2018 Fish Passage Plan

Chapter 5 – McNary Dam

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McNary Dam *

Project Acronym	MCN
River Mile (RM)	Columbia River – RM 292
Reservoir	Lake Wallula
Minimum Instantaneous Flow (kcfs)	Dec–Feb: 12.5 kcfs \ Mar–Nov: 50 kcfs
Forebay Normal Operating Range (ft)	337’ – 340’
Tailrace Rate of Change Limit (ft)	1.5’/hr
Powerhouse Length (ft)	1,422’
Powerhouse Hydraulic Capacity (kcfs)	232 kcfs
Turbine Units (#)	14 Main Units (S. Morgan Smith Kaplan)
Turbine Unit Generating Capacity (MW)	Rated: 980 MW (70 MW/unit) \ Maximum: 1,127 MW (80.5 MW/unit)
Gatewell Orifice Diameter (in)	Two 12” orifices per gatewell (6 per unit)
Spillway Length (ft)	1,310’
Spillway Hydraulic Capacity (kcfs)	2,200 kcfs
Spillbays (#)	22
Spillway Weirs (#)	2 (Bays 19-20)
Navigation Lock Length x Width (ft)	650’ x 84’ (Usable Space)
Navigation Lock Maximum Lift (ft)	75’
FISH STRUCTURE/OPERATION START DATE	
Fish Lock	1953 (1st Generation)
Adult Fish Counts – WA Shore & OR Shore	1954
Juvenile Bypass System (JBS)	1980 (1st Generation); 1994 (current); Bypass Outfall Flume relocated 2012
Submersible Traveling Screens (STS)	1980 (Prototype Mesh)
Extended-Length Submersible Bar Screens (ESBS)	1997
Juvenile Fish Transportation Program - Corps	1981-2012
Temporary Spillway Weirs (TSW)	2007

* More information is available on the Corps Walla Walla District website for McNary Dam at: www.nww.usace.army.mil/Locations/District-Locks-and-Dams/McNary-Lock-and-Dam/

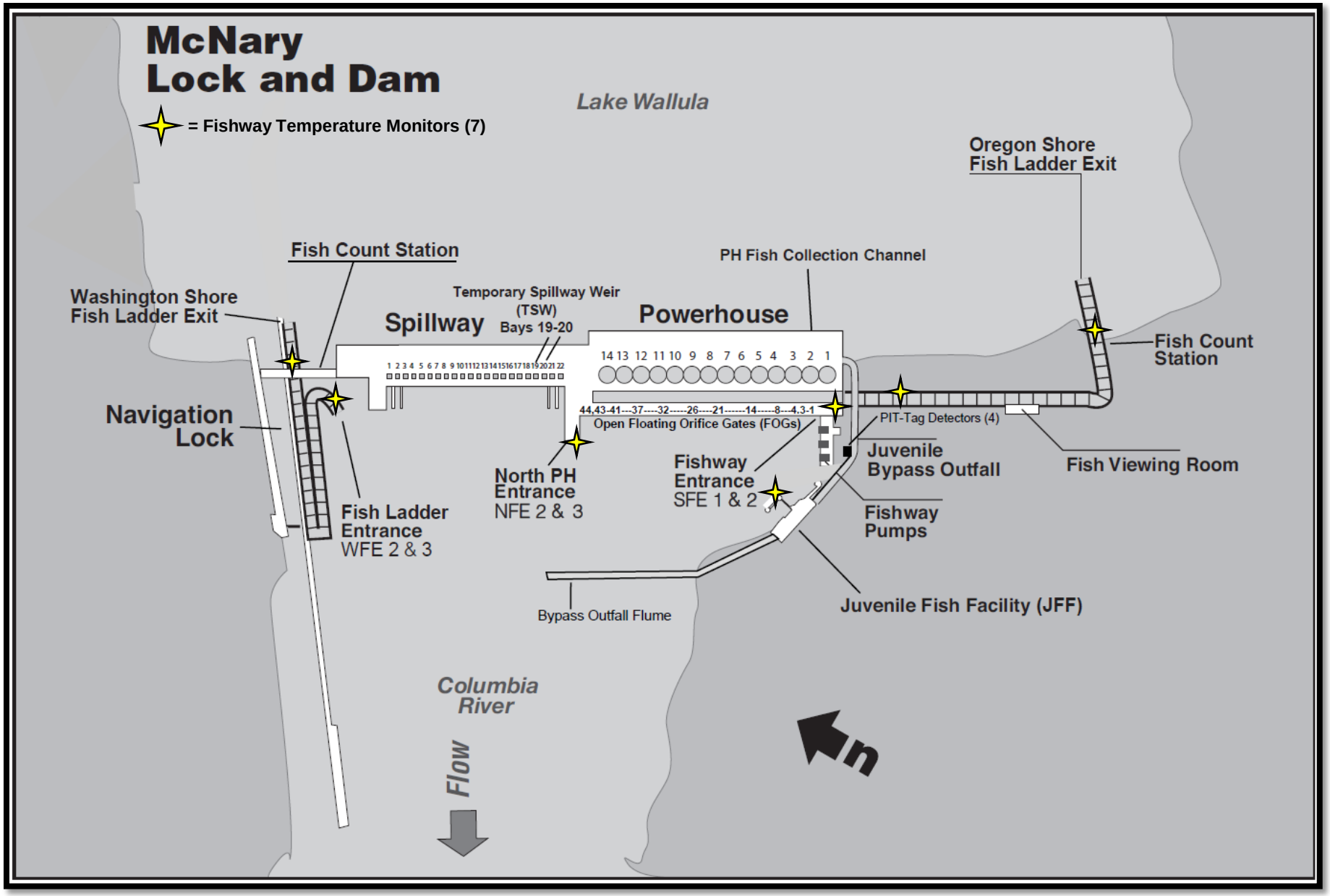
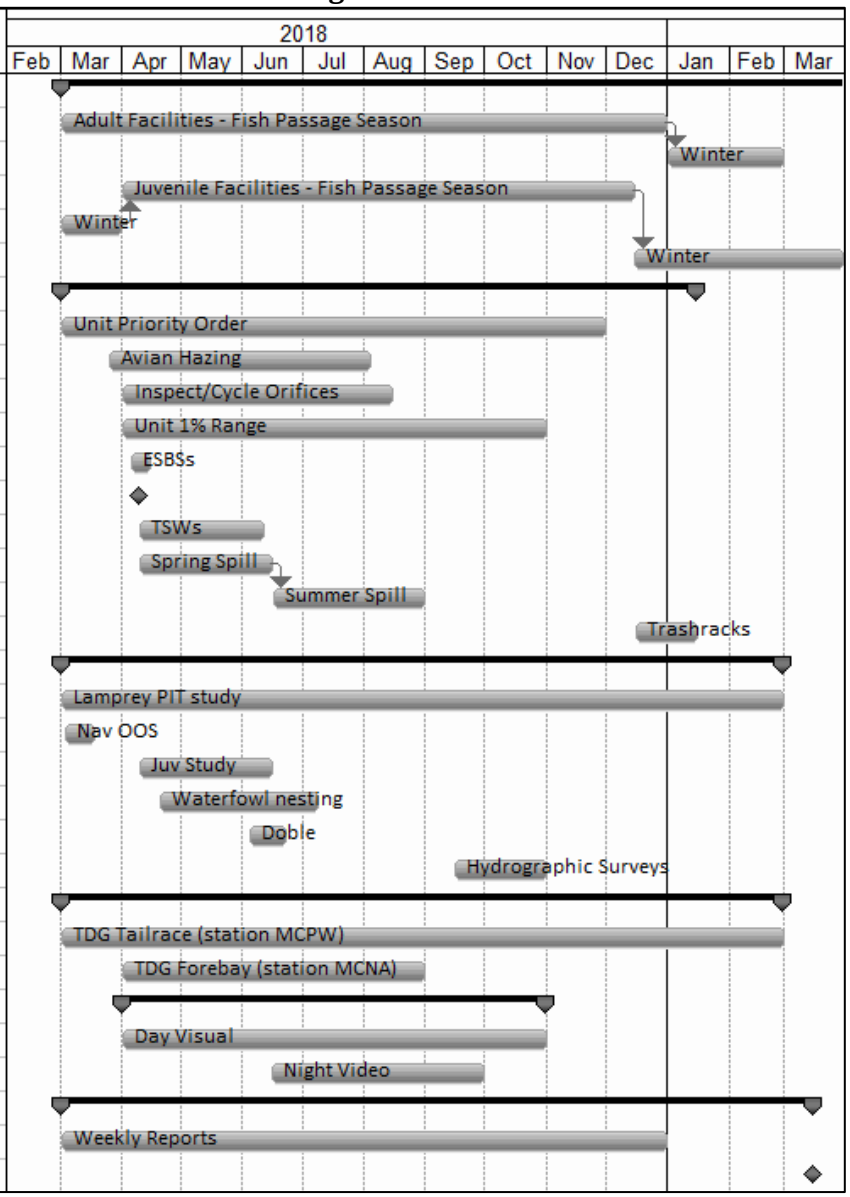


Figure MCN-1. McNary Lock & Dam General Site Plan.

Table MCN-1. McNary Dam Schedule of Operations and Actions Defined in the 2018 Fish Passage Plan.

Task Name	Start	End	FPP Section
FISH PASSAGE FACILITIES	**3/1/18**	**3/30/19**	
Adult Facilities - Fish Passage Season	3/1/18	12/31/18	2.4.2
Adult Facilities - Winter Maintenance	1/1/19	2/28/19	2.4.1
Juvenile Facilities - Fish Passage Season	4/1/18	12/15/18	2.3.2
Juvenile Facilities - Winter Maintenance	3/1/18	3/31/18	2.3.1
	12/15/18	3/30/19	
PROJECT OPERATIONS FOR FISH PASSAGE	**3/1/18**	**1/15/19**	
Turbine unit priority order	3/1/18	11/30/18	Table MCN-5
Avian hazing	3/25/18	8/4/18	App L 5.3
Inspect/cycle orifices ≥ twice per day	4/1/18	8/15/18	2.3.2.3.vi.
Turbine unit 1% operating range	4/1/18	10/31/18	4.3
ESBS install	4/5/18	4/15/18	2.3.2.2.i.
Avian Wires installed NLT April 10	4/10/18	4/10/18	App L 1.4
TSW operation	4/10/18	6/11/18	2.3.2.7
Spring Spill	4/10/18	6/15/18	App E (FOP)
Summer Spill	6/16/18	8/31/18	App E (FOP)
Inspect/rake trashracks	12/16/18	1/15/19	2.3.1.1.
SPECIAL OPS & STUDIES (Appendix A)	**3/1/18**	**2/28/19**	
Adult Lamprey PIT study	3/1/18	2/28/19	App A 5.2
Navigation Lock annual outage	3/3/18	3/18/18	App A 1.4
Juvenile System Survival Study	4/10/18	6/15/18	App A 5.2
Forebay for waterfowl nesting (dates approx)	4/20/18	7/8/18	App A 5.1
Doble testing	6/4/18	6/22/18	App A 5.1
Stilling Basin Surveys	9/15/18	10/31/18	App A 5.2
TDG MONITORING	**3/1/18**	**2/28/19**	
TDG Monitoring - Tailrace (year-round)	3/1/18	2/28/19	2.2
TDG Monitoring - Forebay	4/1/18	8/31/18	2.2
ADULT FISH COUNTING	**4/1/18**	**10/31/18**	
Day Visual 0500-2100 PDT	4/1/18	10/31/18	Table MCN-3
Night Video 2100-0500 PDT	6/15/18	9/30/18	Table MCN-3
REPORTS	**3/1/18**	**3/15/19**	
Weekly Reports	3/1/18	12/31/18	2.5.2
Annual Report due NLT Jan 31	3/15/19	3/15/19	2.5.3



1. FISH PASSAGE INFORMATION

Fish passage facilities at McNary Lock & Dam are shown in **Figure MCN-1**. The schedule for project operations described in the Fish Passage Plan (FPP) and Appendices is in **Table MCN-1**.

1.1. Juvenile Fish Passage.

1.1.1. Juvenile Fish Facilities. Juvenile fish sampling facilities at McNary Dam consist of extended-length submersible bar screens (ESBSs) with flow vanes, vertical barrier screens (VBSs), gatewell orifices, a concrete collection channel with emergency bypass outlets, primary and secondary dewatering structures, a pipeline/corrugated metal flume for routing juvenile fish to the sampling facilities or bypassing them back to the river, and a full-flow PIT tag detection system. Juvenile sampling facilities at McNary include: a separator to separate adult from juvenile fish and juvenile fish by size; a flume system routing juvenile fish either through the secondary bypass system or to the sample system; covered raceways and tanks for holding sampled fish; sampling facilities; an office and sampling building with fish marking facilities; and PIT tag detection and deflection systems. Maintenance of juvenile fish passage facilities that may impact juvenile fish or facility operations should be conducted during the winter maintenance period.

1.1.2. Juvenile Migration Timing. Juvenile fish passage timing at McNary Dam is shown in **Table MCN-2**, based on juvenile fish collection data over the most recent 10-year period (does not reflect bypass (FGE) or spillway passage). Salmon, steelhead, bull trout, lamprey, and other species are routinely counted.

Table MCN-2. Juvenile Salmonid Passage Timing at McNary Dam for Most Recent 10 Years (based on daily & yearly collection data).

Year	10%	50%	90%	#	10%	50%	90%	#
	Yearling Chinook				Subyearling Chinook			
2008	9-Apr	15-May	27-May	48	22-Jun	8-Jul	9-Aug	48
2009	2-May	15-May	25-May	23	18-Jun	4-Jul	22-Jul	34
2010	3-May	17-May	27-May	24	18-Jun	4-Jul	4-Aug	47
2011	29-Apr	8-May	23-May	24	24-Jun	24-Jul	19-Aug	56
2012	29-Apr	11-May	25-May	26	22-Jun	18-Jul	22-Aug	61
2013	1-May	9-May	29-May	28	16-Jun	4-Jul	22-Jul	36
2014	27-Apr	11-May	19-May	22	22-Jun	4-Jul	26-Jul	34
2015	27-Apr	7-May	19-May	22	14-Jun	2-Jul	10-Jul	26
2016	23-Apr	3-May	13-May	20	8-Jun	26-Jun	2-Jul	24
2017	23-Apr	5-May	19-May	26	6-Jun	2-Jul	22-Jul	36
10-Yr	**28-Apr**	**10-May**	**24-May**	**24**	**18-Jun**	**4-Jul**	**24-Jul**	**36**
10-Yr MIN	**9-Apr**	**3-May**	**13-May**	**20**	**6-Jun**	**26-Jun**	**2-Jul**	**24**
10-Yr MAX	**3-May**	**17-May**	**29-May**	**48**	**24-Jun**	**24-Jul**	**22-Aug**	**61**
	Unclipped Steelhead				Clipped Steelhead			
2008	1-May	15-May	29-May	28	3-May	11-May	23-May	20
2009	25-Apr	7-May	23-May	28	27-Apr	7-May	23-May	26
2010	1-May	13-May	2-Jun	32	1-May	9-May	29-May	28
2011	19-Apr	7-May	27-May	38	19-Apr	1-May	17-May	28
2012	24-Apr	5-May	25-May	31	23-Apr	1-May	17-May	24
2013	23-Apr	11-May	2-Jun	40	25-Apr	3-May	19-May	24
2014	23-Apr	7-May	19-May	26	25-Apr	5-May	15-May	20
2015	1-May	15-May	27-May	26	27-Apr	9-May	27-May	30
2016	19-Apr	3-May	23-May	34	21-Apr	1-May	15-May	24
2017	21-Apr	5-May	29-May	38	19-Apr	29-Apr	13-May	24
10-Yr	**23-Apr**	**7-May**	**27-May**	**32**	**25-Apr**	**4-May**	**18-May**	**24**
10-Yr MIN	**19-Apr**	**3-May**	**19-May**	**26**	**19-Apr**	**29-Apr**	**13-May**	**20**
10-Yr MAX	**1-May**	**15-May**	**2-Jun**	**40**	**3-May**	**11-May**	**29-May**	**30**
	Coho				Sockeye (Wild & Hatchery)			
2008	13-May	25-May	6-Jun	24	15-May	25-May	6-Jun	22
2009	13-May	23-May	12-Jun	30	5-May	21-May	2-Jun	28
2010	9-May	31-May	12-Jun	34	11-May	29-May	2-Jun	22
2011	24-Apr	19-May	8-Jun	45	4-May	13-May	31-May	27
2012	7-May	23-May	4-Jun	28	1-May	11-May	21-May	20
2013	3-May	21-May	8-Jun	36	29-Apr	15-May	27-May	28
2014	1-May	17-May	2-Jun	32	3-May	17-May	23-May	20
2015	5-May	21-May	4-Jun	30	27-Apr	17-May	25-May	28
2016	29-Apr	13-May	25-May	26	29-Apr	11-May	19-May	20
2017	1-May	19-May	29-May	28	27-Apr	13-May	25-May	28
10-Yr	**4-May**	**21-May**	**5-Jun**	**30**	**2-May**	**16-May**	**26-May**	**25**
10-Yr MIN	**24-Apr**	**13-May**	**25-May**	**24**	**27-Apr**	**11-May**	**19-May**	**20**
10-Yr MAX	**13-May**	**31-May**	**12-Jun**	**45**	**15-May**	**29-May**	**6-Jun**	**28**

1.2. Adult Fish Passage.

1.2.1. Adult Fish Facilities. McNary Dam adult fish passage facilities consist of separate north and south shore facilities, described below. Maintenance of adult facilities is scheduled for January–February, typically one shore at a time, to minimize impacts on upstream migrants.

