US Army Corps of Engineers ®
Portland District

Willamette Fish Operations Plan
Willamette Valley Project

Chapter 1 – Overview (OVE)
Chapter 2 – North Santiam (NS)
Chapter 3 – South Santiam (SS)
Chapter 4 – South Fork McKenzie (SFM)
Chapter 5 – Middle Fork Willamette (MFW)

APPENDICES
Appendix A – Fish Operations
Appendix B – Project Features (Dams)
Appendix C – Minto Fish Facility O&M Manual
Appendix D – Foster Fish Facility O&M Manual
Appendix E – Cougar Fish Facility O&M Manual
Appendix F – Rule Curves
Appendix G – Outplant Forms
Appendix H – Gate Construction Schedule
Appendix I – Notification Protocol: Flow Deviations and Power Generation Requests
Appendix J – Acronyms

1. WILLAMETTE FISH OPERATIONS PLAN (WFOP) OVERVIEW

1.1. Background

1.1.1. The *Willamette Fish Operations Plan* (WFOP) is developed annually by the U.S. Army Corps of Engineers (Corps) in coordination with the Bonneville Power Administration (BPA) and regional Federal, State and Tribal fish agencies and other partners through the *Willamette Fish Passage Operations & Maintenance* (WFPOM) coordination team. The WFOP describes year-round operations and maintenance (O&M) activities at Corps projects in the Willamette Basin (**Figure OVE-1**) as coordinated through WFPOM to protect and enhance anadromous and resident fish species listed as endangered or threatened under the *Endangered Species Act* (ESA), as well as non-listed species of concern (e.g., lamprey, sturgeon). The WFOP describes project operations necessary to protect and enhance anadromous and resident fish species listed as endangered or threatened under the Endangered Species Act (ESA), as well as providing benefits to other native fish species. The WFOP guides USACE actions related to fish protection and passage at the 13 Willamette projects. Other Corps documents and agreements related to fish passage at these projects are consistent with the WFOP.

1.1.2. Pursuant to ESA Section 7, NOAA Fisheries and U.S. Fish and Wildlife Services consulted on the effects of Willamette project operations on ESA-listed anadromous fish species and issued a Biological Opinion (BiOp) on July 11, 2008, that included a suite of recommended actions and strategies in the *Reasonable & Prudent Alternative* (RPA). The BiOps, decision documents and other related information are available online at: http://www.salmonrecovery.gov/BiologicalOpinions/WillametteBiOp.aspx

1.1.3. The WFOP is developed in accordance with the NOAA Willamette BiOp RPA Action 4.3 for the operation and maintenance of Willamette Valley dams and fish passage facilities to minimize impacts to fish. The WFOP is revised as necessary to incorporate changes to project O&M as a result of new facilities or changes in operational procedures. Revisions will incorporate changes adopted through coordination with NOAA Fisheries and USFWS as part of the ESA Section 7 consultation, Recovery Plan, or Incidental Take permit processes, and through consideration of other regional input and plans. If any revisions to the WFOP are necessary, they will be made in accordance with the coordination process for revisions. Comments on the WFOP are welcome and may be sent to WFPOM and/or the Corps' Portland District Operations Division Fisheries Section, in Portland, Oregon. Draft and final WFOPs from 2015 through present, including all Change Forms, are available online at the *Willamette Fish Operations Plan Website*: http://www.nwd-wc.usace.army.mil/FMWQT/documents/WFPOM/2010/Willamette_Coordination/WFOP/

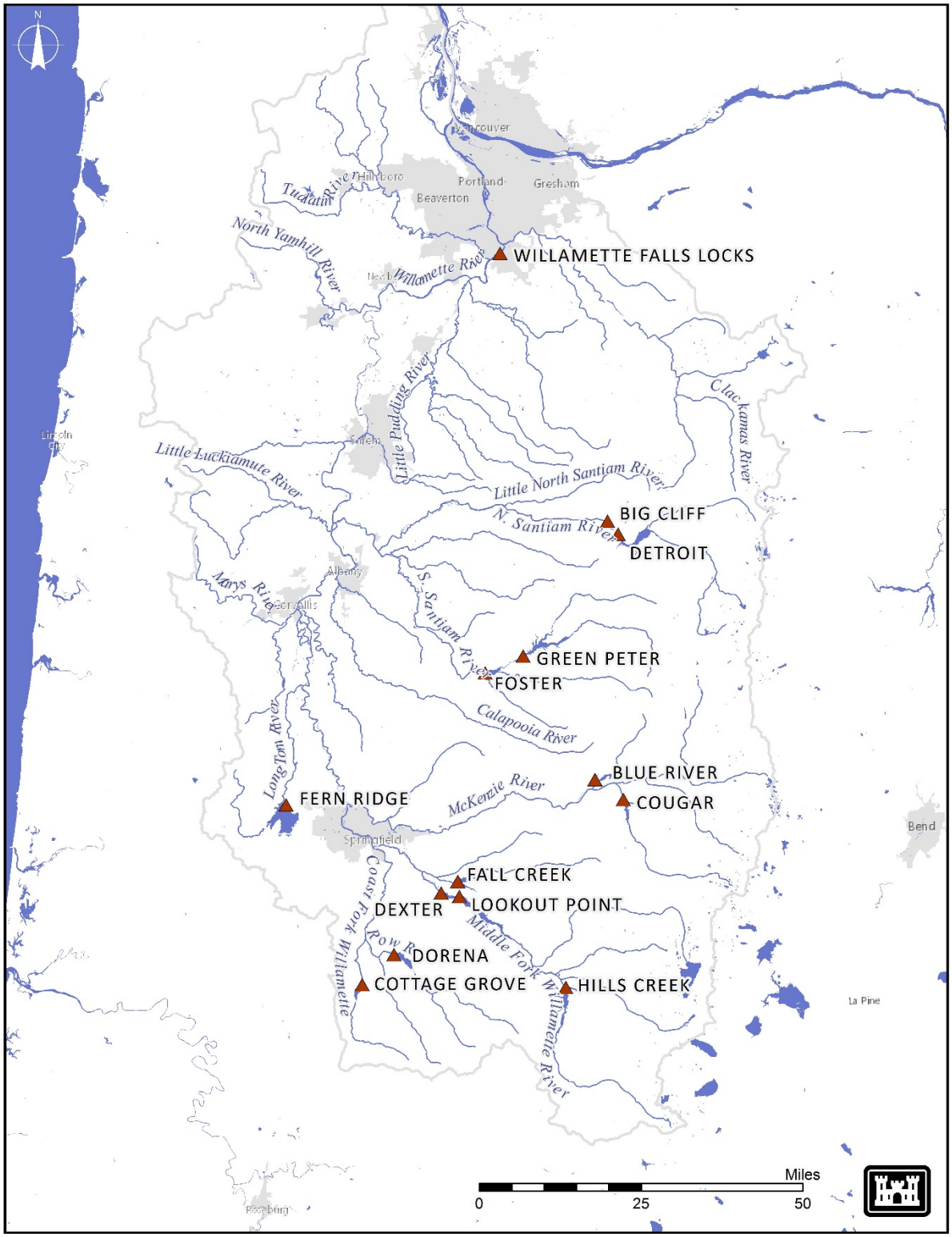


Figure OVE-1. Willamette River Basin and NWP USACE dams.

1.1.4. ESA Listed Fish

Upper Willamette River (UWR) spring Chinook (*Oncorhynchus tshawytscha*), UWR winter steelhead (*O. mykiss*), and bull trout (*Salvelinus confluentus*) are ESA-listed fish species found in the Willamette subbasins affected by operation of the WVP. Oregon chub were delisted in 2015. The distribution of each species by subbasin is provided in **Table OVE-1**.

Table OVE-2. ESA-listed Fish Presence by Willamette Subbasin

Subbasin	WVP Facilities	Fish Species			
		Spring Chinook	Winter Steelhead	Bull Trout	Oregon Chub[c]
North Santiam	Detroit/Big Cliff	**Present**	**Present**	Absent	**Present**
South Santiam	Green Peter (Middle Santiam)/ Foster (South Santiam)	**Present**	**Present**	Absent	**Present**
McKenzie	Cougar (South Fork McKenzie)/ Blue River	**Present**	Absent[b]	**Present**	**Present**
Middle Fork Willamette	Hills Creek/Lookout Point/Dexter	**Present**	Absent[b]	**Present**	**Present**
Fall Creek	Fall Creek	**Present**	Absent[b]	Absent	**Present**
Long Tom	Fern Ridge	Absent[a]	Absent	Absent	Absent
Coast Fork Willamette	Dorena	Absent[a]	Absent	Absent	**Present**
Row River	Cottage Grove	Absent	Absent	Absent	Absent

[a] Juvenile spring Chinook salmon have been documented using lower accessible reaches for winter off-channel use.
[b] Winter steelhead in the McKenzie and Middle Fork Willamette rivers and in Fall Creek are not designated as part of the distinct population segment but may be present in small numbers. Source: NMFS 2008
[c] Oregon Chub were delisted in 2015.

1.2. Emergency Deviations from Fish Passage Plan (WFOP) Criteria

1.2.1. The phrase "*when practicable*" is used in the WFOP to describe Project actions for fish that may vary on a case-by-case basis and thus require the exercise of professional judgment by Project staff. These situations may be due to real-time biological and/or other environmental conditions, availability of Project staff and/or equipment, or integrity of fish facility or other dam structures. In these cases, the Project biologist and other Project personnel will consider all relevant factors to determine the best way to proceed and implement appropriate action. These actions will be coordinated with fish agencies and tribes when they deviate from the WFOP.

1.2.2. River operational emergencies may occur that require projects to temporarily deviate from the WFOP. To the extent practicable, these operations will be coordinated with fish agencies and tribes, and conducted in a manner to avoid or minimize fish impacts. Normally, coordination occurs prior to an action; however, if an emergency situation requires immediate attention, coordination will be completed as soon as practicable afterwards.

1.3. Flow Management and Water Quality Team (FMWQT)

1.3.1. In-season decisions on river operations will be made in coordination with the regional forum *Flow Management and Water Quality Team* (FMWQT). Special operations identified in the WFOP will be coordinated through FMWQT. FMWQT meets monthly, or as often as necessary. When a water quality specific operation is required, a Memorandum of Coordination (MOC) is distributed to the region for

documentation and coordination through the WFPOM forum. Detailed information regarding the MOC process can be found in Section 2.4.2.1. below.

1.3.2. Water Conservation Planning Process

1.3.2.1. The USACE prepares an annual plan for the conservation release season (April/May-October). This plan is drafted in the spring, in coordination with the FMWQT, and finalized in May and an update will be given and coordinated through WFPOM. The Conservation Plan describes how the authorized project purposes will be accomplished during the conservation season based on the water supply forecast.

1.3.2.2. The plan calls for setting operational flow targets at Salem beginning on April 1, based on a storage forecast for mid-May (May 10-20). At this time, the designation for conservation season is determined as deficit, insufficient, adequate, abundant, or maximum.

1.3.2.3. BiOp RPA 3.4 excerpt during deficit years: "
(a) In "deficit" water years (as defined in Appendix D), the USACE will inform Reclamation that either (1) a specified partial supply or (2) no supply is available for the upcoming irrigation season in specific tributaries and will include this determination in the annual operating plan. The April 1 determination will remain in effect until October 31. The USACE may revise its "deficit" water year determination after April 1 if forecasts change significantly toward a wet year, and may make additional stored water available to meet irrigation contracts.
(b) Reclamation will notify affected contractees that water deliveries will be ceased or curtailed under these circumstances. Reclamation may apply the curtailment or cessation of water deliveries to specific tributaries where it is needed, but not in others, depending on water availability and storage capacity in each basin's reservoirs. Reclamation will also inform the OWRD of such actions.
(c) If the USACE determines initially that a partial supply is available for contractees, but later forecasts indicate even less water is available, in order to protect fish habitat the USACE will release additional flow from the applicable dams to offset the amounts diverted by contractees, based on the partial use that had been permitted on April 1. This additional flow will not be released if, based on coordination through WATER, it is determined these additional flows would impact ability to meet Table 9.2-1 (mainstem) and 9.2-2 (tributary) minimum flows during other seasons."

1.3.3. Streamflow. WVP dams were designed and constructed to modify the streamflow characteristics of their respective tributaries and the mainstem Willamette River. The storage facilities are drafted each fall to provide storage space for flood damage reduction and are refilled each spring to provide water for conservation season uses. In general, WVP operations have resulted in higher flows in the summer and reduced peak flows in the winter. These hydrologic effects, seasonally, modify fish habitat characteristics in the downstream stream reaches.

1.3.4. Water Temperature. The typical operation of the WVP dams with hydropower is to route water through the powerhouse of each dam, generating hydropower for regional energy demand. During the summer months, when reservoirs are at full pool, the water released through the turbine outlets is deep (hypolimnetic) water, which produces downstream water temperatures cooler than inflow temperatures (Figure OVE-2). During fall as the reservoirs are drawn down, the thermocline is pulled deeper and water released through the turbine outlets increases downstream water temperatures, which are much warmer than inflow temperatures (Figure OVE-3).

Figure OVE-2. Influence on Downstream Water Temperatures with no Temperature Control During Conservation Season.

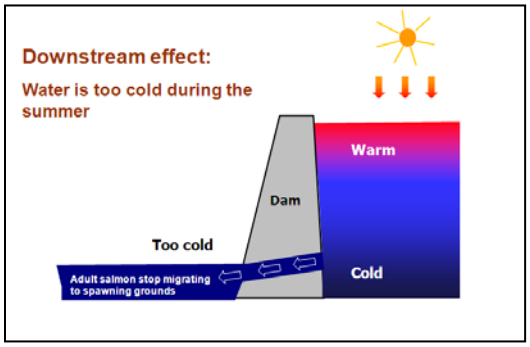
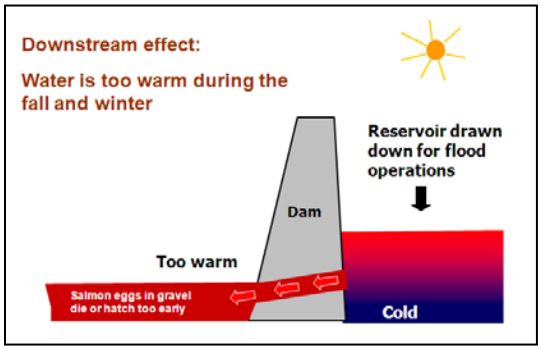


Figure OVE-3. Influence on Downstream Water Temperatures with no Temperature Control During Reservoir Drawdown for Flood Damage Reduction



1.3.5. Zebra Mussels. The USACE has an established policy that requires measures be included in O&M that either prevent or reduce the establishment of invasive and non-native species. Non-native aquatic mussels, specifically zebra mussels, can have a significant impact on native species, as well as increase facility O&M costs. These organisms have become a serious problem elsewhere in the country and may become introduced into the Willamette Basin. Inspections will be made when dewatering all WVP fish facilities. Due to transfers of water and equipment both from within and outside the Willamette Basin, extreme diligence should be taken during transfers as the water or equipment may harbor invasive species. Immediate reporting of suspect or confirmed zebra mussels or other invasive aquatic species will be made to the USACE. If additional aquatic invasive species are identified and require monitoring, the WFOP will be revised to reflect these new species.

1.4. <u>Total Dissolved Gas (TDG) Monitoring</u>

1.4.1. The Federal *Clean Water Act* establishes total dissolved gas (TDG) aquatic life standard of 110% that has been adopted by the states of Washington, Oregon, Idaho and Montana. Oregon Administrative Rules 340-041-0031 states that waters will be free from dissolved gases, such as carbon dioxide, hydrogen sulfide, or other gases, in sufficient quantities to cause objectionable odors or to be deleterious to fish or other aquatic life, navigation, recreation, or other reasonable uses made of such water. Except when stream flow exceeds the 10-year, 7-day average flood, the concentration of TDG relative to atmospheric pressure at the point of sample collection may not exceed 110% of saturation. However, in

hatchery receiving waters and other waters of less than 2 feet in depth, the concentration of TDG relative to atmospheric pressure at the point of sample collection may not exceed 105% of saturation.

1.4.2. Each year, a Willamette Basin Annual Water Quality Report is drafted to address Reasonable and Prudent Alternative (RPA) 5.1.4 of the NMFS 2008 Biological Opinion (BiOp). This report documents water quality monitoring, data collection and improvement actions implemented throughout the Willamette Basin for that year.

1.4.3. Reporting of high TDG will be conducted to interested individuals using the alert system provided by USGS for gages funded by the USACE and will require the individual to register for the service. http://maps.waterdata.usgs.gov/mapper/wateralert/

1.5. Mitigation Hatcheries

1.5.1. Mitigation Hatcheries. Since completion of the dams, both anadromous salmonids and resident trout have been produced and released into the Willamette Basin (Table 5). These programs, intended to mitigate for the loss of winter steelhead, spring Chinook, and trout (rainbow and cutthroat), may have further impacted the wild populations of these species through direct and indirect interactions. Current hatchery production provides for sport and commercial harvest, tribal allocations, and brood stock production, as well as a stock source for reintroduction above WVP dams. As natural production increases as a result of actions implemented under the 2008 BiOp, consideration of reduced hatchery production may be warranted. ***Hatchery operations are directed by Hatchery Genetic and Management Plans currently in review and will be incorporated as appendices once approved.***

1.6. Adult Outplanting Plan

1.6.1. Criteria for adult fish bypass facilities are contained in the project-specific **WFOP Chapters 2–5**. Additional criteria may be developed as part of the ESA Section 10 permit process and/or in coordination with the WFPOM.

2. FISH PASSAGE FACILITIES – INSPECTION & REPORTING CRITERIA

2.1.1. Project-specific **WFOP Chapters 2–5** include detailed inspection and reporting criteria for fish passage facilities at Corps projects. The Corps provides MOC/MFRs describing out-of-criteria situations, adjustments made to resolve problems, and a description of impacts on project fish passage and survival.

2.1.2. The Corps and BPA will take all reasonable and practicable steps to provide advance notification through the existing interagency coordinating mechanisms prior to departure from the fish-protection measures set out in the 2008 BiOp. If unforeseen circumstances arise that preclude BPA or the Corps from notifying the WFPOM prior to a variation from required operating criteria, those variations will be reported to the WFPOM as soon as practicable.

2.2. WFOP Implementation & Coordination

2.2.1. Implementation of the WFOP requires information exchange and coordination with NOAA Fisheries, BPA, other Federal and state fish agencies, and tribes. District biologists coordinate through WFPOM on water management, flows, temperature control, adult and juvenile fish facilities, and other project-specific operations. Water Management participates in FMWQT meetings throughout the year to consider recommendations for river operations to implement the WFOP, BiOps, and other recommendations from fish interests. These meetings are held in the Corps' Portland District office in

Portland, Oregon, and are open to the public. Corps representatives are available at these meetings to discuss the latest weather and runoff forecasts, as well as fish, hydrologic, water quality, and power generation information to assist in planning upcoming operations for fish passage. The Corps evaluates fish operation recommendations to determine impact on overall system operations.

2.2.2. Corps' District and Project biologists attend monthly WFPOM meetings dealing with project-specific issues below (see section below regarding WFPOM coordination):

i. Consider recommendations from affected interests;
ii. Provide updates on construction, O&M, research, and other topics;
iii. Develop criteria for the annual WFOP;
iv. Coordinate fish passage issues that may require deviation from WFOP criteria.

2.3. <u>Agency Responsibilities</u>

2.3.1. U.S. Army Corps of Engineers

i. Coordinate with NOAA Fisheries and USFWS on operations that may impact ESA-listed threatened, endangered, or candidate species;
ii. Prepare annual *Willamette Conservation Plan* and seasonal updates in coordination with FMWQT.
iii. In cooperation with fish agencies and tribes, provide fish passage monitoring, surveillance, and reporting at Corps projects throughout the migration period;
iv. Provide timely information on all proposed and/or scheduled studies or special operations that may negatively impact or otherwise constrain fish passage or energy production. Discuss unforeseen changes in fish passage operations with fish agencies and tribes;
v. Carry out routine and emergency fish passage operations and maintenance procedures in accordance with criteria in **WFOP Chapters 2-5** and **Appendix A**;
vi. Conduct the water quality monitoring program.

2.3.2. Federal, State and Tribal Fishery Agencies

i. Request operations that minimize impacts to fish through WFPOM to protect ESA-listed species or other species in accordance with the BiOp;
ii. Provide biological monitoring and surveillance reports throughout the migration period from predetermined locations;
iii. Provide status reports on the timing of the downstream migration, including pertinent marked fish release and recovery data
iv. Where biologically and logistically feasible, coordinate hatchery releases to ensure they are protected by regulated fish flows and spills while minimizing impacts on ESA-listed species. Provide and update hatchery release schedules weekly;
v. Provide recommendations to the operating agencies for maintaining acceptable fish passage conditions. This information can be used to maximize other project uses, including power generation;
vi. Provide information on all proposed and scheduled studies or special operations designed to improve fish passage operations that may affect energy production or project operations. Discuss unforeseen changes with the Corps;
vii. Recommend viable methods and procedures to reduce migratory and resident fish mortality (e.g., collection and transport of migrants, use of alternate bypass strategies, or other methods to minimize fish mortality).

2.3.3. Bonneville Power Administration

i. Utilize available flexibility of the Willamette System to shape flow requirements, spill priorities, and plant generation consistent with BPA policies and statutory requirements related to fish protection.

ii. Adjust system generation to provide adequate water for fish operation requirements in accordance with the WFOP and relevant Willamette BiOps.

iii. Provide project load requests on a real-time/hourly basis that enable the Corps to implement spill priorities.

2.4. <u>WFPOM Coordination</u>

2.4.1. Project O&M activities that impact fish are regionally coordinated through WFPOM, which includes representatives from the Corps, NOAA Fisheries, USFWS, BPA, state fish agencies (OR), tribes, and other interested parties. The printed WFOP is published annually on or about March 1 and is effective year-round, though revisions may be approved through WFPOM at any time. Proposed revisions are presented to the relevant project's District Operations biologist for consideration by the Corps in a WFOP Change Form[1] that includes a description and justification for the change. The Corps will submit Change Forms to WFPOM for a minimum of two weeks to review and provide feedback to the Corps POC. Approved Change Forms will be finalized with comments received and a record of the final action, then amended to the current year's online WFOP (if finalized after mid-February) or published in the next printed WFOP (if finalized before mid-February). The Corps will provide WFOP changes to FMWQT as necessary for use as part of the overall river operation plan. Sections dealing with special operational requirements will also be included in the Action Agencies' annual *Willamette Conservation Plan*.

2.4.2. Project activities under the purview of WFPOM that may require deviations from WFOP criteria will be fully coordinated in a timely manner. Issues discussed and resolved at WFPOM meetings will be considered regionally coordinated upon documentation in the final meeting minutes. Outside of WFPOM meetings, the coordination procedures below shall be followed.

2.4.2.1. Memorandum of Coordination (MOC)

i. For O&M activities within the District's Operations Division, project personnel will communicate their needs to a District biologist (or other appropriate personnel) who will compile relevant information into a *Memorandum of Coordination* (MOC) that includes a summary of the activity, location, date, time, analyses of potential impacts to ESA-listed species, and potential alternative actions (see MOC template at the end of the Overview). The District biologist will submit the MOC to WFPOM at the next monthly meeting and/or via email, and then if necessary, follow up with appropriate WFPOM members via phone or email.

ii. For planned O&M, the MOC should be provided to WFPOM for review at least two weeks in advance.

iii. For unplanned, non-emergency O&M (e.g., equipment failure), the MOC should be provided to WFPOM at least three workdays in advance.

iv. Emergency O&M may be performed immediately and an MOC submitted to WFPOM as soon as possible, either before or after the activity.

v. WFPOM members may submit responses to an MOC by the requested due date via email, phone or in person, and all responses will be documented in the final MOC for

[1] Change Form template is available on the WFOP website at: www.nwd-wc.usace.army.mil/tmt/documents/FPOM/2010/Willamette_Coordination/WFOP/

distribution to WFPOM and posting to the WFPOM website. The District biologist will forward the final coordinated operation to project personnel.

vi. For research and construction activities involving the Planning Division, the Planning Division biologists will coordinate the effort with Operations Division biologists to develop an MOC. Research development is largely carried out and documented through the Research, Monitoring, and Evaluation Work Group (RM&E). New construction or modification of fish facilities is typically carried out and documented through the Willamette Fish Facility Design Review Work Group (WFFDRWG).

vii. If implementation requires assistance from Project personnel, temporary equipment installation, temporary facility modification, and/or operational changes, then both Planning and Operations biologists will work closely together and with Project personnel and any others necessary to ensure all personnel are continually informed and updated throughout the process.

2.4.3. Memorandum for the Record (MFR)

2.4.3.1. Incidents that result in adverse or negative impacts to fish or fishways shall be documented by the Project biologists in a *Memorandum for the Record* (MFR; see template at the end of the Overview for items to include). The MFR will be sent to WFPOM by the next working day after the incident notification is received and will be added to the next WFPOM meeting agenda for review. WFPOM members may submit responses to an MFR by the requested due date via email, phone or in person, and all responses will be documented in the final MFR for posting to the WFPOM website.

2.4.3.2. Deviations, regardless of magnitude, will be identified in annual reporting. This information is useful for not only evaluating project performance in meeting target rates, but also to assess possible changes in operations or potential equipment upgrades to more consistently meet the requirements. This data will be included in the annual operations "after action review" produced by the USACE and provided to the WFPOM Team. This annual operations review of the prior water year is typically provided by the end of January following each operations year.

