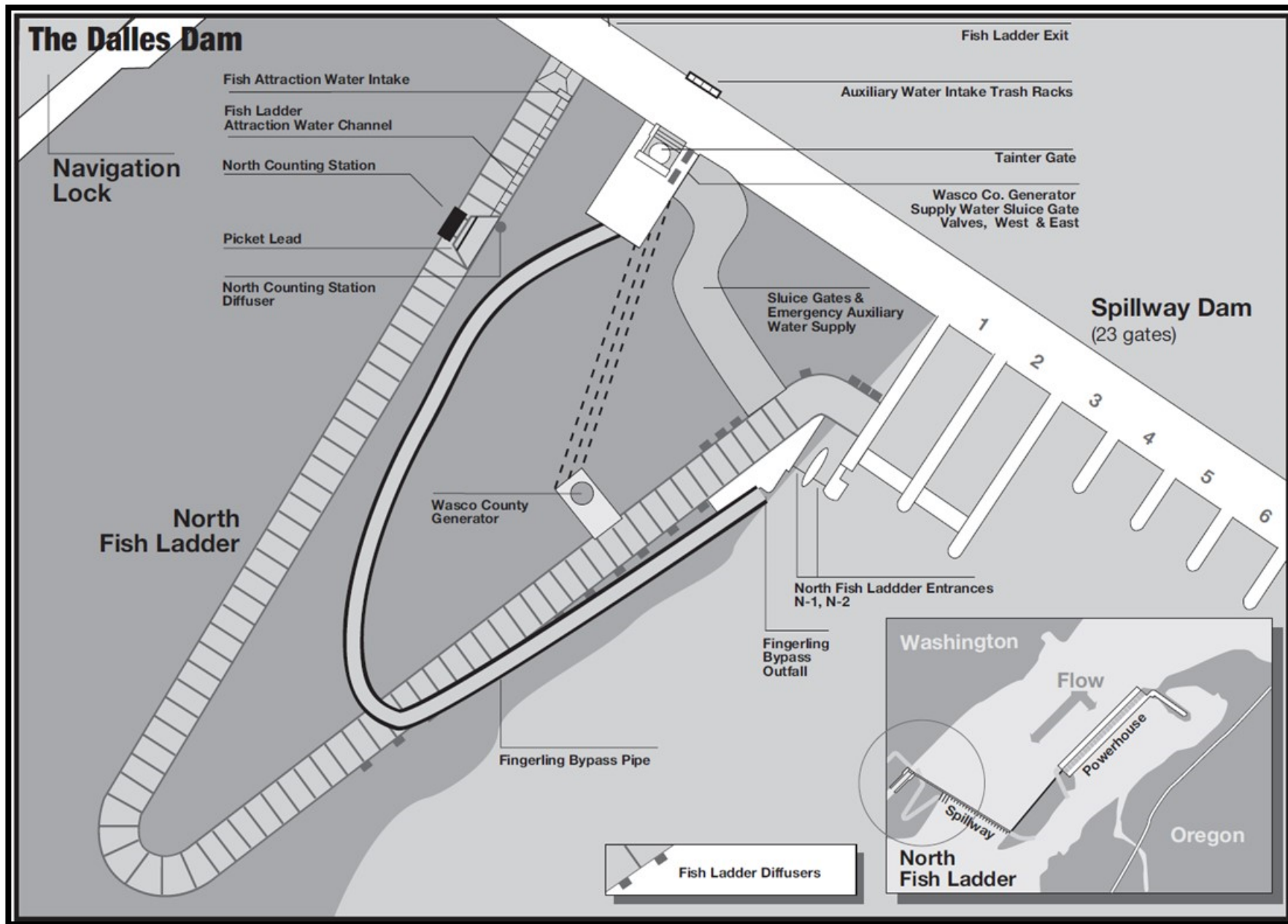


Figure TDA-4. The Dalles Dam North Fish Ladder and Spillway.

1. FISH PASSAGE INFORMATION

Fish passage facilities at The Dalles Lock & Dam are shown in **Figures TDA-1** through **TDA-4** and described below. The annual schedule of project operations, maintenance, and other actions described in the Fish Passage Plan (FPP) and Appendices is included in **Table TDA-1**.

1.1. Juvenile Fish Facilities and Migration Timing

1.1.1. Juvenile Fish Facilities. Turbine units at The Dalles Dam are not screened. Juvenile fish passage routes at The Dalles Dam consist of the spillway, the Ice & Trash Sluiceway (ITS), and one 6” orifice in each turbine unit gatewell. The sluiceway is a rectangular channel that extends along the forebay side of the 22-unit powerhouse that provides a surface passage route for fish. When any of the sluiceway gates (located in the forebay side of the sluiceway) are opened, water and fish are skimmed from the forebay into the sluiceway and released in the tailrace downstream of the project.

1.1.2. Juvenile Fish Migration Timing. There is no juvenile monitoring at The Dalles Dam. The primary juvenile fish passage period at The Dalles Dam is April–November based on monitoring at John Day Dam (see **FPP Chapter 4 - John Day Dam, Table JDA-2**) – juvenile fish arrival at The Dalles Dam is approximately one day later than at John Day. 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 Facilities and Migration Timing

1.2.1. Adult Fish Facilities.

1.2.1.1. Adult fish passage facilities at The Dalles Dam consist of a north shore ladder that passes fish collected at the north end of the spillway and an east ladder that passes fish collected at the south end of the spillway and across the downstream face of the powerhouse. The east fishway auxiliary water is provided by two fish turbine units providing 4.7–5.0 kcfs. A backup auxiliary water supply, unscreened for juveniles, can provide 1.5 kcfs if needed. The backup system can be used in conjunction with a single fish unit. Annual maintenance of adult fish facilities is scheduled during the winter maintenance period (December through February) to minimize impacts on upstream migrants. One ladder is dewatered at a time unless otherwise coordinated through FPOM.