1.2.1.1. North Shore Adult Fish Facility. The north shore facilities are comprised of a fish ladder with counting station, submerged orifice PIT-tag antennas in the ladder, a small collection system, and a gravity-flow auxiliary water supply system that has a turbine unit on it operated by North Wasco County PUD. The gravity-flow auxiliary water supply system takes water from the forebay through two conduits, passes the water through a turbine unit (or through a bypass/energy dissipater when the turbine is not in operation) and distributes the water through a diffuser system at the bottom of the ladder and in the transportation channel. The north shore collection system has three downstream entrances (two of which are used during normal operation) and a side entrance into the spillway basin.

1.2.1.2. South Shore Adult Fish Facility. The south shore facilities are comprised of a fish ladder with counting station, submerged orifice PIT-tag antennas in the ladder and antennas at the counting station, two south shore entrances, a powerhouse collection system, and gravity and pumped auxiliary water supply systems.

1.2.1.3. Powerhouse Collection System. The powerhouse collection system contains three downstream entrances and one side entrance into the spillway basin at the north end of the powerhouse, twelve operating floating orifices, and a common transportation channel. At the north end of the powerhouse, two of the downstream entrances are used during normal operation with the other downstream and side entrances closed. The gravity-flow auxiliary water is provided by one conduit from the forebay and supplies the diffusers at the bottom of the ladder at tailwater level. The pumped auxiliary water is supplied by three electric pumps with variable-pitched blades. Two pumps can provide the required flow when the third pump is bulkheaded to prevent water from flowing back through the pump to the river. The electric pumps supply the auxiliary water for the diffusers at the entrances and in the transportation channel. Excess water from the primary dewatering structure in the juvenile fish collection channel is routed to the adult collection system at the north end of the powerhouse.

1.2.2. Adult Migration Timing & Counting.

1.2.2.1. Upstream migrants are present throughout the year and adult fish facilities are operated year-round. Adult salmon, steelhead, shad, and lamprey are counted per the schedule in **Table MCN-3** and data are posted daily at: www.fpc.org/adultsalmon_home.html. Sturgeon and bull trout are relatively infrequent and 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 fish passage defined in **Table MCN-4**. Time-of-day (diel) distributions of adult salmonid activity at McNary Dam fishway entrances and exits are shown in **Figure MCN-2**.

Table MCN-3. McNary Dam Adult Fish Counting Schedule, 3/1/2018 – 2/28/2019.

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 3/11/18-11/4/18).

Table MCN-4. McNary Dam Adult Fish Count Period and Peak Passage Timing (based on yearly counts from 1954 through most recent count year).

Species	Count Period	Earliest Peak	Latest Peak
Spring Chinook	Apr 1 – Jun 8	Apr 20	May 26
Summer Chinook	Jun 9 – Aug 8	Jun 13	Jul 26
Fall Chinook	Aug 9 – Oct 31	Sep 10	Sep 28
Steelhead	Apr 1 – Oct 31	Jul 9	Oct 13
Sockeye	Apr 1 – Oct 31	Jun 24	Oct 11
Coho	Apr 1 – Oct 31	Jun 27	Oct 5
Lamprey	Apr 1 – Oct 31	Jun 21	Aug 12

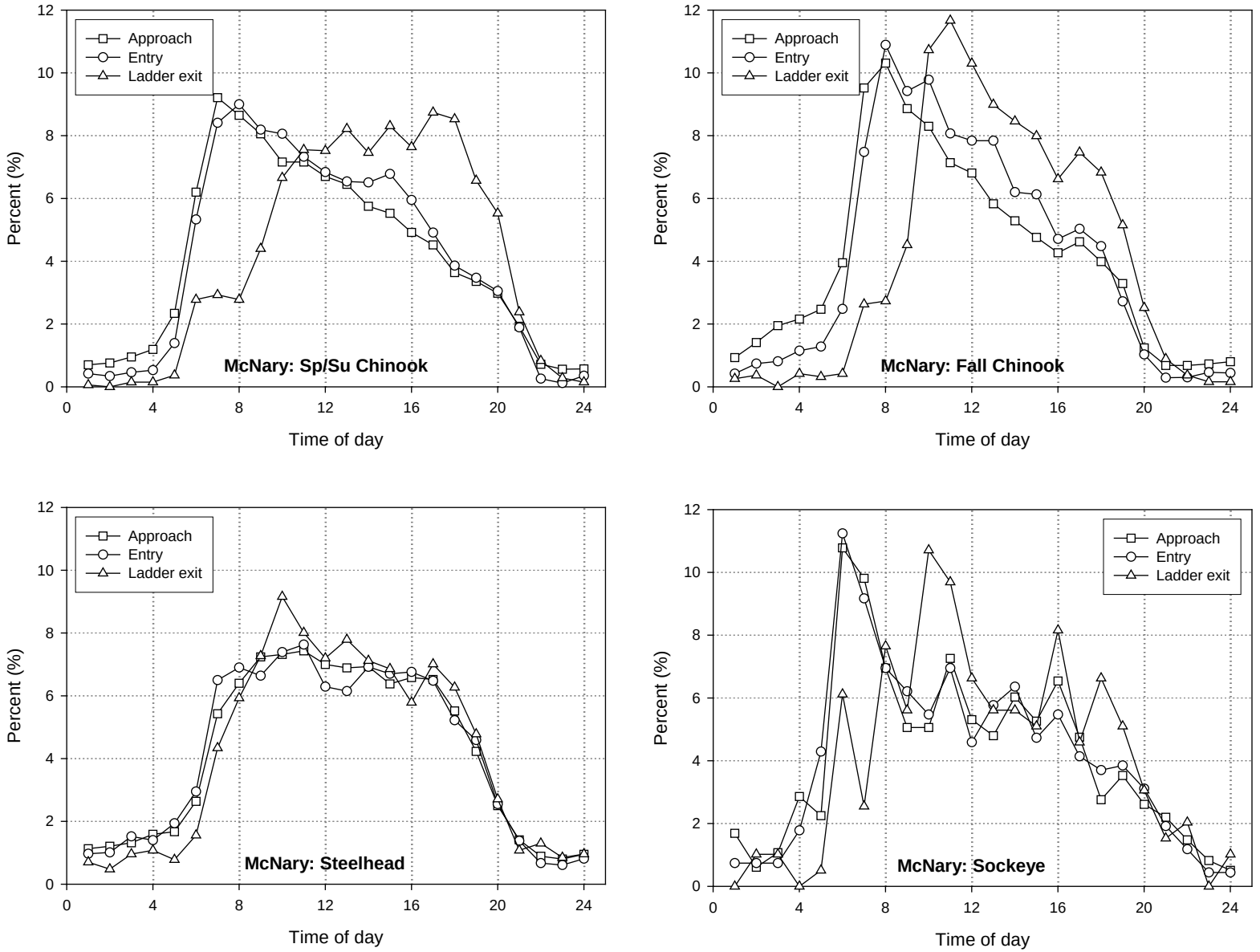


Figure MCN-2. Diel Distribution of Adult Salmonids at McNary Dam Fishway Entrances and Exits (*Keefer & Caudill 2008*).
pweb.crohms.org/tmt/documents/FPOM/2010/2013_FPOM_MEET/2013_JUN/

2. FISH FACILITIES OPERATIONS

2.1. General.

2.1.1. Yearly special operations related to research are described as currently coordinated in **Appendix A - Special Project Operations & Studies**.

2.1.2. Research, non-routine maintenance 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 by the Project, Walla Walla District (NWW) Operations and/or Planning or Construction office through FPOM or FFDRWG. Currently coordinated special operations related to research are described in *Special Project Operations & Studies* (**Appendix A**). These distances are approximate and will be updated after data are collected and analyzed to understand where the threshold for adversely impacting adult fish behavior occurs. Alternate actions will be considered by District and Project biologists in conjunction with the Regional fish agencies on a case-by-case basis.

2.1.3. 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 of steps taken to correct the situation immediately following the incident. All activities within boat restricted zones (BRZ) will be coordinated with the Project at least 2 weeks in advance, unless it is deemed an emergency (see also **FPP Chapter 1 - Overview** for coordination guidance). On a monthly basis, as appropriate, the project biologist will provide a summary of any emergency actions undertaken for review by FPOM.

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 Fish Passage Plan as **Appendix E**. Spill at McNary Dam will be distributed in spill patterns defined in **Tables MCN-7, -8, -9, -10**.

2.2.2. Involuntary spill is the result of river flow above powerhouse capacity, insufficient load (lack of load), turbine unit outages (forced or scheduled), or failure of a key component of the juvenile fish passage facility which forces spill to provide juvenile fish passage.

2.2.3. Total dissolved gas (TDG) is monitored at McNary Dam during the periods defined in **Table MCN-1**, pursuant to the Corps' annual *TDG Monitoring Plan* and *Dissolved Gas Monitoring Plan of Action 2015-2018*.[1]

[1] TDG Monitoring Plan (Appendix 4 of the WMP): pweb.crohms.org/tmt/documents/wmp/. TDG Monitoring Plan 2015-2018: pweb.crohms.org/tmt/wqnew/tdg_monitoring/2015-18.pdf

2.3. Operating Criteria – Juvenile Fish Facilities.

2.3.1. Juvenile Facilities - Winter Maintenance (December 16 – March 31).

2.3.1.1. Prior to January 16, inspect or rake up to four trashracks to assess debris levels. Prioritize raking trashracks at units with known debris issues and longer run times, and ensure that raked units are distributed evenly across the powerhouse to the extent practicable.

2.3.1.2. Forebay Area and Intakes.

i. Remove debris from forebay and trashracks.

ii. Rake trashracks.

iii. Remove debris from gatewell slots.

iv. Measure and log drawdown in gatewell slots.

v. Inspect and repair gatewell dip net as needed.

2.3.1.3. ESBSs, Flow Vanes, and VBSs.

i. Removal of ESBSs will begin on the Monday of the third week of December. After ESBSs are removed ~~at the end of the season~~, inspect for juvenile salmonid mortalities and all other incidental fish mortalities. Inspect ESBSs within a week after removal, or as soon as practical. All mortalities are to be counted, or otherwise estimated, for each ESBS and reported to CENWW-OD-T.

ii. Maintenance completed on all ESBSs.

iii. Inspect ESBSs for good running order and operate debris cleaner one trial run (dogged off at deck level).

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

v. Inspect all VBSs at least once per year by either raising the VBS and visually inspecting or inspecting with an underwater video camera.

2.3.1.4. Collection Channel.

i. Orifice lights operational.

ii. Orifices clean and valves operating correctly.

iii. Orifice air backflush system works correctly.

iv. Netting over handrails and orifice chutes maintained and in good condition.

v. Plastic covers over orifice chutes maintained and in good condition and clean so orifice flow is visible.

2.3.1.5. Dewatering Structure and Flume.

i. Inclined and side dewatering screens are clean and in good condition with no gaps between screen panels, no damaged panels, and no missing silicone.

ii. Cleaning brush systems are maintained and operating correctly.

iii. All valves in good condition and operating correctly.

iv. Stilling well water level sensing device inspected and operable.

v. Flume and pipe interiors smooth with no rough edges.

vi. Maintain full-flow PIT-tag system as required. Coordinate with PSMFC.

2.3.1.6. Sampling Facilities.

i. Flume switch gate is maintained and operational.

ii. Flume is smooth with no rough edges.

iii. Perforated plate and bar screen edges are smooth with no rough edges.

iv. Wet separator and fish distribution system maintained and operating as designed.

v. Brushes on all crowders in good condition or new.

vi. Crowders maintained and operating properly.

vii. All valves, slide gates, and switch gates maintained and operating correctly.

viii. Raceway and tank retainer screens set in place with no holes or sharp wires protruding.

ix. All sampling equipment should be maintained and operating correctly.

x. Maintain juvenile PIT-tag system as required (see "*Columbia Basin PIT-tag Information System, General Gate Maintenance and Inspection, Walla Walla District*", February 2003). Coordinate with PSMFC.

2.3.1.7. Maintenance Records. Record all maintenance and inspections.

2.3.1.8. Avian Predation Areas (Forebay and Tailrace). Inspect bird wires, water cannon, and other deterrent devices and repair or replace as needed. Where possible, install additional

bird wires or other deterrent devices to cover areas of known avian predation activity. Prepare avian abatement contract as needed.

2.3.2. Juvenile Fish Passage Season (April 1 – December 15).

Operate April 1–December 15 for juvenile fish bypass and sampling, and for adult fallback bypass. Operate according to criteria below and in the *Smolt Facility Operating Protocols* (**Appendix J)** for juvenile salmonid bypass and collection (for research purposes).

2.3.2.1. Forebay Area and Intakes.

i. Remove debris from forebay.

ii. Inspect gatewell slots daily for debris, fish buildup, and contaminating substances (particularly oil). Clean gatewells before they become 50% covered with debris. If the volume of debris precludes the ability to keep the gatewell at least 50% clear, they should be cleaned at least once daily. If flows through an orifice or fish conditions give indications that an orifice may be partially obstructed with debris, the orifice will be closed and backflushed to remove the obstruction. If the obstruction cannot be removed, the orifice shall be closed and the alternate orifice for that gatewell slot shall be operated. If both orifices become obstructed or plugged with debris, the turbine unit will not be operated until the gatewell and orifices are cleared of debris.

iii. If a visible accumulation of contaminating substances (e.g., oil) is detected in a gatewell and cannot be removed within 24 hours, the gatewell orifices shall be closed immediately and the turbine unit shut down within one hour until the material has been removed and any problems corrected. A preferred method for removing oil from the water surface is to install absorbent socks, booms, or pads capable of encapsulating the material, tied off with a rope for later disposal. Action should be taken as soon as possible to remove oil from the gatewell so the orifice can be reopened to allow the fish to exit the gatewell. Orifices shall not be closed for longer than 48 hours.

iv. Remove debris from forebay and trashracks as required to minimize fish impacts. Generally this will result in removing debris from trashracks at least four times per year: just prior to fish passage season and monthly for the first three months. Raking may be required when heavy debris loads are present in the river. Fish quality and trashrack differential may also be an indicator of debris buildup on the trashracks. Project biologist shall determine when trash raking is required.

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

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

2.3.2.2. ESBSs and VBSs.

i. Operate ESBSs with flow vanes attached. Installation of ESBSs ~~will not start prior to April 5~~ may begin as early as April 2 starting at the lowest priority units (least likely to operate) and will be completed by no later than April 15.

ii. Operate ESBSs with debris cleaners in automatic mode. Set cleaning frequency to 60 minutes. Increase or decrease frequency if needed to maintain clean screens.

iii. Inspect ESBSs weekly by underwater video in at least 3 operating turbine units. Spot-check VBSs at the same time.

iv. Conduct additional ESBS inspections if fish condition warrants it.

v. If an ESBS is damaged or fails during juvenile fish passage season, follow procedures in **section 3.2.2.2**. In no case should a turbine unit be operated with a missing or known non-operating or damaged ESBS or VBS. Units shall not operate for more than 10 hours, *and preferably less than 3 hours*, with ESBSs in place and orifices closed. Orifice closure should be minimized by efficient planning and completion of work to be done (e.g., having equipment, materials and personnel ready before closing orifices).

vi. Make formal determination at end of season as to adequacy of bar screen panels and debris cleaner brushes and replace components as necessary.

vii. Measure head differentials across VBSs daily during times of debris. Clean and inspect VBS when head differentials reach 1.5'. When a head differential of 1.5' is reached, the respective turbine unit should be operated at a reduced generation loading if the VBSs cannot be cleaned within 8 hours, to minimize loading on the VBS and potential fish impingement.

viii. Between the spring and summer periods, inspect at least four VBSs in two different turbine units that were operated frequently during the spring. If debris accumulation is noted, inspect other VBSs and clean debris as necessary.

ix. Inspect all VBSs at least once per year and when pulled for cleaning. Repair as needed.