2.4.4. WFPOM Representatives & Participants *(**Co-chair*):

• Corps Portland District, Operations – Chris Walker**, Tammy Mackey**, Andy Traylor
• Corps Portland District, Planning, Programs & Project Mgmt – Brad Eppard, Fenton Khan
• Corps Portland District, Reservoir Regulation – Chief: Salina Hart, Mary Karen Scullion, Tina Teed
• Corps Portland District, Water Quality – Kathryn Tackley, Dan Turner
• Bonneville Power Administration (BPA) – Dan Spear, Jason Sweet
• National Marine Fisheries Service (NMFS) – Anne Mullan, Stephanie Burchfield, Lance Kruzic, Ed Meyer, Jeff Brown, and Melissa Jundt
• US Fish & Wildlife Service (USFWS) – Chris Allen, Michael Hudson
• Confederated Tribes of the Grand Ronde (CTGR) – Lawrence Schwabe
• Oregon Department of Fish & Wildlife (ODFW) – Jeff Ziller, Elise Kelley, Tom Friesen, Ryan Couture, Bernadette Graham-Hudson
• Oregon Water Resources Division (OWRD) – Mike McCord
• Oregon Department of Environmental Quality (ODEQ) – Nancy Gramlich

2016 Fish Passage Plan
Chapter 2 – North Santiam Subbasin

Table of Contents

1. NORTH SANTIAM SUB-BASIN OVERVIEW 1
2. FACILITIES 5
2.1. Detroit Dam 6
2.2. Big Cliff Dam 6
2.3. Minto Fish Facility 7
3. DAM OPERATIONS 7
3.1. Flow Management 7
3.2. Downstream Fish Passage 8
3.3. Water Quality Management 9
3.4. Spill Management 10
4. DAM MAINTENANCE 11
5. FISH FACILITY OPERATIONS 11
5.1. Juvenile Fish 12
5.2. Adult Fish 12
6. FISH FACILITY MAINTENANCE 15
7. INSPECTIONS, REPORTING, AND NOTIFICATIONS 15
8. DEWATERING PLAN 17
9. FOREBAY DEBRIS REMOVAL 19

1. NORTH SANTIAM SUB-BASIN OVERVIEW

1.1. The North Santiam subbasin drains about 760 square miles (Figure NS-1). Two U.S. Army Corps of Engineers (USACE) dams were constructed on the North Santiam River. Detroit and Big Cliff dams were both completed in 1953 and are a barrier to upstream fish passage. Multiple smaller diversions/canals are located on the North Santiam River downstream of Big Cliff Dam including:

- Lower Bennett Dam (5.3-feet high) at river mile (RM) 29 owned by the City of Salem.
- Upper Bennett Dam (5.7-feet high) at RM 31.5 owned by the City of Salem.
- Salem Ditch (diversion) just upstream of Lower Bennett Dam and owned by the City of Salem.
- Minto Dam (10-feet high) at RM 55 and owned by the USACE and operated by the Oregon Department of Fish and Wildlife (ODFW).

1.2. The North Santiam subbasin is inhabited by Upper Willamette River (UWR) winter steelhead, UWR spring Chinook salmon, and Oregon chub.

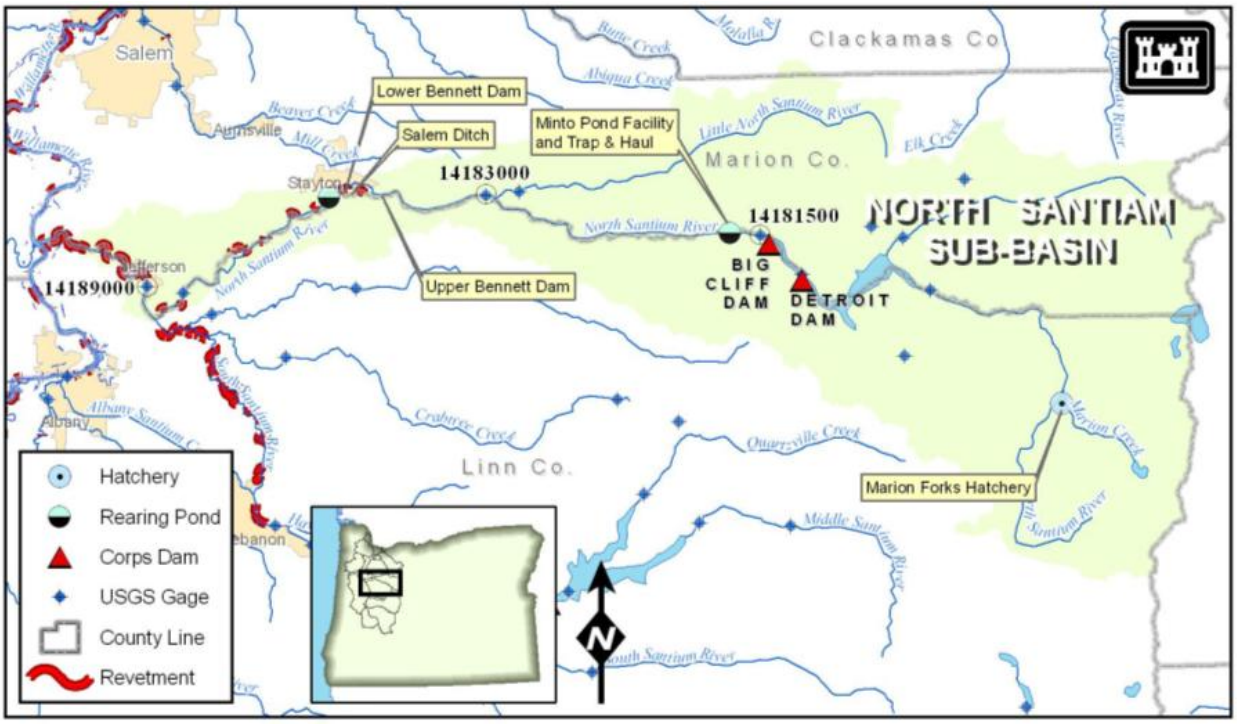


Figure NS-1. North Santiam Subbasin

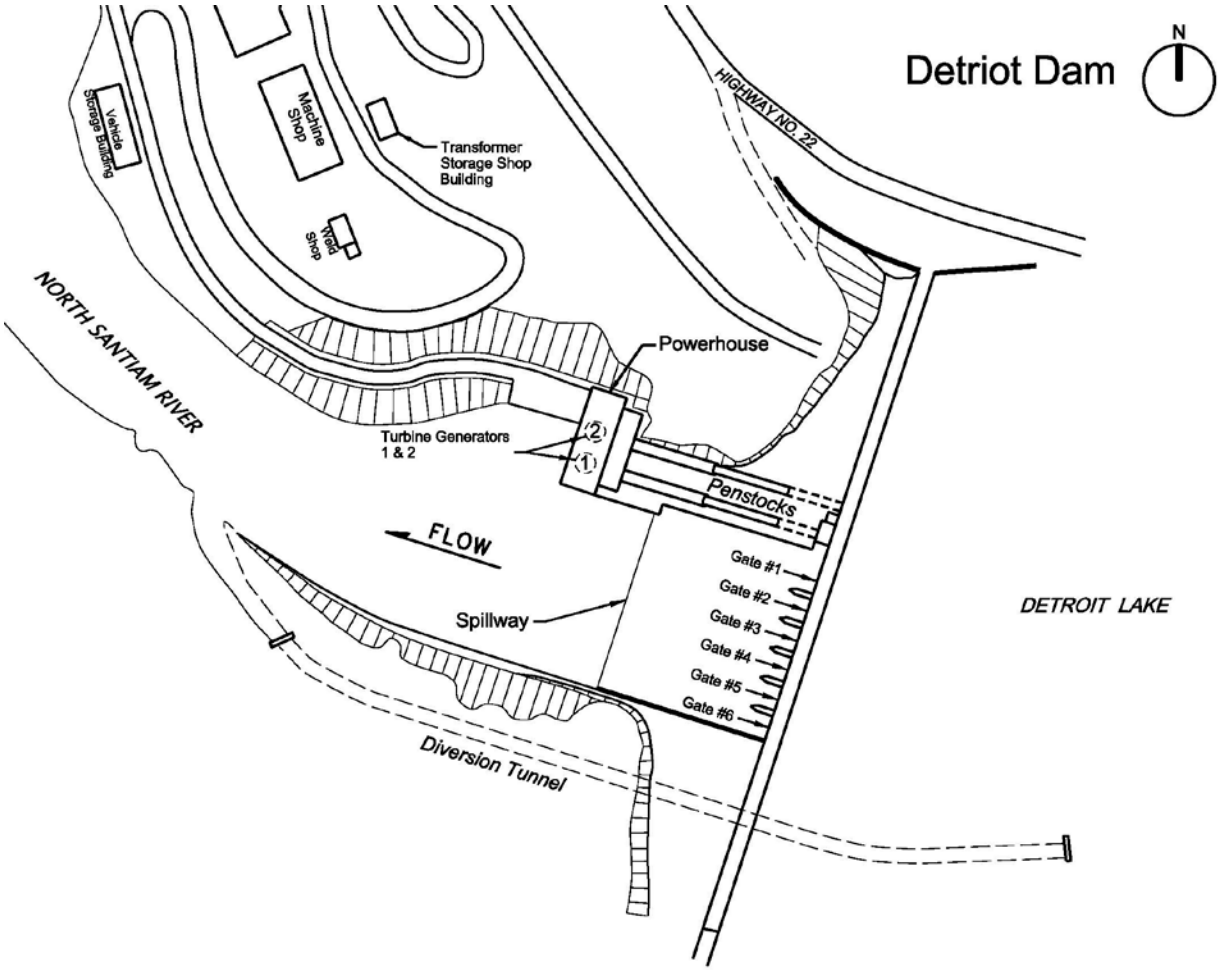


Figure NS-2. Detroit Dam

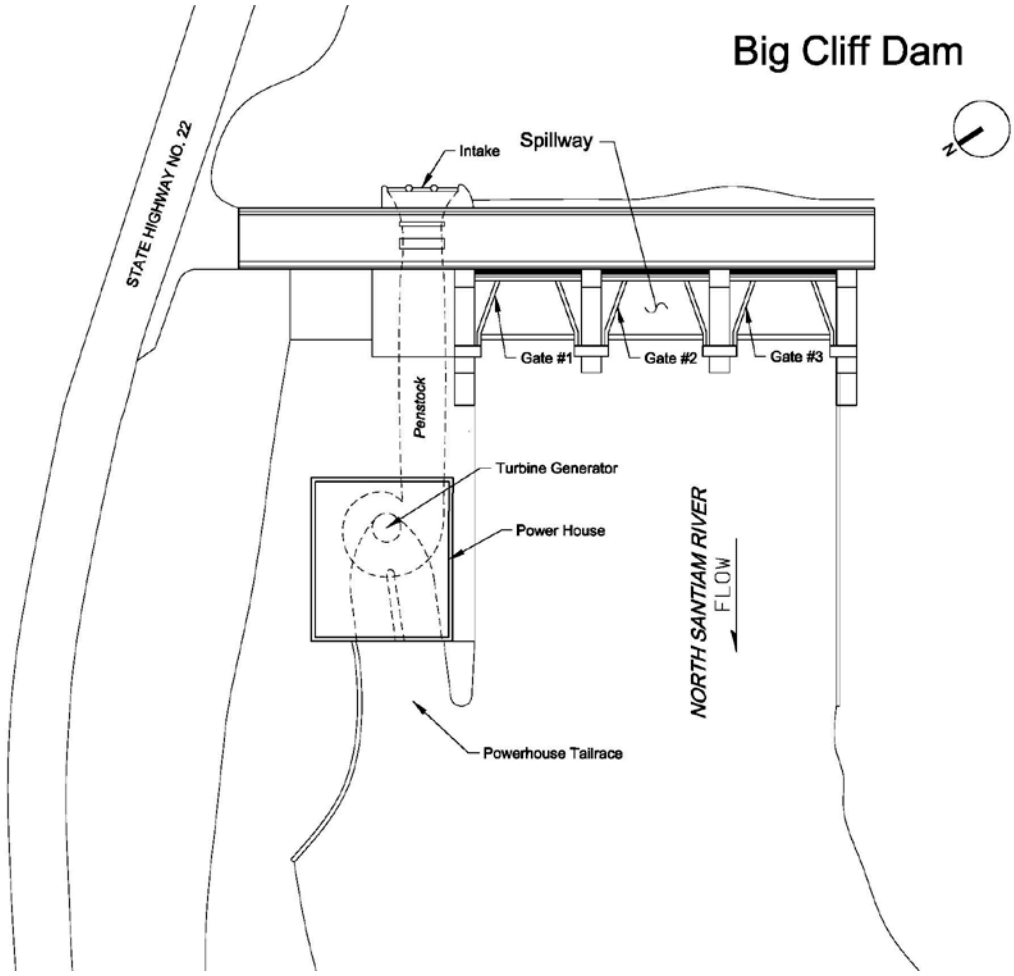


Figure NS-3. Big Cliff Dam

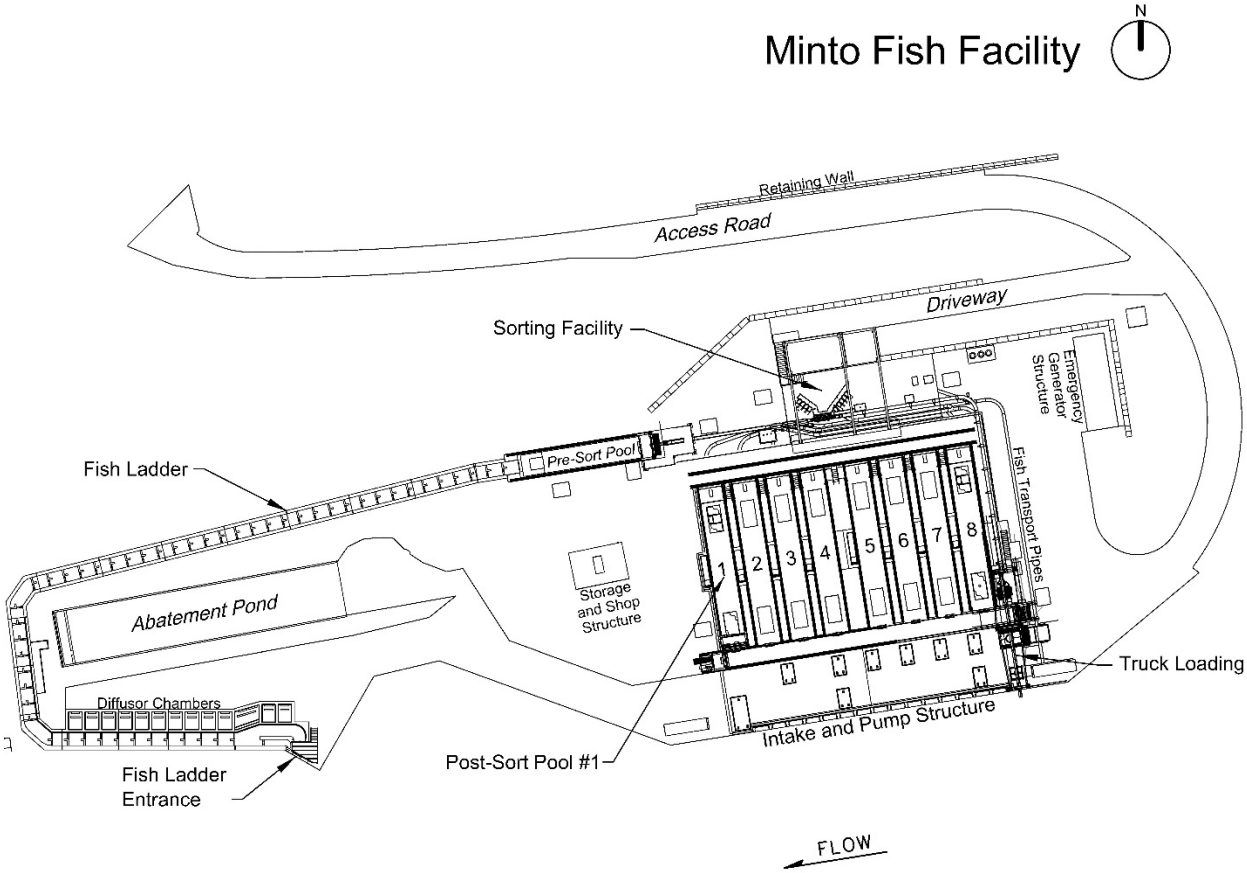
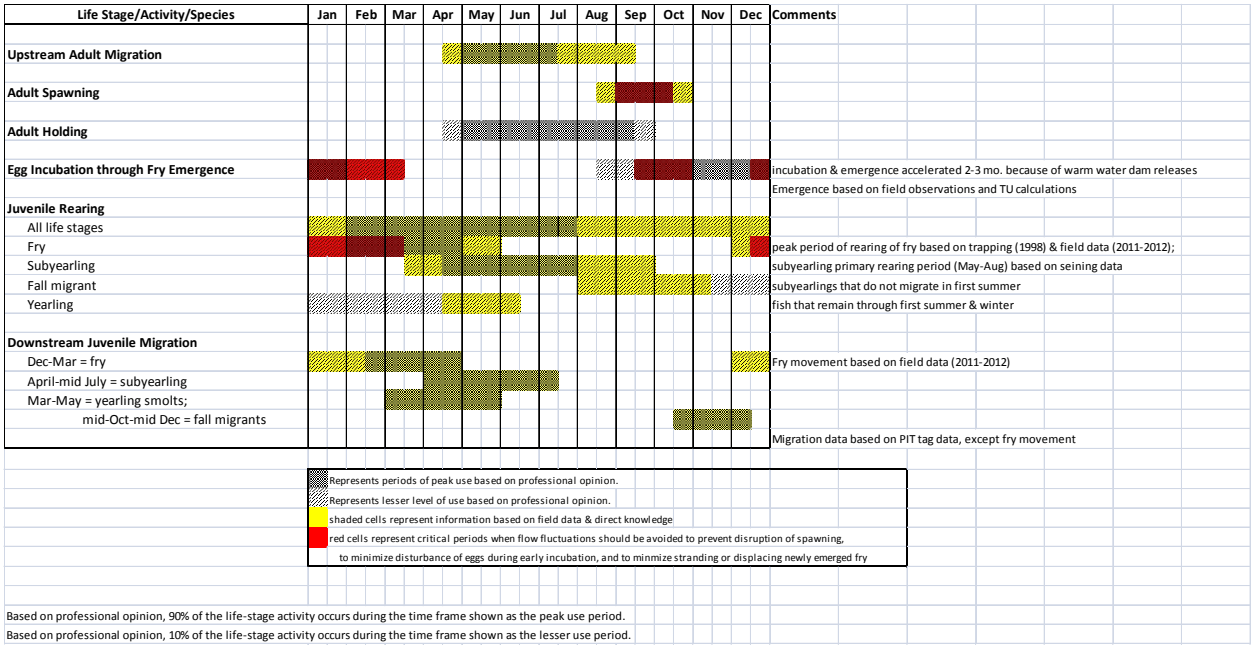


Figure NS-4. Minto Fish Facility

Table NS-1. Periodicity Table for Spring Chinook in the North Santiam River below Big Cliff Dam



2. FACILITIES

Detroit and Big Cliff are the two Willamette Valley Project (WVP) dams located on the North Santiam subbasin. There are no downstream fish passage facilities at either dam, with trapping of adults for upstream fish passage occurring at the Minto Fish Facility located downstream of Big Cliff Dam, and hatchery fish production occurring at the Marion Forks Hatchery located upstream of Detroit Dam in Idahna, OR. In 2013, the rebuild of the Minto Fish Facility was completed; however, existing modifications are still to the facility are ongoing. Spring Chinook salmon and winter steelhead trapped at this location are released above the Minto barrier, transported to designated release sites, used for hatchery brood stock collection, or other approved dispositions.

The operation and maintenance of the Detroit and Big Cliff projects can impact downstream habitat conditions. The operations may alter flow conditions, both total flow and rate of change, and water quality, primarily temperature and total dissolved gas (TDG). To mitigate for these impacts, the USACE operates the Detroit and Big Cliff projects to meet specific flow and ramp rate targets (NMFS 2008). In addition to these flow constraints, the USACE has been providing interim operational temperature control in the North Santiam subbasin.

Both dams are operated from the Detroit Dam control room, which relies on the Supervisory Control and Data Acquisition (SCADA) system. Although SCADA allows for remote operation of Big Cliff Dam, it does have limitations. The precision of SCADA controls are not tuned enough to adjust the amount of water through Big Cliff to meet small flow changes. Additionally, there can be a lag time (30-60 minutes) from when an operational change is made at Big Cliff and when the control room observes the change recorded at the nearest downstream U.S. Geological Survey (USGS) gage at Niagara for verification located three miles below Big Cliff Dam.

2.1. Detroit Dam

Detroit Dam is a multi-purpose storage project that operates to meet the authorized purposes of flood damage reduction, irrigation, power generation, recreation, navigation, municipal and industrial water supply, and downstream water quality improvement. The dam is 450-feet high and situated in the steep, rocky slopes of North Santiam Canyon. The dam is a concrete gravity structure with a gated spillway containing six spillbays and four regulating outlets (ROs).

2.1.1. Turbines

Detroit Dam has two Francis turbines rated at 50 megawatts (MW) each. For both turbines combined, the hydraulic capacity ranges from 4,300 to 5,300 cubic feet per second (cfs) depending on head (the difference between forebay and tailwater elevations).

2.1.2. Spillway Gates

Detroit Dam has six radial tainter spillway gates and a spillway crest at elevation 1,541 feet. The project cannot spill until water has risen above that elevation. The gates can only be controlled locally (not from control room) via a control panel with a mechanical dial detailing the spillway gate position.

2.1.3. Regulating Outlets

Detroit Dam has two sets of ROs (upper and lower) that are controlled with vertical sliding gates. The two upper RO gates at elevation 1,340 feet are controlled with hydraulic gates either locally or from the Detroit control room. A staff gage is used to measure the opening locally. Readings on the staff gage are spaced at 0.1 foot and the SCADA dial is set to 0.01-foot increments. The precision of the gate adjustments limit fine-tuning of RO flows. During emergency use, the RO outlet is controlled locally. There are two lower ROs (LRO) at elevation 1,265 feet. During the drought of 2015 the LRO was tested, passed inspection, and used for temperature management operations. The LRO was successfully operated for temperature management operations from October 08 through November 03.

2.2. Big Cliff Dam

Big Cliff is a re-regulating dam with a small reservoir, located nearly 3 miles downstream from Detroit Dam. Big Cliff is used to capture power generation water releases from Detroit Dam and to control downstream river level fluctuations. Big Cliff Dam is a 172-feet high concrete dam.

2.2.1. Turbines

Big Cliff Dam has one Kaplan turbine rated at 18 MW with a hydraulic capacity that ranges from 2,800 to 3,200 cfs. Turbines are adjusted by making changes to the wicket gate openings. Small flow changes can be difficult due to wicket gate limitations.

2.2.2. Spillway Gates

Big Cliff Dam has three radial tainter spillway gates. The spillway crest is at elevation 1,212 feet. The gates can be controlled locally via a control panel with a mechanical dial detailing the gate position or remotely through the SCADA system. One of the spillway gates automatically opens to a specified opening (1 foot) if the turbine wicket gate opening goes to zero, indicating the turbine has tripped off.

At both Big Cliff and Detroit dams, there is only one speed that the spillway gate can be opened or closed (there is no variable frequency drive). The mechanical dial measures the amount of gate opening locally at the project. The SCADA dial is in 0.01-foot increments and the local dial is set to 1-foot increments. These settings limit the precision that flow changes can be made. The SCADA

monitor provides the ability to set a specific gate opening at Big Cliff Dam. This is a unique feature for Big Cliff and is not used at other Willamette Projects.

2.2.3. Regulating Outlets

Big Cliff Dam does not have any ROs.

2.3. Minto Fish Facility

Adult spring Chinook salmon and steelhead needed for ongoing fish management activities in the North Santiam subbasin are collected at the Minto Fish Facility located on the North Santiam River (Figure NS-4). The facility is owned by the USACE and operated by ODFW. The Minto Fish Facility consists of a fish ladder, presort pool and crowder, sorting flume, eight post-sort holding ponds, fed by pumps, and many other features that accommodates both holding adult salmon and steelhead as well as acclimation of juveniles.

3. DAM OPERATIONS

3.1. Flow Management

3.1.1. Tributary Flow Targets

The 2008 BiOp requires specific flow regimes below Big Cliff Dam. These operations include minimum and maximum flow targets, increasing and decreasing flow rate targets (ramp rates) and recommendations for operations during high flow periods.

Required minimum and maximum flows for Big Cliff Dam vary by time of year and are shown in Table NS-2. Minimum outflow from Big Cliff Dam is 1,000 cfs from July 16 to August 31. Spring spawning flows for winter steelhead are 1,500 cfs from March 16 to May 15, followed by incubation flows of 1,200 cfs lasting until July 15. Spring Chinook salmon spawning requires flows of 1,500 cfs from September 1 to October 15, followed by incubation flows generally through January 31. Maximum flows during spawning are 3,000 cfs if possible.