1.2.1.2. 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 has been upgraded to facilitate its use if needed. The backup system is the originally-constructed water supply to the north fish ladder and does not provide juvenile screening. Survival through this system is unknown.

1.2.2. Adult Fish Migration Timing & Counting.

1.2.2.1. Upstream migrants are present throughout the year and adult passage facilities are operated year-round. Counting of adult salmon, steelhead, lamprey, and shad occurs during the dates defined for the current year in **Table TDA-2**, and daily counts are posted online at: www.fpc.org/adultsalmon_home.html. Sturgeon and bull trout are relatively infrequent and counts are reported in *Miscellaneous Fish Counts* and 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 passage in **Table TDA-3**.

1.2.2.3. Time-of-day (diel) distributions of adult salmonid activity at The Dalles Dam fishway entrances and exits are shown in **Figure TDA-5**.

Table TDA-2. The Dalles Dam Adult Fish Count Schedule in 2020.

Count Period	Counting Method and Hours *
April 1 – October 31	Day Visual 0500–2100 hours (PDT)
June 15 – September 30	Night Video 2100–0500 hours (PDT)

*PST = Pacific Standard Time; PDT = Pacific Daylight Time (in effect during daylight saving time 3/8/20–11/1/20).

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 23
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	Jun 29	Aug 1

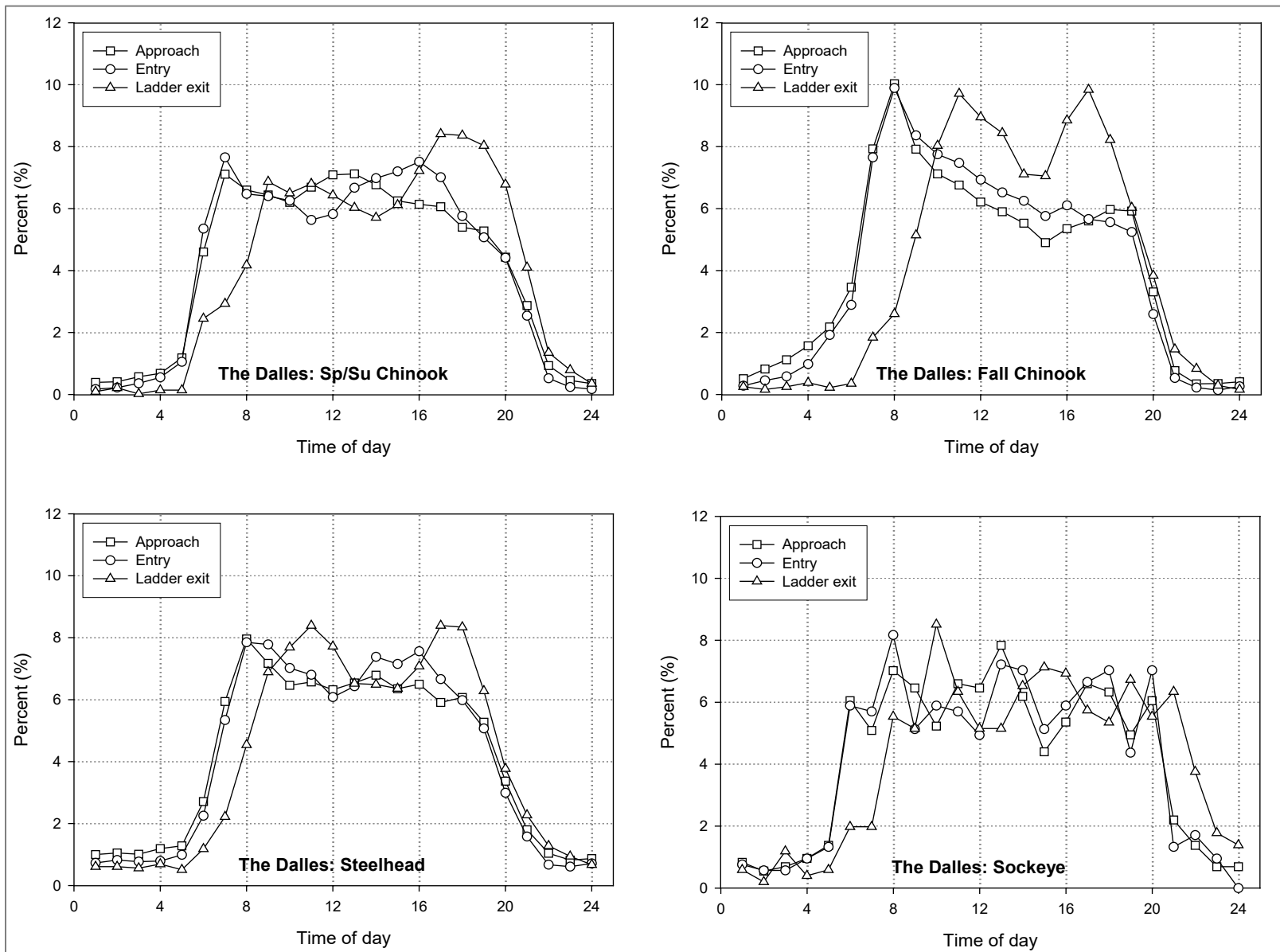


Figure TDA-5. Diel Distribution of Adult Salmonids at The Dalles Dam Fishway Entrances and Exits (*Kefer & Caudill 2008 – report and summary letter available online at: pweb.crohms.org/tmt/documents/FPOM/2010/2013_FPOM_MEET/2013_JUN/*)

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. Yearly special operations related to research are described as currently coordinated 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 in **Table TDA-7**.