2.3.2.3. Collection Channel.

i. Orifices clean and operating. Operate at least one orifice per gatewell slot (preferably the south orifice). If orifices must be closed to repair any part of the facility, do not close orifices in operating turbine units with ESBSs in place for longer than 10 hours, and preferably less than 3 hours. During periods of high fish numbers or high debris, this time period may be less. Reduce turbine unit loading to the lower end of the 1% efficiency range if deemed necessary by the project biologist. Monitor fish conditions in gatewells hourly or more frequently during orifice closure periods.

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

iii. Replace all burned out orifice lights within 24 hours of notification. Orifice lights shall remain lighted 24 hours/day.

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

v. Orifice valves are either fully open or closed.

vi. Cycle orifices at least once per day and more frequently if required. During periods of high fish and debris passage, April 1 through August 15, orifices should be inspected and cycled twice daily or more frequently as determined by the project biologist, to keep orifices clean. If debris is causing continual orifice plugging problems in a particular turbine unit gatewell, the respective turbine unit generation may be restricted to the lower end of the 1% turbine efficiency range to minimize orifice plugging problems.

vii. Netting along handrails maintained in good condition (no holes or gaps).

viii. Plastic covers over orifice chutes in good condition.

2.3.2.4. Dewatering Structure.

i. No gaps between panels or missing silicone in side and inclined screens.

ii. Trash sweeps operating correctly.

iii. The project biologist shall determine the frequency of operation of the trash sweeps. The sweeps should operate at a frequency to maintain a clean screen given present debris loads. Frequency of operation may vary from as low as once every 15 minutes to once every 2 or more hours. This frequency should coincide with the ESBS cycle time.

iv. If problems occur with the automated cleaning system, project personnel shall operate cleaners at least once per shift unless otherwise determined by the project biologist.

v. The dewatering structure may be dewatered twice during the season, during low fish passage periods in June and September, for inspection and cleaning of the dewatering screens. Before dewatering occurs, the project biologist must notify CENWW-OD-T who in turn will coordinate the proposed action with NOAA Fisheries and other FPOM participants.

vi. Lights at the dewatering structure should be turned off at night, unless needed for personnel access, to encourage fish to move downstream volitionally.

2.3.2.5. Sampling Facilities. [Note: normal operations when not sampling fish is to operate the juvenile bypass facilities in full flow bypass to the river. During this operation, fish may be periodically routed through the sampling facilities to sample fish for the Smolt Monitoring Program or for routine sampling to monitor facility descaling and fish condition. Sampling during full flow bypass operations will be coordinated on an as-needed basis. Sampling during the juvenile fish bypass season is normally done every other day, per **Appendix J**.]

i. There should be no holes or gaps between screen panels. All silicone sealer should be in good condition.

ii. Crowder screen brushes should be in good operating condition.

iii. Assure that retainer screens in raceways and tanks are clean with no holes or protruding wires.

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

v. Project personnel shall release ice blocks through each 10" bypass line, 1-3 times per day as warranted by woody debris loads, during the spring as a preventative measure for debris plugging. Additional ice blocks shall be passed down the pipelines during high debris periods as needed to keep the pipes debris free. Releasing ice blocks through the pipes should continue during the summer when transporting fish, as determined by the project biologist to keep the pipelines debris free.

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

2.3.2.6. Avian Predation Areas (Forebay, Tailrace, and Collection Channel).

i. Bird wires and other avian deterrent devices should be monitored to assure good condition. Any broken wires or devices should be replaced as soon as possible.

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

iii. Project biologists shall routinely monitor project areas to determine areas of active avian predation and, if possible, adjust harassment program to cover these areas or install bird wires or other deterrent devices to discourage avian predation activities. Grebes should be routinely captured in the juvenile fish channel and released below the dam, in coordination with USDA/Wildlife Services.

2.3.2.7. Temporary Spillway Weirs (TSW).[2]

2.3.2.7.a. Spring spill for fish passage will begin with TSWs operating in bays 19, 20 and spill distributed in the patterns in **Table MCN-7**. Both TSWs will be in service through June 7, and removed on June 8 or the next available work day. During TSW removal, spill will be distributed in patterns in **Table MCN-10** to ensure worker safety. Upon completion of TSW removal when both TSWs are not in service, spill will be distributed in patterns in **Table MCN-9** for the remainder of fish passage spill season.

2.3.2.8. Emergency Bypass.

i. Freezing Conditions. When cold weather is forecasted for Umatilla, Oregon, between November 1 and December 15, the McNary Fisheries staff may place the Juvenile Fish Facility (JFF) channel in emergency bypass mode until the beginning of winter maintenance period when the channel is fully dewatered.

- "*Cold weather*" is defined as: daily high temperature <32°F or daily low temperature < 20°F, as forecasted for Umatilla, OR, by NOAA's National Weather Service at www.weather.gov.

- If the projects installs a proposed "X" or "Y" valve in the south trash sluiceway that eliminates the need for emergency bypass, then the fisheries staff may shut down the water supply to the JFF after November 1 until the JFF is re-watered the following March, unless earlier re-watering is required for testing or maintenance.

ii. Late Season Mechanical Failure. After November 30, if a mechanical failure forces the McNary JFF juvenile channel into emergency bypass mode, the McNary Fisheries staff may leave the juvenile channel in emergency bypass mode until the beginning of winter maintenance when the channel is fully dewatered.

2.3.2.9. Inspection and Record Keeping. Inspect all facilities according to fish facilities monitoring plan. Record all inspections.

2.4. Operating Criteria - Adult Fish Facilities.

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

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

2.4.1.2. Dewater all ladders and inspect all dewatered sections of fish facilities for projections, debris, or plugged orifices which could injure fish or impede fish passage up the

[2] Spillway weirs provide surface passage routes via spillbay(s). Temporary, or Top, Spillway Weirs (*TSW*s) at Little Goose, McNary and John Day dams can be installed, uninstalled and moved between bays using the gantry crane. Removable Spillway Weirs (*RSW*s) at Lower Granite, Lower Monumental and Ice Harbor dams are "removed" by controlled descent to the bottom of the forebay.

ladder. Fish ladder exit trashracks must have smooth surfaces where fish pass and must have downstream edges that are adequately rounded or padded. Inspect all diffuser gratings and chambers annually by dewatering or by using divers or video inspection techniques. All diffuser gratings and chambers are to be dewatered and physically inspected at least every 3 years. Repair deficiencies.

2.4.1.3. Inspect for and clean debris from fish ladder exits. All trashracks and picketed leads must be clean and installed correctly.

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

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

2.4.1.6. Fish pumps maintained and ready for operation.

2.4.1.7. Maintain adult PIT-tag system as required. Coordinate with PSMFC.

2.4.1.8. Outage periods will be minimized to the extent practicable. Only one ladder may be out of service or operating out of standard operating criteria at any one time, unless specifically coordinated with CENWW-OD-T and FPOM.

2.4.2. Adult Fish Passage Season (March 1 – December 31).

2.4.2.1. Fishway Ladders. Water depth over weirs: 1.0’–1.3'.

2.4.2.2. Counting Windows. The crowder shall be opened to full count slot width and the picketed leads shall be removed when not counting. The crowder shall be open as far as possible to allow accurate counting and shall not be closed to less than 18 inches while counting, to the extent possible. This will usually occur during high turbidity conditions to allow count accuracy criteria to be achieved. All equipment should be maintained and in good condition. The counting window and backboard should be cleaned as needed to maintain good visibility. Crowder ranges at MCN are:

i. Washington Shore = 19 $^{3}/_{16}$” (not adjustable)

ii. Oregon Shore downstream = 13 $^{1}/_{8}$” – 17 $^{5}/_{8}$”

iii. Oregon Shore upstream = 13 $^{1}/_{2}$” – 17 $^{1}/_{8}$”

2.4.2.3. Head on all Fishway Entrances. Head range: 1'–2'.

2.4.2.4. Channel Velocity. Adult collection channel water velocities must flow between 1.5’ and 4’ per second, which is the optimum velocity for returning adult salmon and steelhead to migrate upstream though the fishway. Velocity readings are completed three times per week and included in required fishway inspections and reported in weekly and annual reports.

i. Surface water velocities will be measured in the open access area near the south shore fish entrance by using a large piece of woody debris (stick, bark) timed over a marked fixed distance. A Doppler meter location near the same location measures sub-surface flow. The measurement of the water velocity at this location represents the slowest velocity conditions throughout the length of the channel.

2.4.2.5. North Shore Entrances (WFE 2 & 3).

i. Operate 2 downstream gates.

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

2.4.2.6. North Powerhouse Entrances (NFE 2 & 3).

i. Operate 2 downstream gates.

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

2.4.2.7. Floating Orifice Gates (FOGs). Operate twelve FOGs (1, 3, 4, 8, 14, 21, 26, 32, 37, 41, 43, 44).

2.4.2.8. South Shore Entrances (SFE 1 & 2).

i. Operate two downstream gates.

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

2.4.2.9. Head on Trashracks.

i. Maximum head of 0.5' on ladder exits.

ii. Maximum head on picketed leads shall be 0.5'. Normal head differential on clean leads is 0.3'.

iii. Trashracks and picketed leads installed correctly.

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

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

2.4.2.12. Facility Inspections.

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

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

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

iv. Project personnel shall check calibration of fishway control system twice per month. This may be done as part of routine fishway inspections.

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

vi. Record all inspections.

2.4.2.13. Fishway Temperature Monitoring. From June 1 through September 30, water temperature will be monitored at adult fishway entrances and exits.

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

ii. 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.

iii. The exit monitor shall be 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, it shall be verified that the site accurately reflects water temperature within 10 meters of the entrance or exit.

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

2.5. Fish Facilities Monitoring & Reporting.

2.5.1. Project biologists shall inspect fish passage facilities at the frequencies described in the juvenile and adult fish facilities operating criteria sections.

2.5.2. Weekly Reports. Project Biologists shall prepare weekly reports March 1–December 31, summarizing operations for Friday through Thursday, and email to CENWW-OD-T by noon the following Monday. Reports shall provide an overview of how the project and the fish passage facilities operated during the week and evaluate resulting fish passage conditions, and include:

i. Any out-of-criteria situations observed and subsequent corrective actions taken;
ii. Any equipment malfunctions, breakdowns, or damage along with a summary of resulting repair activities;
iii. Adult fishway control calibrations;

iv. ESBS and VBS inspections;
v. Any unusual activities that occurred at the project that may affect fish passage.

2.5.3. Annual Reports. Project biologists shall prepare a draft annual report by February 10 and a final report by March 15 summarizing the operation of the project fish passage facilities for the previous year. The annual report shall also include a description of all actions taken to discourage avian predation at the project, with an overview of the effectiveness of the activities in discouraging avian predation.

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

3. FISH FACILITIES MAINTENANCE

3.1. Dewatering & Fish Handling.

3.1.1. Project biologists should be present to provide technical guidance at all project activities that may involve fish handling. All dewaterings shall be accomplished in accordance with approved *Dewatering Guidelines and Fish Salvage Plans* (**Appendix F**). When river temperatures exceed 68°F at the Juvenile Fish Facility (JFF) sample tank, all adult fish handling will be coordinated through CENWW-OD-T. Project *Dewatering Plans*[3] were reviewed and revised in 2011 to ensure they comply with **Appendix F**.

3.2. Maintenance - Juvenile Fish Facilities.

3.2.1. Scheduled Maintenance. Scheduled maintenance of the juvenile facilities is conducted during the entire year. Long-term maintenance or modifications of facilities that require them to be out of service for extended periods of time are conducted during the winter maintenance period from December 16 – March 31. During the fish passage season parts of the facilities are maintained on a daily, weekly, or longer interval to keep them in proper operating condition.

3.2.2. Unscheduled Maintenance. Unscheduled maintenance is the correction of any situation that prevents facilities from operating according to criteria or that will impact fish passage or survival.

3.2.2.1. Notification/Reporting. Maintenance of facilities such as ESBSs, which sometimes break down during the fish passage season, will be carried out as described below. In these cases, repairs will be made as prescribed and CENWW-OD-T will be notified as soon as possible after it becomes apparent that repairs are required. The Operations Manager may determine that work must be initiated prior to notifying CENWW-OD-T if a delay will result in an unsafe situation for people, property, or fish. Unscheduled maintenance that will have a significant impact on fish passage shall be coordinated with NOAA Fisheries and FPOM on a

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

case-by-case basis by CENWW-OD-T. Information required by CENWW-OD-T includes (see also **FPP Chapter 1 - Overview**):

i. Description of outage;
ii. Type of outage required;
iii. Impact on facility operation;
iv. Length of time for repairs; and
v. Potential fish impacts and proposed mitigation measures.

3.2.2.2. ESBSs. The ESBSs deflect fish and water up the gatewell slots as part of the fish bypass system and are inspected periodically throughout the juvenile passage season with a video monitoring system. If an ESBS is found to be damaged, it will be removed and either replaced with a spare, or repaired and returned to service. A turbine unit shall not be operated with a known damaged or nonfunctioning screen or without a full complement of ESBSs, flow vanes and VBSs. If a screen fails on a weekend or at night when maintenance crews are not available, the respective turbine unit will be shut down and generation switched to a fully screened unit. If all screened turbine units are in service, water may be spilled until the affected screen can be removed and repaired or replaced.

3.2.2.3. VBSs. Each gatewell has a VBS located vertically between the bulkhead slot and the operating gate slot to guide fish away from the turbine intake. The VBSs are designed to distribute flow evenly through the screens to minimize fish impingement and/or descaling. The gatewell water surface elevations are routinely measured to determine head differential across the VBSs caused by debris. VBSs are to be pulled and cleaned when head differentials reach 1.5'. Prior to pulling a VBS for cleaning, the turbine unit loading will be lowered to the lower end of the 1% efficiency range and the gatewell dipped with a gatewell basket to remove all fish present in the gatewell unless doing so results in increased mortality (e.g., high numbers of adult or juvenile shad in gatewells). Immediately after dipping, the VBS shall be raised and debris hosed off. The turbine unit shall remain operating at the lower end of 1% while the VBS is being cleaned so gatewell flow will carry the debris into the operating gatewell where it will pass through the turbine unit. Immediately after cleaning the VBS, the VBS shall be lowered to the normal operating position to prevent fish passing from the bulkhead slot into the operating gate slot. The VBSs shall not be raised longer than 30 minutes with the turbine unit running. If VBSs cannot be cleaned within 1 workday of the head differential reaching 1.5', the turbine unit loading will be lowered to the lower end of the 1% range until the VBS can be cleaned. If the cleaning frequency of VBSs exceeds project personnel's cleaning capability of approximately 10 VBSs per day, 7 days per week, project personnel will notify CENWW-OD-T. Then CENWW-OD-T will coordinate with NOAA Fisheries and other FPOM participants regarding an exemption to dipping gatewells prior to cleaning VBSs. An exemption to dipping gatewells prior to cleaning VBSs will be based on fish numbers and TDG levels. If a VBS is found to be damaged during an inspection or cleaning, the VBS panel will be repaired or replaced with a spare panel. The turbine unit will not be operated with a known damaged VBS.

3.2.2.4. Gatewell Orifices. Each gatewell has two orifices with valves to allow fish to exit the gatewell. Under normal operation, one orifice per gatewell (normally the south orifice) is operated. If an orifice becomes blocked with debris or is damaged, it will be closed and the alternate orifice for that gatewell operated until repairs can be made. If both orifices are

blocked with debris, damaged, or must be kept closed, the turbine unit will be taken out of service until repairs can be made. If there is a major failure with the bypass system that prevents the gatewell orifices from operating, traveling screens and bar screens will remain in operation. Turbine units shall not be operated with blocked or closed orifices for longer than 10 hours. During any orifice closure, project personnel shall monitor gatewells for signs of fish problems or mortality. If repairs are expected to take longer than two days, a salvage program will be initiated to dip the juveniles from the gatewells with a gatewell basket until repairs are made and the system watered up again or orifices opened. Juvenile fish shall not remain in gatewells longer than 48 hours. During periods of high fish passage, it may be necessary to cease operation of turbine units with ESBSs in place and with closed orifices in less than 10 hours, depending on fish numbers and condition. Spill may occur to provide an alternate avenue for fish passage during facility outages.

3.2.2.5. Dewatering Structure. The dewatering structure acts as a transition from the collection channel to the bypass pipe/flume. An inclined screen and a side dewatering screen allow excess water to be bled off, with all fish and remaining water transitioning into the bypass pipe. Some of the excess water is discharged into the adult fish facility auxiliary water supply system and some is used as the water supply for the sampling facilities. The dewatering structure contains trash sweeps and an air-burst system for cleaning the dewatering screens of impinged debris. If a trash sweep breaks and interferes with juvenile fish passage through the structure or if a screen is damaged, an emergency bypass system in the collection channel may be used to bypass juveniles while repairs are made. Operation of the emergency bypass system requires the juvenile bypass system to be dewatered and stoplogs inserted at the upstream end of the dewatering structure. The emergency bypass is then opened and the bypass system operated with one orifice per gatewell open. Spill may also be required to bypass juvenile fish while in emergency bypass operations. Prior to any emergency dewatering of the collection channel, the project will notify CENWW-OD-T. Then CENWW-OD-T will be responsible for notifying NOAA Fisheries and other FPOM participants of the action and coordinating changes in spill or other project operations. The emergency bypass system is not equipped with PIT-tag detectors.