Table NS-2. Flow Rates and Ramp Rate Requirements for Big Cliff Dam

Time Period or Criterion	Target
High Flow (> 2,000 cfs)	
Minimum Flow	1,000 cfs
Normal Maximum Flow* (for evacuation of stored flood water)	17,000 cfs
Normal Rate of Increase per hour	
100-1,000 cfs	500 cfs
1,000-3,000 cfs	1,000 cfs
3,000-17,000 cfs	1,500 cfs
Maximum Rate of Increase per hour	2,000 cfs
Maximum Rate of Decrease per hour	20% of flow
Low Flow (< 2,000 cfs)	
February 1 – March 15	1,000 cfs
March 16 – May 31 (winter steelhead spawning)	1,500 cfs
June 1 – July 15 (winter steelhead incubation)	1,200 cfs
July 16 – Sept 4 (rearing)	1,000 cfs

Time Period or Criterion	Target
Sep 5 – Oct 30 (Chinook spawning)	1,500 cfs
Nov 1 – Jan 31 (Chinook incubation)	1,200 cfs
Rate of Change (increase)	
Normal	based on a tailwater change of 0.3 feet/hour (ft/hr) and 0.5 ft/day
Special	use when there is an emergency – power requirements, boating accident; based on a tailwater change of 0.3 ft/hr and 0.5 ft/day
Rate of Change (decrease)	
Maximum Rate	- 0.1 ft/hr nighttime hrs, -0.2 ft/hr daytime hrs
Maximum Daily	-1.0 ft/day

*Project outflows during major flood events may exceed these levels. Source: USACE 2009.

These flows are not always achievable in the case of flood damage reduction operations during years with wet springs or large snowpack accumulations. During the high water season (generally November through February), the normal evacuation rate of stored flood waters is 10,000 cfs with a maximum rate of 17,000 cfs. The primary goal of high water outflow regulation is to avoid exceeding bank full at downstream control points when evacuating the reservoir for potential future storm events, while making best efforts to adhere to the general ramping rate guidelines (discussed in next subsection). Additionally, higher spawning flows may result in desiccation of redds if spawning occurs at higher streambed elevations than can be maintained under the specified incubation flows.

3.1.2.Rates of Flow Change (24 hour, day and night)

The North Santiam River downstream from Big Cliff Dam was historically operated with ramping rates that allowed relatively aggressive ramp ups and ramp downs. Since 2006, the USACE has limited the maximum down-ramping rates below Big Cliff Dam to follow general ramping rate guidelines of 0.1 foot/hour during nighttime and 0.2 foot/hour during daytime unless such restrictions have been infeasible with existing equipment at the dam (Table A-1; USACE et al. 2007). Maximum up-ramping rates vary from 500 cfs per hour at initial flows between 100 and 1,000 cfs to 2,000 cfs per hour at initial flows above 17,000 cfs; Table A-1). Historically, during high flows the project was allowed to reduce outflow at 30% per half hour. During real-time storm events where a storm has been under forecast, it may be necessary to ramp the project down at a faster rate than general guideline allowances. In this case, the guideline is 20% per hour at the operator's discretion for purposes of human health and safety.

3.2. Downstream Fish Passage

The USACE does not operate Detroit or Big Cliff dams specifically for juvenile fish passage nor do specific downstream passage facilities exist. However, downstream passage of juvenile outmigrating spring Chinook, progeny of upstream outplanting, can move through Detroit reservoir during water temperature control operations when the spillway is in use and at times of low reservoir elevations during late fall through early spring.

Special, interim, and other operations to provide fish passage are listed below (see Fish Operations Appendix for more detail):

3.2.1.**Big Cliff Dam:** None

3.2.2. **Detroit Dam:** Temperature management operation at Detroit Dam below may provide passage benefits and is being tested by RM&E activities.

3.3. Water Quality Management

3.3.1. Operations to Limit Total Dissolved Gas

Both Detroit and Big Cliff dams generate TDG supersaturation when spillways are operated. The extent of TDG saturation is dependent on the type and duration of operation and whether multiple spillways are operated simultaneously. While spill primarily occurs involuntarily due to high-flow events during winter months, spill also occurs infrequently in other months during powerhouse outages or late spring rainstorms when Detroit reservoir is near full or full.

Special, interim, and other operations to minimize negative impacts from total dissolved gas levels are listed below:

3.3.1.1. **Big Cliff Dam:** Spill may be spread through bays 1-3 to control TDG when not generating or when flows exceed turbine capacity between September 1st and July 31st for spring Chinook and winter steelhead incubation. Minimum gate openings may restrict this action depending on the desired outflow.

3.3.1.2. **Detroit Dam:** When units are off line or when capacity is exceeded spill will be spread through multiple spillway bays (1-6) or multiple ROs depending on elevation to reduce potentially high TDG levels (Figure NS-2). Minimum gate openings may restrict this action depending on the desired outflow.

3.3.1. Operational Water Temperature Management

Interim temperature control operations consist of using the existing outlet configuration at the dam; spillway, powerhouse, and upper ROs. When inflow exceeds the projects ability to regulate temperatures and/or flood damage reduction operations are required, the projects evacuate water as required to meet reservoir operations rule curve requirements.

Detroit Dam interim temperature control operations varies from a pulsing-type operation with release through a single spill bay, cycling open and closed on a daily basis, to a continuous-type operation with release through a single bay at a set gate opening for multiple days. Mixing occurs in Big Cliff pool and outflow is released below Big Cliff Dam to attain temperature targets.

Water temperature management operations will commence approximately June 1st. A blend of spillway and turbine releases (a 60%/40% split, respectively) from Detroit Dam should be implemented in order to manage for downstream water temperatures and meet temperature targets (Table NS-3) throughout the summer. This operation will be carried out until Detroit Reservoir is drawn down below spillway crest. Once below spillway crest, water temperature management operations will shift to powerhouse-only discharges until mid-October or when outflow water temperatures reach 50°F. From around mid-October through mid-November, a blend of powerhouse and regulating outlet flow will be discharged to meet downstream water temperature goals (Table A-2). It is estimated that a 30%/70% split in RO to powerhouse discharge will be needed during this time; however, adaptive management should be used to ensure water temperatures stay below 50°F. The RO/powerhouse operation for fall water temperature

management is based on water quality modeling results and operations conducted in previous years. Big Cliff will be used to moderate downstream flows so that they are consistent and meet instream tributary flow requirements. At no time will water temperature management operations be allowed to violate the current engineering and operational restrictions in place for Detroit/Big Cliff Dams and Reservoirs. Continuity of the operation is contingent upon meeting other critical operating purposes, specifically, but not necessarily limited to flood damage reduction. Flood reduction operations would result in temporary termination of the operation. Should any flow management or dam safety concerns arise, these operations will be modified or suspended.

Table NS-3. Monthly Temperature Targets for North Santiam River below Big Cliff Dam

Month	**Temperature Maximum/Minimum**	
	°F	**°F**
January	40.1	40.1
February	42.1	41.0
March	42.1	41.0
April	45.1	43.2
May	49.1	46.0
June	56.1	51.1
July	61.2	54.1
August	60.3	54.1
September	56.1	52.3
October	<50.0	<50.0
November	<50.0	<50.0
December	41.0	41.0

Interim temperature control operations may be modified annually based on water availability, meteorological conditions, project constraints/limitations, and from information gathered from prior operating years.

Annual results for operational temperature control are provided in the Willamette Basin Annual Water Quality Report. These annual reports detail periods of non-conformance from the temperature targets, providing the duration and cause of the deviation.

3.4. Spill Management

3.4.1. **Big Cliff Dam**. The configuration and numbering of the spillway bays at Big Cliff Dam are shown in Figure NS-3. Spill is spread through bays 1-3 to control TDG when not generating or when flows exceed turbine capacity between September 1st and July 31st for spring Chinook and winter steelhead incubation. Minimum gate openings may restrict this action depending on the desired outflow.

3.4.2. **Detroit Dam**. Operational flexibility at Detroit Dam allows us to conduct interim temperature control operations, minimize TDG, and has potential to aid downstream passage of juvenile salmonids. When turbine units are off line or when capacity is exceeded spill is spread through multiple spillway bays (1-6) or multiple ROs depending on elevation to reduce potentially high TDG levels (Figure NS-2). However, minimum gate openings may restrict this action depending on the desired outflow. Existing outlet use for interim temperature control June through November 15th is a biological priority.

The focus should be on spreading spill or prioritizing use of the ROs all other times to limit TDG. Recent information suggests that ROs produce less TDG than the spillways. Furthermore, to prevent elevated TDG from being transported downstream, the Big Cliff turbines should be used when the Detroit spillways or ROs are in operation. Consideration should also be given to providing larger gate openings to benefit downstream juvenile passage survival.

4. DAM MAINTENANCE

The annual maintenance periods discussed below for Detroit and Big Cliff dams are provided as applicable for the projects and will be adhered to during annual maintenance planning. Potential effects on ESA-listed fish include temperature, TDG, and flow-related impacts downstream of Big Cliff Dam. Detroit contains two turbine units allowing for maintenance to be completed on individual units without impacting flow. Maintenance that requires both turbine units to be offline should be completed during the period identified to avoid impacts to interim operational water temperature control.

4.1. Big Cliff

Target outage periods:
Mar 1-Jun 30: Primary target period.
Jul 1-Aug 31: Limited outage scheduling due to power valuation considerations.
Sep 1-Oct 31: Secondary target period.
Nov 1-Feb 28: Restricted from outage scheduling.

4.2.1. Considerations/Rationale for unit outage scheduling:
Sep 1-Oct 31: The secondary outage period is not preferred but outages are allowed. If a unit is taken out of service, fluctuations in flow should be limited due to spawning spring Chinook salmon. Spring Chinook eggs will be present but are fairly hardy to impacts from excessive TDG.
Nov 1-Mar 31: Minimize generation outages in order to maintain TDG below limit due to impacts on sac fry.

4.3. Detroit

Target outage periods:
Mar 1-May 31: Primary target period.
Jun 1-Nov 15: Restricted to one unit at a time in outage status.
Nov 16-Feb 28: Limited outage scheduling due to power valuation considerations.

4.3.1. Considerations/Rationale for unit outage scheduling:
Jun 1-Nov 15: At least one unit is required for temperature control.
Nov 16-Feb 28: Minimize generation outages in order to maintain TDG below limit due to impacts on sac fry. TDG is not a large concern if Big Cliff is generating. When Big Cliff is not generating and spill is required at Detroit, spill should be spread across as many spill gates as possible.

5. FISH FACILITY OPERATIONS

The Minto Fish Facility is a complex system that must be operated carefully to maintain hydraulics for efficient fish passage and holding. Many features of the facility are automated but can also be operated manually. The facility O&M manual (see Appendix) contains specific information regarding startup, normal and manual operations, as facility shutdown as well as how to maintain hydraulic criteria.

The Minto Fish Facility will operate most of the year except during shutdown if necessary for maintenance or other activities.

5.1. Juvenile Fish

Juvenile hatchery fish will be acclimated at the Minto Fish Facility for a minimum of 30 days prior to release.

5.2. Adult Fish

Disposition of adult fish will be determined annually at the WATER Hatchery Management Team, vetted through WFPOM, and published or attached in the WFOP upon finalization.

5.2.1. Fish Collection and Handling

5.2.1.1. All adult trapping facilities shall be operated for adult spring Chinook salmon and winter steelhead in a manner that minimizes the duration of holding and delay.

5.2.1.2. All trapping, hatchery, and transport personnel must avoid excessive handling of adult fish to minimize stress and reduce the chance of injury.

5.2.1.3. All transfer of fish shall be completed through water to water transfers, unless logistically infeasible.

5.2.1.4. Sorting of adult spring Chinook salmon and winter steelhead for outplanting shall be completed in manner that minimizes stress and injury.

5.2.1.5. All efforts should be made to sort adult fish a single time and not multiple times as was done in the past.

5.2.1.6. Healthy fish should be used for both broodstock collection and outplanting efforts (to support reintroduction) to increase the probability of survival and should be representative of the run.

5.2.1.7. Sorting shall be completed to separate by species or origin (hatchery or natural origin) to ensure an adequate sex ratio for outplanting and brood production. To the extent possible, adjust the sex ratio of releases based on known differences in pre-spawning mortality between males and females to maximize reproductive success. Ensure an adequate number of females are outplanted to seed available habitat.

5.2.1.8. The Hatchery Management Team will develop the annual guidelines regarding when to outplant fish from each location and will be vetted through the WFPOM team. Collect fish on a regular basis throughout the run and outplant when collected, ensuring temporal outplants are representative of the run. However, pre-spawning mortality of early-released fish may be high and thus should be monitored to ensure effectiveness of this strategy. Fish could be held at the Minto Fish Facility if found beneficial to reduce pre-spawning mortality. Fish will not be held longer than the agreed upon time to be developed through the WATER process.

5.2.1.9. During processing/sorting, the anesthetic used will be dependent upon whether a fish will be: for brood, returned to the fishery, outplanted, sampled for RM&E, or surplused (e.g. sold, food bank). Fish will be moved out of the trap quickly and frequently. Fish will be handled as gently as possible during processing and loading onto the truck, attempting to minimize stress and skin abrasions associated with handling.

5.2.1.10. Once fish are sorted, they will spend no longer than the allotted time that will be agreed to through the WATER process within holding tanks prior to being transported to their destination, which is determined by the fish disposition table. Environmental factors such as flow, fish health, and temperature will be considered.

5.2.1.11. The fish trap will be checked at least twice a day, first in the morning, and then in the late afternoon to avoid having fish spend too much time in the trap and to assess the overall density of fish within the trap.

5.2.1.12. Fish will be removed and placed in holding tanks with a density approximately 25 gallons of water per fish. Adult holding will reflect IHOT and NMFS recommendations.

5.2.1.13. Oxygen levels in the holding tank water should not exceed saturation (100%) or drop below 7 parts per million (7 mg/L), however, spill during the wet and flood risk reduction season may preclude meeting this guideline.

5.2.1.14. Experiment with reduced dependence on, or eliminating prophylactic antibiotic treatments.

5.2.1.15. The fish disposition table, developed collaboratively by HMT and approved by NMFS, will be used to guide the management of anadromous and resident fish as they are encountered in adult fish traps.

5.2.1.16. MS-222/CO_2/AQUI-S 20E. At fish handling facilities in the Willamette Basin operated by ODFW, the ODFW and ODEQ have agreed upon a process of dispersal and evaporation (or volatilization) for the disposal of water treated with anesthetics, which are highly volatile substances. The USACE will continue to use eugenol (clove oil) at USACE-operated adult fish trapping facilities (Cougar and Fall Creek).

5.2.1.17. Avoid multiple handling/anesthesia of fish during sorting for outplanting or brood production.

5.2.2. Transport and Outplanting

5.2.2.1. All transport tanks will be treated with NovAqua® or equivalent per manufacturer's instructions to reduce stress during transport.

5.2.2.2. Transport adult spring Chinook at a density of ≥ 25 gallons of water per fish (60 fish/1,500 gallon tank).

5.2.2.3. Oxygen levels above 100% should be minimized in the transport truck or should not drop below 7 parts per million [7 milligrams per liter (mg/L)].

5.2.2.4. All trapping, hatchery, and transport personnel must adhere at all times to existing ODFW policies and procedures to reduce the transfer of pathogens.

5.2.2.5. *No handling* will occur at adult trapping facilities when water temperatures exceed 70°F in the pre-sort pool.

5.2.2.6. In certain situations, the transfer of fish for outplanting or to cooler hatchery waters may occur if fish are being held, or may be held, in waters exceeding 70°F for an extended period of time. Coordination with NMFS prior to transfer and notification to the WFPOM Team is required under these circumstances.

5.2.2.7. When outplanting adult spring Chinook salmon, receiving water temperature shall be less than 68°F *as measured prior to release*.

5.2.2.8. Monitoring of water temperature can be completed using USGS gages or temperature meters, where available.

5.2.2.9. Drivers will measure the temperature of the water in the transport tank and the receiving water prior to releasing the fish.

5.2.2.10. If the temperature difference between the receiving water and tank water is > 7°F, the water will be tempered to a difference of < 5°F at a rate of 1°F/6 minutes.

5.2.2.11. Fish facility personnel are responsible for recording the holding pool water temperature prior to transport, liberation truck water temperatures, and receiving water temperature upon release.

5.2.2.12. If liberation truck waters require tempering, beginning and end temperature as well as time required for acclimation will also be recorded.

5.2.2.13. All outplanting shall be completed at designated outplanting sites consistent with the appropriate disposition table for each subbasin. Releases shall be made in a manner to minimize stress and chance of physical injury. In-season variances to either outplant site use, fish disposition, or other outplanting protocols can be completed with agreement from the WFPOM Team with notification provided to the WATER Steering Team. NMFS must agree to any in-season variances proposed by the WFPOM Team before the action is taken.

5.2.2.14. Release trucks shall have a minimum of a 12-inch opening on all. Discontinue use of collapsible tubes and use 16- to 20-inch smooth walled PVC pipe to convey fish from the truck to the stream. Set pipes at proper discharge angle and use discharge chutes. Use a water spout to flush fish from the truck. Avoid abrupt changes in temperature. Release fish early in the day whenever possible. If receiving waters are known to be too warm at certain times of year, release fish when or where waters are cooler. Investigate the options to improve survival such as holding fish in a hatchery pond and treating with antibiotics until they are ready to spawn, at which time they would be released. Releasing ripe fish may limit numbers outplanted and potentially reduce pre-spawning mortality.

5.2.2.15. Fish liberation truck driver and/or trained volunteer will observe released fish and document any mortality and unusual behavior after release.

5.2.2.16. All truck drivers will complete an adult salmonid outplant form to document oxygen levels, temperatures in the tank and release stream, immediate mortalities, loading densities, and release method. These data will be used to enable better monitoring of outplanted fish.

5.2.2.17. Hauling frequency will depend on factors that include run size, stream temperatures, and transport/ holding constraints. Some fish will likely be held prior to outplanting to some extent depending on these constraints. Unless environmental conditions in areas where fish are to be transported are poor, hauling frequency should be such that it minimizes holding times to no more than 24 hours.

5.2.2.18. It is the intent to reduce holding times and complete outplanting as soon as possible upon a fish's return to the adult trapping facility. Given the typical adult monthly return timing and abundance observed, expected hauling frequencies are:

Transport Period	**Hauling Frequency**
April 1 – May 15	2 times per week
May 16 – June 30	3 times per week
July 1 – October 15	2 times per week

5.2.2.19. The current program involves releasing fish according to the targets identified in Table NS-4. Detailed protocols for the disposition of excess hatchery fish will be contained in the WFOP. These goals will be updated annually by the WATER Hatchery Management Team and vetted through WFPOM team. When numerical adult abundance recovery goals are established for the North Santiam spring Chinook salmon population through the recovery planning process, these targets will be adjusted accordingly.

Table NS-4. Number of Adult Spring Chinook to be Outplanted

Location	Target Number of Fish (number of pairs in parentheses)	Origin	
		Hatchery	Natural
North Santiam River upstream of DET	900 (450)	X	
Breitenbush River upstream of DET	600 (300)	X	
North Santiam River upstream of Minto[a]	All		X

Table NS-5. Outplanting release sites

Release Site
Dry Creek (head of reservoir)
Parish Lake Road (15 river miles above head of reservoir)
Hot Springs (Breitenbush River)

6. FISH FACILITY MAINTENANCE

6.1. The proposed maintenance period where a shutdown is required for the ladder will be from **December 1 to February 15**. The following will be performed during the maintenance period:

6.1.1. All staff gages and water level indicators will be inspected, cleaned, and repaired as necessary.

6.1.2. The fish ladder will be dewatered and inspected for debris, projections, or clogged orifices that could injure or impede fish. Necessary repairs will be completed at this time.

6.2. The proposed maintenance period where a shutdown is required for the post sort pools will be from **April 15 to May 31**. The following will be performed during the maintenance period:

6.2.1. All staff gages and water level indicators will be inspected, cleaned, and repaired as necessary.

6.2.2. The pools will be dewatered and inspected for damage, cracks, debris, or projections that could injure fish. Necessary repairs will be completed at this time.

6.2.3. Specific maintenance activities listed for monthly, quarterly, and annual actions will be appended to the WFOP.

7. INSPECTIONS, REPORTING, AND NOTIFICATIONS

7.1. The following will be checked on a daily basis:

7.1.1. Intake structure sump pumps

7.1.2. PLC s, both on the spawning deck and in the IPS, for any alarms, make sure all systems are in AUTO

7.1.3. FWS pumps oil level

7.1.4. FWS pumps packing box for adequate water

7.1.5. FWS pump VFD panels for any fault codes and proper lighting on panel

7.1.6. Deck wash pump panel for light indication and check tank for pressure between 35 - 65 psi
7.1.7. Intake pressure gages and flow meter working
7.1.8. Intake air compressor oil level
7.1.9. Air compressor condensate traps and drain if needed
7.1.10. Intake air compressor for abnormal vibration or noise
7.1.11. Intake header for any leaks
7.1.12. Intake structure for any leaks
7.1.13. Intake structure power panels
7.1.14. Domestic water controller in Mechanical/Electrical room
7.1.15. Presort pool for correct water level
7.1.16. Post Sort pools for correct water level
7.1.17. Diesel Generator block heater on
7.1.18. Diesel Generator in AUTO
7.1.19. Battery charger on generator working
7.1.20. Any fuel leaks around generator and tank
7.1.21. Lighting around facility working correctly

7.2. Fish facility inspections will be performed in accordance with guidelines in the operations and maintenance (O&M) manual.

7.3. The results of all inspections and the readiness of the facilities for operation will be reported to the Willamette Fish Passage Operations and Maintenance Team (WFPOM) by March 1.

7.4. More frequent inspections will occur as requested by the WFPOM Team or at any time by facility personnel. During the field season, WFPOM members will visit fish facilities to evaluate adherence to protocols and SOPs. The site visit assessment activities include observing fish sorting and handling procedures. A check sheet will be filled out and initialed indicating whether procedures are or are not being performed according to protocol. Protocol drift for any activity must be reported to the immediate supervisor and corrective actions must be implemented immediately.

7.5. Fish trapping facilities will be initially inspected prior to being removed from service for the year to assess facility condition and maintenance needs.

7.6. Staff gages and other water-level sensors will be installed, cleaned, and/or repaired as required to allow for monitoring facility performance.

7.7. Fish facility personnel shall prepare monthly reports throughout the year summarizing project operations. These monthly reports will provide an overview of how the project operated during the prior month.

7.8. The reports shall cover a monthly period and they shall be provided to WATER stakeholders at monthly WFPOM Team meetings and recorded in a record of the meeting minutes.

7.9. The reports shall include:
7.9.1. Any out-of-criteria situations, observed deviations from the WFOP, and subsequent corrective actions taken.
7.9.2. Any equipment malfunctions, breakdowns, or damage along with a summary of resulting repair activities.
7.9.3. Progress in reaching outplant numbers targeted in the fish disposition table.
7.9.4. Mechanical and/or structural issues preventing optimum facility operation.

7.9.5. General hatchery operations including trap counts, transfer information, juvenile releases, and updates on hatchery research.

7.9.6. Adult outplanting data documenting release locations, numbers released, any observed transport or liberation mortalities, holding, transport and receiving water temperatures, and poaching/harassment issues.

7.9.7. Any adult mortality that occurs within the trapping facility during holding or handling prior to transport and must documents species, origin, size, marks/injuries, cause and time of death, and future preventative measures. When mortality occurs, this should also be reported immediately to USACE that will be included in a memorandum to the Services.

7.9.8. Adult mortalities should be reported as soon as possible to the Services.

7.10. The facility operator will produce an annual report summarizing the species, number, origin, and destination of all fish collected at USACE fish facilities in the Willamette Basin, as well as all BiOp deviatons. This annual report will be a summary of the monthly or quarterly progress reports. The report shall assist in identifying potential operational changes. Reporting may be included in baseline hatchery monitoring or the annual hatchery operations reports and provided at specified dates (WFOP, contract, cooperative agreement).

7.11. Hazardous Spills. Hazardous spill notification will continue to be completed through the Oregon Emergency Response System (OERS). This system provides 24-hour service through Oregon Emergency Management of the Department of State Police. Local public safety agencies such as law enforcement, fire and emergency medical services normally provide the first response to an incident. Access to this local assistance is through 9-1-1. Once notified, local public safety agencies would call OERS at 800-452-0311 or in the Salem area at 503-378-6377. If necessary, responsible parties would then call the National Response Center at 800-424-8802. The USACE operations fisheries biologist will be included as an initial contact to address any immediate fisheries response needs, as well as to provide additional notification directly to the Services. Although the OERS serves to disseminate spill response notification to both the state and federal fisheries agencies, the USACE operations fisheries biologist will notify the Services directly of the incident.

7.12. Any poaching, suspicion of poaching activities or observed harassment of outplanted fish shall be reported immediately to the Oregon State Police at 1-800-452-7888.

7.13. The annual report will be distributed to the members of the WFPOM Team.

8. DEWATERING PLAN

Fish facilities and turbines are drained for regularly scheduled maintenance and sometimes for emergency maintenance. These activities may involve handling fish and could cause other adverse effects on juvenile and adult fish in the watershed (e.g. stranding of fish in the reservoir). This plan is subject to change as improvements are developed and will be revised on an annual basis as part of the WFOP. Not all dewatering efforts will require fish salvage; as such, the need will be determined by USACE and ODFW fish biologists.