2.2.2. Excessive total dissolved gas (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. Monitoring of TDG at The Dalles Dam occurs during the periods defined in **Table TDA-1**, pursuant to the Corps' annual *TDG Management Plan* and the current *Dissolved Gas Monitoring Plan of Action*.¹

2.2.3. 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 three gates on Unit 1 and three gates on Unit 18.

¹ TDG Management Plan (Appendix 4 of the WMP) - pweb.crohms.org/tmt/documents/wmp/
TDG Monitoring Plan of Action - www.nwd.usace.army.mil/Missions/Water/Columbia/Water-Quality/

2.3. Operating Criteria - Juvenile Fish Facilities

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

2.3.1.1. Use an ROV to inspect trashracks and main unit intakes. Remove debris from forebay, trashracks, gatewell slots, and gatewell orifices so that these areas are free of debris on the first day of juvenile passage season, 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 repair spill gates and control systems where necessary. The spillway must be able to achieve spill patterns on April 10, except for coordinated changes.

2.3.1.4. Discontinue operation of the ice & trash sluiceway (ITS) from December 16 through the end of February, 24 hours/day, except during periods of spill when the sluiceway will be operated if available, per **section 2.2.3**. Close the endgate and open sluice gates 1-1 and 18-3 to allow fish egress from the ITS when equalized with the forebay. Inspect and correct any epoxy or concrete deficiencies on the ITS walls and floors, where accessible.

2.3.1.5. Ensure avian abatement measures are in place by April 1, in accordance with the *Predation Monitoring & Deterrence Action Plans* in **Appendix L**, Table 1 and section 3.

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

2.3.2.1. Inspect all gatewells daily.

2.3.2.2. 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, clean at least once daily. Do not operate turbines with a gatewell fully covered with debris except to be in compliance with other coordinated fish measures, and then only on a last-on/first-off basis.

2.3.2.3. Measure gatewell drawdown at least once per week and more frequently (three times per week or more) as needed during high debris periods. Clean trashracks when drawdown in gatewell slots exceeds 1.5', or as flow conditions dictate.

2.3.2.4. Between June 1 and June 15, determine if there is debris buildup on the trashracks by inspecting three units across the powerhouse that have the most prior operation and will not interfere with sluiceway operation. Rake trashracks as needed (all trashracks can be raked using the Hammerhead crane).

2.3.2.5. 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.

2.3.2.6. Operate the ITS 24 hours/day for juvenile fish passage per **Table TDA-4**. Open gates 1-1, 1-2, 1-3 over operating Main Unit (MU)-1; open gates 8-2, 8-3 over operating MU-8; and open 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, operate MU-2 w/gates; if MU-18 is OOS, operate MU-17 w/gates or MU-19 w/gates).

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	2.4.2.9 (Mar) 2.4.1.7 (Dec)
April 1– November 30	OPEN End gate OPEN Sluice gates 1-1, 1-2, 1-3 / 8-2, 8-3 / 18-2	Juvenile passage	2.3.2.6
*December 16– end of February	CLOSE End gate OPEN Sluice gates 1-1 / 18-3	No passage; allows egress when equalized w/ forebay	2.3.1.4, 2.4.1.7

*Dec 16–end of Feb, discontinue ITS operation except during periods of spill when the ITS will be operated if available, per **section 2.2.3**.

2.3.2.7. When units are being dewatered, leave ITS endgate open and close sluice gates to expose gatewell orifices, then install orifice blocker. After orifice-sealing devices are installed, sluice gates should be returned to the open position. All 6” orifices will be closed as units are dewatered. Installation time should be approximately 1 hour.

2.3.2.8. 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.

2.3.2.9. Spill for fish passage will be distributed across the spillbays as defined in the spill pattern table at the end of this chapter (**Table TDA-7**).

2.3.2.10. Operate in accordance with the *Predation Monitoring and Deterrence Action Plans* for The Dalles Dam in **Appendix L**, Table 1 and section 3.

2.4. Operating Criteria - Adult Fish Facilities

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

2.4.1.1. Only one of the two adult fish facilities may be out of service at any one time during the winter maintenance period unless coordinated through FPOM. The operating facility shall be operated in accordance with fish passage season criteria in **section 2.4.2** unless specially coordinated. Outage periods will be minimized to the extent practicable.

2.4.1.2. Dewatering of areas below tailwater can be done every other year as determined by maintenance needs. All diffuser gratings and weirs will be inspected by ROV if not dewatered.

2.4.1.3. 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.

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

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

2.4.1.6. Inspect count station equipment and ensure operational. Prior to watering up ladders, reinstall picket leads at counting stations and ensure they are properly seated with a 1" gap (not to exceed 1.25") along the bottom for lamprey passage.

2.4.1.7. Ice & Trash Sluiceway (ITS).

i. From December 1 through December 15, operate the ITS 24 hours/day for adult fallback and steelhead kelt passage, per **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).

ii. From December 16 through the end of February (except during periods of spill when the ITS will be operated if available, per **section 2.2.3**), discontinue ITS operation 24 hours/day. Close the endgate and open sluice gates 1-1 and 18-3 to allow fish egress from the ITS when equalized with the forebay.

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

2.4.2.1. Maintain staff gauges and water level indicators in readable condition at all water levels encountered during the fish passage season and check accuracy weekly. When necessary, clean and/or recalibrate instruments ASAP.