3.2.2.6. Bypass Outfall Flume. The corrugated metal bypass flume routes juveniles to either the sampling facilities or to the river below the project through the primary bypass pipe. If a problem interferes with the flume's operation, the project can open the emergency bypass system in the collection system and all of the fish in the bypass system will be diverted into the ice and trash sluiceway and passed to the river through the north powerhouse ice and trash sluiceway exit.

3.2.2.7. Sampling Facilities. The sampling facilities can be operated to collect and hold juveniles for research and sampling purposes, enumerate fish through the sampling system, or bypass part or all of the fish back to the river (secondary bypass). If part of the facility malfunctions or is damaged, the switch gate in the bypass flume will be used to bypass fish directly to the river (primary bypass) until repairs can be made. .

3.3. Maintenance - Adult Fish Facilities.

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

3.3.2. Unscheduled Maintenance.

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

3.3.2.2. Fish Ladders & Counting Stations. Fish ladders contain tilting weirs, fixed weirs, counting stations with picket leads, and fish exits with trashracks. If any part of the fish ladder fails or is blocked with debris during fish passage season, efforts will first be made to correct the problem without dewatering the ladder. Trashracks, picket leads, tilting weir mechanisms, and counting stations can sometimes be repaired or maintained without dewatering the ladder. The decision to dewater the ladder and make repairs during the fish passage season or wait until the winter maintenance period will be made after coordination with the fish agencies and tribes.

3.3.2.2.a. Hazardous Materials Spill. 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.

3.3.2.3. North Shore Auxiliary Water Supply System. The auxiliary water for the north shore fish ladder is provided by gravity-flow from the forebay. The water passes either through a turbine unit or through a bypass system. The turbine/bypass system is operated by North Wasco County PUD. During normal operations, when the turbine unit is operating, water passes through conduits 3 and 4 to the turbine unit. From the turbine unit, the water discharges into an open pool where it feeds into ladder diffusers. If there are problems with the turbine unit, automatic valves close and the auxiliary water is diverted through conduits 1 and 3A to the baffled bypass system within the old fish lock, where the hydraulic head is dissipated and the water discharged into the diffuser pool.

3.3.2.4. South Shore Auxiliary Water Supply System. The south shore auxiliary water is made up of a combination of gravity flow from the forebay, pumped water from the tailrace and 450 cfs of water from the juvenile collection channel. The gravity flow supplies the diffusers above weir 253 (diffusers 7 through 14) and the pumps supply diffusers below weir 253 (diffusers 1 through 7 and main unit diffusers). Diffuser 7 is where both systems meet and is supplied by either gravity flow or pumped flow. Gravity flow diffusers are regulated by rotovalves and pumped flow diffusers by sluice gates. Water from the juvenile collection channel enters the south fishway near the north powerhouse entrances.

i. If a rotovalve fails, the nearest closed rotovalve will be opened to supply flow. If more rotovalves fail than there are closed valves, the sluice gates in diffusers 3 through 7 will be opened more to provide required flows.

ii. If any sluice gates fail, the nearest sluice gates will be opened further to make up the flow.

iii. If one pump fails, the other two pumps will be operated to maintain facilities within criteria.

iv. If two pumps are expected to be out of service short-term (up to five days), then NFE3 will be closed and SFE1, SFE2, NFE2 will be operated as deep as possible while maintaining head differential at 1–2’ at both north and south PH entrances.

v. If two pumps are expected to be out of service long-term (six days or longer), then the middle eight of twelve open floating orifices (4,8,14,21,26,32,37,41) should be closed and monitored before closing main entrances. If extra water is still needed, NFE3 will be closed and SFE1, SFE2, NFE2 will be operated as deep as possible to maintain head differential at 1–2' at both north and south PH entrances.

vi. If all three pumps fail and the outage is expected to last five days or less, CENWW-OD-T will be notified and in turn will coordinate with NOAA Fisheries and other FPOM participants.

vii. If all three pumps fail and the outage is expected to last six days or longer close NFE3 and the middle eight of twelve open floating orifices (4,8,14,21,26,32,37,41) and operate SFE1 and SFE2 as deep as possible while maintaining head differential at 1–2' at the south PH entrances. If a depth of 6' on both gates cannot be maintained, SFE1 will be closed as long as the lamprey passage structure is in place at SFE2, if the lamprey structure is not in place then close SFE2.

viii. If both pumped auxiliary water supply systems and juvenile collection channel are closed or in emergency bypass (eliminating the 450 cfs contribution from the juvenile system), close north powerhouse entrances and eight of twelve open floating orifices starting at the north end of collection channel, and operate SFE1, SFE2 as deep as possible while maintaining head differential at 1–2' at the

south PH entrances. If both gates cannot be maintained at a depth of 6', SFE1 will be closed as long as the lamprey passage structure is in place at SFE2. If the lamprey structure is not in place, close SFE2.

3.3.2.5. Fishway Entrances. Fishway entrances consist of main entrance weirs with hoists and automatic controls, and floating orifices that self-regulate with tailwater fluctuations. If any automatic controls malfunction, the weirs can be operated manually by project personnel and kept within criteria. If there is a further failure that prevents the entrance from being operated manually, the entrance may be lowered down and left in an operating position or an alternate entrance opened until repairs can be made. If a floating orifice fails, it will be pulled out of the water and replaced with a spare floating orifice.

3.3.2.6. 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 ensure they are in place. These inspections are done by both dewatering and physically inspecting the diffuser gratings, or by using underwater video cameras, divers, or other methods. Diffuser gratings may come loose during the fish passage season due to a variety of reasons. Daily inspections of fish ladders and collection systems should include looking for any flow changes that may indicate problems with diffuser gratings. If a diffuser grating is known or suspected to have moved, creating an opening into a diffuser chamber, efforts must immediately be taken to correct the situation and minimize impacts on adult fish in the fishway. Coordination of the problems should begin immediately through the established coordination procedure in **section 3.2.2**. If possible, a video inspection should be made as soon as possible to determine extent of the problem. If diffuser gratings are found to be missing or displaced, creating openings into the diffuser chambers, a method of repair shall be developed and coordinated with the fish agencies and tribes through the established coordination procedure. Repairs shall be made as quickly as possible unless otherwise coordinated.

4. TURBINE UNITS OPERATION & MAINTENANCE

4.1. Turbine Unit Priority Order.

4.1.1. Turbine units will be operated in the order of priority defined in **Table MCN-5** to optimize adult and juvenile fish passage. 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. Unit operation during warm water events are described in **section 4.2.**

Table MCN-5. McNary Dam Turbine Unit Priority Order.

Dates/Operation	Unit Priority Order
March 1 – November 30 Fish Passage/Bypass Season	1, then 14–2 in descending order [a]
Warm Water Operations [b] (see **section 4.2**)	U1 available: STOP every other unit starting w/ 2 and move north. = 2, 4, 6, 8, 10, 12, 14, 3, 5, 7, 9, 11, 13, 1 Unit 1 OOS: STOP every other unit starting w/ 3 and move north. = 3, 5, 7, 9, 11, 13, 2, 4, 6, 8, 10, 12, 14
December 1 – End February Winter Maintenance Period	Any Order (if OR ladder is in service, request to operate Unit 1 or 2 if possible)

a. Provides positive downstream flows at the outfall, based on unit availability.

b. Warm Water Operations priority order may be adjusted if necessary as coordinated by the Project Biologist.

4.2. Warm Water Turbine Operations.

4.2.1. In order to minimize thermal stress on juvenile salmonids during warm water conditions, the turbine operations described below will be implemented at the request of the Project Biologist when *any* of the following conditions occur:

i. Water temperatures in the McNary JFF sample tank >68°F;

ii. Water temperatures elsewhere at the Project (e.g., gatewells) that are likely to induce thermal stress in juvenile salmonids;

iii. Temperature gradients >5°F;

iv. Sample mortality >3%;

v. System mortality >6%.

4.2.2. Operation in Secondary Bypass or Sample Mode. When any of the conditions listed above occur, the Project will begin to shut down units in a staggered order (**Table MCN-5**, stopping every other unit starting at Unit 2, then ascending as necessary to avoid temperature shocks in the juvenile channel (i.e., shutting down units 2, 4, 6, 8, 10, 12 and 14). If possible, Unit 1 shall be left in operation to provide attraction flow to the two entrances of the Oregon shore fish ladder. Project Fisheries will coordinate with CENWW to modify the sequence as necessary to provide equal or better levels of fish protection. Starting and stopping of two or more units at a time should be avoided if possible during warm water periods, especially during the hours of 1000–2400. The Project and CENWW will coordinate these protocols with fish agencies and tribes through FPOM and other entities as necessary. The purpose of these protocols is to provide precautionary measures to avoid or minimize any direct or delayed mortality resulting from additional thermal stress when handling juvenile salmonid fishes.

4.2.3. Continued Mortality. If juvenile salmonid populations continue to experience high mortality after implementing the above turbine operations, collection for fish condition sampling by smolt monitoring staff should continue for up to 8 hours a day. Except for daily monitoring, the Project shall switch to primary bypass, routing fish past the JFF and through the bypass outfall for the duration of the event.

4.3. Turbine Unit Operating Range.

4.3.1. In-Season (April 1–October 31). As defined in the *BPA Load Shaping Guidelines* (**Appendix C**), all units will be operated within ±1% of peak turbine efficiency (1% range) to maximize survival of juvenile fish that pass through the turbines. Turbine unit flow and power output at the lower and upper limits of the 1% range are defined in **Table MCN-6**.

4.3.1.1. If operation outside the 1% range is necessary, Project personnel shall record the information 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 4.4.4**), 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.

4.3.2. 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.

Table MCN-6. McNary 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	With ESBS						No ESBS					
Head	1% Lower Limit		1% Upper Limit		Operating Limit		1% Lower Limit		1% Upper Limit		Operating Limit	
(feet)	MW	cfs	MW	cfs	MW	cfs	MW	cfs	MW	cfs	MW	cfs
62	34.5	7,951	49.7	11,454	68.0	16,311	34.7	7754	50.8	11,346	68.0	15,710
63	35.2	7,963	51.0	11,552	69.6	16,399	35.4	7765	52.1	11,444	69.6	15,793
64	35.8	7,974	52.3	11,646	71.2	16,486	36.0	7776	53.5	11,537	71.2	15,875
65	36.5	7,984	53.7	11,736	72.8	16,571	36.7	7,786	54.8	11,627	72.8	15,955
66	37.0	7,959	55.2	11,869	74.1	16,574	37.2	7,762	56.3	11,759	74.1	15,945
67	37.5	7,934	56.7	11,997	75.3	16,574	37.7	7,739	57.9	11,887	75.3	15,933
68	38.0	7,911	58.2	12,121	76.6	16,572	38.2	7,716	59.4	12,009	76.6	15,919
69	38.5	7,887	59.7	12,240	77.8	16,567	38.7	7,694	60.9	12,128	77.8	15,903
70	39.0	7,864	61.2	12,355	79.0	16,560	39.2	7,671	62.5	12,243	79.0	15,884
71	39.6	7,874	62.1	12,355	79.7	16,433	39.8	7,681	63.4	12,243	79.7	15,782
72	40.2	7,883	63.1	12,354	80.4	16,303	40.4	7,691	64.4	12,242	80.4	15,676
73	40.9	7,892	64.0	12,353	81.0	16,169	41.1	7,699	65.3	12,241	81.0	15,567
74	41.5	7,901	64.9	12,351	81.6	16,033	41.7	7,708	66.3	12,240	81.3	15,455
75	42.2	7,909	65.8	12,350	82.2	15,893	42.4	7,716	67.2	12,239	81.3	15,340
76	42.8	7,907	66.4	12,282	82.5	15,705	43.0	7,714	67.9	12,172	81.3	15,161
77	43.4	7,905	67.1	12,216	82.8	15,513	43.6	7,713	68.5	12,107	81.3	14,979
78	44.0	7,903	67.7	12,151	83.1	15,319	44.2	7,711	69.1	12,044	81.3	14,795
79	44.6	7,900	68.3	12,088	83.3	15,122	44.8	7,709	69.7	11,981	81.3	14,608
80	45.2	7,897	68.9	12,026	83.4	14,922	45.5	7,706	70.3	11,920	81.3	14,418
81	45.9	7,911	70.0	12,067	83.7	14,747	46.1	7,720	71.5	11,961	81.3	14,256
82	46.5	7,925	71.1	12,106	83.8	14,569	46.8	7,734	72.6	12,000	81.3	14,091
83	47.2	7,939	72.2	12,145	84.0	14,389	47.4	7,747	73.7	12,038	81.3	13,924
84	47.9	7,952	73.3	12,182	84.1	14,206	48.1	7,759	74.9	12,076	81.3	13,754
85	48.5	7,964	74.4	12,219	84.2	14,020	48.8	7,772	76.0	12,112	81.3	13,582
86	49.2	7,987	75.1	12,179	84.0	13,806	49.5	7,794	76.7	12,073	81.3	13,373
87	50.0	8,008	75.7	12,140	83.8	13,588	50.2	7,815	77.3	12,034	81.3	13,161

a. Table values derived from HDC report (Mar 1999; updated Jan 2005). Flow (cfs) is calculated based on turbine efficiency, head, and power output (MW). "Operating Limit" is the maximum safe operating point, based on cavitation or generator limit (added Feb 2018).

4.4. Turbine Unit Maintenance.

4.4.1. Maintenance Schedules.

4.4.1.1. Turbine unit maintenance schedules will be reviewed annually by Project and District Operations biologists for fish impacts.

4.4.1.2. Each turbine unit requires annual maintenance that may take from several days to two weeks, and is normally scheduled from mid-July through late December. Annual maintenance of priority units for adult passage is normally conducted in November-December, but can be completed in mid-August.

4.4.1.3. Priority unit maintenance will be scheduled for winter maintenance period or when there are few fish passing the project, to the extent possible. Impacts to migrating adults should be minimized.

4.4.1.4. When possible, units used for temperature operations should remain available.

4.4.1.5. Turbine units may occasionally require overhauls to repair major problems with the turbine or generator. Overhauls may take over one year to accomplish.

4.4.1.6. Turbine units, governors, exciters, and control systems require periodic maintenance, calibration, and testing which may take them outside of the 1% peak efficiency range. This work will be scheduled in compliance with the *BPA Load Shaping Guidelines* (**Appendix C**) to minimize impacts on juvenile fish.

4.4.2. Operational Testing.

4.4.2.1. Pre-Maintenance: Units may be operationally tested for up to 30 minutes prior to going into maintenance status by running at speed-no-load and various loads within the 1% range for pre-maintenance measurements and testing, and to allow all fish to move through the unit.

4.4.2.2. Post-Maintenance: Units may be operationally tested while remaining in maintenance or forced outage status by running the unit for up to a cumulative time of 30 minutes (within 1% range) before returning to operational status.

4.4.2.3. 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.

4.4.3. Head Gates. [4] Head gates will normally remain in standard operating position except as required for maintenance.

4.4.4. Dewatering. Dewatering turbine units should be accomplished in accordance with project dewatering plans. If the turbine unit draft tube is to be dewatered, operate unit with full load for a minimum of 15 minutes prior to installing tail logs. If not possible to load, run unit at speed-no-load for minimum of 15 minutes. This is to reduce the number of fish in the scrollcase prior to installing stop logs. If a turbine unit is out of service for maintenance for an extended period of time without tailrace stoplogs in place, efforts should be made to not open the wicket gates if the scroll case must be dewatered at a later date without the unit being spun beforehand.

5. FOREBAY DEBRIS REMOVAL

5.1.1. Debris at projects can adversely impact fish passage conditions by plugging or blocking trashracks, VBSs, gatewell orifices, dewatering screens, separators, and facility piping resulting in impingement, injuries, and descaling of fish. Removing debris at its source in the forebay is sometimes necessary to maintain safe and efficient fish passage conditions, navigation, and other project activities. The preferred option is to remove debris at each project when possible to avoid passing debris on to the next project downstream. Debris can be removed from the forebay by:

i. Using a boat to physically encircle debris with a log boom to pull it to the spillway where operators can spill it or to the shore to be removed by crane;

ii. removing the debris from the top of the dam using a crane and scoop;

iii. passing debris via the spillway with special turbine and/or spill operations;

iv. Using a boom, spreader bar or other device, suspended from a crane, to move the debris to the spillway, in coordination with special powerhouse and spill operations (if needed).