8.1. Coordination

8.1.1. Facility outages will be scheduled to minimize impact on fish while accomplishing necessary repairs and maintenance on facilities. Specific outages will be scheduled according to maintenance periods detailed in appendices. Fish facility personnel (either ODFW or

USACE) will coordinate these activities with Portland District Operations Division fishery biologists and will ensure that the fisheries agencies, particularly those whose activities may be impacted, are kept informed. Primary points of contact include ODFW, NMFS, and USFWS.

8.1.2. The Willamette Project Supervisory Fisheries biologist coordinates fishway dewatering and salvage activities with the project operations and maintenance supervisor. This includes having the appropriate personnel and equipment on site. The designated fish facility lead, likely the Operations Division project biologist for USACE operated facilities, or an ODFW hatchery manager for ODFW operated facilities, directs execution of the drainage plan at least until fish removal is complete. Before or at the beginning of each draining operation, a pre-work briefing will be held to explain procedures, responsibilities and safety considerations for all participants. After the salvage activity, lead personnel are responsible for reporting species, number, and condition of fish. The reporting template is attached at the end of the document and will be provided to the WFPOM Team.

8.2. Fish Handling

8.2.1. When facilities are drained, a primary objective is to minimize stress and injury to all fish. Generally, the best way to protect fish during facility draining is to avoid having to handle them. Instructions for draining most facilities involve steps, such as operating with low ladder flow just prior to draining, intended to minimize handling fish by encouraging the fish to exit the ladder. When it is necessary to handle fish, they are handled in plenty of fresh water, if possible. Holding fish in nets unnecessarily is avoided (e.g., tank or fish bag not ready). When it is necessary to transport fish in bags, ensure that the salvage bags contain a sufficient amount of water and that fish return to fresh water as soon as possible.

8.2.2. Tanks should be large enough to carry plenty of water with the fish. Tanks should be covered to keep fish from leaping out. When large numbers of fish are placed in a tank, supplemental oxygen will be used to increase the level of dissolved oxygen. Reduce fish concentration when river temperature is greater than 65°F. During warm weather, the temperature in tanks will be monitored and kept within 2°F of the river release point temperature. Further, the time fish are kept in tanks will be minimized and not exceed 2 hours.

8.2.3. Fish will be released at a predetermined site. However, when the tank contains a mixed load, it can be released into the forebay or tailrace depending upon the recommendation of lead personnel.

8.2.4. When it is necessary to prioritize attention to different species, generally ESA-listed species and adult salmonids should be helped first. Lamprey are relatively stress resistant and can be collected as a lower priority. However, their numbers are declining and care should be given to salvage them, as well as the more sensitive fish. All fish are to be salvaged.

8.3. Adult Fish Trap/Ladder

The general procedures for draining the adult fish trapping facilities are described below.

8.3.1. **Prior to Dewatering**

8.3.1.1. 24 to 48 hours before draining, stop attraction flow by minimizing auxiliary water flow.

8.3.1.2. For at least 24 hours before dewatering, but not longer than 96 hours, operate the ladder at orifice flow.

8.3.2. **On Dewatering Day**

8.3.2.1. Convene safety meeting before starting activity. Describe the procedure for all participants and assign responsibilities (ensure clearances are in place)
8.3.2.2. Stage fish bags or transport tank.
8.3.2.3. Place ladder near the pre-sort holding pool
8.3.2.4. The water supply level to the ladder should be reduced to approximately 1" to 2".
8.3.2.5. Begin visual inspection of ladder for stranded fish. Salvage personnel will need to access any pools where fish are stranded and either remove the stranded fish and put into a fish bag or tank or, if the fish is close to the entrance pool, gently guide fish down the ladder to the entrance pool.
8.3.2.6. Drain pre-sort holding pool.
8.3.2.7. Salvage fish with a net and put them into a fish bag
8.3.2.8. Place fish from fish bag into post sort holding raceway for transport or into recovery tank for direct release to the river.
8.3.2.9. Shut down facility water supply when fish salvage is complete.

8.3.3. Fish Salvage Equipment

The following fish salvage equipment is required.

8.3.3.1. Dip nets/buckets
8.3.3.2. Fish salvage bags
8.3.3.3. Seine
8.3.3.4. Extension ladder for access into the fish ladder
8.3.3.5. Fish truck with oxygen bottle
8.3.3.6. Personal protection equipment such as life vests/float coats, fall protection (harness/lanyard), waders w/felt soles, gloves (sealskins), hearing protection, and hardhats
8.3.3.7. Communication devices
8.3.3.8. Submersible pumps

9. FOREBAY DEBRIS REMOVAL

9.1. Debris at projects can adversely impact fish passage conditions. Debris can plug or block trashracks, VBSs, gatewell orifices, dewatering screens, separators, and facility piping resulting in impingement, injuries, and descaling of fish. Removing debris at its source in the forebay is sometimes necessary to maintain safe and efficient fish passage conditions, navigation, and other project activities. Debris can be removed from the forebay by:

9.2. 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;
9.3. Removing the debris from the top of the dam using a crane and scoop;
9.4. Passing debris through the spillway with special powerhouse and/or spill operations; or
9.5. 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).

2016 Fish Passage Plan
Chapter 3 – South Santiam Subbasin

Table of Contents

1. SOUTH SANTIAM SUB-BASIN OVERVIEW 1
2. FACILITIES 5
2.1. Foster Dam 5
2.2. Green Peter Dam 6
2.3. Foster Fish Facility 6
3. DAM OPERATIONS 7
3.1. Flow Management 7
3.2. Downstream Fish Passage 8
3.3. Water Quality Management 8
3.4. Spill Management 9
4. DAM MAINTENANCE 9
5. FISH FACILITY OPERATIONS 10
5.1. Juvenile Fish 10
5.2. Adult Fish 10
6. FISH FACILITY MAINTENANCE 13
7. INSPECTIONS, REPORTING, AND NOTIFICATIONS 14
8. DEWATERING PLAN 15
9. FOREBAY DEBRIS REMOVAL 17

1. SOUTH SANTIAM SUB-BASIN OVERVIEW

1.1. The South Santiam River is about 63 miles long and drains an area of about 1,000 square miles (Figure SS-1). The construction of the two U.S. Army Corps of Engineers (USACE) dams in the subbasin, Green Peter and Foster, began in 1961 and was completed in 1967. A third dam was planned but never constructed. Most inflow to Foster Dam comes from a combination of outflows from Green Peter and the unregulated South Santiam River above Foster Lake. The Lebanon Diversion Dam, owned by the city of Albany, is 8 feet high and located at river mile (RM) 21 downstream from Foster Dam. In 2005-2006, this dam was outfitted with new fish ladders and a screened diversion intake.

1.2. The South Santiam subbasin is inhabited by Upper Willamette River (UWR) winter steelhead, UWR spring Chinook salmon, and Oregon chub.

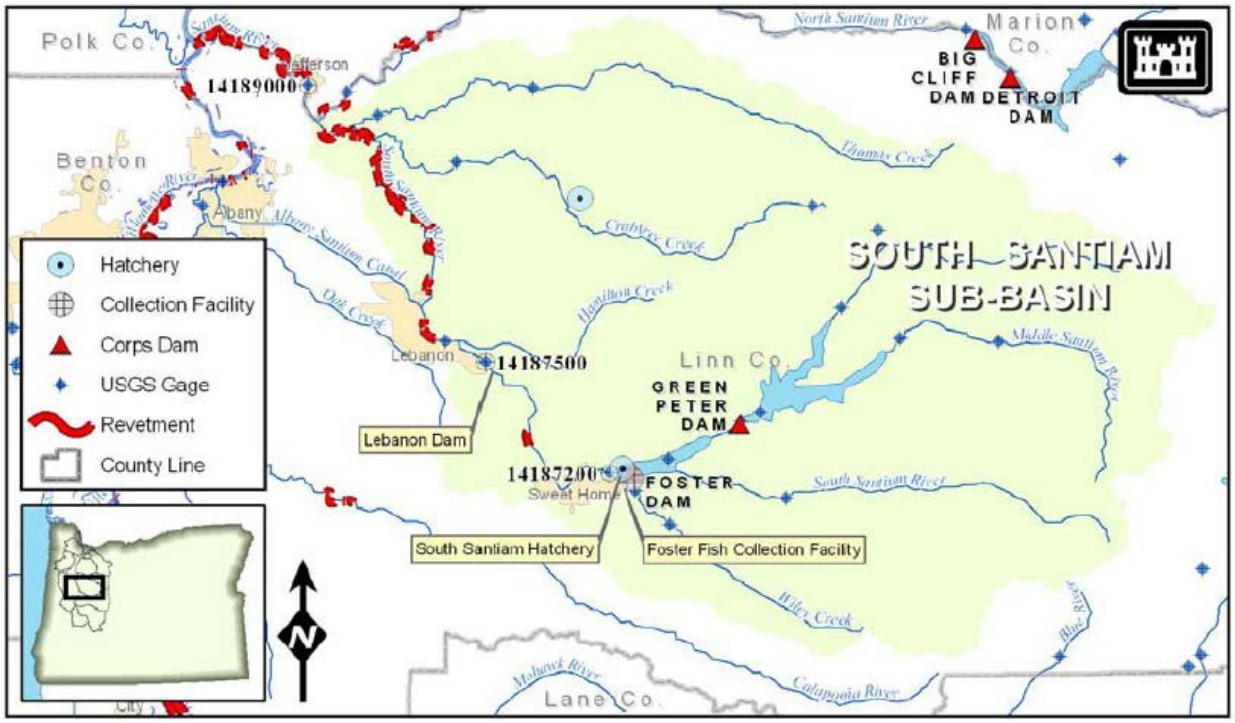


Figure SS-1. South Santiam Subbasin

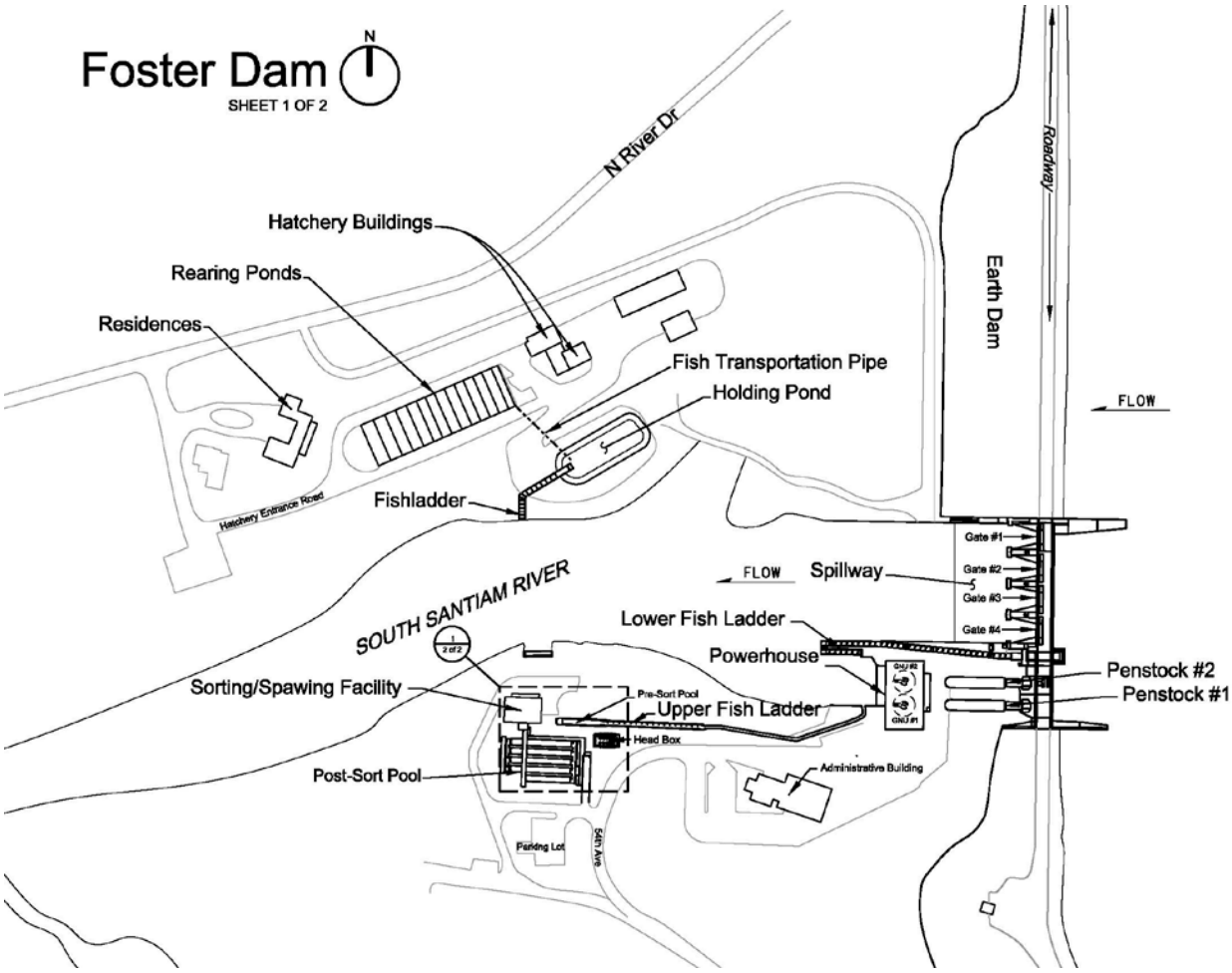


Figure SS-2. Foster Dam

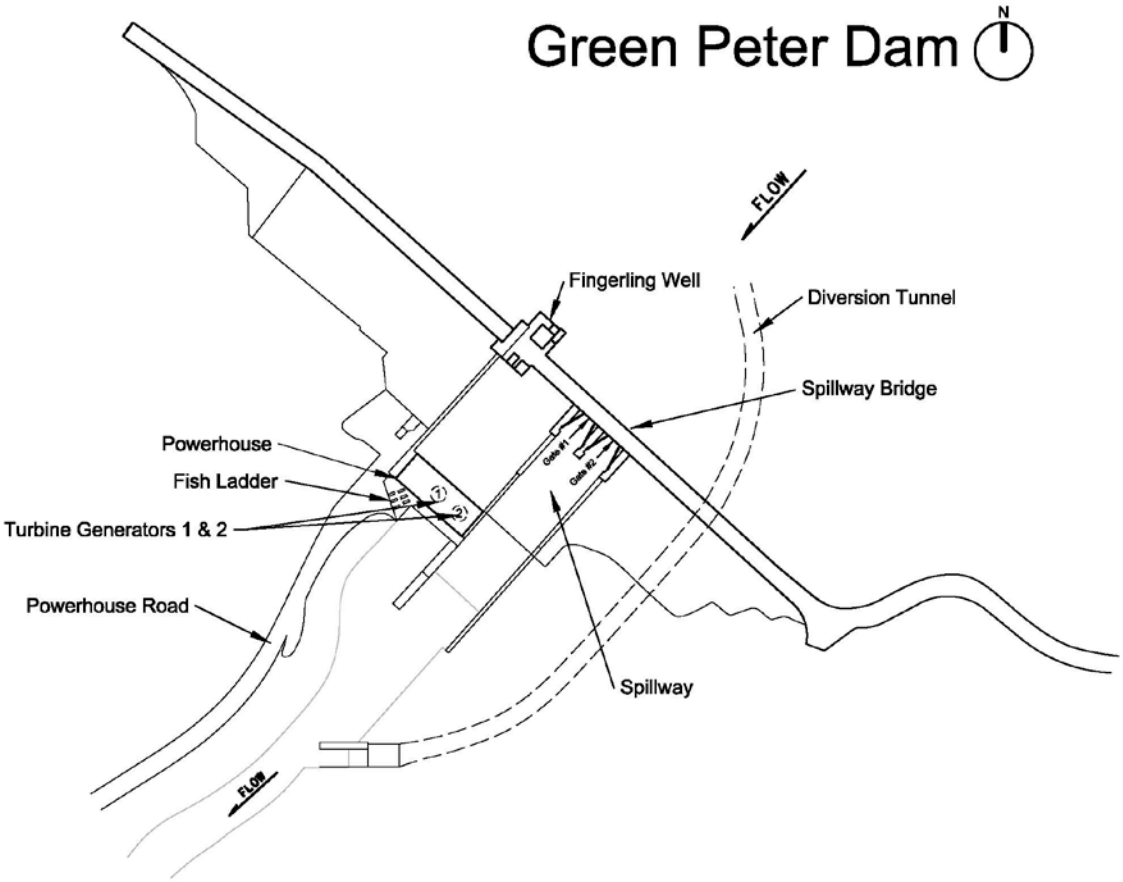


Figure SS-3. Green Peter Dam

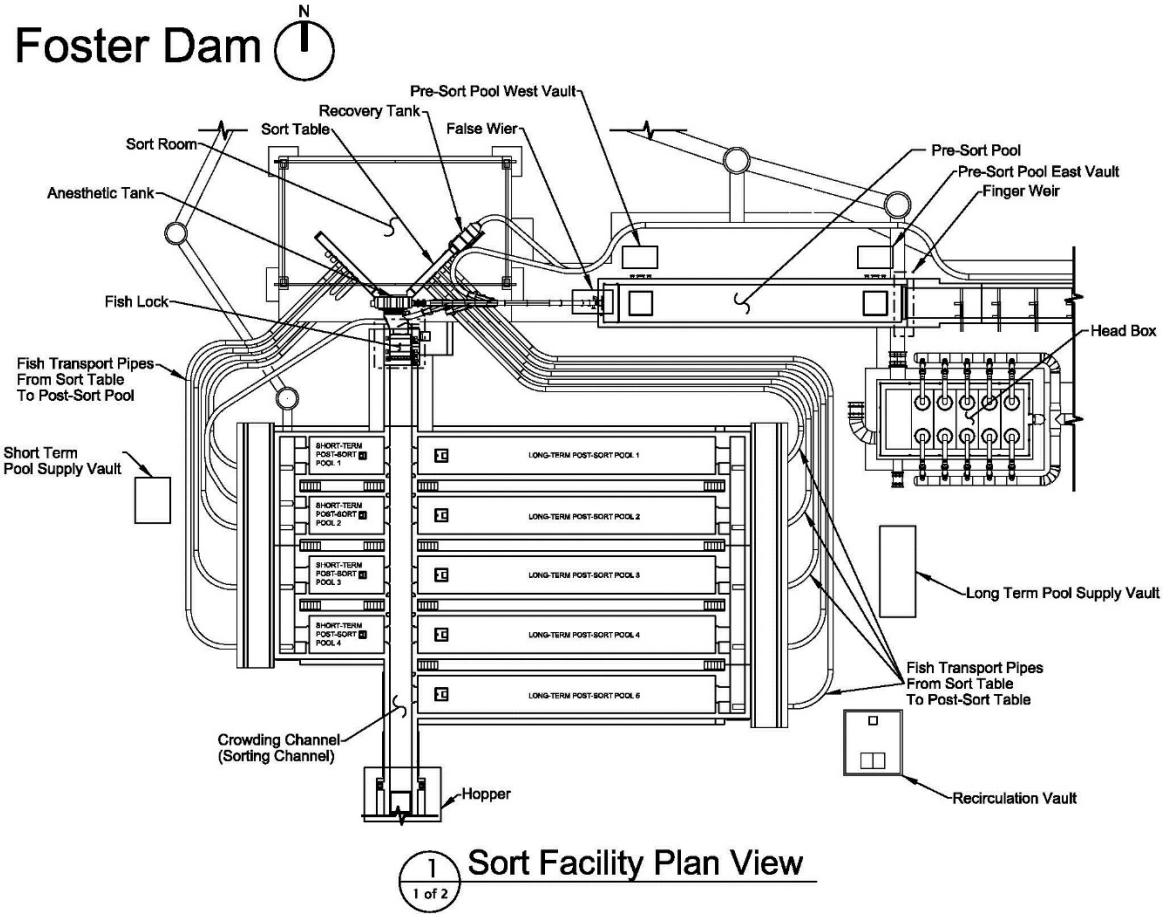
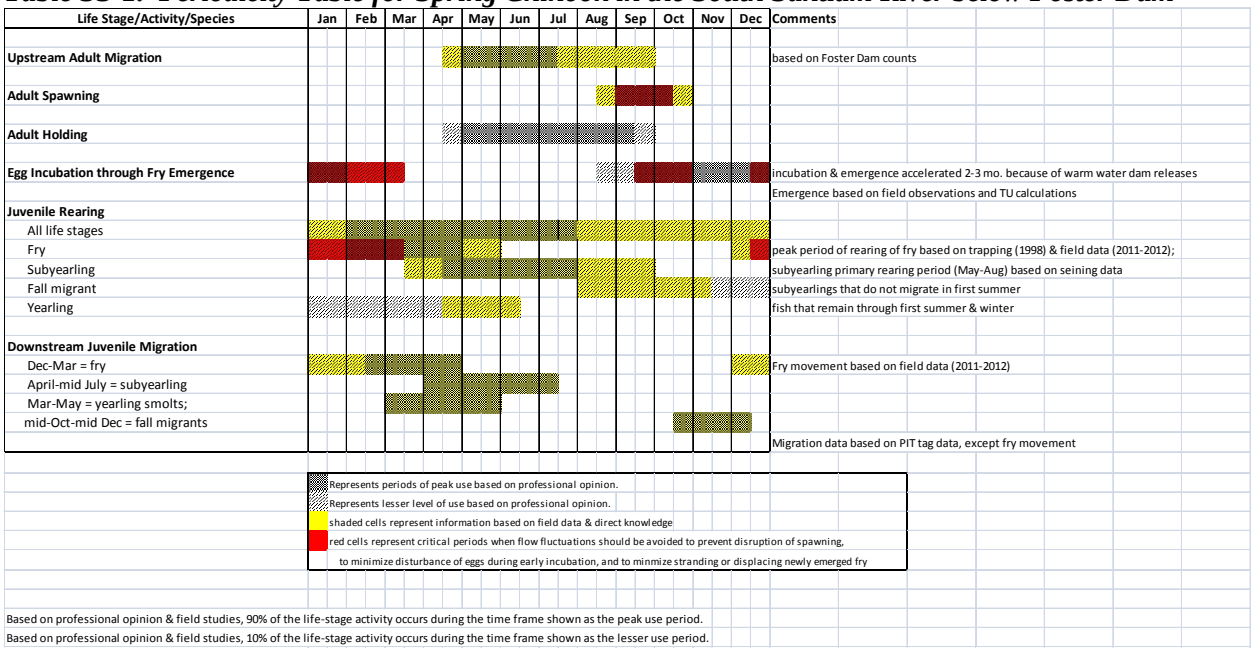


Figure SS-4. Foster Fish Facility

Table SS-1. Periodicity Table for Spring Chinook in the South Santiam River below Foster Dam



2. FACILITIES

Foster and Green Peter are the two Willamette Valley Project (WVP) dams located in the South Santiam subbasin. Adult fish passage facilities are directly located below Foster Dam on the south bank. Rearing of juvenile salmonids occurs at the South Santiam Hatchery located at the Foster project on the north bank. In 2014, the rebuild of the Foster Fish Facility was completed. Spring Chinook salmon and winter steelhead trapped at this location are transported above Foster Dam, to designated release sites, or used for hatchery brood stock collection.

The operation and maintenance of the Foster and Green Peter projects can impact downstream habitat conditions. The operations may alter flow conditions, both total flow and rate of change, and water quality, primarily temperature and total dissolved gas (TDG) under some circumstances. To minimize these impacts, the USACE operates the Green Peter and Foster projects to meet specific flow and ramp rate targets (NMFS 2008).

Both dams are operated from the Foster Dam control room, which relies on the Supervisory Control and Data Acquisition (SCADA) system. Although SCADA allows for remote operation of Foster Dam, it does have some limitations. The precision of SCADA controls are not designed to adjust the amount of water through Foster to meet small flow changes. In addition, there can be a lag time (30-60 minutes) from when an operational change is made at Foster before the control room observes the change at the nearest downstream U.S. Geological Survey (USGS) gage near Foster, Oregon.

2.1. Foster Dam

Foster Dam is located on the South Santiam River just downstream from the mouth of the Middle Santiam River (Figure SS-2). Foster Dam re-regulates the flow from Green Peter Dam and also acts as a storage project. Foster Dam is a rock-fill structure with a concrete-gated spillway.

2.1.1.Turbines

Foster has two Kaplan turbines rated at 10 MW each with a total hydraulic capacity that ranges from 2,700 to 3,400 cfs. The turbines (at both projects) are adjusted by making changes to the wicket gate openings. Small flow changes can be difficult due to wicket gate limitations.

2.1.2.Spillway Gates

Foster has four radial tainter spillway gates. The spillway crest is at elevation 596.8 feet. The gates can be controlled locally via a control panel with a mechanical dial detailing the spillway gate position, or through the SCADA system. Currently, spillway gate #4 will automatically open to a set point of 3 feet in case the turbine wicket gate opening goes to zero indicating the turbine has tripped off. The mechanical dial measures the amount of gate opening locally at the project. The local dial is set to 0.5-foot increments. These settings limit the precision that flow changes can be made.

2.1.3.Regulating Outlets

Foster does not have any ROs.

2.2. Green Peter Dam

Green Peter Dam is a multi-purpose storage project that operates to meet the authorized purposes of flood damage reduction, irrigation, power generation, recreation, navigation, municipal and industrial water supply, and downstream water quality improvement. Green Peter Dam is 380 feet high and is located on the Middle Santiam River, a tributary to the South Santiam River (Figure SS-3). The dam is a concrete structure with a gated spillway, powerhouse, and two regulating outlets (ROs).