2.4.2.2. Maintain water depth over fish ladder weirs at 1.0' \pm 0.1'. During adult shad passage season when more than 5,000 shad/day are counted at Bonneville Dam, increase depth to 1.3' \pm 0.1', except as defined below.

2.4.2.3. Maintain main entrance weir depths at 8' or greater below tailwater. RCC will regulate to maintain a minimum tailwater of 70' msl to remain in the entrance weir criteria operating range.

2.4.2.4. Maintain head on all entrances in the range of 1'–2' (1.5' optimum). When unable to achieve head criteria, refer to **section 3.2.2**.

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

2.4.2.6. Measure fishway channel water velocities at least three times per week (daily preferred) during adult passage season as part of the fishway inspection program. Floats will be timed through all fishway channels that are supplemented by auxiliary water and results provided in the project weekly fishway status report. Maintain water velocity in the range of 1.5–4.0 feet per second (fps), 2 fps optimum, for the full length of the powerhouse collection channel and the lower ends of fish ladders that are below tailwater.

2.4.2.7. Fishway Temperature Monitoring.

2.4.2.7.a. Measure water temperatures in the count station of each adult fishway and record 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.

2.4.2.7.b. From June 1 through September 30, measure water temperature at adult fishway entrances and exits and submit data to the Fish Passage Center (FPC) weekly for posting online.² Ensure the location of the monitors meets the following criteria:

- i.** Within 10 meters of all shore-oriented entrances and exits.
- ii.** Entrance monitor within 1 meter above the ladder floor and at least 10 meters downstream of ladder diffusers, if possible, to allow for sufficient mixing with surface water.
- iii.** Exit monitor within 1 meter above the ladder floor and above all diffusers to allow for sufficient mixing with surface water.
- iv.** If an existing temperature monitoring location is proposed to be used for either the exit or entrance, verify that the site accurately reflects water temperature within 10 meters of the entrance or exit.

² FPC ladder temperature data website: www.fpc.org/smolt/smolt_queries/Q_ladderwatertempgraphv2.php

2.4.2.8. Adult Fish Counting.

- i. Maintain count station crowders and picket leads in operating position while visual counting, video recording, and when the PIT-tag antenna operation is being conducted. The current fish counting schedule is in **Table TDA-2**.
- ii. Crowder ranges are: TDA-East = 20–34”, TDA-North = 18–38”
- iii. When not counting, or if counting is temporarily discontinued due to unscheduled events, open the crowder to full count slot width. The crowder may remain in operating position during the counter’s hourly 10-minute break.
- iv. During counting, open the crowder as far as possible to allow accurate counting, at least 18”. Do not close to less than 18”. This will usually occur during high turbidity conditions to allow count accuracy criteria to be achieved. 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. Project biologists, FFU, and the fish count supervisor shall coordinate to achieve optimum count slot passage and/or count accuracy conditions.

2.4.2.9. Ice & Trash Sluiceway (ITS). From March 1–31, operate the ITS 24 hours/day for adult fallback and steelhead kelt passage, per **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.

- i. 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’.
- ii. Telescoping weir #159 will adjust to maintain 1.1’ ±0.1’ depth over the weirs, measured below the counting station.
- iii. 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. West Powerhouse 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 will remain operational as backup to W1 and W2.

2.4.2.13. East Powerhouse Entrance. Operate entrance weirs E2 and E3 to maintain a gate crest of 8’ or greater below tailwater, currently operated at 13’ below tailwater. E1 will be closed at 81’ msl but will remain operational. At lower tailwater elevations, E1 may be operated manually at any depth to provide criteria entrance differential. Operate east ladder

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

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

2.4.2.15. Ladder Crowding. Beginning September 1 (after spill for juvenile fish passage has ended), assess ladder crowding on a daily basis during peak seasonal passage periods and operate according to the following criteria:

- i. If the East Fishway daily count of combined adult salmonids exceeds 25,000 per day (or 20,000 if ladder temperatures are above 70°F), inspect the entire the East Fishway ladder twice each day by walking from the exit to the east entrance and make observations and picture recording at the pool between 157 and 158, the pool downstream of the count station, and the pool at the 180° bend in the ladder.
- ii. If Project Biologists determine there is a fish crowding emergency, or if the East Fishway daily count of combined adult salmonids exceeds 35,000 per day (or 30,000 if ladder temperatures are above 70°F), 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, as follows: 15 kcfs total spill, with Bay 1 open four stops (6 kcfs) and Bays 7 and 8 each open three stops (4.5 kcfs per bay). Continue this operation and daily coordination with FPOM as long as adult counts are greater than or equal to project passage (both ladders) when the operation started, or unless otherwise coordinated with FPOM.
- iii. If inspectors see crowding that is not an emergency but is a concern, consult with FPOM to evaluate the situation. If the team determines crowding is severe enough, implement the spill operation as defined above.

2.5. Fish Facilities Monitoring & Reporting

2.5.1. Monitoring.

2.5.1.1. During fish passage season, inspect fish passage facilities at least twice per day, seven days a week, to ensure operations are in accordance with established criteria. A third inspection will be made using the data logging system. Check entrance conditions daily for the previous 24 hours for entrance criteria.

2.5.1.2. During the winter maintenance period, inspect fish passage facilities once per day, seven days a week.

2.5.1.3. More frequent inspections of some facility components will occur per criteria in this document. Additional fishway inspections may be performed by FFU and fish agencies.

2.5.1.4. Report results of all inspections and the readiness of the facilities for operation to FPOM at the meeting immediately prior to the fish passage season.