5.1.2. Debris Spill. If the Project does not have forebay debris removal capability, the only viable alternative is to pass the debris via spill. Except in an emergency, the Project shall contact CENWW-OD-T and the John Day Dam Control Room and Fishery Biologist at least one workday in advance of debris spill operations. CENWW-OD-T will notify FPOM and the special operation will be detailed in a teletype issued by RCC. In an emergency operation, notification may be provided as described below**.**

5.1.3. Special Spills. All special spills (other than normal spill patterns for ongoing spill operations) and project operations for passing debris will be coordinated prior to the operations taking place. Each project shall contact CENWW-OD-T at least two workdays prior to the day they want the special project operation for spilling to pass debris. Then CENWW-OD-T shall coordinate the special operation with RCC, NOAA Fisheries, and other FPOM participants. Project personnel shall provide CENWW-OD-T the reason for the debris spill request, including

[4] Head gates may also be referred to as “operating” gates. The terms are interchangeable.

an explanation of Project facilities being impacted by debris, the date and time of the requested spill, and any special powerhouse or other operations required to move debris to the spillway. When a debris spill is coordinated and approved, RCC shall issue a teletype detailing the specifics of the special operations.

5.1.4. Emergency Spills. Implement as necessary to pass woody debris that is accumulating in the forebay and compromising the safe, unobstructed passage of fish**.** The operating project will immediately spill the woody debris to remove obstructions to fish passage. The operating project will notify CENWW-OD-T of the emergency spill as soon as possible to notify RCC, NOAA Fisheries, and other FPOM participants.

Table MCN-7. [*pg 1 of 5*] McNary Dam Spill Patterns for Fish Passage with TSWs in Bays 19-20.

MCN Spill Patterns with TSWs (# Gate Stops per Spillbay)																						Total Stops	Spill [a]
1 [b]	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19 [c]	20 [c]	21	22 [b]	(#)	(kcfs)
																		TSW	TSW	1		**1**	**21.2**
																	1	TSW	TSW	1		**2**	**23.2**
																	1	TSW	TSW	1	1	**3**	**25.2**
																	1	TSW	TSW	2	1	**4**	**27.1**
																	2	TSW	TSW	2	1	**5**	**29.0**
																1	2	TSW	TSW	2	1	**6**	**31.0**
																2	2	TSW	TSW	2	1	**7**	**32.9**
														1		2	2	TSW	TSW	2	1	**8**	**34.9**
														1		2	2	TSW	TSW	2	2	**9**	**36.8**
														2		2	2	TSW	TSW	2	2	**10**	**38.7**
														2	1	2	2	TSW	TSW	2	2	**11**	**40.7**
														2	2	2	2	TSW	TSW	2	2	**12**	**42.6**
													1	2	2	2	2	TSW	TSW	2	2	**13**	**44.6**
													2	2	2	2	2	TSW	TSW	2	2	**14**	**46.5**
										1		2		2	2	2	2	TSW	TSW	2	2	**15**	**48.5**
										2		2		2	2	2	2	TSW	TSW	2	2	**16**	**50.4**
								1		2		2		2	2	2	2	TSW	TSW	2	2	**17**	**52.4**
								2		2		2		2	2	2	2	TSW	TSW	2	2	**18**	**54.3**
								2	1	2		2		2	2	2	2	TSW	TSW	2	2	**19**	**56.3**
								2	2	2		2		2	2	2	2	TSW	TSW	2	2	**20**	**58.2**
								2	2	2		2	1	2	2	2	2	TSW	TSW	2	2	**21**	**60.2**
								2	2	2		2	2	2	2	2	2	TSW	TSW	2	2	**22**	**62.1**
								2	2	2	1	2	2	2	2	2	2	TSW	TSW	2	2	**23**	**64.1**
								2	2	2	2	2	2	2	2	2	2	TSW	TSW	2	2	**24**	**66.0**
						1		2	2	2	2	2	2	2	2	2	2	TSW	TSW	2	2	**25**	**68.0**
						2		2	2	2	2	2	2	2	2	2	2	TSW	TSW	2	2	**26**	**69.9**
				1		2		2	2	2	2	2	2	2	2	2	2	TSW	TSW	2	2	**27**	**71.9**
				2		2		2	2	2	2	2	2	2	2	2	2	TSW	TSW	2	2	**28**	**73.8**
2.5	2	3.5		2		2		2		2		2	1	2		2	2	TSW	TSW	2	2	**29**	**75.3**
2.5	2	3.5		2		2		2		2		2	1	2	1	2	2	TSW	TSW	2	2	**30**	**77.3**
2.5	2	3.5		2	1	2		2		2		2	1	2	1	2	2	TSW	TSW	2	2	**31**	**79.3**

[a] Spill (kcfs) is calculated as a function of total stops + TSW spill at forebay elevation 339 ft.

[b] Bays 1 & 22 *MAY* require special open/close sequence (pending field test verification). Open Bays 2–21 for ≥ 10 minutes, then open Bays 1, 22. Close Bays 1, 22 first.

[c] Bays 19-20 with TSWs = fixed spill of ~19.2 kcfs (~9.6 kcfs per bay) at fb el 339'. Raise tainter gates ~3-5 ft above water surface to ensure free flow through TSWs.

MCN Spill Patterns with TSWs (# Gate Stops per Spillbay)																						Total Stops	Spill [a]
1 [b]	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19 [c]	20 [c]	21	22 [b]	(#)	(kcfs)
2.5	2	3.5		2	1	2		2	1	2		2	1	2	1	2	2	TSW	TSW	2	2	**32**	**81.3**
2.5	2	3.5		2	1	2		2	1	2	1	2	1	2	1	2	2	TSW	TSW	2	2	**33**	**83.3**
2.5	2	3.5		2	1	2	1	2	1	2	1	2	1	2	1	2	2	TSW	TSW	2	2	**34**	**85.3**
2.5	2	3.5	1	2	1	2	1	2	1	2	1	2	1	2	1	2	2	TSW	TSW	2	2	**35**	**87.3**
2.5	2	3.5	1	2	1	2	1	2	1	2	1	2	1	2	1	2	2	TSW	TSW	2.5	2.5	**36**	**89.0**
2.5	2	3.5	1	2	1	2	1	2	1	2	1	2	2	2	1	2	2	TSW	TSW	2.5	2.5	**37**	**90.9**
2.5	2	3.5	1	2	1	2	1	2	1	2	1	2	2	2	2	2	2	TSW	TSW	2.5	2.5	**38**	**92.8**
2.5	2	3.5	1	2	2	2	1	2	1	2	1	2	2	2	2	2	2	TSW	TSW	2.5	2.5	**39**	**94.7**
2.5	2	3.5	1	2	2	2	1	2	2	2	1	2	2	2	2	2	2	TSW	TSW	2.5	2.5	**40**	**96.6**
2.5	2	3.5	1	2	2	2	1	2	2	2	2	2	2	2	2	2	2	TSW	TSW	2.5	2.5	**41**	**98.5**
2.5	2	3.5	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	TSW	TSW	2.5	2.5	**42**	**100.4**
2.5	2	3.5	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	TSW	TSW	2.5	2.5	**43**	**102.3**
2.5	2.5	4	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	TSW	TSW	2.5	2.5	**44**	**103.9**
2.5	2.5	4	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	TSW	TSW	3.5	2.5	**45**	**105.6**
2.5	2.5	4	2	2	2	2	2	2	2	2	2	2	2	2	2.5	2.5	3	TSW	TSW	2.5	2.5	**46**	**107.3**
2.5	2.5	4	2	2	2	2.5	2	2	2	2.5	2	2	2	2	2.5	2.5	3	TSW	TSW	2.5	2.5	**47**	**109.0**
2.5	2.5	4	2	2.5	2	2.5	2	2	2	2.5	2	2	2	2.5	2.5	2.5	3	TSW	TSW	2.5	2.5	**48**	**110.7**
2.5	2.5	4	2	2.5	2	2.5	2	2.5	2	2.5	2	2.5	2	2.5	2.5	2.5	3	TSW	TSW	2.5	2.5	**49**	**112.4**
2.5	2.5	4	2	2.5	2.5	2.5	2	2.5	2.5	2.5	2	2.5	2	2.5	2.5	2.5	3	TSW	TSW	2.5	2.5	**50**	**114.1**
2.5	2.5	4	2	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2	2.5	2.5	2.5	3	TSW	TSW	2.5	2.5	**51**	**115.8**
2.5	2.5	4	3	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2	2.5	2.5	2.5	3	TSW	TSW	2.5	2.5	**52**	**117.5**
2.5	2.5	4	3	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	3	TSW	TSW	3	2.5	**53**	**119.2**
2.5	2.5	4	3	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	3	3	3	TSW	TSW	3	2.5	**54**	**120.9**
2.5	2.5	4.5	3	2.5	2.5	2.5	2.5	2.5	2.5	3	2.5	2.5	2.5	2.5	3	3	3	TSW	TSW	3	2.5	**55**	**122.6**
2.5	2.5	4.5	3	2.5	2.5	3	2.5	2.5	2.5	3	2.5	3	2.5	2.5	3	3	3	TSW	TSW	3	2.5	**56**	**124.3**
2.5	2.5	4.5	3	3	2.5	3	2.5	3	2.5	3	2.5	3	2.5	2.5	3	3	3	TSW	TSW	3	2.5	**57**	**126.0**
2.5	2.5	4.5	3	3	3	3	2.5	3	2.5	3	2.5	3	2.5	3	3	3	3	TSW	TSW	3	2.5	**58**	**127.7**
2.5	2.5	5	3	3	3	3	2.5	3	3	3	2.5	3	2.5	3	3	3	3	TSW	TSW	3	2.5	**59**	**129.3**
2.5	2.5	5	3	3	3	3	3	3	3	3	3	3	2.5	3	3	3	3	TSW	TSW	3	2.5	**60**	**131.0**
3	3	5	3	3	3	3	3	3	3	3	3	3	2.5	3	3	3	3	TSW	TSW	3	2.5	**61**	**132.7**
3	3	5	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	TSW	TSW	3	3	**62**	**134.4**
3	3	5	3	3	3	3	3	3	3	3	3	3	3	3	3	3	4	TSW	TSW	3	3	**63**	**136.0**
3	3	5	3	3	3	3	3	3	3	3	3	3	3	3	3	4	4	TSW	TSW	3	3	**64**	**137.6**
3	4	5	3	3	3	3	3	3	3	3	3	3	3	3	3	4	4	TSW	TSW	3	3	**65**	**139.2**
4	4	5	3	3	3	3	3	3	3	3	3	3	3	3	3	4	4	TSW	TSW	3	3	**66**	**140.8**
4	4	5	3	3	3	4	3	3	3	3	3	3	3	3	3	4	4	TSW	TSW	3	3	**67**	**142.4**
4	4	5	3	3	3	4	3	3	3	4	3	3	3	3	3	4	4	TSW	TSW	3	3	**68**	**144.0**

MCN Spill Patterns with TSWs (# Gate Stops per Spillbay)																						Total Stops	Spill [a]
1 [b]	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19 [c]	20 [c]	21	22 [b]	(#)	(kcfs)
4	4	5	3	4	3	4	3	3	3	4	3	3	3	3	3	4	4	TSW	TSW	3	3	**69**	**145.6**
4	4	5	3	4	3	4	3	3	3	4	3	3	3	4	3	4	4	TSW	TSW	3	3	**70**	**147.2**
4	4	5	3	4	3	4	3	4	3	4	3	3	3	4	3	4	4	TSW	TSW	3	3	**71**	**148.8**
4	4	5	3	4	3	4	3	4	3	4	3	4	3	4	3	4	4	TSW	TSW	3	3	**72**	**150.4**
4	4	5	3	4	4	4	3	4	3	4	3	4	3	4	3	4	4	TSW	TSW	3	3	**73**	**152.0**
4	4	5	3	4	4	4	3	4	4	4	3	4	3	4	3	4	4	TSW	TSW	3	3	**74**	**153.6**
4	4	5	3	4	4	4	3	4	4	4	4	4	3	4	3	4	4	TSW	TSW	3	3	**75**	**155.2**
4	4	5	3	4	4	4	4	4	4	4	4	4	3	4	3	4	4	TSW	TSW	3	3	**76**	**156.8**
4	4	5	3	4	4	4	4	4	4	4	4	4	3	4	4	4	4	TSW	TSW	3	3	**77**	**158.4**
4	4	5	4	4	4	4	4	4	4	4	4	4	3	4	4	4	4	TSW	TSW	3	3	**78**	**160.0**
4	4	5	4	4	4	4	4	4	4	4	4	4	3	4	4	4	4	TSW	TSW	4	3	**79**	**161.6**
4	4	5	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	TSW	TSW	4	3	**80**	**163.2**
4	4	5	4	4	4	4	4	4	4	4	4	4	4	4	4	4	5	TSW	TSW	4	3	**81**	**164.8**
4	4	5	4	4	4	4	4	4	4	4	4	4	4	4	4	5	5	TSW	TSW	4	3	**82**	**166.4**
4	5	5	4	4	4	4	4	4	4	4	4	4	4	4	4	5	5	TSW	TSW	4	3	**83**	**168.0**
5	5	5	4	4	4	4	4	4	4	4	4	4	4	4	4	5	5	TSW	TSW	4	3	**84**	**169.6**
5	5	5	4	4	4	5	4	4	4	4	4	4	4	4	4	5	5	TSW	TSW	4	3	**85**	**171.2**
5	5	5	4	4	4	5	4	4	4	5	4	4	4	4	4	5	5	TSW	TSW	4	3	**86**	**172.8**
5	5	5	4	5	4	5	4	4	4	5	4	4	4	4	4	5	5	TSW	TSW	4	3	**87**	**174.4**
5	5	5	4	5	4	5	4	4	4	5	4	4	4	5	4	5	5	TSW	TSW	4	3	**88**	**176.0**
5	5	5	4	5	4	5	4	5	4	5	4	4	4	5	4	5	5	TSW	TSW	4	3	**89**	**177.6**
5	5	5	4	5	4	5	4	5	4	5	4	5	4	5	4	5	5	TSW	TSW	4	3	**90**	**179.2**
5	5	5	4	5	4	5	4	5	4	5	4	5	4	5	4	5	5	TSW	TSW	5	3	**91**	**180.8**
5	5	5	4	5	5	5	4	5	4	5	4	5	4	5	4	5	5	TSW	TSW	5	3	**92**	**182.4**
5	5	5	4	5	5	5	4	5	5	5	4	5	4	5	4	5	5	TSW	TSW	5	3	**93**	**184.0**
5	5	5	4	5	5	5	4	5	5	5	5	5	4	5	4	5	5	TSW	TSW	5	3	**94**	**185.6**
5	5	5	4	5	5	5	5	5	5	5	5	5	4	5	4	5	5	TSW	TSW	5	3	**95**	**187.2**
5	5	5	4	5	5	5	5	5	5	5	5	5	4	5	5	5	5	TSW	TSW	5	3	**96**	**188.8**
5	5	5	5	5	5	5	5	5	5	5	5	5	4	5	5	5	5	TSW	TSW	5	3	**97**	**190.4**
5	5	6	5	5	5	5	5	5	5	5	5	5	4	5	5	5	5	TSW	TSW	5	3	**98**	**192.0**
5	5	6	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	TSW	TSW	5	3	**99**	**193.6**
5	5	6	5	5	5	5	5	5	5	5	5	5	5	5	5	5	6	TSW	TSW	5	3	**100**	**195.2**
5	5	6	5	5	5	5	5	5	5	5	5	5	5	5	5	6	6	TSW	TSW	5	3	**101**	**196.8**
5	5	6	5	5	5	5	5	5	5	5	5	5	5	6	5	6	6	TSW	TSW	5	3	**102**	**198.4**
5	5	6	5	5	5	5	5	5	5	5	5	6	5	6	5	6	6	TSW	TSW	5	3	**103**	**200.0**
5	5	6	5	5	5	5	5	5	5	5	5	6	5	6	6	6	6	TSW	TSW	5	3	**104**	**201.6**
5	5	6	6	5	5	5	5	5	5	5	5	6	5	6	6	6	6	TSW	TSW	5	3	**105**	**203.2**