2.2.1.Turbines

Green Peter has two Francis turbines each rated at 40 megawatts (MW) each and an additional smaller unit, called the fish unit. The hydraulic capacity through the turbines ranges from 3,600 to 4,400 cubic feet per second (cfs) depending on head (the difference between forebay and tailwater elevations).

2.2.2.Spillway Gates

Green Peter has two radial tainter spillway gates and a spillway crest at elevation 967.8 feet. The project cannot spill through the spillway until water has risen above that elevation. The gates can be controlled remotely via the Supervisory Control and Data Acquisition (SCADA) system, or locally through a control panel with a mechanical dial detailing the spillway gate position. Green Peter does not have an automatic system in place that would open a discharge outlet to maintain flow if a unit were to trip offline.

2.2.3.Regulating Outlets

Green Peter has two ROs that are controlled with vertically sliding gates either locally or from the control room at Foster. A staff gage is used to measure the opening locally. Readings on the staff gage are spaced at 0.1-foot increments and the SCADA dial is set to 0.01-foot increments. The precision of the gate adjustments limit fine-tuning of RO flows.

2.3. Foster Fish Facility

Adult spring Chinook salmon and steelhead needed for ongoing fish management activities in the South Santiam subbasin are collected at the Foster Fish Facility located on the South Santiam River (Figure SS-4). The facility is owned by the USACE and operated by ODFW. The Foster Fish Facility consists of a fish ladder, presort pool and crowder, sorting flume, four short-term and five long-term post-sort holding pools, and many other features that accommodates both holding adult salmon and steelhead.

3. DAM OPERATIONS

3.1. Flow Management

3.1.1. Tributary Flow Targets

The 2008 BiOp requires specific flow regimes below Foster Dam. These operations include minimum and maximum flow targets, increasing and decreasing flow rate targets (ramp rates) and recommendations for operations during high flow periods.

Required minimum and maximum flows for Foster Dam vary by time of year and are shown in Table SS-2. Minimum outflow from Foster Dam is 800 cfs from July 1 to August 31. Spring spawning flows for winter steelhead are 1,500 cfs from March 16 to May 15, followed by incubation flows of 1,100 cfs lasting until June 30. Spring Chinook salmon spawning requires flows of 1,500 cfs from September 1 to October 15, followed by incubation flows through January 31. Maximum flows during the spawning are 3,000 cfs if possible.

Table SS-2. Flow Rates and Ramp Rate Requirements for Foster Dam

Time Period or Criterion	Target
High Flow Period (> 2,000 cfs)	
Minimum Flow	Up to 10,000 cfs
Normal Maximum Flow* (for evacuation of stored flood water)	18,000 cfs
Normal Rate of Increase per hour	
100-1,000 cfs	500 cfs
1,000-3,000 cfs	1,000 cfs
3,000-17,000 cfs	1,500 cfs
Maximum Rate of Decrease per hour	20% of flow
Low Flow Period (< 2,000 cfs)	
Minimum Flow	
February 1 – March 15	800 cfs
March 16 – May 15 (winter steelhead spawning)	1,500 cfs
May 16 – June 30 (winter steelhead incubation)	1,100 cfs
July 1 – August 31 (rearing)	800 cfs
Sep 1 – Oct 15 (Chinook spawning)	1,500 cfs
Oct 16 – Jan 31 (Chinook incubation)	1,100 cfs
Rate of Change (increase)	300/hr
Rate of Change (decrease)	
Maximum Rate of Decrease	0.1 ft/hr nighttime hrs, 0.2 ft/hr daytime hrs
Maximum Daily Decrease	1.0 ft/day or 50% of flow

*Project outflows during major flood events may exceed these levels. Source: USACE 2009.

At higher flow events, Foster Dam passes inflow until an outflow of 10,000 cfs is reached (Table SS-2). During this time, Green Peter Dam flows are typically reduced as needed to a minimum of 50 cfs, which is maintained at this level throughout the event, unless high storage levels at Green Peter Dam mandate higher flows. Once flows at Foster reach 10,000 cfs, this release is held constant and the reservoir is allowed to fill. Outflows are not changed unless high storage levels at Foster Dam mandate higher releases, or the peak has passed and pool evacuation begins. During evacuation, Foster is drafted first with releases as high as 15,000 cfs, but more typically 12,000 cfs. Drafting of stored water from Green Peter Dam is achieved by maintaining draft rates from Foster Dam and increasing Green Peter Dam as other inflows drop off.

3.1.2.Rates of Flow Change (24 hour, day and night)

Ramping rates below Green Peter are unrestricted and highly variable, causing water levels in Foster reservoir to change by 5 to 15 feet per day (USFWS 1961, USACE 1989). The magnitude and frequency of current flow fluctuations, due to Green Peter power peaking, may have rendered the length of the Middle Santiam River between Green Peter Dam and Foster reservoir unsuitable for fish habitation (USACE 2000). Prior to 2006, the maximum allowable down-ramping rate at Foster Dam was 30% of discharge per half hour. Up-ramping rates varied from 500 cfs per hour at initial flows between 500 and 1,000 cfs, to 2,500 cfs per hour when initial flows are higher than 18,000 cfs. Ramping operations at Foster Dam were modified in 2006 to reduce fishery impacts (Table SS-2). Currently, the USACE attempts to maintain ramping rates of 0.1 foot/hour at night and 0.2 foot/hour during daylight hours, except during active flood damage reduction operations.

3.2. Downstream Fish Passage

The USACE operates the Foster fish weir, located in spillway bay #1, from April 15th through May 15th at reservoir elevation 635 feet annually, to provide downstream fish passage primarily for emigrating juvenile winter steelhead. The operation provides spill of 0.5 to 1.5 feet (~92-238 cfs) from 6:00 a.m. to 9:00 p.m. daily. The weir provides a more focused surface passage route which may better facilitate efficiency and survival. Steelhead kelts may also use the weir if operations overlap with their emigration for ocean re-entry. Foster reservoir is drawn down to elevation 616 feet in order to operate the fish weir. The weir structure is located at 614 feet. Discharges during this operation average 300 cfs through the weir.

Special, interim, and other operations to provide fish passage are listed below (see Fish Operations Appendix for more detail):

3.2.1. **Green Peter Dam:** None

3.2.2. **Foster Dam:** The annual operation will be extended throughout the year. During spring (~March 1-April 30) the Foster fish weir will be operated at a forebay elevation of 616 feet. Near the beginning of June to the end of September, the Foster fish weir will be operated at a reservoir elevation of 635 feet. A winter operation for the Foster fish weir is being proposed.

3.3. Water Quality Management

3.3.1.Operations to Limit Total Dissolved Gas

Both Green Peter and Foster dams generate TDG supersaturation when their spillways are operated. The extent of TDG saturation is dependent on the type and duration of operation and the number of spillways that are operated simultaneously. While spill primarily occurs involuntarily due to high-flow events during winter months, spill also occurs infrequently in other months during powerhouse outages or late spring rainstorms when reservoirs are near full or full.

Special, interim, and other operations to minimize negative impacts from total dissolved gas levels are listed below:

3.3.1.1. **Green Peter Dam:** None

3.3.1.2. **Foster Dam:** Spread spill across multiple spillway gates (#1-#4) during times when turbine capacity is exceeded or when off-line to limit TDG. Minimum gate openings may restrict this action depending on the desired outflow.

3.3.1. Operational Water Temperature Management

Currently, operational water temperature management is not implemented at Green Peter or Foster dams. During times of the year when reservoir operations typically impact water temperature (spring through fall), generation at Green Peter provides a substantial portion of the releases from Green Peter reservoir. This operation, combined with the unregulated flow of the South Santiam upstream of Foster, tends to provide adequate summer water temperatures in the South Santiam River. In the future, temperature management may be carried out to improve downstream conditions for ESA-listed fish. The USACE CE-QUAL W2 models are currently being used to inform future operations for successful downstream water temperature management.

Annual results for operational temperature control are provided in the Willamette Basin Annual Water Quality Report. These annual reports detail periods of non-conformance from the temperature targets, providing the duration and cause of the deviation. This section of the WFOP will be changed in the event that temperature targets, operating period, or the compliance monitoring point are modified.

Annual results for operational temperature control are provided in the Willamette Basin Annual Water Quality Report. These annual reports detail periods of non-conformance from the temperature targets, providing the duration and cause of the deviation.

3.4. Spill Management

3.4.1. **Foster Dam**: The configuration and numbering of the spill gates are shown in Figure SS-2. Use of turbines during adult fish passage from February 1st through October 31st should be prioritized and operate spillway bay #4 nearest the fish ladder during fish collection activities if turbine flows are exceeded or off line. Spread spill across multiple spillway gates (#1-#4) during times when turbine capacity is exceeded or when off-line to limit TDG (prioritize spillway bay #1 nearest fish ladder) between September 1st and July 31st for spring Chinook and winter steelhead incubation. Minimum gate openings may restrict this action depending on the desired outflow.

3.4.2. **Green Peter Dam**: No recommendations at this time.

4. DAM MAINTENANCE

The annual maintenance periods discussed below for Foster and Green Peter dams are provided as applicable for the projects and will be adhered to during annual maintenance planning. Potential effects on ESA-listed fish include temperature, TDG, and flow-related impacts downstream of Foster Dam. Foster Dam has two turbine units and can impact flow during maintenance, so it is important that planned maintenance occur during the time frame shown below.

4.1. Green Peter

Target outage periods:
Mar 1-Jun 30: Primary scheduling period.
Jul 1-Aug 31: Limited outage scheduling due to power valuation considerations.

Sep 1-Oct 31: Secondary scheduling period.
Nov 1-Feb 28: Limited outage scheduling due to power valuation considerations.

4.2.1. Considerations/Rationale for unit outage scheduling:
No fish operations currently affect outage scheduling and therefore power valuations and historical stream flows will be the major factors affecting outage scheduling.

4.3. Foster

Target outage periods:
Mar 1-Apr 30: Primary scheduling period.
May 1-Oct 31: Attempt to schedule one unit at a time.
Nov 1-Feb 28: Restricted from outage scheduling.

4.3.1. Considerations/Rationale for unit outage scheduling:
Mar 1-Apr 30: Spring Chinook salmon have mostly emerged and few sac fry are present. There will be steelhead eggs present but are fairly hardy to impacts from excessive TDG.
Apr 15-May 15: Fish weir in operation for downstream fish passage, minimize generating outages that would cause flow through other spillway gates.
May 1- Oct 31: Minimize generation outages in order to maintain fish attraction water to fish ladder. Although, the few Foster Fish facility will have functioning AWS pumps.
Nov 1-Feb 28: Generation outages restricted to maintain TDG below limit due to impacts on sac fry.

5. FISH FACILITY OPERATIONS

The Foster Fish Facility is a complex system that must be operated carefully to maintain hydraulics for efficient fish passage and holding. Many features of the facility are automated but can also be operated manually. The facility O&M manual (see Appendix) contains specific information regarding startup, normal and manual operations, as facility shutdown as well as how to maintain hydraulic criteria.

The Foster Fish Facility will operate most of the year except during shutdown if necessary for maintenance or other activities.

5.1. Juvenile Fish

Juvenile hatchery fish will be acclimated at the Foster Fish Facility for a minimum of 30 days prior to release.

5.2. Adult Fish

Disposition of adult fish will be determined annually at the WATER Hatchery Management Team, vetted through WFPOM, and published or attached in the WFOP upon finalization.

5.2.1. Fish Collection and Handling

5.2.1.1. All adult trapping facilities shall be operated for adult spring Chinook salmon and winter steelhead in a manner that minimizes the duration of holding and delay.
5.2.1.2. All trapping, hatchery, and transport personnel must avoid excessive handling of adult fish to minimize stress and reduce the chance of injury.
5.2.1.3. All transfer of fish shall be completed through water to water transfers, unless logistically infeasible.

5.2.1.4. Sorting of adult spring Chinook salmon and winter steelhead for outplanting shall be completed in manner that minimizes stress and injury.

5.2.1.5. All efforts should be made to sort adult fish a single time and not multiple times as was done in the past.

5.2.1.6. Healthy fish should be used for both broodstock collection and outplanting efforts (to support reintroduction) to increase the probability of survival and should be representative of the run.

5.2.1.7. Sorting shall be completed to separate by species or origin (hatchery or natural origin) to ensure an adequate sex ratio for outplanting and brood production. To the extent possible, adjust the sex ratio of releases based on known differences in pre-spawning mortality between males and females to maximize reproductive success. Ensure an adequate number of females are outplanted to seed available habitat.

5.2.1.8. The Hatchery Management Team will develop the annual guidelines regarding when to outplant fish from each location and will be vetted through the WFPOM team. Collect fish on a regular basis throughout the run and outplant when collected, ensuring temporal outplants are representative of the run. However, pre-spawning mortality of early-released fish may be high and thus should be monitored to ensure effectiveness of this strategy. Fish could be held at the Foster Fish Facility if found beneficial to reduce pre-spawning mortality. Fish will not be held longer than the agreed upon time to be developed through the WATER process.

5.2.1.9. During processing/sorting, the anesthetic used will be dependent upon whether a fish will be: for brood, returned to the fishery, outplanted, sampled for RM&E, or surplused (e.g. sold, food bank). Fish will be moved out of the trap quickly and frequently. Fish will be handled as gently as possible during processing and loading onto the truck, attempting to minimize stress and skin abrasions associated with handling.

5.2.1.10. Once fish are sorted, they will spend no longer than the allotted time that will be agreed to through the WATER process within holding tanks prior to being transported to their destination, which is determined by the fish disposition table. Environmental factors such as flow, fish health, and temperature will be considered.

5.2.1.11. The fish trap will be checked at least twice a day, first in the morning, and then in the late afternoon to avoid having fish spend too much time in the trap and to assess the overall density of fish within the trap.

5.2.1.12. Fish will be removed and placed in holding tanks with a density approximately 25 gallons of water per fish. Adult holding will reflect IHOT and NMFS recommendations.

5.2.1.13. Oxygen levels in the holding tank water should not exceed saturation (100%) or drop below 7 parts per million (7 mg/L), however, spill during the wet and flood risk reduction season may preclude meeting this guideline.

5.2.1.14. Experiment with reduced dependence on, or eliminating prophylactic antibiotic treatments.

5.2.1.15. The fish disposition table, developed collaboratively by HMT and approved by NMFS, will be used to guide the management of anadromous and resident fish as they are encountered in adult fish traps.

5.2.1.16. MS-222/CO_2/AQUI-S 20E. At fish handling facilities in the Willamette Basin operated by ODFW, the ODFW and ODEQ have agreed upon a process of dispersal and evaporation (or volatilization) for the disposal of water treated with anesthetics, which are highly volatile substances. The USACE will continue to use eugenol (clove oil) at USACE-operated adult fish trapping facilities (Cougar and Fall Creek).

5.2.1.17. Avoid multiple handling/anesthesia of fish during sorting for outplanting or brood production.

5.2.2. Transport and Outplanting

5.2.2.1. All transport tanks will be treated with NovAqua® or equivalent per manufacturer's instructions to reduce stress during transport.

5.2.2.2. Transport adult spring Chinook at a density of ≥ 25 gallons of water per fish (60 fish/1,500 gallon tank).

5.2.2.3. Oxygen levels above 100% should be minimized in the transport truck or should not drop below 7 parts per million [7 milligrams per liter (mg/L)].

5.2.2.4. All trapping, hatchery, and transport personnel must adhere at all times to existing ODFW policies and procedures to reduce the transfer of pathogens.

5.2.2.5. *No handling* will occur at adult trapping facilities when water temperatures exceed 70°F in the pre-sort pool.

5.2.2.6. In certain situations, the transfer of fish for outplanting or to cooler hatchery waters may occur if fish are being held, or may be held, in waters exceeding 70°F for an extended period of time. Coordination with NMFS prior to transfer and notification to the WFPOM Team is required under these circumstances.

5.2.2.7. When outplanting adult spring Chinook salmon, receiving water temperature shall be less than 68°F *as measured prior to release*.

5.2.2.8. Monitoring of water temperature can be completed using USGS gages or temperature meters, where available.

5.2.2.9. Drivers will measure the temperature of the water in the transport tank and the receiving water prior to releasing the fish.

5.2.2.10. If the temperature difference between the receiving water and tank water is > 7°F, the water will be tempered to a difference of < 5°F at a rate of 1°F/6 minutes.

5.2.2.11. Fish facility personnel are responsible for recording the holding pool water temperature prior to transport, liberation truck water temperatures, and receiving water temperature upon release.

5.2.2.12. If liberation truck waters require tempering, beginning and end temperature as well as time required for acclimation will also be recorded.

5.2.2.13. All outplanting shall be completed at designated outplanting sites consistent with the appropriate disposition table for each subbasin. Releases shall be made in a manner to minimize stress and chance of physical injury. In-season variances to either outplant site use, fish disposition, or other outplanting protocols can be completed with agreement from the WFPOM Team with notification provided to the WATER Steering Team. NMFS must agree to any in-season variances proposed by the WFPOM Team before the action is taken.

5.2.2.14. Release trucks shall have a minimum of a 12-inch opening on all. Discontinue use of collapsible tubes and use 16- to 20-inch smooth walled PVC pipe to convey fish from the truck to the stream. Set pipes at proper discharge angle and use discharge chutes. Use a water spout to flush fish from the truck. Avoid abrupt changes in temperature. Release fish early in the day whenever possible. If receiving waters are known to be too warm at certain times of year, release fish when or where waters are cooler. Investigate the options to improve survival such as holding fish in a hatchery pond and treating with antibiotics until they are ready to spawn, at which time they would be released. Releasing ripe fish may limit numbers outplanted and potentially reduce pre-spawning mortality.

5.2.2.15. Fish liberation truck driver and/or trained volunteer will observe released fish and document any mortality and unusual behavior after release.

5.2.2.16. All truck drivers will complete an adult salmonid outplant form to document oxygen levels, temperatures in the tank and release stream, immediate mortalities, loading densities, and release method. These data will be used to enable better monitoring of outplanted fish.

5.2.2.17. Hauling frequency will depend on factors that include run size, stream temperatures, and transport/ holding constraints. Some fish will likely be held prior to outplanting to some extent depending on these constraints. Unless environmental conditions in areas where fish are to be transported are poor, hauling frequency should be such that it minimizes holding times to no more than 24 hours.

5.2.2.18. It is the intent to reduce holding times and complete outplanting as soon as possible upon a fish's return to the adult trapping facility. Given the typical adult monthly return timing and abundance observed, expected hauling frequencies are:

Transport Period	Hauling Frequency
April 1 – May 15	2 times per week
May 16 – June 30	3 times per week
July 1 – October 15	2 times per week

5.2.2.19. The current program involves releasing fish according to the targets identified in Table SS-5. Detailed protocols for the disposition of excess hatchery fish will be contained in the WFOP. These goals will be updated annually by the WATER Hatchery Management Team and vetted through WFPOM team. When numerical adult abundance recovery goals are established for the North Santiam spring Chinook salmon population through the recovery planning process, these targets will be adjusted accordingly.

Table SS-5. Number of Adult Spring Chinook to be Outplanted

Location	Target Number of Fish	Origin	
		Hatchery	Natural
Above Foster [a]	All		X

Table SS-5. Outplanting Release Sites

Release Site
Gordon Road (15 river miles upstream of Foster Reservoir)
River Bend (4 river miles upstream of Foster Reservoir)

6. FISH FACILITY MAINTENANCE

6.1. The proposed maintenance period where a shutdown is required for the ladder will be from **December 1 to February 15**. The following will be performed during the maintenance period:

6.1.1. All staff gages and water level indicators will be inspected, cleaned, and repaired as necessary.

6.1.2. The fish ladder will be dewatered and inspected for debris, projections, or clogged orifices that could injure or impede fish. Necessary repairs will be completed at this time.

6.2. The proposed maintenance period where a shutdown is required for the post sort pools will be from **March 1 to April 15**. The following will be performed during the maintenance period:

6.2.1. All staff gages and water level indicators will be inspected, cleaned, and repaired as necessary.

6.2.2. The pools will be dewatered and inspected for damage, cracks, debris, or projections that could injure fish. Necessary repairs will be completed at this time.

6.2.3. Specific maintenance activities listed for monthly, quarterly, and annual actions will be appended to the WFOP.

7. INSPECTIONS, REPORTING, AND NOTIFICATIONS

7.1. Fish facility inspections will be performed in accordance with guidelines in the operations and maintenance (O&M) manual.

7.2. The results of all inspections and the readiness of the facilities for operation will be reported to the Willamette Fish Passage Operations and Maintenance Team (WFPOM) by March 1.

7.3. More frequent inspections will occur as requested by the WFPOM Team or at any time by facility personnel. During the field season, WFPOM members will visit fish facilities to evaluate adherence to protocols and SOPs. The site visit assessment activities include observing fish sorting and handling procedures. A check sheet will be filled out and initialed indicating whether procedures are or are not being performed according to protocol. Protocol drift for any activity must be reported to the immediate supervisor and corrective actions must be implemented immediately.

7.4. Fish trapping facilities will be initially inspected prior to being removed from service for the year to assess facility condition and maintenance needs.

7.5. Staff gages and other water-level sensors will be installed, cleaned, and/or repaired as required to allow for monitoring facility performance.

7.6. Fish facility personnel shall prepare monthly reports throughout the year summarizing project operations. These monthly reports will provide an overview of how the project operated during the prior month.

7.7. The reports shall cover a monthly period and they shall be provided to WATER stakeholders at monthly WFPOM Team meetings and recorded in a record of the meeting minutes.

7.8. The reports shall include:

7.8.1. Any out-of-criteria situations, observed deviations from the WFOP, and subsequent corrective actions taken.

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

7.8.3. Progress in reaching outplant numbers targeted in the fish disposition table.

7.8.4. Mechanical and/or structural issues preventing optimum facility operation.

7.8.5. General hatchery operations including trap counts, transfer information, juvenile releases, and updates on hatchery research.

7.8.6. Adult outplanting data documenting release locations, numbers released, any observed transport or liberation mortalities, holding, transport and receiving water temperatures, and poaching/harassment issues.

7.8.7. Any adult mortality that occurs within the trapping facility during holding or handling prior to transport and must documents species, origin, size, marks/injuries, cause and time of death, and future preventative measures. When mortality occurs, this should also be reported immediately to USACE that will be included in a memorandum to the Services.

7.8.8. Adult mortalities should be reported as soon as possible to the Services.

7.9. The facility operator will produce an annual report summarizing the species, number, origin, and destination of all fish collected at USACE fish facilities in the Willamette Basin, as well as all BiOp deviatons. This annual report will be a summary of the monthly or quarterly progress reports. The report shall assist in identifying potential operational changes. Reporting may be included in baseline hatchery monitoring or the annual hatchery operations reports and provided at specified dates (WFOP, contract, cooperative agreement).

7.10. Hazardous Spills. Hazardous spill notification will continue to be completed through the Oregon Emergency Response System (OERS). This system provides 24-hour service through Oregon Emergency Management of the Department of State Police. Local public safety agencies such as law enforcement, fire and emergency medical services normally provide the first response to an incident. Access to this local assistance is through 9-1-1. Once notified, local public safety agencies would call OERS at 800-452-0311 or in the Salem area at 503-378-6377. If necessary, responsible parties would then call the National Response Center at 800-424-8802. The USACE operations fisheries biologist will be included as an initial contact to address any immediate fisheries response needs, as well as to provide additional notification directly to the Services. Although the OERS serves to disseminate spill response notification to both the state and federal fisheries agencies, the USACE operations fisheries biologist will notify the Services directly of the incident.

7.11. Any poaching, suspicion of poaching activities or observed harassment of outplanted fish shall be reported immediately to the Oregon State Police at 1-800-452-7888.

7.12. The annual report will be distributed to the members of the WFPOM Team.

8. DEWATERING PLAN

Fish facilities and turbines are drained for regularly scheduled maintenance and sometimes for emergency maintenance. These activities may involve handling fish and could cause other adverse effects on juvenile and adult fish in the watershed (e.g. stranding of fish in the reservoir). This plan is subject to change as improvements are developed and will be revised on an annual basis as part of the WFOP. Not all dewatering efforts will require fish salvage; as such, the need will be determined by USACE and ODFW fish biologists.

8.1. Coordination

8.1.1. Facility outages will be scheduled to minimize impact on fish while accomplishing necessary repairs and maintenance on facilities. Specific outages will be scheduled according to maintenance periods detailed in appendices. Fish facility personnel (either ODFW or USACE) will coordinate these activities with Portland District Operations Division fishery biologists and will ensure that the fisheries agencies, particularly those whose activities may be impacted, are kept informed. Primary points of contact include ODFW, NMFS, and USFWS.

8.1.2. The Willamette Project Supervisory Fisheries biologist coordinates fishway dewatering and salvage activities with the project operations and maintenance supervisor. This includes having the appropriate personnel and equipment on site. The designated fish facility lead, likely the Operations Division project biologist for USACE operated facilities, or an ODFW hatchery manager for ODFW operated facilities, directs execution of the drainage plan at least until fish removal is complete. Before or at the beginning of each draining operation, a pre-work briefing will be held to explain procedures, responsibilities and safety considerations for all participants. After the salvage activity, lead personnel are responsible for reporting species, number, and condition of fish. The reporting template is attached at the end of the document and will be provided to the WFPOM Team.