2.5.1.5. Continue to implement the zebra mussel monitoring program. This includes veliger sampling with plankton net collection, colonization sample units, and dewatering inspections. Samples will be provided to PSU for analysis. These organisms are a serious problem elsewhere in the country and may become introduced into the Columbia River basin. Inspections should also be made when dewatering project facilities.

2.5.2. Reporting.

2.5.2.1. Weekly Reports. Project biologists shall prepare weekly reports throughout the year summarizing project and fish facility operations for each week (Sunday through Saturday), along with an evaluation of resulting fish passage conditions. The reports will be e-mailed to CENWP-OD, CENWD-PDW-R (RCC), and other interested parties as soon as possible the following week. The weekly reports shall include:

- i. Out-of-criteria situations and subsequent corrective actions;
- ii. Maintenance or equipment malfunctions, breakdowns, or damage, with a summary of resulting repairs;
- iii. Adult fishway control calibrations;
- iv. AWS closures (i.e., cleaning times);
- v. Unusual activities at the project that may have affected fish passage.

2.5.2.2. In-Season. Any adverse or negative impact to fish or fishways shall be reported in a *Memorandum for the Record* (MFR) prepared by Project biologists and sent to FPOM by the next working day, pursuant to the coordination process and template in **FPP Chapter 1 – Overview, section 2.3.2.**

2.5.2.3. Annual Report. Project biologists shall prepare an annual report by January 31 each year, summarizing fish facility operations for the previous year's winter maintenance period and fish passage season, December 1 through November 30. The annual report also will include all actions taken to discourage avian predation at the project, with an overview of the effectiveness. The annual report will be provided to CENWP-OD in time for distribution to FPOM members at the February meeting.

3. FISH FACILITIES MAINTENANCE

3.1. Fish Facilities Routine Maintenance

3.1.1. Routine maintenance of fish facilities will be conducted when fish passage has been documented to be at its lowest, to the extent practicable, to minimize fish impacts. Maintenance that occurs during juvenile or adult passage season that may affect fish passage will be included in the weekly reports. If maintenance requires operating outside of FPP criteria, the work will be coordinated with FPOM per the procedures defined in **FPP Chapter 1–Overview, section 2.3.**

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

3.1.3. Ice & Trash Sluiceway (ITS). The ITS will receive preventive maintenance throughout the year. During the juvenile passage season (April 1–Nov 30), work will normally be above water, 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 juvenile fish. Any problems will be repaired and modifications to the channel and general maintenance completed.

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

3.1.5. Turbines & Spillbays. Routine maintenance of turbines and spillbays is a regular and recurring process that requires extended outages, as defined in **Turbine Maintenance section 4.3** and **Dewatering Plans section 5.** If maintenance requires operating outside of FPP criteria, the work will be coordinated with FPOM. Certain turbine and spillbay discharges are secondarily used to attract adult fish to fishway entrances, thus maintenance schedules for these turbines and spillbays 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. Units that will be the lowest priority for scheduling maintenance during the fish passage season are: F1, F2, 1, 2, 3, 4, 8, and 18 (during ITS operation). Trash racks are raked if necessary as determined by ROV inspection just prior to the juvenile fish passage season (before April 1), between June 1 and June 15, and whenever debris accumulation is suspected because of increased head across the trash racks.

3.1.6. 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 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 when the system is dewatered. An inspection during the first week of August with the system watered-up will also be conducted. A diver or underwater video system may be used for underwater

inspections. The Project biologist or alternate Corps fish personnel will attend all dewatering activities and inspections potentially involving fish to provide fish input.

3.1.7. Adult Ladders and Count Stations. The adult ladders are 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 count station equipment, and other potential problems. Problems identified throughout the passage season that do not affect fish passage, as well as those identified during the dewatered period, are repaired. Rake trashracks at the ladder exits and the north AWS intake when criteria are exceeded. Rake trashracks between 1100 and one hour before sunset. Clean fish count station windows when necessary and when practicable.

3.2. Fish Facilities Non-Routine Maintenance

3.2.1. Non-routine or unscheduled fish facility maintenance that may impact fish passage or operation of fish facilities (e.g., repair of diffuser gratings, etc.) shall be coordinated through FPOM on a case-by-case basis by Project and CENWP-OD biologists, per the coordination process described in **FPP Chapter 1–Overview, section 2.3**. The CENWP-OD biologists will be notified as soon as possible after it becomes apparent that non-routine maintenance 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.

3.2.2. Non-routine maintenance that affects fish passage will be included in the weekly reports.

3.2.3. If a sluiceway chain gate fails, an adjacent gate can be operated until repairs can be made. Failed gate hoists will be promptly repaired. The gate will be removed when there are problems with the seal and it cannot be promptly repaired. Damage to the epoxy-lined section of the sluiceway will be repaired. The sluiceway may be closed temporarily to install a gatewell orifice plug in preparation for turbine dewatering.

3.2.1. If a spill gate becomes inoperable, the operators will make necessary changes to provide spill and then immediately notify the Project Operations supervisor and the Project biologist to determine the best spill 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.

3.2.2. Fishway Auxiliary Water Systems. Most fishway auxiliary water systems operate automatically. If the automatic system fails, Project personnel will manually operate the system as described below and increase surveillance to ensure criteria are being met until the system is repaired. In the event of AWS failure, the project will coordinate with FPOM to determine the best operating procedure.

- i. If one of the two fishway auxiliary water turbines fails or malfunctions for any duration, follow the sequential steps below until an entrance head of 1' is reached:
 - Increase discharge of remaining operating fish unit to maximum capacity.
 - Open AWS backup water supply.