MCN Spill Patterns with TSWs (# Gate Stops per Spillbay)																						Total Stops	Spill [a]
1 [b]	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19 [c]	20 [c]	21	22 [b]	(#)	(kcfs)
5	5	6	6	5	5	5	5	5	5	5	5	6	5	6	6	6	6	TSW	TSW	6	3	**106**	**204.8**
5	5	6	6	5	5	5	5	5	5	5	6	6	5	6	6	6	6	TSW	TSW	6	3	**107**	**206.4**
5	5	6	6	5	5	5	5	5	5	5	5	6	6	6	6	6	6	TSW	TSW	6	4	**108**	**208.0**
5	5	6	6	6	5	5	5	5	5	5	6	6	6	6	6	6	6	TSW	TSW	6	4	**110**	**211.2**
5	5	6	6	6	5	6	5	5	5	6	6	6	6	6	6	6	6	TSW	TSW	6	4	**112**	**214.4**
5	5	6	6	6	6	6	5	6	5	6	6	6	6	6	6	6	6	TSW	TSW	6	4	**114**	**217.6**
5	5	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	TSW	TSW	6	4	**116**	**220.8**
6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	TSW	TSW	6	4	**118**	**224.0**
6	6	6	6	6	6	6	6	6	6	7	6	7	6	7	6	7	6	TSW	TSW	6	4	**122**	**230.4**
6	6	6	6	6	6	7	6	7	6	7	6	7	6	7	6	7	6	TSW	TSW	6	4	**124**	**233.6**
6	6	7	6	7	6	7	6	7	6	7	6	7	6	7	6	7	6	TSW	TSW	6	4	**126**	**236.8**
7	6	7	6	7	6	7	6	7	6	7	6	7	6	7	6	7	7	TSW	TSW	6	4	**128**	**240.0**
7	6	7	6	7	6	7	6	7	6	7	6	7	7	7	7	7	7	TSW	TSW	6	4	**130**	**243.2**
7	6	7	6	7	6	7	6	7	7	7	7	7	7	7	7	7	7	TSW	TSW	6	4	**132**	**246.4**
7	6	7	6	7	7	7	7	7	7	7	7	7	7	7	7	7	7	TSW	TSW	6	4	**134**	**249.6**
7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	TSW	TSW	6	4	**136**	**252.8**
7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	TSW	TSW	6	6	**138**	**256.0**
7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	TSW	TSW	7	7	**140**	**259.2**
8	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	TSW	TSW	7	8	142	**262.6**
8	8	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	TSW	TSW	8	8	144	**266.0**
8	8	8	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	TSW	TSW	8	8	145	**267.7**
8	8	8	8	7	7	7	7	7	7	7	7	7	7	7	7	7	7	TSW	TSW	8	8	146	**269.4**
8	8	8	8	8	7	7	7	7	7	7	7	7	7	7	7	7	8	TSW	TSW	8	8	148	**272.8**
8	8	8	8	8	8	7	7	7	7	7	7	7	7	7	7	8	8	TSW	TSW	8	8	150	**276.2**
8	8	8	8	8	8	8	7	7	7	7	7	7	7	7	8	8	8	TSW	TSW	8	8	152	**279.6**
8	8	8	8	8	8	8	8	7	7	7	7	7	7	8	8	8	8	TSW	TSW	8	8	154	**283.0**
8	8	8	8	8	8	8	8	8	7	7	7	7	8	8	8	8	8	TSW	TSW	8	8	156	**286.4**
8	8	8	8	8	8	8	8	8	8	7	7	8	8	8	8	8	8	TSW	TSW	8	8	158	**289.8**
8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	TSW	TSW	8	8	160	**293.2**
9	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	TSW	TSW	8	9	162	**296.4**
9	9	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	TSW	TSW	9	9	164	**299.6**
9	9	9	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	TSW	TSW	9	9	165	**301.2**
9	9	9	9	8	8	8	8	8	8	8	8	8	8	8	8	8	8	TSW	TSW	9	9	166	**302.8**
9	9	9	9	9	8	8	8	8	8	8	8	8	8	8	8	8	9	TSW	TSW	9	9	168	**306.0**
9	9	9	9	9	9	8	8	8	8	8	8	8	8	8	8	9	9	TSW	TSW	9	9	170	**309.2**
9	9	9	9	9	9	9	8	8	8	8	8	8	8	8	9	9	9	TSW	TSW	9	9	172	**312.4**
9	9	9	9	9	9	9	9	8	8	8	8	8	8	9	9	9	9	TSW	TSW	9	9	174	**315.6**

MCN Spill Patterns with TSWs (# Gate Stops per Spillbay)																						Total Stops	Spill [a]
1 [b]	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19 [c]	20 [c]	21	22 [b]	(#)	(kcfs)
9	9	9	9	9	9	9	9	9	8	8	8	8	9	9	9	9	9	TSW	TSW	9	9	176	**318.8**
9	9	9	9	9	9	9	9	9	9	8	8	9	9	9	9	9	9	TSW	TSW	9	9	178	**322.0**
9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	TSW	TSW	9	9	180	**325.2**
10	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	TSW	TSW	9	10	182	**328.4**
10	10	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	TSW	TSW	10	10	184	**331.6**

Table MCN-8. McNary Dam Spill Patterns with TSWs for Navigation.

MCN Spill Patterns with TSWs for Navigation (# Gate Stops per Spillbay)																						Total Stops	Spill [a]
1 [b]	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19 [c]	20 [c]	21	22 [b]	(#)	(kcfs)
																		TSW	TSW	1		**1**	**21.2**
																	1	TSW	TSW	1		**2**	**23.2**
	1																1	TSW	TSW	1		**3**	**25.2**
	2																1	TSW	TSW	1		**4**	**27.1**
	3																1	TSW	TSW	1		**5**	**28.8**
	3																1	TSW	TSW	1	1	**6**	**30.8**
	4																1	TSW	TSW	1	1	**7**	**32.4**
	3	2															1	TSW	TSW	1	1	**8**	**34.7**
	4	2															1	TSW	TSW	1	1	**9**	**36.3**
	4	3															1	TSW	TSW	1	1	**10**	**38.0**
	4	3													1		1	TSW	TSW	1	1	**11**	**40.0**
	4	4													1		1	TSW	TSW	1	1	**12**	**41.6**
	4	4												1	1		1	TSW	TSW	1	1	**13**	**43.6**
	4	4										1		1	1		1	TSW	TSW	1	1	**14**	**45.6**
	4	4										2		1	1		1	TSW	TSW	1	1	**15**	**47.5**
	4	4								1		2		1	1		1	TSW	TSW	1	1	**16**	**49.5**
	4	4						1		1		2		1	1		1	TSW	TSW	1	1	**17**	**51.5**
	4	4						1		2		2		1	1		1	TSW	TSW	1	1	**18**	**53.4**
	4	4						1		2		2		1	1		1	TSW	TSW	2	1	**19**	**55.3**
	4	4						1		2		2		1	1		2	TSW	TSW	2	1	**20**	**57.2**
	4	4						2		2		2		1	1		2	TSW	TSW	2	1	**21**	**59.1**
	4	4						2		2		2		1	2		2	TSW	TSW	2	1	**22**	**61.0**
	4	4						2		2		2		2	2		2	TSW	TSW	2	1	**23**	**62.9**
	5	4						2		2		2		2	2		2	TSW	TSW	2	1	**24**	**64.5**
	5	4						2		2		2		2	2		2	TSW	TSW	2	2	**25**	**66.4**

Table MCN-9. [*pg 1 of 4*]. McNary Dam Spill Patterns with No TSWs.

MCN Spill Patterns with No TSWs (# Gate Stops per Spillbay)																						Total Stops	Spill [a]
1 [b]	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22 [b]	(#)	(kcfs)
																		3				3	5.6
																		4				4	7.2
																	2	3				5	9.5
																	2	4				6	11.1
																	2	3	2			7	13.4
																	2	4	2			8	15.0
														1			2	4	2			9	17.0
														2			2	4	2			10	18.9
													1	2			2	4	2			11	20.9
													2	2			2	4	2			12	22.8
											1		2	2			2	4	2			13	24.8
											2		2	2			2	4	2			14	26.7
									1		2		2	2			2	4	2			15	28.7
									2		2		2	2			2	4	2			16	30.6
							1		2		2		2	2			2	4	2			17	32.6
							2		2		2		2	2			2	4	2			18	34.5
					1		2		2		2		2	2			2	4	2			19	36.5
					2		2		2		2		2	2			2	4	2			20	38.4
					2		2		2		2		2	2			2	5	2			21	40.0
	2				2		2		2		2		2	2			2	4	2			22	42.3
	2	1			2		2		2		2		2	2			2	4	2			23	44.3
	2	2			2		2		2		2		2	2			2	4	2			24	46.2
	3	2			2		2		2		2		2	2			2	4	2			25	47.9
	3	3			2		2		2		2		2	2			2	4	2			26	49.6
	3	3			2		2		2		2		2	2			3	4	2			27	51.3
	3	3			2		2		2		2		2	2			4	4	2			28	52.9
	3	3			2		2		2		2		2	2		2	3	4	2			29	55.2
	3	3			2		2		2		2		2	2		2	4	4	2			30	56.8
	3	3			2		2		2		2		2	2		2	4	5	2			31	58.4
	3	3			2		2		2		2		2	2		2	5	5	2			32	60.0
2	3	3			2		2		2		2		2	2		2	5	4	2			33	62.3
2	3	3	2		2		2		2		2		2	2		2	4	4	2			34	64.6
2	3	3	2	2	2		2		2		2		2	2		2	4	3	2			35	66.9
2	3	3	2	2	2	2	2		2		2		2	2		2	3	3	2			36	69.2
2	3	3	2	2	2	2	2		2		2	1	2	2		2	3	3	2			37	71.2
2	3	4	2	2	2	2	2		2		2	2	2	2		2	2	3	2			38	73.0

MCN Spill Patterns with No TSWs (# Gate Stops per Spillbay)																						Total Stops	Spill [a]
1 [b]	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22 [b]	(#)	(kcfs)
2	4	4	2	2	2	2	2	2	2		2	2	2	2		2	2	3				39	74.6
2	4	4	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2					40	76.8
3	4	4	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2					41	78.5
3	4	4	3	2	2	2	2	2	2	2	2	2	2	2	2	2	2					42	80.2
3	5	5	3	2	3	2	2	2	2	2	2	2	2	2	2	2						43	81.2
3	5	5	3	2	3	2	3	2	2	2	2	2	2	2	2	2						44	82.9
3	5	5	3	2	3	2	2	2	2	2	2	2	2	2	2	2	2					45	85.1
3	5	5	3	2	3	2	3	2	2	2	2	2	2	2	2	2	2					46	86.8
3	5	5	3	2	3	2	3	2	3	2	2	2	2	2	2	2	2					47	88.5
3	5	5	3	2	3	2	3	2	3	2	3	2	2	2	2	2	2					48	90.2
3	5	5	3	2	3	2	3	2	3	2	2	2	2	2	2	2	2	2				49	92.4
3	5	5	3	2	3	2	3	2	3	2	3	2	2	2	2	2	2	2				50	94.1
3	5	5	3	2	3	2	3	2	3	2	3	2	2	3	2	2	2	2				51	95.8
3	5	5	3	2	3	2	3	2	3	2	3	2	2	2	2	2	2	2	2			52	98.0
3	5	5	3	2	3	2	3	2	3	2	3	2	2	3	2	2	2	2	2			53	99.7
3	5	5	3	2	3	2	3	2	3	2	3	2	2	3	2	3	2	2	2			54	101.4
3	5	5	3	2	3	2	3	2	3	2	3	2	2	3	2	3	2	3	2			55	103.1
3	5	5	3	2	3	2	3	2	3	2	3	2	2	3	2	3	2	2	2	2		56	105.3
3	5	5	3	2	3	2	3	2	3	2	3	2	2	3	2	3	2	3	2	2		57	107.0
3	5	5	3	3	3	2	3	2	3	2	3	2	2	3	2	3	2	3	2	2		58	108.7
3	5	5	3	3	3	3	3	2	3	2	3	2	2	3	2	3	2	3	2	2		59	110.4
3	5	5	3	3	3	3	3	2	3	2	3	2	2	3	2	3	2	3	2	3		60	112.1
3	5	5	3	3	3	3	3	2	3	2	3	2	2	3	2	3	2	3	2	2	2	61	114.3
3	5	5	3	3	3	3	3	2	3	2	3	2	2	3	2	3	2	3	2	3	2	62	116.0
4	5	5	3	3	3	3	3	2	3	2	3	2	2	3	2	3	2	3	2	3	2	63	117.6
4	5	5	3	3	3	3	3	3	3	2	3	2	2	3	2	3	2	3	2	3	2	64	119.3
4	5	5	3	3	3	3	3	3	3	3	3	2	2	3	2	3	2	3	2	3	2	65	121.0
4	5	5	3	3	3	3	3	3	3	3	3	3	2	3	2	3	2	3	2	3	2	66	122.7
4	5	5	3	3	3	3	3	3	3	3	3	3	3	3	2	3	2	3	2	3	2	67	124.4
4	5	6	3	3	3	3	3	3	3	3	3	3	3	3	2	3	2	3	2	3	2	68	126.0
4	6	6	3	3	3	3	3	3	3	3	3	3	3	3	2	3	2	3	2	3	2	69	127.6
4	6	6	3	3	3	3	3	3	3	3	3	3	3	3	3	3	2	3	2	3	2	70	129.3
4	6	6	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	2	3	2	71	131.0
4	6	6	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	2	72	132.7
4	6	6	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	73	134.4
4	6	6	4	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	74	136.0
4	6	6	4	3	4	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	75	137.6

MCN Spill Patterns with No TSWs (# Gate Stops per Spillbay)																						Total Stops	Spill [a]
1 [b]	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22 [b]	(#)	(kcfs)
4	6	6	4	3	4	3	4	3	3	3	3	3	3	3	3	3	3	3	3	3	3	**76**	**139.2**
4	6	7	4	3	4	3	4	3	3	3	3	3	3	3	3	3	3	3	3	3	3	**77**	**140.8**
4	7	7	4	3	4	3	4	3	3	3	3	3	3	3	3	3	3	3	3	3	3	**78**	**142.4**
4	7	7	4	3	4	3	4	3	3	3	3	3	3	3	4	3	3	3	3	3	3	**79**	**144.0**
4	7	7	4	3	4	3	4	3	3	3	3	3	3	3	4	3	4	3	3	3	3	**80**	**145.6**
4	7	7	4	3	4	3	4	3	3	3	3	3	4	3	4	3	4	3	3	3	3	**81**	**147.2**
4	7	7	4	3	4	3	4	3	3	3	4	3	4	3	4	3	4	3	3	3	3	**82**	**148.8**
4	7	7	4	3	4	3	4	3	3	3	4	3	4	3	4	3	4	3	4	3	3	**83**	**150.4**
4	7	7	4	3	4	3	4	3	4	3	4	3	4	3	4	3	4	3	4	3	3	**84**	**152.0**
4	7	7	4	3	4	3	4	3	4	3	4	3	4	3	4	3	4	3	4	3	4	**85**	**153.6**
5	7	7	4	3	4	3	4	3	4	3	4	3	4	3	4	3	4	3	4	3	4	**86**	**155.2**
5	7	8	4	3	4	3	4	3	4	3	4	3	4	3	4	3	4	3	4	3	4	**87**	**156.9**
5	8	8	4	3	4	3	4	3	4	3	4	3	4	3	4	3	4	3	4	3	4	**88**	**158.6**
5	8	8	4	3	4	3	4	3	4	3	4	3	4	3	4	4	4	3	4	3	4	**89**	**160.2**
5	8	8	4	3	4	3	4	3	4	3	4	3	4	3	4	4	4	4	4	3	4	**90**	**161.8**
5	8	8	4	3	4	3	4	3	4	3	4	3	4	4	4	4	4	4	4	3	4	**91**	**163.4**
5	8	8	4	3	4	3	4	3	4	3	4	3	4	4	4	4	4	4	4	4	4	**92**	**165.0**
5	8	8	4	3	4	3	4	3	4	3	4	4	4	4	4	4	4	4	4	4	4	**93**	**166.6**
5	8	8	4	3	4	3	4	3	4	4	4	4	4	4	4	4	4	4	4	4	4	**94**	**168.2**
5	8	8	4	3	4	3	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	**95**	**169.8**
5	8	8	4	3	4	3	4	4	4	4	4	4	4	4	4	5	4	4	4	4	4	**96**	**171.4**
5	8	8	4	3	4	3	4	4	4	4	4	4	4	4	4	5	4	5	4	4	4	**97**	**173.0**
5	8	8	4	3	4	3	4	4	4	4	4	4	5	4	4	5	4	5	4	4	4	**98**	**174.6**
5	8	8	4	3	4	3	4	4	4	4	5	4	5	4	4	5	4	5	4	4	4	**99**	**176.2**
5	8	8	4	3	4	3	4	4	4	4	5	4	5	4	5	5	4	5	4	4	4	**100**	**177.8**
5	8	8	4	3	4	3	4	4	4	4	5	4	5	4	5	5	4	5	4	5	4	**101**	**179.4**
5	8	8	4	3	4	4	4	4	4	4	5	4	5	4	5	5	4	5	4	5	4	**102**	**181.0**
5	8	8	4	3	4	4	4	4	5	4	5	4	5	4	5	5	4	5	4	5	4	**103**	**182.6**
5	8	8	4	3	4	4	4	4	5	4	5	4	5	4	5	5	5	5	4	5	4	**104**	**184.2**
5	8	8	4	3	4	4	5	4	5	4	5	4	5	4	5	5	5	5	4	5	4	**105**	**185.8**
5	8	8	4	3	4	4	5	4	5	4	5	4	5	5	5	5	5	5	4	5	4	**106**	**187.4**
5	8	8	4	4	4	4	5	4	5	4	5	4	5	5	5	5	5	5	4	5	4	**107**	**189.0**
5	8	8	4	4	5	4	5	4	5	4	5	4	5	5	5	5	5	5	4	5	4	**108**	**190.6**
6	8	8	4	4	5	4	5	4	5	4	5	4	5	5	5	5	5	5	4	5	4	**109**	**192.2**
6	8	8	4	4	5	4	5	4	5	4	5	4	5	5	5	5	5	5	5	5	4	**110**	**193.8**
6	8	8	5	4	5	4	5	4	5	4	5	4	5	5	5	5	5	5	5	5	4	**111**	**195.4**
6	8	8	5	4	5	4	5	4	5	4	5	5	5	5	5	5	5	5	5	5	4	**112**	**197.0**