8.2. Fish Handling

8.2.1. When facilities are drained, a primary objective is to minimize stress and injury to all fish. Generally, the best way to protect fish during facility draining is to avoid having to handle them. Instructions for draining most facilities involve steps, such as operating with low ladder flow just prior to draining, intended to minimize handling fish by encouraging the fish to exit the ladder. When it is necessary to handle fish, they are handled in plenty of fresh water, if possible. Holding fish in nets unnecessarily is avoided (e.g., tank or fish bag not ready). When it is necessary to transport fish in bags, ensure that the salvage bags contain a sufficient amount of water and that fish return to fresh water as soon as possible.

8.2.2. Tanks should be large enough to carry plenty of water with the fish. Tanks should be covered to keep fish from leaping out. When large numbers of fish are placed in a tank, supplemental oxygen will be used to increase the level of dissolved oxygen. Reduce fish concentration when river temperature is greater than 65°F. During warm weather, the temperature in tanks will be monitored and kept within 2°F of the river release point temperature. Further, the time fish are kept in tanks will be minimized and not exceed 2 hours.

8.2.3. Fish will be released at a predetermined site. However, when the tank contains a mixed load, it can be released into the forebay or tailrace depending upon the recommendation of lead personnel.

8.2.4. When it is necessary to prioritize attention to different species, generally ESA-listed species and adult salmonids should be helped first. Lamprey are relatively stress resistant and can be collected as a lower priority. However, their numbers are declining and care should be given to salvage them, as well as the more sensitive fish. All fish are to be salvaged.

8.3. Adult Fish Trap/Ladder

The general procedures for draining the adult fish trapping facilities are described below.

8.3.1. **Prior to Dewatering**

8.3.1.1. 24 to 48 hours before draining, stop attraction flow by minimizing auxiliary water flow.

8.3.1.2. For at least 24 hours before dewatering, but not longer than 96 hours, operate the ladder at orifice flow.

8.3.2. **On Dewatering Day**

8.3.2.1. Convene safety meeting before starting activity. Describe the procedure for all participants and assign responsibilities (ensure clearances are in place)

8.3.2.2. Stage fish bags or transport tank.
8.3.2.3. Place ladder near the pre-sort holding pool
8.3.2.4. The water supply level to the ladder should be reduced to approximately 1” to 2”.
8.3.2.5. Begin visual inspection of ladder for stranded fish. Salvage personnel will need to access any pools where fish are stranded and either remove the stranded fish and put into a fish bag or tank or, if the fish is close to the entrance pool, gently guide fish down the ladder to the entrance pool.
8.3.2.6. Drain pre-sort holding pool.
8.3.2.7. Salvage fish with a net and put them into a fish bag
8.3.2.8. Place fish from fish bag into post sort holding raceway for transport or into recovery tank for direct release to the river.
8.3.2.9. Shut down facility water supply when fish salvage is complete.

8.3.3. Fish Salvage Equipment

The following fish salvage equipment is required.

8.3.3.1. Dip nets/buckets
8.3.3.2. Fish salvage bags
8.3.3.3. Seine
8.3.3.4. Extension ladder for access into the fish ladder
8.3.3.5. Fish truck with oxygen bottle
8.3.3.6. Personal protection equipment such as life vests/float coats, fall protection (harness/lanyard), waders w/felt soles, gloves (sealskins), hearing protection, and hardhats
8.3.3.7. Communication devices
8.3.3.8. Submersible pumps

9. FOREBAY DEBRIS REMOVAL

9.1. Debris at projects can adversely impact fish passage conditions. Debris can plug or block trashracks, VBSs, gatewell orifices, dewatering screens, separators, and facility piping resulting in impingement, injuries, and descaling of fish. Removing debris at its source in the forebay is sometimes necessary to maintain safe and efficient fish passage conditions, navigation, and other project activities. Debris can be removed from the forebay by:

9.2. 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;
9.3. Removing the debris from the top of the dam using a crane and scoop;
9.4. Passing debris through the spillway with special powerhouse and/or spill operations; or
9.5. 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).

2016 Fish Passage Plan
Chapter 4 – South Fork McKenzie Subbasin

Table of Contents

1. SOUTH FORK MCKENZIE SUB-BASIN OVERVIEW 1
2. FACILITIES 5
2.1. Cougar Dam 5
2.2. Blue River Dam 7
2.3. Cougar Fish Facility 7
3. DAM OPERATIONS 7
3.1. Flow Management 7
3.2. Downstream Fish Passage 9
3.3. Water Quality Management 10
3.4. Spill Management 11
4. DAM MAINTENANCE 11
5. FISH FACILITY OPERATIONS 11
5.1. Juvenile Fish 11
5.2. Adult Fish 12
6. FISH FACILITY MAINTENANCE 14
7. INSPECTIONS, REPORTING, AND NOTIFICATIONS 15
8. DEWATERING PLAN 16
9. FOREBAY DEBRIS REMOVAL 18

1. SOUTH FORK MCKENZIE SUB-BASIN OVERVIEW

1.1. The McKenzie River is about 90 miles long and drains an area of about 1,340 square miles (Figure SFM-1). Two U.S. Army Corps of Engineers (USACE) dams were constructed in the McKenzie subbasin – Cougar Dam at river mile (RM) 4.4 on the South Fork McKenzie River was completed in 1963 and Blue River Dam at RM 1.8 on the Blue River was completed in 1968. Multiple smaller diversions/canals and some higher dams are located on the McKenzie River including Leaburg Dam (RM 29) and the Carmen-Smith Hydroelectric Project (RM 82), both owned and operated by the Eugene Water and Electric Board (EWEB). Leaburg Dam was outfitted with new ladders and a screened diversion intake in 2005-2006.

1.2. The subbasin is inhabited by Endangered Species Act-listed Upper Willamette River (UWR) spring Chinook salmon and bull trout, as well as recently delisted Oregon chub.

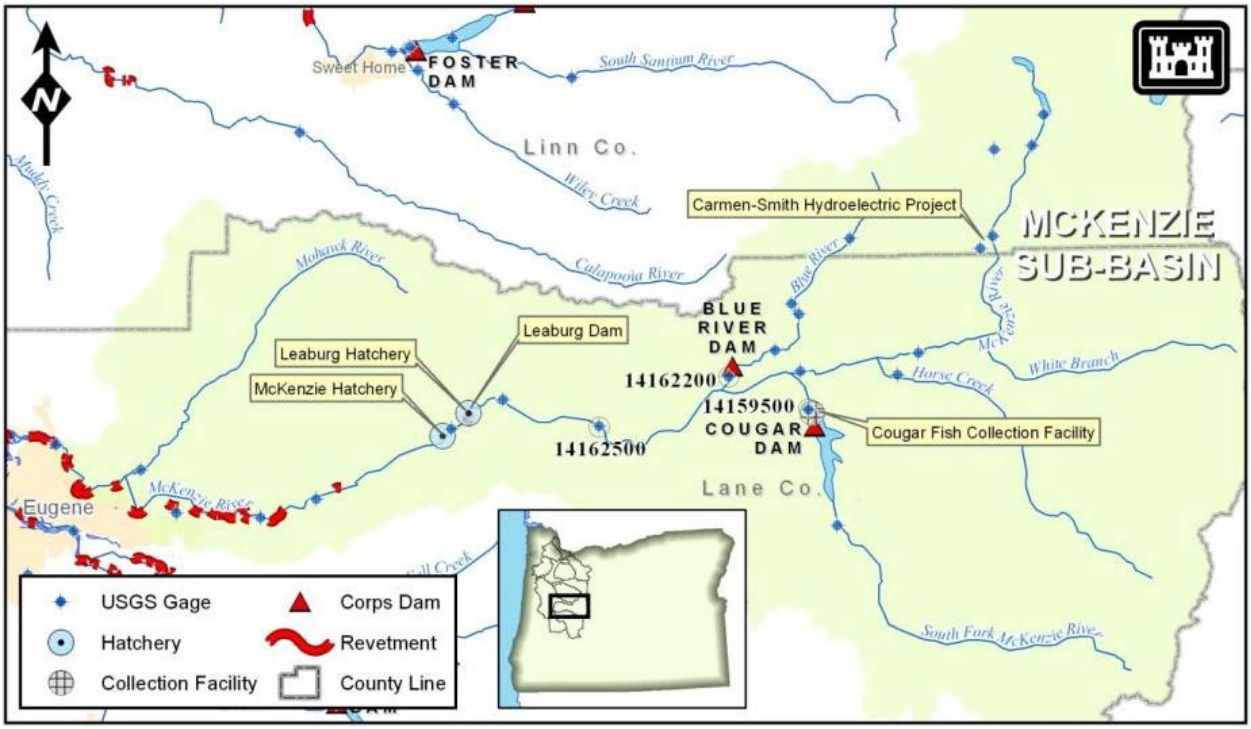


Figure SFM-1. South Fork McKenzie Subbasin

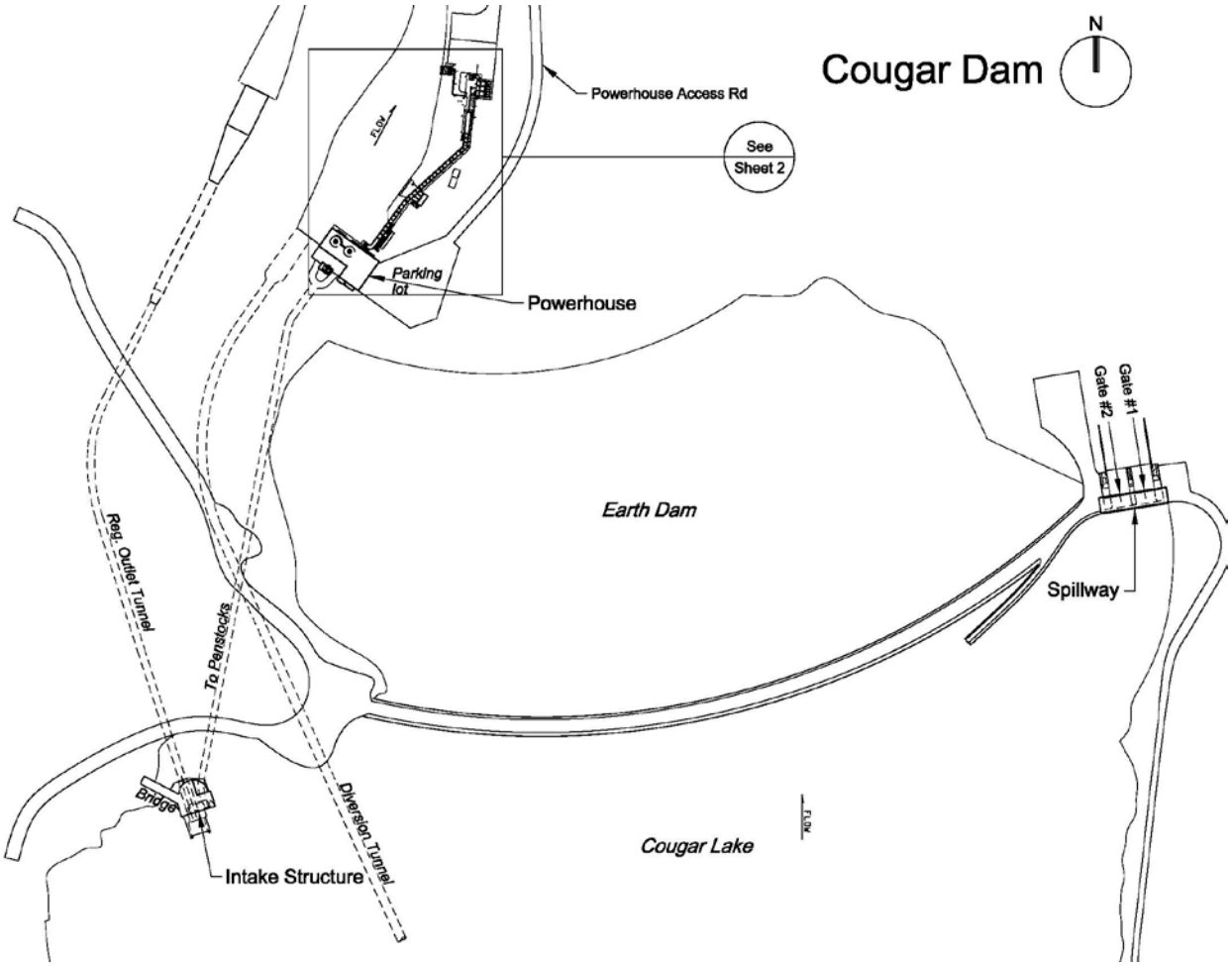


Figure SFM-2. Cougar Dam

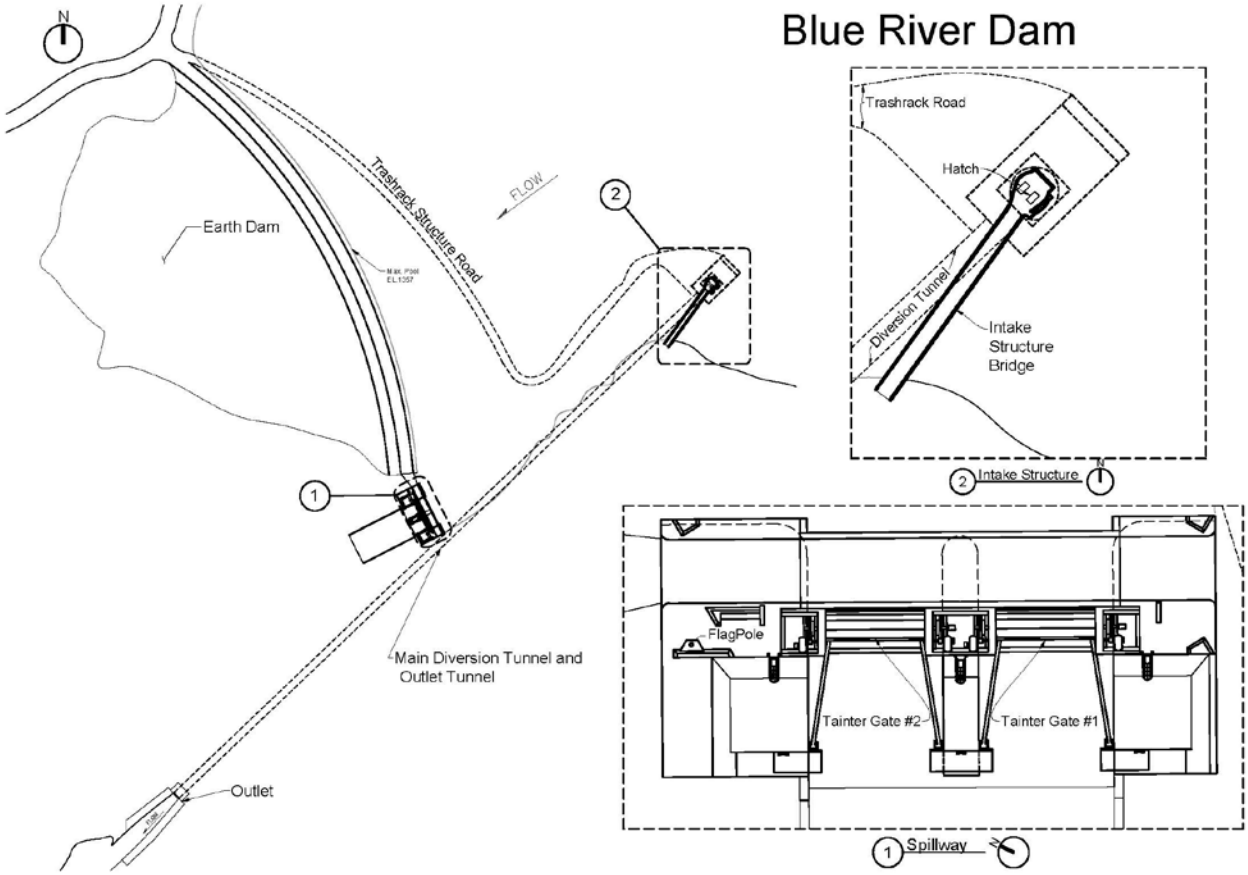


Figure SFM-3. Blue River Dam

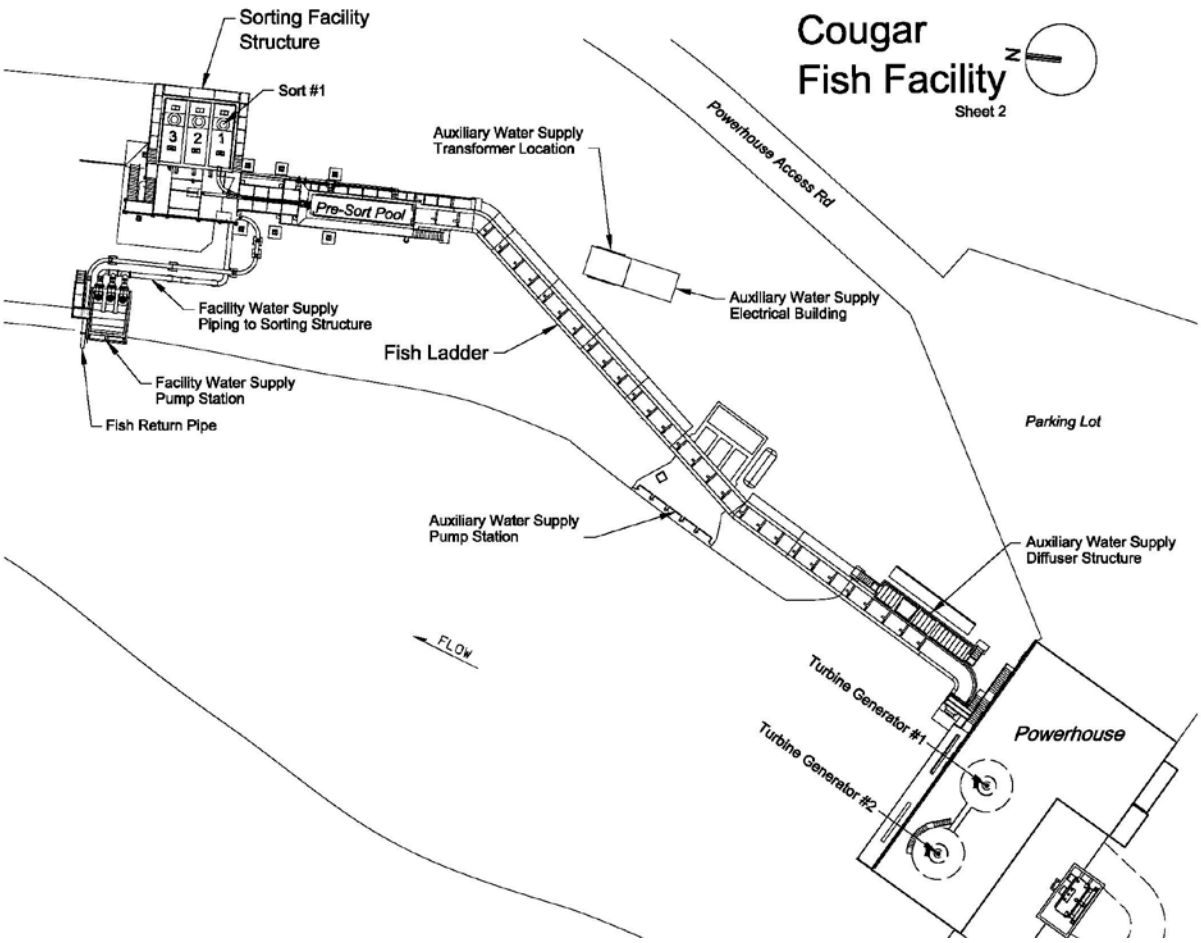
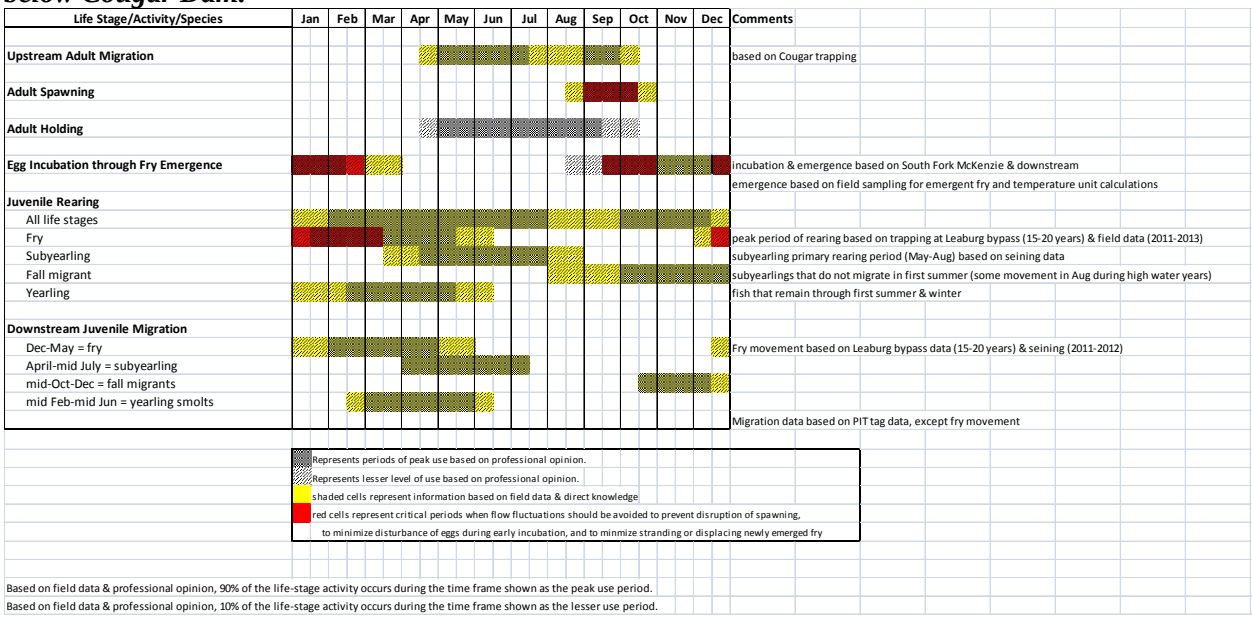


Figure SFM-4. Cougar Fish Facility

Table SFM-1. Periodicity Table for Spring Chinook Salmon in the South Fork McKenzie River below Cougar Dam.



2. FACILITIES

Cougar and Blue River are the two Willamette Valley Project (WVP) dams located in the McKenzie subbasin. The USACE completed construction of Cougar Dam on the South Fork McKenzie River in 1964 and Blue River Dam on Blue River in 1968.

Cougar and Blue River dams are operated remotely from the Lookout Point control room. The precision of the Supervisory Control and Data Acquisition (SCADA) system controls are not finely tuned enough to adjust the amount of water through the projects to meet small flow changes as required by the project schedule. Additionally, there can be a lag time (30-60 minutes) from when an operational change is made at Cougar or Blue River dams and when the control room observes the change recorded at the nearest downstream U.S. Geological Survey (USGS) gages #14162200 (Blue River at Blue River) or #14159500 (South Fork McKenzie near Rainbow).

2.1. Cougar Dam

Cougar Dam is a multi-purpose storage project that operates to meet authorized purposes of flood damage reduction, irrigation, power generation, recreation, navigation, municipal and industrial water supply, and downstream water quality improvement. The dam is a rock-fill structure with a powerhouse, concrete spillway with two tainter gates, and two slide gate regulating outlets (ROs). The dam is about 1,600-feet long and 450-feet high from average tailwater to the dam crest. The RO and penstock tunnels have a common intake structure in the left abutment. The outlet capacity is 6,000 cubic feet per second (cfs) at minimum flood control pool (elevation 1,532 feet). The power plant has a capacity of 25 megawatts (MW) and is located at the toe of the rock-fill dam. A water temperature control (WTC) structure began operation in May 2005. A diversion tunnel used during construction of the WTC structure is an additional outlet but is not designed for routine use. Outflow is primarily released through the powerhouse and ROs.

2.1.1. Turbines

The intake to the penstock from the WTC wet well is an 8-foot, 2-inch by 10-foot, 6-inch rectangular section with a transition between the intake and penstock. The 10-foot, 6-inch diameter main penstock is 1,030 feet long in rock. The penstock at the lower end branches into two 7-foot, 6-inch diameter conduits which lead to the turbines in the powerhouse. Cougar has two Francis turbines rated at 12.5 MW each. The hydraulic capacity through the turbines ranges from 650 to 1,100 cfs depending on head. The head of the turbines varies from a minimum of 266 feet, between normal tailwater and minimum power pool, and a maximum of 449 feet, between tailwater and maximum or full pool. Turbines are adjusted by making changes to the wicket gate openings. Small flow changes can be difficult due to wicket gate limitations.

2.1.2. Spillway Gates

The dual tainter gate ogee-type spillway has a net crest length of 80 feet and is located in the right abutment. The spillway has a discharge capacity of 76,140 cfs at maximum pool (elevation 1,699 feet), with the gates fully open. The spillway discharges into a 90-foot-long chute with no stilling basin. Interim risk reduction measures (IRRMs) are being implemented at Cougar Dam to address concerns with tainter gate stability. The use of the spillway is reserved only for extreme emergencies.