- ii. If both fishway auxiliary water turbines fail or malfunction, regardless of fish passage season, operate the adult passage facility as follows:
- Open AWS backup water supply.
 - Raise the south entrance weirs to elevation 81' msl (closed position).
 - Close west entrance.
 - Close entrance weir E1 and keep E2 and E3 at 8' depth.
 - Operate closest available main unit to the east entrance for attraction flow.
- iii. If both fishway auxiliary water turbines and the AWS fail or malfunction, regardless of fish passage season, operate the adult passage facility as follows:
- Raise the south entrance weirs to elevation 81' msl (closed position).
 - Close west entrance.
 - Close entrance weir E1 and E2 and keep E3 at 6' depth.
 - Evaluate modifying spill operations at the north shore ladder to enhance adult passage.
- iv. If the North Wasco County power unit auxiliary water system fails, start the backup auxiliary water system and operate the system to maintain north fish ladder entrance criteria. Schedule unit outages for October 1–March 15. If the backup auxiliary water system fails, N1 will remain open with a weir depth of 6' below the tailwater surface.

3.2.3. Powerhouse & Spillway Adult 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 repaired. If this operation becomes necessary, Project personnel will increase surveillance on the adult system to ensure criteria are being met. If the failure will not allow the entrance to be manually operated, the gate will be maintained in an operational position to the extent possible. If not possible, the entrance will be repaired expediently and returned to manual or automatic control at the earliest possible date.

3.2.4. Adult Ladders and Count Stations. Fish ladder structures include picket leads, count 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.

3.2.5. Diffuser Gratings. Diffuser chambers for adding auxiliary water to fish ladders and collection channels are covered by gratings attached by several different methods. Diffuser gratings are normally checked during winter maintenance to confirm they are in place, either by dewatering the fish passage system to physically inspect the diffuser gratings, by using underwater video cameras and divers, or by other methods. Diffuser gratings may come loose during fish passage season due to a variety of reasons. If a diffuser grating is known or suspected to have moved, creating an opening into a diffuser chamber, close the associated diffuser valve ASAP. Immediate action must be taken to correct the situation and minimize impacts on 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 FPOM. Repairs will be made as quickly as possible unless otherwise coordinated.

4. TURBINE UNIT OPERATION & MAINTENANCE

4.1. Turbine Unit Priority Order

4.1.1. Turbine units will be operated in the order of priority defined in **Table TDA-5** to optimize fish passage conditions (excluding synchronous condenser unit operation at Units 15-20). If a unit is out of service, the next unit in the priority order will be operated. Unit priority order may be coordinated differently for fish research, construction, or project maintenance.

Table TDA-5. The Dalles Dam Turbine Unit Priority Order.

PERIOD	UNIT PRIORITY ORDER
March 1–31	1 and 18 [†]
April 1 – November 30 (Juvenile Fish Passage Season) If additional units needed, operate one unit from each block moving west to east. Repeat as needed.	1, 8, 18* Block 2-4, Block 5-7, Block 9-12, Block 13-16, Block 17-22
December 1–15	1 and 18 [†]
December 16 – end of February	Any Order

[†] Mar 1-31 and Dec 1-15 priority order for adult fallbacks and kelt passage = Units 1 & 18 with two open sluice gates/unit (per **Table TDA-4**).

*Apr–Nov priority order for juvenile fish passage = Units under open sluice gates 1, 8, 18 (per **Table TDA-4**).

4.2. Turbine Unit Operating Range

4.2.1. Turbine unit flow and power output at the lower and upper limits of the $\pm 1\%$ peak efficiency range are defined in **Table TDA-6**.

4.2.2. **In-Season (April 1–October 31).** As defined in the *BPA Load Shaping Guidelines* in **Appendix C**, all units will be operated within $\pm 1\%$ of peak turbine efficiency (1% range) to maximize survival of juvenile fish that pass through the turbines. If necessary in-season to operate turbines outside of the 1% range, units will be selected in the following priority order: Units 7–14 first, spacing by at least one unit (e.g., 7, 9, 11, 13, 15, 5, 2, 1, 8, etc.). Since each successive unit in this order is thought to pass more fish, the intent is to minimize fish impacts during turbine passage. In-season operation outside of the 1% range shall be recorded by Project personnel to provide to BPA on a weekly basis according to the *Guidelines*. Operation outside the 1% range may be necessary to:

- i. Meet BPA load requests made pursuant to BPA's policy, statutory requirements, and *Load Shaping Guidelines* (**Appendix C**);
- ii. If the draft tube is to be dewatered (**section 5.5**), the unit will be operated at full load $> 1\%$, or at speed-no-load $< 1\%$ if not possible to load, for a minimum of 15 minutes prior to installing tail logs in order to flush fish from the unit;

- iii. Operate a turbine unit solely to provide station service; or
- iv. Comply with other coordinated fish measures.

4.2.3. Off-Season (November 1–March 31). While not required to do so in the off-season, turbines will normally run 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.

4.3. Turbine Unit Maintenance

4.3.1. Turbine maintenance schedules will be reviewed by Project and District biologists for fish impacts. If maintenance requires operating outside of FPP criteria, the work will be coordinated with FPOM per the procedures defined in **FPP Chapter 1–Overview, section 2.3**.

4.3.2. If the draft tube is to be dewatered (see **section 5.5**), the unit will be operated at full load above the 1% range (or at speed-no-load below the 1% range if not possible to load) for a minimum of 15 minutes prior to installing tail logs to flush fish from the unit.

4.3.3. Operational Testing. Some types of turbine maintenance require testing turbine operation throughout its full range before and after maintenance. 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 project is operating at minimum generation requirements. 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.

i. 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.

ii. 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 returning to operational status.