MCN Spill Patterns with No TSWs (# Gate Stops per Spillbay)																						Total Stops	Spill [a]
1 [b]	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22 [b]	(#)	(kcfs)
6	8	8	5	4	5	4	5	4	5	5	5	5	5	5	5	5	5	5	5	5	4	**113**	**198.6**
6	8	8	5	4	5	4	5	4	5	5	5	5	5	5	5	6	5	5	5	5	4	**114**	**200.2**
6	8	8	5	4	5	4	5	4	5	5	5	5	5	5	5	6	5	5	5	5	5	**115**	**201.8**
6	8	8	5	4	5	4	5	4	5	5	5	5	5	6	5	6	5	5	5	5	5	**116**	**203.4**
6	8	8	5	4	5	4	5	4	5	5	5	5	5	6	5	6	5	6	5	5	5	**117**	**205.0**
6	8	8	5	4	5	5	5	4	5	5	5	5	5	6	5	6	5	6	5	5	5	**118**	**206.6**
6	8	8	5	4	5	5	5	4	5	5	5	6	5	6	5	6	5	6	5	6	5	**120**	**209.8**
6	8	8	5	4	5	5	5	4	5	5	5	6	5	6	6	6	6	6	5	6	5	**122**	**213.0**
6	8	8	5	5	5	5	5	5	5	5	5	6	5	6	6	6	6	6	5	6	5	**124**	**216.2**
7	9	8	5	5	5	5	5	5	5	5	5	6	5	6	6	6	6	6	5	6	5	**126**	**219.4**
7	9	8	5	5	5	5	5	5	5	5	5	6	6	6	6	6	6	6	6	6	5	**128**	**222.6**
7	9	8	5	5	5	5	5	5	5	5	6	6	6	6	6	6	6	6	6	6	6	**130**	**225.8**
7	9	8	5	5	5	5	5	5	6	6	6	6	6	6	6	6	6	6	6	6	6	**132**	**229.0**
7	9	8	5	5	5	5	5	5	6	6	6	6	6	7	6	6	7	6	6	6	6	**134**	**232.2**
7	9	8	5	5	5	5	5	5	6	6	6	6	6	7	7	6	7	7	6	6	6	**136**	**235.4**
7	9	8	5	5	5	5	5	5	6	6	6	6	7	7	7	7	7	7	6	6	6	**138**	**238.6**
7	9	8	5	5	5	5	6	6	6	6	6	6	7	7	7	7	7	7	6	6	6	**140**	**241.8**
7	9	8	5	5	5	5	6	6	6	6	6	6	7	7	7	8	7	7	7	6	6	**142**	**245.1**
7	9	8	5	5	5	5	6	6	6	6	6	6	7	8	7	8	7	8	7	6	6	**144**	**248.5**
7	9	8	5	5	5	5	6	6	7	6	7	6	7	8	7	8	7	8	7	6	6	**146**	**251.7**
7	9	8	6	5	6	5	6	6	7	6	7	6	7	8	7	8	7	8	7	6	6	**148**	**254.9**
7	9	8	6	5	6	5	6	6	7	6	7	7	7	8	7	8	7	8	7	7	6	**150**	**258.1**
7	9	8	6	5	6	5	6	6	7	6	7	8	7	8	7	8	7	8	7	7	7	**152**	**261.4**
7	9	8	6	6	6	6	6	6	7	6	7	8	7	8	7	8	7	8	7	7	7	**154**	**264.6**
7	9	8	6	6	6	6	6	6	7	7	7	8	7	8	8	8	7	8	7	7	7	**156**	**267.9**
7	9	8	6	6	6	6	6	6	7	7	7	8	8	8	8	8	8	8	7	7	7	**158**	**271.3**
7	9	8	6	6	6	6	6	6	7	7	8	8	8	8	8	8	8	8	8	7	7	**160**	**274.7**
7	9	8	6	6	7	6	6	7	7	7	8	8	8	8	8	8	8	8	8	7	7	**162**	**277.9**
7	9	8	6	6	7	6	6	7	7	8	8	8	8	8	8	8	8	8	8	8	7	**164**	**281.3**
7	9	8	7	6	7	6	7	7	7	8	8	8	8	8	8	8	8	8	8	8	7	**166**	**284.5**
7	9	8	7	6	7	6	7	7	8	8	8	8	8	8	8	8	8	8	8	8	8	**168**	**287.9**
7	9	8	7	7	7	7	7	7	8	8	8	8	8	8	8	8	8	8	8	8	8	**170**	**291.1**
8	9	8	7	7	7	7	7	8	8	8	8	8	8	8	8	8	8	8	8	8	8	**172**	**294.5**
8	9	8	7	8	7	8	7	8	8	8	8	8	8	8	8	8	8	8	8	8	8	**174**	**297.9**
8	9	8	7	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	**176**	**301.3**

Table MCN-10. [*pg 1 of 5*]. McNary Dam Spill Patterns during TSW Removal in Bays 19-20.

MCN Spill Patterns During TSW Removal (# Gate Stops per Spillbay)																						Total Stops	Spill [a]
1 [b]	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22 [b]	(#)	(kcfs)
								2		2		2		2	2	2	CLOSE	CLOSE	CLOSE	CLOSE		**12**	**23.4**
								2	1	2		2		2	2	2	CLOSE	CLOSE	CLOSE	CLOSE		**13**	**25.4**
								2	2	2		2		2	2	2	CLOSE	CLOSE	CLOSE	CLOSE		**14**	**27.3**
								2	2	2		2	1	2	2	2	CLOSE	CLOSE	CLOSE	CLOSE		**15**	**29.3**
								2	2	2		2	2	2	2	2	CLOSE	CLOSE	CLOSE	CLOSE		**16**	**31.2**
								2	2	2	1	2	2	2	2	2	CLOSE	CLOSE	CLOSE	CLOSE		**17**	**33.2**
								2	2	2	2	2	2	2	2	2	CLOSE	CLOSE	CLOSE	CLOSE		**18**	**35.1**
						1		2	2	2	2	2	2	2	2	2	CLOSE	CLOSE	CLOSE	CLOSE		**19**	**37.1**
						2		2	2	2	2	2	2	2	2	2	CLOSE	CLOSE	CLOSE	CLOSE		**20**	**39.0**
				1		2		2	2	2	2	2	2	2	2	2	CLOSE	CLOSE	CLOSE	CLOSE		**21**	**41.0**
				2		2		2	2	2	2	2	2	2	2	2	CLOSE	CLOSE	CLOSE	CLOSE		**22**	**42.9**
2.5	2	3.5		2		2		2		2		2	1	2		2	CLOSE	CLOSE	CLOSE	CLOSE		**23**	**44.4**
2.5	2	3.5		2		2		2		2		2	1	2	1	2	CLOSE	CLOSE	CLOSE	CLOSE		**24**	**46.4**
2.5	2	3.5		2	1	2		2		2		2	1	2	1	2	CLOSE	CLOSE	CLOSE	CLOSE		**25**	**48.4**
2.5	2	3.5		2	1	2		2	1	2		2	1	2	1	2	CLOSE	CLOSE	CLOSE	CLOSE		**26**	**50.4**
2.5	2	3.5		2	1	2		2	1	2	1	2	1	2	1	2	CLOSE	CLOSE	CLOSE	CLOSE		**27**	**52.4**
2.5	2	3.5		2	1	2	1	2	1	2	1	2	1	2	1	2	CLOSE	CLOSE	CLOSE	CLOSE		**28**	**54.4**
2.5	2	3.5	1	2	1	2	1	2	1	2	1	2	1	2	1	2	CLOSE	CLOSE	CLOSE	CLOSE		**29**	**56.4**
2.5	2	3.5	1	2	1	2	1	2	1	2	1	2	2	2	1	2	CLOSE	CLOSE	CLOSE	CLOSE		**30**	**58.3**
2.5	2	3.5	1	2	1	2	1	2	1	2	1	2	2	2	2	2	CLOSE	CLOSE	CLOSE	CLOSE		**31**	**60.2**
2.5	2	3.5	1	2	2	2	1	2	1	2	1	2	2	2	2	2	CLOSE	CLOSE	CLOSE	CLOSE		**32**	**62.1**
2.5	2	3.5	1	2	2	2	1	2	2	2	1	2	2	2	2	2	CLOSE	CLOSE	CLOSE	CLOSE		**33**	**64.0**
2.5	2	3.5	1	2	2	2	1	2	2	2	2	2	2	2	2	2	CLOSE	CLOSE	CLOSE	CLOSE		**34**	**65.9**
2.5	2	3.5	1	2	2	2	2	2	2	2	2	2	2	2	2	2	CLOSE	CLOSE	CLOSE	CLOSE		**35**	**67.8**
2.5	2	3.5	2	2	2	2	2	2	2	2	2	2	2	2	2	2	CLOSE	CLOSE	CLOSE	CLOSE		**36**	**69.7**
2.5	2.5	4	2	2	2	2	2	2	2	2	2	2	2	2	2	2	CLOSE	CLOSE	CLOSE	CLOSE		**37**	**71.3**
2.5	2.5	4	2	2	2	2	2	2	2	2	2	2	2	2	2.5	2.5	CLOSE	CLOSE	CLOSE	CLOSE		**38**	**73.0**
2.5	2.5	4	2	2	2	2.5	2	2	2	2.5	2	2	2	2	2.5	2.5	CLOSE	CLOSE	CLOSE	CLOSE		**39**	**74.7**
2.5	2.5	4	2	2.5	2	2.5	2	2	2	2.5	2	2	2	2.5	2.5	2.5	CLOSE	CLOSE	CLOSE	CLOSE		**40**	**76.4**
2.5	2.5	4	2	2.5	2	2.5	2	2.5	2	2.5	2	2.5	2	2.5	2.5	2.5	CLOSE	CLOSE	CLOSE	CLOSE		**41**	**78.1**
2.5	2.5	4	2	2.5	2.5	2.5	2	2.5	2.5	2.5	2	2.5	2	2.5	2.5	2.5	CLOSE	CLOSE	CLOSE	CLOSE		**42**	**79.8**
2.5	2.5	4	2	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2	2.5	2.5	2.5	CLOSE	CLOSE	CLOSE	CLOSE		**43**	**81.5**
2.5	2.5	4	3	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2	2.5	2.5	2.5	CLOSE	CLOSE	CLOSE	CLOSE		**44**	**83.2**
2.5	2.5	4	3	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	CLOSE	CLOSE	CLOSE	CLOSE		**45**	**84.1**
2.5	2.5	4	3	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	3	3	CLOSE	CLOSE	CLOSE	CLOSE		**46**	**85.8**
2.5	2.5	4.5	3	2.5	2.5	2.5	2.5	2.5	2.5	3	2.5	2.5	2.5	2.5	3	3	CLOSE	CLOSE	CLOSE	CLOSE		**47**	**87.4**

MCN Spill Patterns During TSW Removal (# Gate Stops per Spillbay)																						Total Stops	Spill [a]
1 [b]	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22 [b]	(#)	(kcfs)
2.5	2.5	4.5	3	2.5	2.5	3	2.5	2.5	2.5	3	2.5	3	2.5	2.5	3	3	CLOSE	CLOSE	CLOSE	CLOSE		48	89.1
2.5	2.5	4.5	3	3	2.5	3	2.5	3	2.5	3	2.5	3	2.5	2.5	3	3	CLOSE	CLOSE	CLOSE	CLOSE		49	90.8
2.5	2.5	4.5	3	3	3	3	2.5	3	2.5	3	2.5	3	2.5	3	3	3	CLOSE	CLOSE	CLOSE	CLOSE		50	92.5
2.5	2.5	5	3	3	3	3	2.5	3	3	3	2.5	3	2.5	3	3	3	CLOSE	CLOSE	CLOSE	CLOSE		51	94.2
2.5	2.5	5	3	3	3	3	3	3	3	3	3	3	2.5	3	3	3	CLOSE	CLOSE	CLOSE	CLOSE		52	95.9
3	3	5	3	3	3	3	3	3	3	3	3	3	2.5	3	3	3	CLOSE	CLOSE	CLOSE	CLOSE		53	97.6
3	3	5	3	3	3	3	3	3	3	3	3	3	3	3	3	3	CLOSE	CLOSE	CLOSE	CLOSE		53	98.4
3	3	5	3	3	3	3	3	3	3	3	3	3	3	3	3	4	CLOSE	CLOSE	CLOSE	CLOSE		54	100.0
3	4	5	3	3	3	3	3	3	3	3	3	3	3	3	3	4	CLOSE	CLOSE	CLOSE	CLOSE		55	101.6
4	4	5	3	3	3	3	3	3	3	3	3	3	3	3	3	4	CLOSE	CLOSE	CLOSE	CLOSE		56	103.2
4	4	5	3	3	3	4	3	3	3	3	3	3	3	3	3	4	CLOSE	CLOSE	CLOSE	CLOSE		57	104.8
4	4	5	3	3	3	4	3	3	3	4	3	3	3	3	3	4	CLOSE	CLOSE	CLOSE	CLOSE		58	106.4
4	4	5	3	4	3	4	3	3	3	4	3	3	3	3	3	4	CLOSE	CLOSE	CLOSE	CLOSE		59	108.0
4	4	5	3	4	3	4	3	3	3	4	3	3	3	4	3	4	CLOSE	CLOSE	CLOSE	CLOSE		60	109.6
4	4	5	3	4	3	4	3	4	3	4	3	3	3	4	3	4	CLOSE	CLOSE	CLOSE	CLOSE		61	111.2
4	4	5	3	4	3	4	3	4	3	4	3	4	3	4	3	4	CLOSE	CLOSE	CLOSE	CLOSE		62	112.8
4	4	5	3	4	4	4	3	4	3	4	3	4	3	4	3	4	CLOSE	CLOSE	CLOSE	CLOSE		63	114.4
4	4	5	3	4	4	4	3	4	4	4	3	4	3	4	3	4	CLOSE	CLOSE	CLOSE	CLOSE		64	116.0
4	4	5	3	4	4	4	3	4	4	4	4	4	3	4	3	4	CLOSE	CLOSE	CLOSE	CLOSE		65	117.6
4	4	5	3	4	4	4	4	4	4	4	4	4	3	4	3	4	CLOSE	CLOSE	CLOSE	CLOSE		66	119.2
4	4	5	3	4	4	4	4	4	4	4	4	4	3	4	4	4	CLOSE	CLOSE	CLOSE	CLOSE		67	120.8
4	4	5	4	4	4	4	4	4	4	4	4	4	3	4	4	4	CLOSE	CLOSE	CLOSE	CLOSE		68	122.4
4	4	5	4	4	4	4	4	4	4	4	4	4	4	4	4	4	CLOSE	CLOSE	CLOSE	CLOSE		69	124.0
4	4	5	4	4	4	4	4	4	4	4	4	4	4	4	4	5	CLOSE	CLOSE	CLOSE	CLOSE		70	125.6
4	5	5	4	4	4	4	4	4	4	4	4	4	4	4	4	5	CLOSE	CLOSE	CLOSE	CLOSE		71	127.2
5	5	5	4	4	4	4	4	4	4	4	4	4	4	4	4	5	CLOSE	CLOSE	CLOSE	CLOSE		72	128.8
5	5	5	4	4	4	5	4	4	4	4	4	4	4	4	4	5	CLOSE	CLOSE	CLOSE	CLOSE		73	130.4
5	5	5	4	4	4	5	4	4	4	5	4	4	4	4	4	5	CLOSE	CLOSE	CLOSE	CLOSE		74	132.0
5	5	5	4	5	4	5	4	4	4	5	4	4	4	4	4	5	CLOSE	CLOSE	CLOSE	CLOSE		75	133.6
5	5	5	4	5	4	5	4	4	4	5	4	4	4	5	4	5	CLOSE	CLOSE	CLOSE	CLOSE		76	135.2
5	5	5	4	5	4	5	4	5	4	5	4	4	4	5	4	5	CLOSE	CLOSE	CLOSE	CLOSE		77	136.8
5	5	5	4	5	4	5	4	5	4	5	4	5	4	5	4	5	CLOSE	CLOSE	CLOSE	CLOSE		78	138.4
5	5	5	4	5	5	5	4	5	4	5	4	5	4	5	4	5	CLOSE	CLOSE	CLOSE	CLOSE		79	140.0
5	5	5	4	5	5	5	4	5	5	5	4	5	4	5	4	5	CLOSE	CLOSE	CLOSE	CLOSE		80	141.6
5	5	5	4	5	5	5	4	5	5	5	5	5	4	5	4	5	CLOSE	CLOSE	CLOSE	CLOSE		81	143.2
5	5	5	4	5	5	5	5	5	5	5	5	5	4	5	4	5	CLOSE	CLOSE	CLOSE	CLOSE		82	144.8
5	5	5	4	5	5	5	5	5	5	5	5	5	4	5	5	5	CLOSE	CLOSE	CLOSE	CLOSE		83	146.4