2.1.3. Regulating Outlets

Cougar Dam has two ROs that are controlled with vertically sliding gates from the Lookout Point control room or locally. There is only one speed that the RO gates can be opened or closed. A staff gage is used to measure the opening locally. Readings on the staff gage are spaced at 0.1 foot and the SCADA dial is set to 0.01-foot increments. The precision of the gate adjustments limit fine-tuning RO flows. The dam's RO gate #2 currently has a set point of 1 foot in case the turbine wicket gate opening goes to zero indicating the turbine as tripped off. The set point is not adjustable when in use or through SCADA, so it requires an emergency stop. Turbine tripping offline at Cougar Dam can cause problems for juvenile fish or incubating eggs because the ROs are located on a different channel than the powerhouse. When the turbines shut off, even if the ROs are maintaining a consistent total project outflow, the powerhouse channel can still experience significant drops in water levels.

2.1.4. Water Temperature Control Tower

The 302-foot-high WTC tower was constructed adjoining the original intake tower and began operation in May 2005 to regulate downstream temperatures. The original intake tower includes a dry well (with operating equipment, stairs, and elevator), dual RO conduits, trash structure, and access bridge. The original intake tower was modified for construction of the WTC tower through addition of a wet well with three adjustable weir gates for selective withdrawal and lower RO and penstock bypass gates. The WTC wet well serves both the power generating facilities and the RO works. The selective withdrawal gates for temperature control consist of three 9-foot wide independently telescoping weirs, one located over each of the regulating outlets and one located over the penstock. The RO bypass gates consist of two 9-foot wide by 27-foot high gated openings at centerline (elevation 1,488.5 feet) that pass water into the lower portion of the WTC tower wet well. The penstock bypass gate is a 9-foot wide by 19-foot high gated opening that passes water into the lower portion of the WTC tower wet well.

Decisions on flow distribution are based on outflow and data from temperature instrumentation on the face of the structure. This instrumentation allows for effective remote operation of the tower through SCADA from Lookout Point. In addition to controlling the volume of flows, temperature data is required to determine thermal stratification in the reservoir and outflow water temperatures. Gates can be adjusted to control the proportion of flow from different levels. In addition, the electrical

generation system was upgraded to include replacement of turbine runners with minimum gap technology intended to improve fish passage survival.

2.2. Blue River Dam

Blue River Dam is a multi-purpose storage project that operates to meet the same authorized purposes as Cougar except there is no powerhouse (Figure SFM-3). The dam is a rock-fill structure with a gated concrete spillway with two tainter gates, two slide gate ROs, and two emergency slide gate ROs. All outflow is typically released through the ROs. The dam is about 270 feet tall with top of dam at elevation 1,362 feet. Outflow is governed by the rule curve (a relationship between date and reservoir elevation to provide multipurpose use of the pool) and other project requirements.

Blue River Dam does not have a powerhouse and outflow is governed by the project rule curve and other streamflow requirements or special project requirements. Under all but emergency conditions, all outflow is released through the ROs. Blue River is one of the more "flashy" projects in the Willamette system. During significant winter storm events, it is not unusual for the project to fill 20 feet or more daily. During the lower flow summer season, the project can draw down quickly causing problems for recreational users.

2.2.1. Turbines

Blue River Dam has no turbines.

2.2.2. Spillway Gates

Blue River Dam has two radial tainter spillway gates and a spillway crest at elevation 1,321 feet. The Blue River Dam spillway gates are used relatively infrequently. The gates are controlled locally via a control panel with a mechanical dial detailing the spillway gate position, or through the SCADA system. The mechanical dial measures the amount of gate opening locally. The local dial is set to 0.5-foot increments. These settings limit the precision that flow changes can be made.

2.2.3. Regulating Outlets

Blue River has two ROs controlled with vertically sliding gates either locally or from the control room at Lookout Point. There is only one speed that the RO gates can be opened or closed. A staff gage is used to measure the opening locally. Readings on the staff gage are spaced at 0.1 foot and the SCADA dial is set to 0.01-foot increments. The precision of the gate adjustments limits the fine-tuning of RO flows.

2.3. Cougar Fish Facility

The Cougar Adult Fish Facility consists of a fish ladder, presort pool and crowder, three post-sort pools, and many other features that accommodate holding adult salmonids, bull trout, and other resident fish.

3. DAM OPERATIONS

3.1. Flow Management

3.1.1. Tributary Flow Targets

Cougar's minimum outflow is 300 cfs, except during June 1-30 when it is 400 cfs (Table C-1). During high flow conditions, the typical maximum evacuation rate at Cougar Dam is 5,000 cfs and the maximum evacuation rate is 6,500 cfs. In cases of unusual and sustained storm events, Cougar Dam's outflow may be increased gradually above the maximum evacuation rate using a prescribed formula to avoid passing inflow at the peak of the storm due to a full reservoir. Capacity of the

outflow through the turbines ranges between 900 and 1,100 cfs; with total dissolved gas (TDG) issues, it is preferable to keep Cougar outflow below 2,000 cfs. During the summer flow augmentation season, project maximum outflow is usually capped in order to balance flow from the various Willamette projects.

Table SFM-2. Flow Rates and Ramp Rate Requirements for Cougar Dam

Time Period or Criterion	Target
Evacuation of Stored Flood Water (> 1,200 cfs)	
Normal	5,000 cfs
Maximum*	6,500 cfs
Firm Power	750 cfs
High Flow Period	
Minimum Flow	300 cfs
Normal Maximum Flow* (for evacuation of stored flood water)	18,000 cfs
Rate of Increase per hour	
100-500 cfs	250 cfs
500-6,500 cfs	500 cfs
Maximum Rate of Increase per hour	750 cfs
Rate of Decrease per hour	
Maximum	20% of flow
Low Flow Period (< 1,200 cfs)	
Minimum Flow	
July 1-May 31	300 cfs
June 1-30	400 cfs
Maximum Rate of Change (increase)	200 cfs/hr
Rate of Change (decrease during nighttime)	
30-2,400 cfs	150 cfs/hr
> 2,400 cfs	0.1 ft/hr
Daytime of Decrease	0.2 ft/hr
Maximum Daily Decrease	1.0 ft/day or 50%

*Project outflows during major flood events may exceed these levels. Source: USACE 2009.

During high flow conditions at Blue River, the typical evacuation rate is 3,000 cfs and the maximum evacuation rate is 3,700 cfs (Table C-2). Similar to Cougar Dam, the project outflow may be increased gradually above the maximum evacuation rate using a prescribed formula to avoid passing inflow at the peak of the storm due to a full reservoir. During the summer flow augmentation season, maximum outflow is usually capped in order to balance flow from the various Willamette projects. In 2009, the recommended maximum outflow cap was no greater than 1,000 cfs with a full pool, and is gradually reduced to 50 cfs based on the amount of stored water.

Table SFM-3. Flow Rates and Ramp Rate Requirements for Blue River Dam

Time Period or Criterion	Target
Evacuation of Stored Flood Water	
Normal	3,000 cfs
Maximum*	3,700 cfs
High Flow Period	
Minimum Flow	50 cfs
Rate of Increase per hour	
50-100 cfs	50 cfs
100-500 cfs	100 cfs
500-1,000 cfs	200 cfs
1,000-2,000 cfs	400 cfs
2,000-3,700 cfs	600 cfs

Time Period or Criterion	Target
Rate of Decrease per hour	
Maximum	20% of flow
Low Flow Period	
Minimum Flow	
July-May	300 cfs
June 1-30	400 cfs
Maximum Rate of Change (increase)	200 cfs/hr
Rate of Change (decrease during nighttime)	
50-2,300 cfs	100 cfs/hr
> 2,300 cfs	0.1 ft/hr
Daytime of Decrease	0.2 ft/hr
Maximum Daily Decrease	1.0 ft/day or 50% of flow

* Project outflows during major flood events may exceed these levels.

3.1.2. Rates of Flow Change (24 hour, day and night)

Historically, ramping rates at Cougar Dam were limited to 500 cfs per hour during high flow and 200 cfs per hour during low flow (USACE 2000). Changes in river stage corresponding to these discharge ramping rates have not been defined. Up-ramping limits at Blue River Dam range from 50 cfs per hour at total project flows of 50-100 cfs to 600 cfs per hour at flows greater than 2,000 cfs (USACE 2000). The maximum down-ramping rate was 30% of total project discharge per hour. Ramping operations at Cougar and Blue River dams were modified in 2006 to reduce fishery impacts. Currently, the USACE attempts to maintain ramping rates of 0.1 foot/hour at night and 0.2 foot/hour during daylight hours except during active flood damage reduction operations (Tables SMR-2 and SMF-3).

During the winter high inflow period, Cougar Dam may decrease outflows at up to 500 cfs per hour. The allowance is for those cases where unanticipated conditions require flow reductions in order to control downstream control points for human health and safety considerations. At Blue River Dam, the project may decrease at rates up to 30% per hour with 20% per hour recommended. Whenever feasible, the project would attempt to adhere to the 0.1 foot/hour ramp down guideline. During the winter months when the reservoirs contain significant flood storage, water is evacuated pursuant to the water control manual requirements. In these cases, flow ramp ups at Cougar and Blue River are prescribed according to a sliding scale. For example, Cougar flows will be increased at 250 cfs per hour when initial flows are between 100 cfs and 500 cfs, ranging up to 750 cfs per hour when the flow range is above 6,500 cfs (Table C-1). At Blue River, ramp ups are slightly more constrained with starting hourly increases at 50 cfs per hour when initial flows are between 50 and 100 cfs, ranging up to 600 cfs per hour when the flow range is above 3,700 cfs (Table C-2).

3.2. Downstream Fish Passage

The USACE does not operate Cougar dam specifically for juvenile fish passage. However, past operations have been tested to facilitate downstream fish passage such as reservoir drawdown or using a regulating outlet.

Special, interim, and other operations to provide fish passage are listed below (see Fish Operations Appendix for more detail):

3.2.1. **Cougar Dam:** Flow through a regulating outlet may be prioritized to facilitate downstream fish passage and implementation will be dependent on regional prioritization.

3.2.2. **Blue River Dam:** None

3.3. Water Quality Management

3.3.1. Operations to Limit Total Dissolved Gas

If possible, flow will be capped during peak migration to minimize TDG levels during regulating outlet operations.

Special, interim, and other operations to minimize negative impacts from total dissolved gas levels are listed below:

3.3.1.1. **Cougar Dam:** When a unit is off line, there is a need to be able to maintain the lowest instream flow requirement (300 cfs) through the RO (Figure SFM-2). The RO should be able to pass 300 cfs (min flow) at maximum pool. The minimum gate opening at maximum pool would provide an estimated flow of 677 cfs. Although, a release of 677 cfs solely through the RO may result in elevated TDG levels downstream of Cougar Dam.

3.3.1.2. **Blue River Dam:** No recommendations at this time.

3.3.1. Operational Water Temperature Management

The Water Temperature Control tower is operated to meet temperature targets that emulate the historical normative temperature range.

Table SFM-4. Monthly Temperature Targets for the South Fork McKenzie below Cougar Dam

Month	Temperature Maximum/Minimum	
	°F	°F
January	40.1	40.1
February	42.1	41.0
March	42.1	41.0
April	45.1	43.2
May	49.1	46.0
June	56.1	51.1
July	61.2	54.1
August	60.3	54.1
September	56.1	52.3
October	49.1	47.1
November	44.1	43.2
December	41.0	41.0

Annual results for operational temperature control are provided in the Willamette Basin Annual Water Quality Report. These annual reports detail periods of non-conformance from the temperature targets, providing the duration and cause of the deviation.

3.4. Spill Management

3.4.1. **Cougar Dam:** When a unit is off line, there is a need to be able to maintain the lowest instream flow requirement (300 cfs) through the RO (Figure SFM-2). The RO should be able to pass 300 cfs (min flow) at maximum pool. The minimum gate opening at maximum pool would provide an estimated flow of 677 cfs. Although, a release of 677 cfs solely through the RO may result in elevated TDG levels downstream of Cougar Dam.

3.4.2. **Blue River Dam**. No recommendations at this time.

4. DAM MAINTENANCE

The annual maintenance periods discussed below for Cougar Dam is provided as applicable for the project and will be adhered to during annual maintenance planning. Potential effects on ESA-listed fish include temperature, TDG, and flow-related impacts downstream of Cougar Dam. Cougar Dam has two turbines allowing for maintenance to be completed on individual units without impacting flow. Maintenance that requires both turbine units to be offline should be completed during the time frame shown below to avoid impacts to fish downstream of Cougar Dam.

4.1. Cougar
Target outage periods:
Apr 1-May 31: Primary target period.
Jun 1-Oct 31: Restricted to one unit at a time in outage status.
Nov 1-Mar 31: Restricted from outage scheduling.

4.2.1. Considerations/Rationale for unit outage scheduling:
Apr 1-May 31: Spring Chinook salmon have mostly emerged and few sac fry are present.
Jun 1-Oct 31: Minimize outage to one unit because unit flow is used for fish attraction to the adult fish collection facility.
Nov 1-Mar 31: Generation outages are restricted in order to prevent high levels of TDG that has negative impacts on sac fry.

4.3. Blue River
Target outage periods:
No restrictions on outage periods

4.3.1. Considerations/Rationale for unit outage scheduling:
Outage periods have not been developed.

5. FISH FACILITY OPERATIONS

The Cougar Fish Facility is a complex system that must be operated carefully to maintain hydraulics for efficient fish passage. The facility O&M manual (see Appendix) contains specific information regarding operations.

The Cougar Fish Facility will be operated from April 1 to October 15 unless there is a need to extend operations.

5.1. Juvenile Fish

Juvenile fish will be passed upstream of Cougar Dam.

5.2. Adult Fish

Disposition of adult fish will be determined annually at the WATER Hatchery Management Team, vetted through WFPOM, and published or attached in the WFOP upon finalization.

5.2.1. Fish Collection and Handling

5.2.1.1. All adult trapping facilities shall be operated for adult spring Chinook salmon and winter steelhead in a manner that minimizes the duration of holding and delay.

5.2.1.2. All trapping, hatchery, and transport personnel must avoid excessive handling of adult fish to minimize stress and reduce the chance of injury.

5.2.1.3. All transfer of fish shall be completed through water to water transfers, unless logistically infeasible.

5.2.1.4. Sorting of adult spring Chinook salmon and winter steelhead for outplanting shall be completed in manner that minimizes stress and injury.

5.2.1.5. All efforts should be made to sort adult fish a single time and not multiple times as was done in the past.

5.2.1.6. Healthy fish should be used for both broodstock collection and outplanting efforts (to support reintroduction) to increase the probability of survival and should be representative of the run.

5.2.1.7. Sorting shall be completed to separate by species or origin (hatchery or natural origin) to ensure an adequate sex ratio for outplanting and brood production. To the extent possible, adjust the sex ratio of releases based on known differences in pre-spawning mortality between males and females to maximize reproductive success. Ensure an adequate number of females are outplanted to seed available habitat.

5.2.1.8. The Hatchery Management Team will develop the annual guidelines regarding when to outplant fish from each location and will be vetted through the WFPOM team. Collect fish on a regular basis throughout the run and outplant when collected, ensuring temporal outplants are representative of the run. However, pre-spawning mortality of early-released fish may be high and thus should be monitored to ensure effectiveness of this strategy. Fish will not be held longer than the agreed upon time to be developed through the WATER process.

5.2.1.9. During processing/sorting, the anesthetic used will be dependent upon whether a fish will be: for brood, returned to the fishery, outplanted, sampled for RM&E, or surplused (e.g. sold, food bank). Fish will be moved out of the trap quickly and frequently. Fish will be handled as gently as possible during processing and loading onto the truck, attempting to minimize stress and skin abrasions associated with handling.

5.2.1.10. Once fish are sorted, they will spend no longer than the allotted time that will be agreed to through the WATER process within holding tanks prior to being transported to their destination, which is determined by the fish disposition table. Environmental factors such as flow, fish health, and temperature will be considered.

5.2.1.11. The fish trap will be checked at least twice a day, first in the morning, and then in the late afternoon to avoid having fish spend too much time in the trap and to assess the overall density of fish within the trap.

5.2.1.12. Fish will be removed and placed in holding tanks with a density approximately 25 gallons of water per fish. Adult holding will reflect IHOT and NMFS recommendations.

5.2.1.13. Oxygen levels in the holding tank water should not exceed saturation (100%) or drop below 7 parts per million (7 mg/L), however, spill during the wet and flood risk reduction season may preclude meeting this guideline.

5.2.1.14. Experiment with reduced dependence on, or eliminating prophylactic antibiotic treatments.

5.2.1.15. The fish disposition table, developed collaboratively by HMT and approved by NMFS, will be used to guide the management of anadromous and resident fish as they are encountered in adult fish traps.

5.2.1.16. MS-222/CO_2/AQUI-S 20E. At fish handling facilities in the Willamette Basin operated by ODFW, the ODFW and ODEQ have agreed upon a process of dispersal and evaporation (or volatilization) for the disposal of water treated with anesthetics, which are highly volatile substances. The USACE will continue to use eugenol (clove oil) at USACE-operated adult fish trapping facilities (Cougar and Fall Creek).

5.2.1.17. Avoid multiple handling/anesthesia of fish during sorting for outplanting or brood production.

5.2.2. Transport and Outplanting

5.2.2.1. All transport tanks will be treated with NovAqua® or equivalent per manufacturer's instructions to reduce stress during transport.

5.2.2.2. Transport adult spring Chinook at a density of ≥ 25 gallons of water per fish (60 fish/1,500 gallon tank).

5.2.2.3. Oxygen levels above 100% should be minimized in the transport truck or should not drop below 7 parts per million [7 milligrams per liter (mg/L)].

5.2.2.4. All trapping, hatchery, and transport personnel must adhere at all times to existing ODFW policies and procedures to reduce the transfer of pathogens.

5.2.2.5. *No handling* will occur at adult trapping facilities when water temperatures exceed 70°F in the pre-sort pool.

5.2.2.6. In certain situations, the transfer of fish for outplanting or to cooler hatchery waters may occur if fish are being held, or may be held, in waters exceeding 70°F for an extended period of time. Coordination with NMFS prior to transfer and notification to the WFPOM Team is required under these circumstances.

5.2.2.7. When outplanting adult spring Chinook salmon, receiving water temperature shall be less than 68°F *as measured prior to release*.

5.2.2.8. Monitoring of water temperature can be completed using USGS gages or temperature meters, where available.

5.2.2.9. Drivers will measure the temperature of the water in the transport tank and the receiving water prior to releasing the fish.

5.2.2.10. If the temperature difference between the receiving water and tank water is > 7°F, the water will be tempered to a difference of < 5°F at a rate of 1°F/6 minutes.

5.2.2.11. Fish facility personnel are responsible for recording the holding pool water temperature prior to transport, liberation truck water temperatures, and receiving water temperature upon release.

5.2.2.12. If liberation truck waters require tempering, beginning and end temperature as well as time required for acclimation will also be recorded.

5.2.2.13. All outplanting shall be completed at designated outplanting sites consistent with the appropriate disposition table for each subbasin. Releases shall be made in a manner to minimize stress and chance of physical injury. In-season variances to either outplant site use, fish disposition, or other outplanting protocols can be completed with agreement from the WFPOM Team with notification provided to the WATER Steering Team. NMFS must agree to any in-season variances proposed by the WFPOM Team before the action is taken.

5.2.2.14. Release trucks shall have a minimum of a 12-inch opening on all. Discontinue use of collapsible tubes and use 16- to 20-inch smooth walled PVC pipe to convey fish from the

truck to the stream. Set pipes at proper discharge angle and use discharge chutes. Use a water spout to flush fish from the truck. Avoid abrupt changes in temperature. Release fish early in the day whenever possible. If receiving waters are known to be too warm at certain times of year, release fish when or where waters are cooler. Investigate the options to improve survival such as holding fish in a hatchery pond and treating with antibiotics until they are ready to spawn, at which time they would be released. Releasing ripe fish may limit numbers outplanted and potentially reduce pre-spawning mortality.

5.2.2.15. Fish liberation truck driver and/or trained volunteer will observe released fish and document any mortality and unusual behavior after release.

5.2.2.16. All truck drivers will complete an adult salmonid outplant form to document oxygen levels, temperatures in the tank and release stream, immediate mortalities, loading densities, and release method. These data will be used to enable better monitoring of outplanted fish.

5.2.2.17. Hauling frequency will depend on factors that include run size, stream temperatures, and transport/ holding constraints. Some fish will likely be held prior to outplanting to some extent depending on these constraints. Unless environmental conditions in areas where fish are to be transported are poor, hauling frequency should be such that it minimizes holding times to no more than 24 hours.

5.2.2.18. It is the intent to reduce holding times and complete outplanting as soon as possible upon a fish's return to the adult trapping facility. Given the typical adult monthly return timing and abundance observed, expected hauling frequencies are:

Transport Period	Hauling Frequency
April 1 - October 15	2 times per week (more frequent if needed on returns to facility

5.2.2.19. The current program involves releasing fish according to the targets identified in Table NS-4. Detailed protocols for the disposition of excess hatchery fish will be contained in the WFOP. These goals will be updated annually by the WATER Hatchery Management Team and vetted through WFPOM team. When numerical adult abundance recovery goals are established for the North Santiam spring Chinook salmon population through the recovery planning process, these targets will be adjusted accordingly.

Table SFM-5. Number of Adult Spring Chinook to be Outplanted

Release Site	Distance (miles)	Transport time (minutes)
South Fork McKenzie Upstream of Cougar Dam	35	120
McKenzie River Upstream of Trail Bridge Dam	45	120
Mohawk River	35	100

Table SFM-6. Outplanting Release Sites

Release Site
Hard Rock (12 river miles above Cougar Reservoir)
430 Bridge (18 river miles above Cougar Reservoir)

6. FISH FACILITY MAINTENANCE

6.1. The proposed maintenance period where a shutdown is required for the ladder will be from **October 16 to March 1**. The following will be performed during the maintenance period:

6.1.1. All staff gages and water level indicators will be inspected, cleaned, and repaired as necessary.

6.1.2. The fish ladder will be dewatered and inspected for debris, projections, or clogged orifices that could injure or impede fish. Necessary repairs will be completed at this time.

6.2. The proposed maintenance period where a shutdown is required for the post sort pools will be from **October 16 to March 1**. The following will be performed during the maintenance period:

6.2.1. All staff gages and water level indicators will be inspected, cleaned, and repaired as necessary.

6.2.2. The pools will be dewatered and inspected for damage, cracks, debris, or projections that could injure fish. Necessary repairs will be completed at this time.

6.2.3. Specific maintenance activities listed for monthly, quarterly, and annual actions will be appended to the WFOP.

7. INSPECTIONS, REPORTING, AND NOTIFICATIONS

7.1. Fish facility inspections will be performed in accordance with guidelines in the operations and maintenance (O&M) manual.

7.2. The results of all inspections and the readiness of the facilities for operation will be reported to the Willamette Fish Passage Operations and Maintenance Team (WFPOM) by March 1.

7.3. More frequent inspections will occur as requested by the WFPOM Team or at any time by facility personnel. During the field season, WFPOM members will visit fish facilities to evaluate adherence to protocols and SOPs. The site visit assessment activities include observing fish sorting and handling procedures. A check sheet will be filled out and initialed indicating whether procedures are or are not being performed according to protocol. Protocol drift for any activity must be reported to the immediate supervisor and corrective actions must be implemented immediately.

7.4. Fish trapping facilities will be initially inspected prior to being removed from service for the year to assess facility condition and maintenance needs.

7.5. Staff gages and other water-level sensors will be installed, cleaned, and/or repaired as required to allow for monitoring facility performance.

7.6. Fish facility personnel shall prepare monthly reports throughout the year summarizing project operations. These monthly reports will provide an overview of how the project operated during the prior month.

7.7. The reports shall cover a monthly period and they shall be provided to WATER stakeholders at monthly WFPOM Team meetings and recorded in a record of the meeting minutes.

7.8. The reports shall include:

7.8.1. Any out-of-criteria situations, observed deviations from the WFOP, and subsequent corrective actions taken.
7.8.2. Any equipment malfunctions, breakdowns, or damage along with a summary of resulting repair activities.
7.8.3. Progress in reaching outplant numbers targeted in the fish disposition table.
7.8.4. Mechanical and/or structural issues preventing optimum facility operation.
7.8.5. General hatchery operations including trap counts, transfer information, juvenile releases, and updates on hatchery research.
7.8.6. Adult outplanting data documenting release locations, numbers released, any observed transport or liberation mortalities, holding, transport and receiving water temperatures, and poaching/harassment issues.
7.8.7. Any adult mortality that occurs within the trapping facility during holding or handling prior to transport and must documents species, origin, size, marks/injuries, cause and time of death, and future preventative measures. When mortality occurs, this should also be reported immediately to USACE that will be included in a memorandum to the Services.
7.8.8. Adult mortalities should be reported as soon as possible to the Services.

7.9. The facility operator will produce an annual report summarizing the species, number, origin, and destination of all fish collected at USACE fish facilities in the Willamette Basin, as well as all BiOp deviatons. This annual report will be a summary of the monthly or quarterly progress reports. The report shall assist in identifying potential operational changes. Reporting may be included in baseline hatchery monitoring or the annual hatchery operations reports and provided at specified dates (WFOP, contract, cooperative agreement).