4.3.4. 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.

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

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

Project Head (feet)	TDA Units 1–14						TDA Units 15–22					
	1% Lower Limit		1% Upper Limit		Operating Limit ^b		1% Lower Limit		1% Upper Limit		Operating Limit ^b	
	MW	cfs	MW	cfs	MW	cfs	MW	cfs	MW	cfs	MW	cfs
55	35.1	8,854	44.1	11,108	61.3	16,600	38.5	9,643	49.3	12,346	71.7	18,942
56	35.9	8,875	45.1	11,147	62.8	16,639	39.0	9,554	50.6	12,402	73.5	18,997
57	36.7	8,894	46.2	11,184	64.2	16,675	39.4	9,468	51.9	12,454	75.2	19,049
58	37.5	8,912	47.2	11,219	65.7	16,709	39.9	9,384	53.2	12,503	76.9	19,098
59	38.3	8,929	48.3	11,252	67.1	16,740	40.4	9,302	54.4	12,548	78.7	19,145
60	39.1	8,945	49.4	11,282	68.6	16,769	40.8	9,223	55.7	12,590	80.5	19,189
61	39.5	8,870	50.8	11,415	70.0	16,803	41.6	9,219	56.8	12,599	82.2	19,254
62	39.9	8,798	52.3	11,543	71.4	16,834	42.3	9,215	57.9	12,607	83.9	19,316
63	40.3	8,728	53.8	11,665	72.9	16,862	43.0	9,211	58.9	12,613	85.6	19,376
64	40.7	8,660	55.3	11,783	74.3	16,889	43.8	9,207	60.0	12,619	87.3	19,433
65	41.0	8,593	56.8	11,896	75.7	16,913	44.5	9,202	61.1	12,624	89.0	19,488
66	41.8	8,614	58.0	11,939	77.2	16,953	45.1	9,164	62.5	12,719	90.8	19,528
67	42.6	8,633	59.2	11,980	78.7	16,992	45.6	9,127	64.0	12,810	92.5	19,566
68	43.4	8,652	60.3	12,019	80.2	17,029	46.1	9,091	65.5	12,899	94.2	19,602
69	44.2	8,670	61.5	12,056	81.7	17,063	46.7	9,056	66.9	12,984	95.9	19,636
70	45.0	8,686	62.7	12,092	83.2	17,096	47.2	9,021	68.4	13,066	97.6	19,667
71	45.8	8,693	63.7	12,111	84.2	17,009	47.9	9,019	70.0	13,168	98.7	19,501
72	46.5	8,700	64.5	12,067	85.1	16,920	48.6	9,016	70.6	13,105	98.7	19,141
73	47.2	8,706	65.2	12,024	86.1	16,827	49.3	9,014	71.3	13,043	98.7	18,792
74	47.9	8,712	65.9	11,982	87.0	16,733	50.0	9,011	72.0	12,983	98.7	18,453
75	48.6	8,717	68.0	12,179	87.9	16,635	50.7	9,008	76.2	13,542	98.7	18,123
76	49.1	8,673	69.2	12,226	88.9	16,526	51.3	8,984	77.8	13,638	98.7	17,824
77	49.5	8,629	70.4	12,270	89.7	16,379	51.8	8,960	79.4	13,731	98.7	17,533
78	49.9	8,587	71.6	12,314	89.7	16,091	52.4	8,936	81.0	13,821	98.7	17,249
79	50.4	8,545	72.8	12,356	89.7	15,810	53.0	8,913	82.6	13,908	98.7	16,973
80	50.8	8,505	74.0	12,396	89.7	15,537	53.5	8,891	84.3	13,993	98.7	16,704
81	51.4	8,493	75.4	12,471	89.7	15,285	54.2	8,896	85.9	14,092	98.7	16,465
82	52.0	8,482	76.8	12,543	89.7	15,040	54.9	8,902	87.5	14,188	98.7	16,231
83	52.5	8,471	78.2	12,613	89.7	14,802	55.6	8,908	89.2	14,283	98.7	16,004
84	53.1	8,460	79.6	12,681	89.7	14,569	56.3	8,914	90.8	14,375	98.7	15,781
85	53.7	8,449	81.0	12,748	89.7	14,343	57.0	8,919	92.4	14,465	98.7	15,564
86	54.3	8,441	82.5	12,833	89.7	14,134	57.5	8,898	94.1	14,564	98.7	15,363
87	54.9	8,433	84.0	12,916	89.7	13,931	58.0	8,877	95.8	14,660	98.7	15,166
88	55.5	8,425	85.6	12,997	89.7	13,733	58.5	8,856	97.4	14,755	98.7	14,974
89	56.0	8,417	87.1	13,076	89.7	13,539	59.0	8,836	99.1	14,848	98.7	14,786
90	56.6	8,409	88.6	13,154	89.7	13,350	59.5	8,817	100.8	14,939	98.7	14,602
91	57.3	8,411	89.9	13,201	89.7	13,192	60.1	8,815	101.7	14,908	98.7	14,429
92	57.9	8,414	91.2	13,248	89.7	13,037	60.8	8,813	102.6	14,878	98.7	14,260
93	58.6	8,416	92.5	13,293	89.7	12,885	61.4	8,811	103.5	14,848	98.7	14,094
94	59.2	8,418	93.8	13,338	89.7	12,737	62.1	8,809	104.4	14,819	98.7	13,932
95	59.8	8,420	95.1	13,381	89.7	12,592	62.7	8,808	105.3	14,790	98.7	13,773

- a. Values provided by HDC for Units 1-14 (Jan 2001) and Units 15-22 (Oct 2002). Flow (cfs) was calculated based on turbine efficiency, project head, and power output (MW).
- b. “Operating Limit” is the maximum safe operating point based on cavitation or generator limit (added Feb 2018). TDA units have a generator limit that restricts turbine output at higher heads. Values shaded in gray indicate the Operating Limit is below the 1% Upper Limit.