MCN Spill Patterns During TSW Removal (# Gate Stops per Spillbay)																						Total Stops	Spill [a]
1 [b]	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22 [b]	(#)	(kcfs)
5	5	5	5	5	5	5	5	5	5	5	5	5	4	5	5	5	CLOSE	CLOSE	CLOSE	CLOSE		**84**	**148.0**
5	5	6	5	5	5	5	5	5	5	5	5	5	4	5	5	5	CLOSE	CLOSE	CLOSE	CLOSE		**85**	**149.6**
5	5	6	5	5	5	5	5	5	5	5	5	5	5	5	5	5	CLOSE	CLOSE	CLOSE	CLOSE		**86**	**151.2**
5	5	6	5	5	5	5	5	5	5	5	5	5	5	5	5	6	CLOSE	CLOSE	CLOSE	CLOSE		**87**	**152.8**
5	6	6	5	5	5	5	5	5	5	5	5	5	5	5	5	6	CLOSE	CLOSE	CLOSE	CLOSE		**88**	**154.4**
6	6	6	5	5	5	5	5	5	5	5	5	5	5	5	5	6	CLOSE	CLOSE	CLOSE	CLOSE		**89**	**156.0**
6	6	6	5	5	5	6	5	5	5	5	5	5	5	5	5	6	CLOSE	CLOSE	CLOSE	CLOSE		**90**	**157.6**
6	6	6	5	5	5	6	5	5	5	6	5	5	5	5	5	6	CLOSE	CLOSE	CLOSE	CLOSE		**91**	**159.2**
6	6	6	5	6	5	6	5	5	5	6	5	5	5	5	5	6	CLOSE	CLOSE	CLOSE	CLOSE		**92**	**160.8**
6	6	6	5	6	5	6	5	5	5	6	5	5	5	6	5	6	CLOSE	CLOSE	CLOSE	CLOSE		**93**	**162.4**
6	6	6	5	6	5	6	5	6	5	6	5	5	5	6	5	6	CLOSE	CLOSE	CLOSE	CLOSE		**94**	**164.0**
6	6	6	5	6	5	6	5	6	5	6	5	6	5	6	5	6	CLOSE	CLOSE	CLOSE	CLOSE		**95**	**165.6**
6	6	6	5	6	6	6	5	6	5	6	5	6	5	6	5	6	CLOSE	CLOSE	CLOSE	CLOSE		**96**	**167.2**
6	6	6	5	6	6	6	5	6	6	6	5	6	5	6	5	6	CLOSE	CLOSE	CLOSE	CLOSE		**97**	**168.8**
6	6	6	5	6	6	6	5	6	6	6	6	6	5	6	5	6	CLOSE	CLOSE	CLOSE	CLOSE		**98**	**170.4**
6	6	6	5	6	6	6	6	6	6	6	6	6	5	6	5	6	CLOSE	CLOSE	CLOSE	CLOSE		**99**	**172.0**
6	6	6	5	6	6	6	6	6	6	6	6	6	5	6	6	6	CLOSE	CLOSE	CLOSE	CLOSE		**100**	**173.6**
6	6	6	6	6	6	6	6	6	6	6	6	6	5	6	6	6	CLOSE	CLOSE	CLOSE	CLOSE		**101**	**175.2**
6	6	7	6	6	6	6	6	6	6	6	6	6	5	6	6	6	CLOSE	CLOSE	CLOSE	CLOSE		**102**	**176.8**
6	6	7	6	6	6	6	6	6	6	6	6	6	6	6	6	6	CLOSE	CLOSE	CLOSE	CLOSE		**103**	**178.4**
6	6	7	6	6	6	6	6	6	6	6	6	6	6	6	6	7	CLOSE	CLOSE	CLOSE	CLOSE		**104**	**180.0**
6	7	7	6	6	6	6	6	6	6	6	6	6	6	6	6	7	CLOSE	CLOSE	CLOSE	CLOSE		**105**	**181.6**
7	7	7	6	6	6	6	6	6	6	6	6	6	6	6	6	7	CLOSE	CLOSE	CLOSE	CLOSE		**106**	**183.2**
7	7	7	6	6	6	7	6	6	6	6	6	6	6	6	6	7	CLOSE	CLOSE	CLOSE	CLOSE		**107**	**184.8**
7	7	7	6	6	6	7	6	6	6	7	6	6	6	6	6	7	CLOSE	CLOSE	CLOSE	CLOSE		**108**	**186.4**
7	7	7	6	7	6	7	6	6	6	7	6	6	6	6	6	7	CLOSE	CLOSE	CLOSE	CLOSE		**109**	**188.0**
7	7	7	6	7	6	7	6	6	6	7	6	6	6	7	6	7	CLOSE	CLOSE	CLOSE	CLOSE		**110**	**189.6**
7	7	7	6	7	6	7	6	7	6	7	6	6	6	7	6	7	CLOSE	CLOSE	CLOSE	CLOSE		**111**	**191.2**
7	7	7	6	7	6	7	6	7	6	7	6	7	6	7	6	7	CLOSE	CLOSE	CLOSE	CLOSE		**112**	**192.8**
7	7	7	6	7	7	7	6	7	6	7	6	7	6	7	6	7	CLOSE	CLOSE	CLOSE	CLOSE		**113**	**194.4**
7	7	7	6	7	7	7	6	7	7	7	6	7	6	7	6	7	CLOSE	CLOSE	CLOSE	CLOSE		**114**	**196.0**
7	7	7	6	7	7	7	6	7	7	7	7	7	6	7	6	7	CLOSE	CLOSE	CLOSE	CLOSE		**115**	**197.6**
7	7	7	6	7	7	7	7	7	7	7	7	7	6	7	6	7	CLOSE	CLOSE	CLOSE	CLOSE		**116**	**199.2**
7	7	7	6	7	7	7	7	7	7	7	7	7	6	7	7	7	CLOSE	CLOSE	CLOSE	CLOSE		**117**	**200.8**
7	7	7	7	7	7	7	7	7	7	7	7	7	6	7	7	7	CLOSE	CLOSE	CLOSE	CLOSE		**118**	**202.4**
7	7	8	7	7	7	7	7	7	7	7	7	7	6	7	7	7	CLOSE	CLOSE	CLOSE	CLOSE		**119**	**204.1**
7	7	8	7	7	7	7	7	7	7	7	7	7	7	7	7	7	CLOSE	CLOSE	CLOSE	CLOSE		**120**	**205.7**

MCN Spill Patterns During TSW Removal (# Gate Stops per Spillbay)																						Total Stops	Spill [a]
1 [b]	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22 [b]	(#)	(kcfs)
7	7	8	7	7	7	7	7	7	7	7	7	7	7	7	7	8	CLOSE	CLOSE	CLOSE	CLOSE		**121**	**207.4**
7	8	8	7	7	7	7	7	7	7	7	7	7	7	7	7	8	CLOSE	CLOSE	CLOSE	CLOSE		**122**	**209.1**
8	8	8	7	7	7	7	7	7	7	7	7	7	7	7	7	8	CLOSE	CLOSE	CLOSE	CLOSE		**123**	**210.8**
8	8	8	7	7	7	8	7	7	7	7	7	7	7	7	7	8	CLOSE	CLOSE	CLOSE	CLOSE		**124**	**212.5**
8	8	8	7	7	7	8	7	7	7	8	7	7	7	7	7	8	CLOSE	CLOSE	CLOSE	CLOSE		**125**	**214.2**
8	8	8	7	8	7	8	7	7	7	8	7	7	7	7	7	8	CLOSE	CLOSE	CLOSE	CLOSE		**126**	**215.9**
8	8	8	7	8	7	8	7	7	7	8	7	7	7	8	7	8	CLOSE	CLOSE	CLOSE	CLOSE		**127**	**217.6**
8	8	8	7	8	7	8	7	8	7	8	7	7	7	8	7	8	CLOSE	CLOSE	CLOSE	CLOSE		**128**	**219.3**
8	8	8	7	8	7	8	7	8	7	8	7	8	7	8	7	8	CLOSE	CLOSE	CLOSE	CLOSE		**129**	**221.0**
8	8	8	7	8	8	8	7	8	7	8	7	8	7	8	7	8	CLOSE	CLOSE	CLOSE	CLOSE		**130**	**222.7**
8	8	8	7	8	8	8	7	8	8	8	7	8	7	8	7	8	CLOSE	CLOSE	CLOSE	CLOSE		**131**	**224.4**
8	8	8	7	8	8	8	7	8	8	8	8	8	7	8	7	8	CLOSE	CLOSE	CLOSE	CLOSE		**132**	**226.1**
8	8	8	7	8	8	8	8	8	8	8	8	8	7	8	7	8	CLOSE	CLOSE	CLOSE	CLOSE		**133**	**227.8**
8	8	8	7	8	8	8	8	8	8	8	8	8	7	8	8	8	CLOSE	CLOSE	CLOSE	CLOSE		**134**	**229.5**
8	8	8	8	8	8	8	8	8	8	8	8	8	7	8	8	8	CLOSE	CLOSE	CLOSE	CLOSE		**135**	**231.2**
8	8	9	8	8	8	8	8	8	8	8	8	8	7	8	8	8	CLOSE	CLOSE	CLOSE	CLOSE		**136**	**232.8**
8	8	9	8	8	8	8	8	8	8	8	8	8	8	8	8	8	CLOSE	CLOSE	CLOSE	CLOSE		**137**	**234.5**
8	8	9	8	8	8	8	8	8	8	8	8	8	8	8	8	9	CLOSE	CLOSE	CLOSE	CLOSE		**138**	**236.1**
8	9	9	8	8	8	8	8	8	8	8	8	8	8	8	8	9	CLOSE	CLOSE	CLOSE	CLOSE		**139**	**237.7**
9	9	9	8	8	8	8	8	8	8	8	8	8	8	8	8	9	CLOSE	CLOSE	CLOSE	CLOSE		**140**	**239.3**
9	9	9	8	8	8	8	8	8	8	8	8	8	8	8	9	9	CLOSE	CLOSE	CLOSE	CLOSE		**141**	**240.9**
9	9	9	8	8	8	8	8	8	8	8	8	8	8	9	9	9	CLOSE	CLOSE	CLOSE	CLOSE		**142**	**242.5**
9	9	9	8	8	8	8	8	8	8	8	8	8	9	9	9	9	CLOSE	CLOSE	CLOSE	CLOSE		**143**	**244.1**
9	9	9	9	8	8	8	8	8	8	8	8	8	9	9	9	9	CLOSE	CLOSE	CLOSE	CLOSE		**144**	**245.7**
9	9	9	9	8	8	8	8	8	8	8	8	9	9	9	9	9	CLOSE	CLOSE	CLOSE	CLOSE		**145**	**247.3**
9	9	9	9	9	8	8	8	8	8	8	8	9	9	9	9	9	CLOSE	CLOSE	CLOSE	CLOSE		**146**	**248.9**
9	9	9	9	9	8	8	8	8	8	8	9	9	9	9	9	9	CLOSE	CLOSE	CLOSE	CLOSE		**147**	**250.5**
9	9	9	9	9	9	8	8	8	8	8	9	9	9	9	9	9	CLOSE	CLOSE	CLOSE	CLOSE		**148**	**252.1**
9	9	9	9	9	9	9	8	8	8	8	9	9	9	9	9	9	CLOSE	CLOSE	CLOSE	CLOSE		**149**	**253.7**
9	9	9	9	9	9	9	8	8	8	9	9	9	9	9	9	9	CLOSE	CLOSE	CLOSE	CLOSE		**150**	**255.3**
9	9	9	9	9	9	9	9	8	8	9	9	9	9	9	9	9	CLOSE	CLOSE	CLOSE	CLOSE		**151**	**256.9**
9	9	9	9	9	9	9	9	8	9	9	9	9	9	9	9	9	CLOSE	CLOSE	CLOSE	CLOSE		**152**	**258.5**
9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	CLOSE	CLOSE	CLOSE	CLOSE		**153**	**260.1**
10	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	CLOSE	CLOSE	CLOSE	CLOSE		**154**	**261.7**
10	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	10	CLOSE	CLOSE	CLOSE	CLOSE		**155**	**263.3**
10	10	9	9	9	9	9	9	9	9	9	9	9	9	9	9	10	CLOSE	CLOSE	CLOSE	CLOSE		**156**	**264.9**
10	10	9	9	9	9	9	9	9	9	9	9	9	9	9	10	10	CLOSE	CLOSE	CLOSE	CLOSE		**157**	**266.5**

MCN Spill Patterns During TSW Removal (# Gate Stops per Spillbay)																						Total Stops	Spill [a]
1 [b]	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22 [b]	(#)	(kcfs)
10	10	10	9	9	9	9	9	9	9	9	9	9	9	9	10	10	CLOSE	CLOSE	CLOSE	CLOSE		**158**	**268.1**
10	10	10	9	9	9	9	9	9	9	9	9	9	9	10	10	10	CLOSE	CLOSE	CLOSE	CLOSE		**159**	**269.7**
10	10	10	10	9	9	9	9	9	9	9	9	9	9	10	10	10	CLOSE	CLOSE	CLOSE	CLOSE		**160**	**271.3**
10	10	10	10	9	9	9	9	9	9	9	9	9	10	10	10	10	CLOSE	CLOSE	CLOSE	CLOSE		**161**	**272.9**
10	10	10	10	10	9	9	9	9	9	9	9	9	10	10	10	10	CLOSE	CLOSE	CLOSE	CLOSE		**162**	**274.5**
10	10	10	10	10	9	9	9	9	9	9	9	10	10	10	10	10	CLOSE	CLOSE	CLOSE	CLOSE		**163**	**276.1**
10	10	10	10	10	10	9	9	9	9	9	9	10	10	10	10	10	CLOSE	CLOSE	CLOSE	CLOSE		**164**	**277.7**
10	10	10	10	10	10	9	9	9	9	9	10	10	10	10	10	10	CLOSE	CLOSE	CLOSE	CLOSE		**165**	**279.3**
10	10	10	10	10	10	10	9	9	9	9	10	10	10	10	10	10	CLOSE	CLOSE	CLOSE	CLOSE		**166**	**280.9**
10	10	10	10	10	10	10	9	9	9	10	10	10	10	10	10	10	CLOSE	CLOSE	CLOSE	CLOSE		**167**	**282.5**
10	10	10	10	10	10	10	10	9	9	10	10	10	10	10	10	10	CLOSE	CLOSE	CLOSE	CLOSE		**168**	**284.1**
10	10	10	10	10	10	10	10	9	10	10	10	10	10	10	10	10	CLOSE	CLOSE	CLOSE	CLOSE		**169**	**285.7**
10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	CLOSE	CLOSE	CLOSE	CLOSE		**170**	**287.3**
11	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	CLOSE	CLOSE	CLOSE	CLOSE		**171**	**288.8**
11	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	11	CLOSE	CLOSE	CLOSE	CLOSE		**172**	**290.3**
11	11	10	10	10	10	10	10	10	10	10	10	10	10	10	10	11	CLOSE	CLOSE	CLOSE	CLOSE		**173**	**291.8**
11	11	10	10	10	10	10	10	10	10	10	10	10	10	10	11	11	CLOSE	CLOSE	CLOSE	CLOSE		**174**	**293.3**
11	11	11	10	10	10	10	10	10	10	10	10	10	10	10	11	11	CLOSE	CLOSE	CLOSE	CLOSE		**175**	**294.8**
11	11	11	10	10	10	10	10	10	10	10	10	10	10	11	11	11	CLOSE	CLOSE	CLOSE	CLOSE		**176**	**296.3**
11	11	11	11	10	10	10	10	10	10	10	10	10	10	11	11	11	CLOSE	CLOSE	CLOSE	CLOSE		**177**	**297.8**
11	11	11	11	10	10	10	10	10	10	10	10	10	11	11	11	11	CLOSE	CLOSE	CLOSE	CLOSE		**178**	**299.3**
11	11	11	11	11	10	10	10	10	10	10	10	10	11	11	11	11	CLOSE	CLOSE	CLOSE	CLOSE		**179**	**300.8**