5. DEWATERING PLANS

5.1. General

5.1.1. *Guidelines for Dewatering and Fish Handling (Appendix F)* and project *Dewatering Plans*³ have been developed by the projects and approved by FPOM and are followed for most project facility dewaterings. The appropriate plans are reviewed by participants before each salvage operation. The plans include consideration for fish safety and are consistent with the following general guidance.

5.1.2. The Project biologist and/or alternate Corps fish personnel will attend all project activities involving fish handling. The fish agencies and tribes are encouraged to participate in all ladder dewaterings.

5.2. Dewatering – Juvenile Bypass System [not applicable for TDA]

5.3. Dewatering – Adult Fish Ladder

5.3.1. When possible prior to dewatering, operate the ladder to be dewatered at orifice flow with the AWS off for at least 24 hours but not more than 96 hours. For non-routine or unscheduled maintenance, discontinue fishway auxiliary water and operate the ladder at reduced flow as long as possible (prefer 3-24 hours).

5.3.2. A Project biologist will ensure availability of fish rescue equipment and adequate numbers of personnel necessary to move fish out of the dewatered ladder.

5.3.3. 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.

5.3.4. The Project biologist or alternate Corps fish personnel will oversee fish rescue when the ladders are dewatered. Juvenile fish will be transported and released in the tailrace and adults released in the forebay (except identifiable steelhead kelts should be released into the tailrace).

5.3.5. 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.

³ Project Dewatering Plans are available on the FPOM website at: pweb.crohms.org/tmt/documents/FPOM/2010/

5.4. Dewatering – Powerhouse Collection System

5.4.1. 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 onsite during pumping operations to ensure fish are not stranded or a water level sensor that deactivates the dewatering process will be used.

5.4.2. The Project biologist will ensure that rescue equipment is available if needed.

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

5.5. Dewatering – Turbine Units

5.5.1. Gatewells need not be dipped as is required at other projects due to the lack of VBSs at The Dalles Dam. Immediately before draining, operate the unit at speed no load briefly to flush fish out of the draft tube. If the turbine unit draft tube is dewatered, operate unit with full load for a minimum of 15 minutes prior to immediately installing tail logs. If not possible to load, operate at speed no load for a minimum of 15 minutes. Install the 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.

5.5.2. 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 as determined by the Project Biologist.

5.5.3. 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, ensure that rescue equipment is available if needed, and directly participate in fish salvage.

5.6. Dewatering – Navigation Lock

5.6.1. 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. 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 and transported via bag or tank to be released in the river.

6. **FOREBAY DEBRIS REMOVAL**

Debris at projects can impact fish passage conditions by plugging or blocking trashracks, gatewell orifices, dewatering screens, separators, or facility piping, resulting in fish injuries, impingement, and descaling. 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 as some projects do not have forebay debris removal capability. In this case, the only viable alternative is to spill to pass the debris. Special spill operations that don't follow the normal spill schedule or volume limits will be coordinated prior to implementation. Normally, the project will contact CENWP-OD at least two workdays prior to the day the special operation is required. CENWP-OD will then coordinate with FPOM and RCC, as necessary. Once the coordination is complete, RCC will issue a teletype detailing the special operations.

7. **RESPONSE TO HAZARDOUS MATERIALS SPILLS**

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

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 (contact info available in the Control Room):

- Bob Cordie (Supervisor); Jeff Randall; James Day; Tammy Mackey

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																							Total Open (ft)	Note
Total (kcf)	Range (kcf)		Total (kcf)	% Range ^c		Vertical Gate Opening (ft) per Spillbay ^{a, b}																								
	Low	High		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		
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

PROJECT OUTFLOW			SPILL		TDA 40% Spill Patterns																			Total Open (ft)	Note				
Total (kcf)	Range (kcf)		Total (kcf)	% Range ^c	Vertical Gate Opening (ft) per Spillbay ^{a, b}																								
(kcf)	Low	High	(kcf)	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	
175.5	171.1	178.4	70.2	39.4%	41.0%	6	6	6	6	6	6	6	6															48	c
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

PROJECT OUTFLOW			SPILL			TDA 40% Spill Patterns																							Total Open (ft)	Note
Total (kcf)	Range (kcf)		Total (kcf)	% Range ^c		Vertical Gate Opening (ft) per Spillbay ^{a, b}																								
	Low	High		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		
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
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	

PROJECT OUTFLOW			SPILL		TDA 40% Spill Patterns																							Total Open (ft)	Note	
Total (kcfs)	Range (kcfs)		Total (kcfs)	% Range ^c		Vertical Gate Opening (ft) per Spillbay ^{a, b}																								
	Low	High		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		
617.6			347.6	56.3%	15	16	18	18	18	18	18	18				16		16	16		16			16	12	12		243		
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	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	8	21			21	16	12		361		

PROJECT OUTFLOW			SPILL		TDA 40% Spill Patterns																			Total Open (ft)	Note				
Total (kcfs)	Range (kcfs)		Total (kcfs)	% Range ^c		Vertical Gate Opening (ft) per Spillbay ^{a, b}																							
	Low	High		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	
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	
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	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	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	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	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	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. Spillbay 9 cannot be used due to failure of the trunnion pin in 2009.
- 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