7.10. Hazardous Spills. Hazardous spill notification will continue to be completed through the Oregon Emergency Response System (OERS). This system provides 24-hour service through Oregon Emergency Management of the Department of State Police. Local public safety agencies such as law enforcement, fire and emergency medical services normally provide the first response to an incident. Access to this local assistance is through 9-1-1. Once notified, local public safety agencies would call OERS at 800-452-0311 or in the Salem area at 503-378-6377. If necessary, responsible parties would then call the National Response Center at 800-424-8802. The USACE operations fisheries biologist will be included as an initial contact to address any immediate fisheries response needs, as well as to provide additional notification directly to the Services. Although the OERS serves to disseminate spill response notification to both the state and federal fisheries agencies, the USACE operations fisheries biologist will notify the Services directly of the incident.

7.11. Any poaching, suspicion of poaching activities or observed harassment of outplanted fish shall be reported immediately to the Oregon State Police at 1-800-452-7888.

7.12. The annual report will be distributed to the members of the WFPOM Team.

8. DEWATERING PLAN

Fish facilities and turbines are drained for regularly scheduled maintenance and sometimes for emergency maintenance. These activities may involve handling fish and could cause other adverse effects on juvenile and adult fish in the watershed (e.g. stranding of fish in the reservoir). This plan is subject to change as improvements are developed and will be revised on an annual basis as part of the WFOP. Not all dewatering efforts will require fish salvage; as such, the need will be determined by USACE and ODFW fish biologists.

8.1. Coordination

8.1.1. Facility outages will be scheduled to minimize impact on fish while accomplishing necessary repairs and maintenance on facilities. Specific outages will be scheduled according to maintenance periods detailed in appendices. Fish facility personnel (either ODFW or USACE) will coordinate these activities with Portland District Operations Division fishery biologists and will ensure that the fisheries agencies, particularly those whose activities may be impacted, are kept informed. Primary points of contact include ODFW, NMFS, and USFWS.

8.1.2. The Willamette Project Supervisory Fisheries biologist coordinates fishway dewatering and salvage activities with the project operations and maintenance supervisor. This includes having the appropriate personnel and equipment on site. The designated fish facility lead, likely the Operations Division project biologist for USACE operated facilities, or an ODFW hatchery manager for ODFW operated facilities, directs execution of the drainage plan at least until fish removal is complete. Before or at the beginning of each draining operation, a pre-work briefing will be held to explain procedures, responsibilities and safety considerations for all participants. After the salvage activity, lead personnel are responsible for reporting species, number, and condition of fish. The reporting template is attached at the end of the document and will be provided to the WFPOM Team.

8.2. Fish Handling

8.2.1. When facilities are drained, a primary objective is to minimize stress and injury to all fish. Generally, the best way to protect fish during facility draining is to avoid having to handle them. Instructions for draining most facilities involve steps, such as operating with low ladder flow just prior to draining, intended to minimize handling fish by encouraging the fish to exit the ladder. When it is necessary to handle fish, they are handled in plenty of fresh water, if possible. Holding fish in nets unnecessarily is avoided (e.g., tank or fish bag not ready). When it is necessary to transport fish in bags, ensure that the salvage bags contain a sufficient amount of water and that fish return to fresh water as soon as possible.

8.2.2. Tanks should be large enough to carry plenty of water with the fish. Tanks should be covered to keep fish from leaping out. When large numbers of fish are placed in a tank, supplemental oxygen will be used to increase the level of dissolved oxygen. Reduce fish concentration when river temperature is greater than 65°F. During warm weather, the temperature in tanks will be monitored and kept within 2°F of the river release point temperature. Further, the time fish are kept in tanks will be minimized and not exceed 2 hours.

8.2.3. Fish will be released at a predetermined site. However, when the tank contains a mixed load, it can be released into the forebay or tailrace depending upon the recommendation of lead personnel.

8.2.4. When it is necessary to prioritize attention to different species, generally ESA-listed species and adult salmonids should be helped first. Lamprey are relatively stress resistant and can be collected as a lower priority. However, their numbers are declining and care should be given to salvage them, as well as the more sensitive fish. All fish are to be salvaged.

8.3. Adult Fish Trap/Ladder

The general procedures for draining the adult fish trapping facilities are described below.

8.3.1. **Prior to Dewatering**

8.3.1.1. 24 to 48 hours before draining, stop attraction flow by minimizing auxiliary water flow.

8.3.1.2. For at least 24 hours before dewatering, but not longer than 96 hours, operate the ladder at orifice flow.

8.3.2. **On Dewatering Day**

8.3.2.1. Convene safety meeting before starting activity. Describe the procedure for all participants and assign responsibilities (ensure clearances are in place)
8.3.2.2. Stage fish bags or transport tank.
8.3.2.3. Place ladder near the pre-sort holding pool
8.3.2.4. The water supply level to the ladder should be reduced to approximately 1” to 2”.
8.3.2.5. Begin visual inspection of ladder for stranded fish. Salvage personnel will need to access any pools where fish are stranded and either remove the stranded fish and put into a fish bag or tank or, if the fish is close to the entrance pool, gently guide fish down the ladder to the entrance pool.
8.3.2.6. Drain pre-sort holding pool.
8.3.2.7. Salvage fish with a net and put them into a fish bag
8.3.2.8. Place fish from fish bag into post sort holding raceway for transport or into recovery tank for direct release to the river.
8.3.2.9. Shut down facility water supply when fish salvage is complete.

8.3.3. Fish Salvage Equipment

The following fish salvage equipment is required.

8.3.3.1. Dip nets/buckets
8.3.3.2. Fish salvage bags
8.3.3.3. Seine
8.3.3.4. Extension ladder for access into the fish ladder
8.3.3.5. Fish truck with oxygen bottle
8.3.3.6. Personal protection equipment such as life vests/float coats, fall protection (harness/lanyard), waders w/felt soles, gloves (sealskins), hearing protection, and hardhats
8.3.3.7. Communication devices
8.3.3.8. Submersible pumps

9. FOREBAY DEBRIS REMOVAL

9.1. Debris at projects can adversely impact fish passage conditions. Debris can plug or block trashracks, VBSs, gatewell orifices, dewatering screens, separators, and facility piping resulting in impingement, injuries, and descaling of fish. Removing debris at its source in the forebay is sometimes necessary to maintain safe and efficient fish passage conditions, navigation, and other project activities. Debris can be removed from the forebay by:

9.2. 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;
9.3. Removing the debris from the top of the dam using a crane and scoop;
9.4. Passing debris through the spillway with special powerhouse and/or spill operations; or

9.5. 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).

2016 Fish Passage Plan
Chapter 5 – Middle Fork Willamette Subbasin

Table of Contents

1. MIDDLE FORK WILLAMETTE SUB-BASIN OVERVIEW 1
2. FACILITIES 8
2.1. Hills Creek Dam 8
2.2. Lookout Point Dam 9
2.3. Dexter Fish Facility 9
2.4. Fall Creek Fish Facility 10
3. DAM OPERATIONS 10
3.1. Flow Management 10
3.2. Downstream Fish Passage 13
3.3. Water Quality Management 13
3.4. Spill Management 14
4. DAM MAINTENANCE 15
5. FISH FACILITY OPERATIONS 16
5.1. Juvenile Fish 16
5.2. Adult Fish 16
6. FISH FACILITY MAINTENANCE 19
7. INSPECTIONS, REPORTING, AND NOTIFICATIONS 20
8. DEWATERING PLAN 21
9. FOREBAY DEBRIS REMOVAL 23

1. MIDDLE FORK WILLAMETTE SUB-BASIN OVERVIEW

1.1. The Middle Fork Willamette subbasin drains about 1,370 square miles (Figure MFW-1). Four projects were constructed by the U.S. Army Corps of Engineers (USACE) in the subbasin. Hills Creek at river mile (RM) 47.8 on the Middle Fork Willamette River was completed in 1961. Lookout Point at RM 19.9 and Dexter at RM 16.8 on the Middle Fork Willamette River were completed together in 1955. Fall Creek Dam on Fall Creek (RM 7.9) was completed in 1965.

1.2. The subbasin is inhabited by Upper Willamette River (UWR) spring Chinook salmon, Oregon chub, and bull trout.

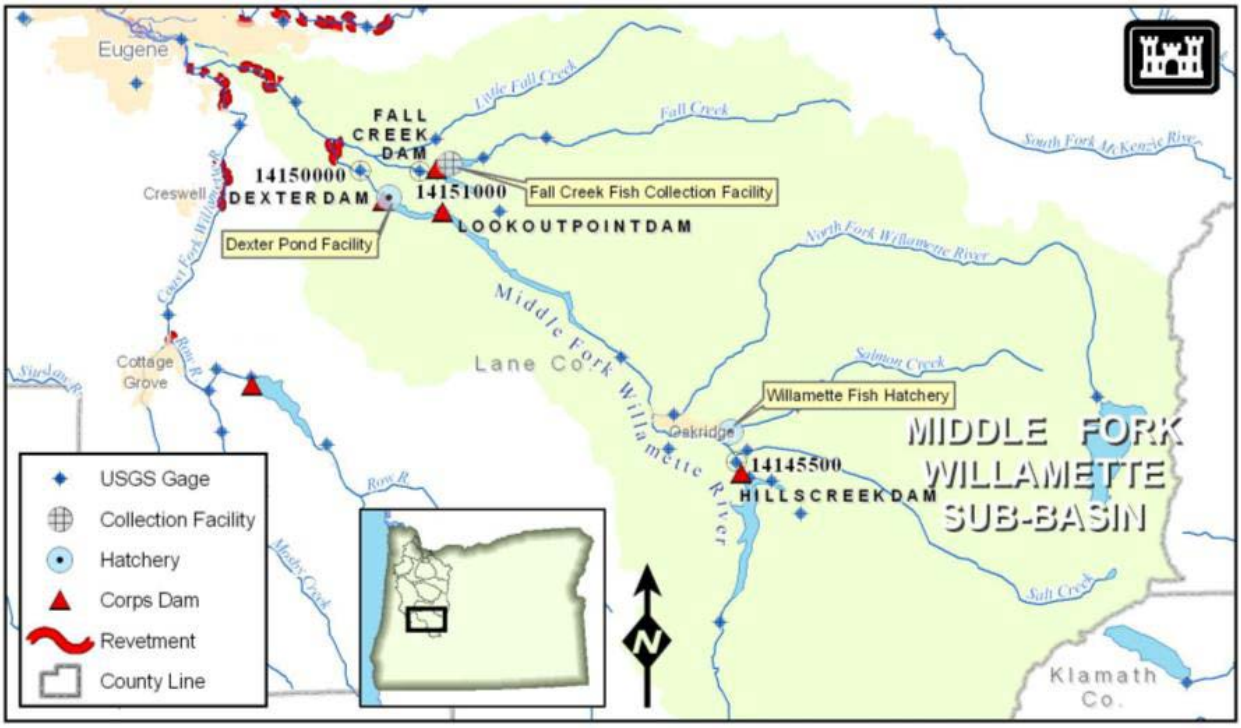


Figure MFW-1. Middle Fork Willamette Subbasin

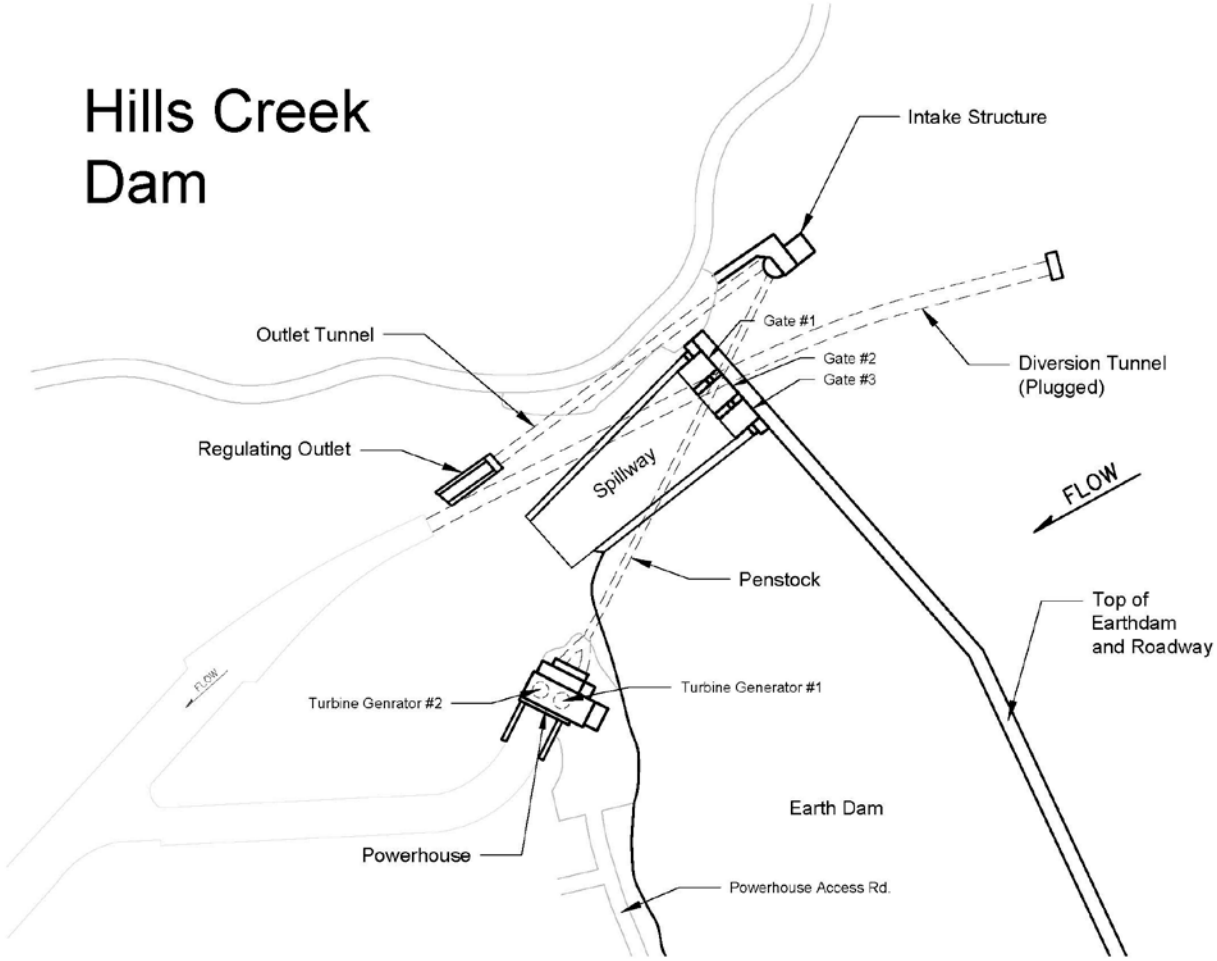


Figure MFW-2. Hills Creek Dam

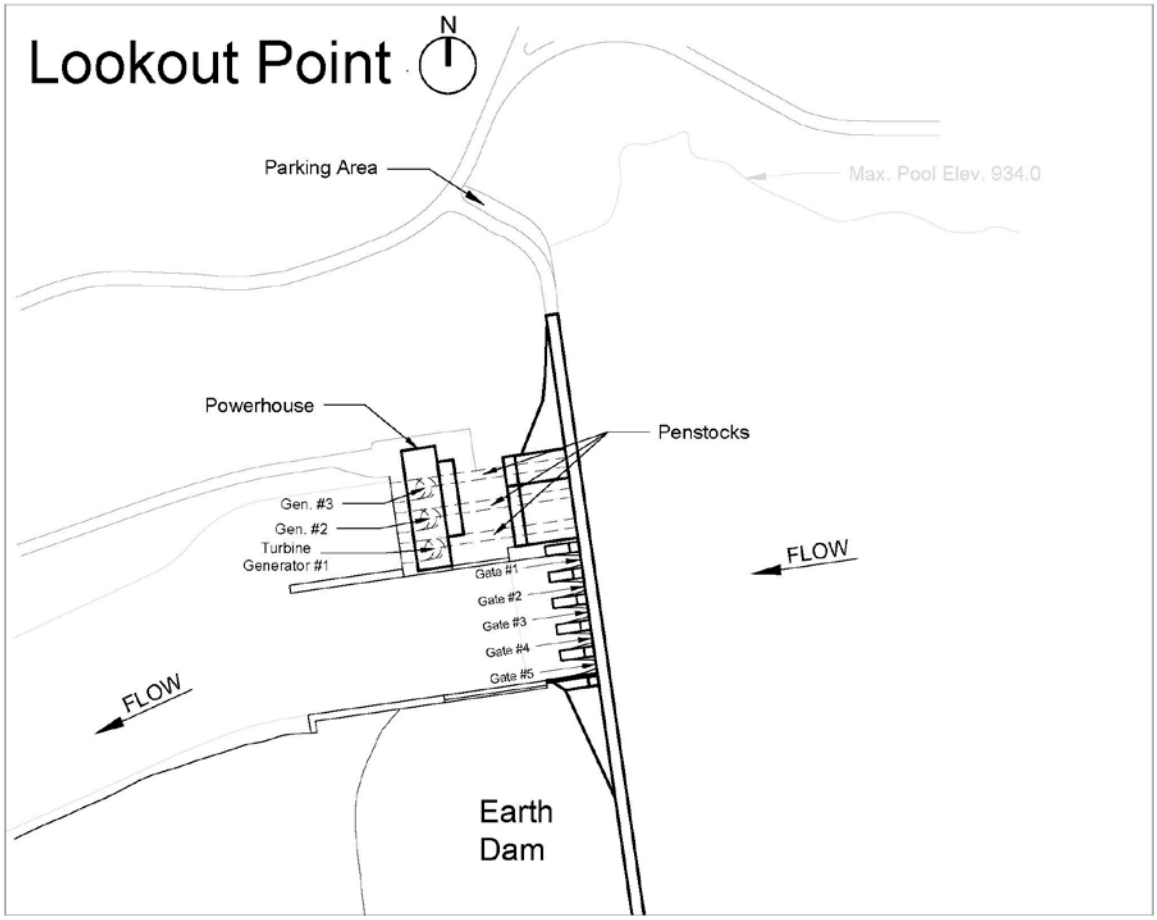


Figure MFW-3. Lookout Point Dam

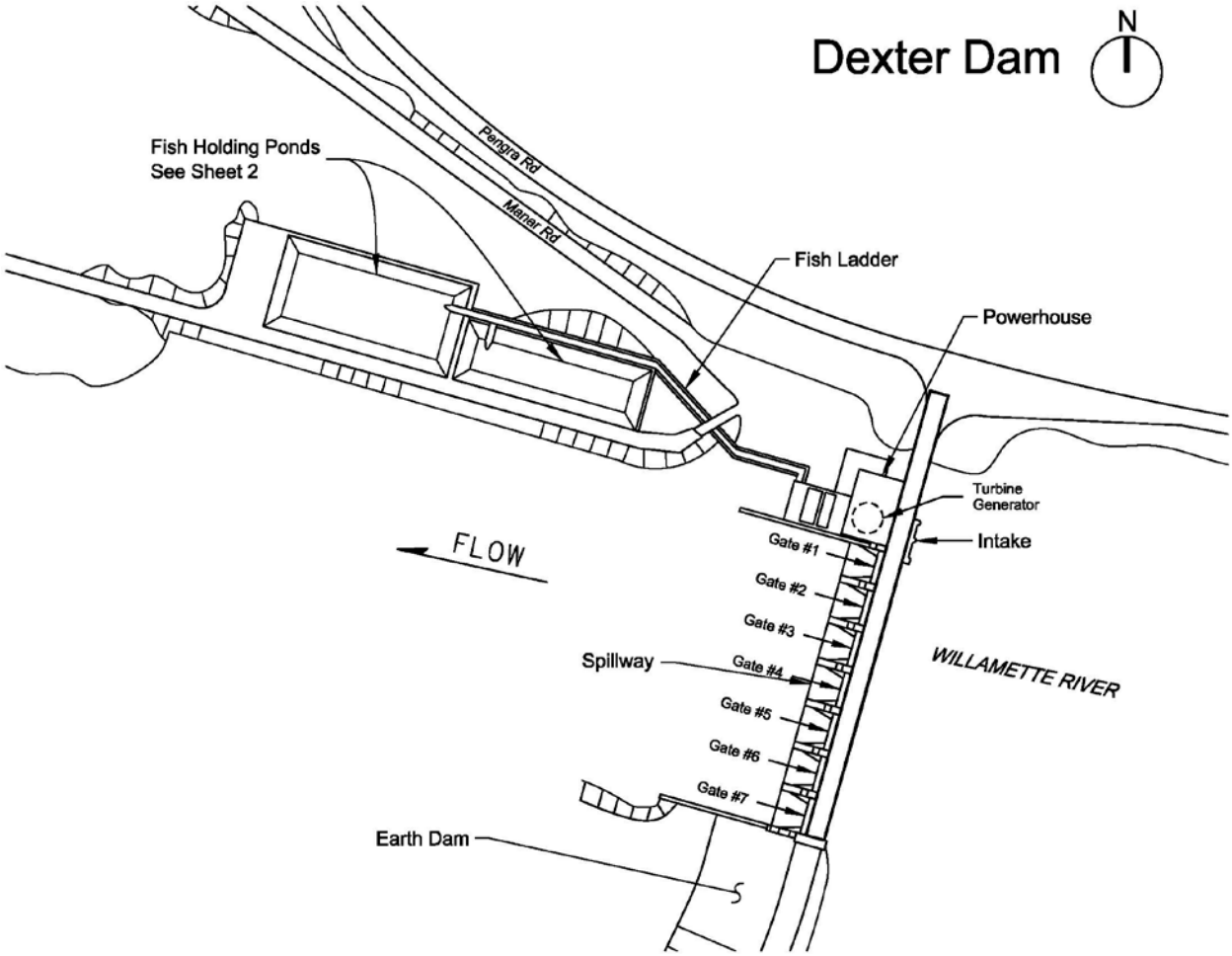


Figure MFW-4. Dexter Dam

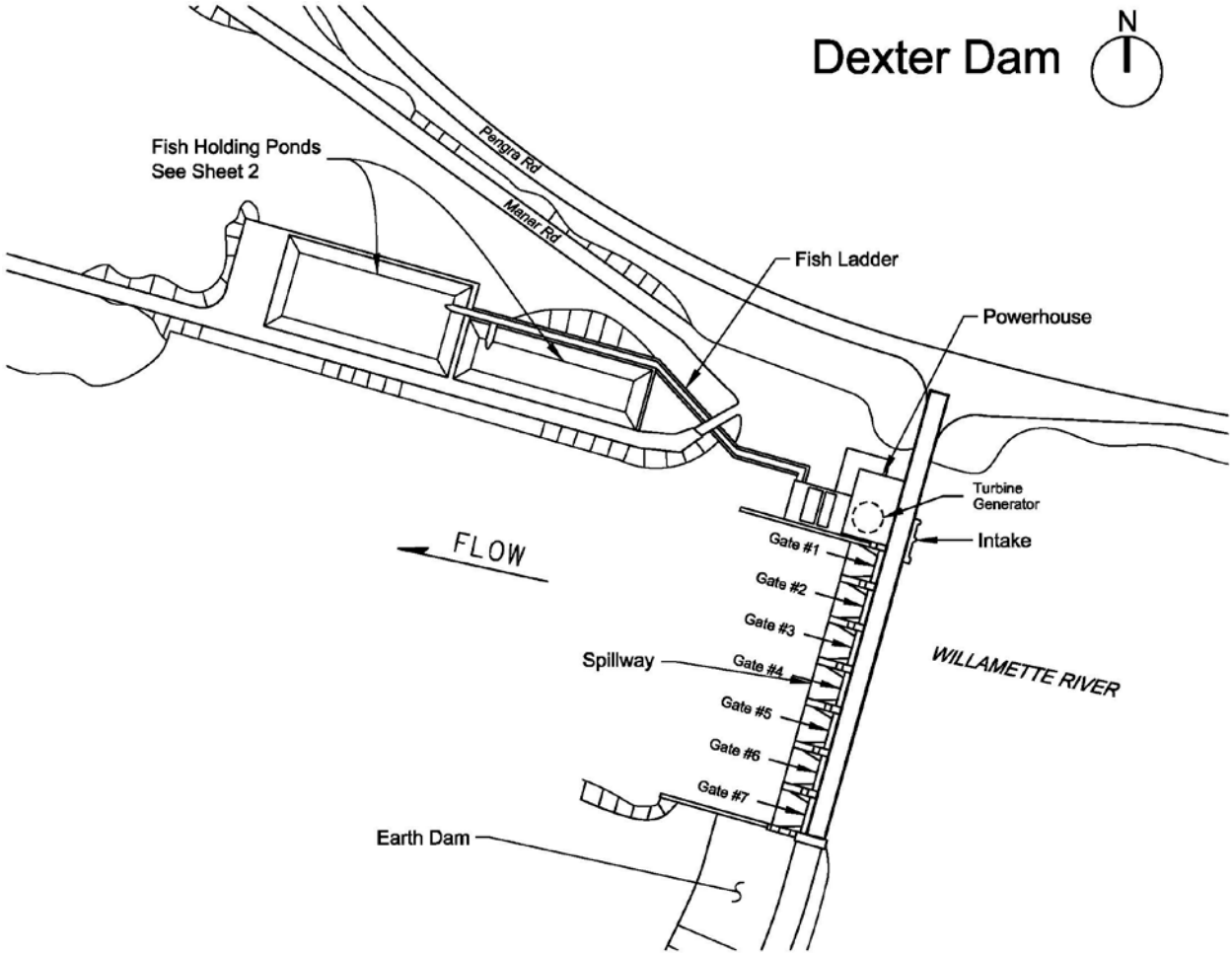


Figure MFW-5. Dexter Fish Facility

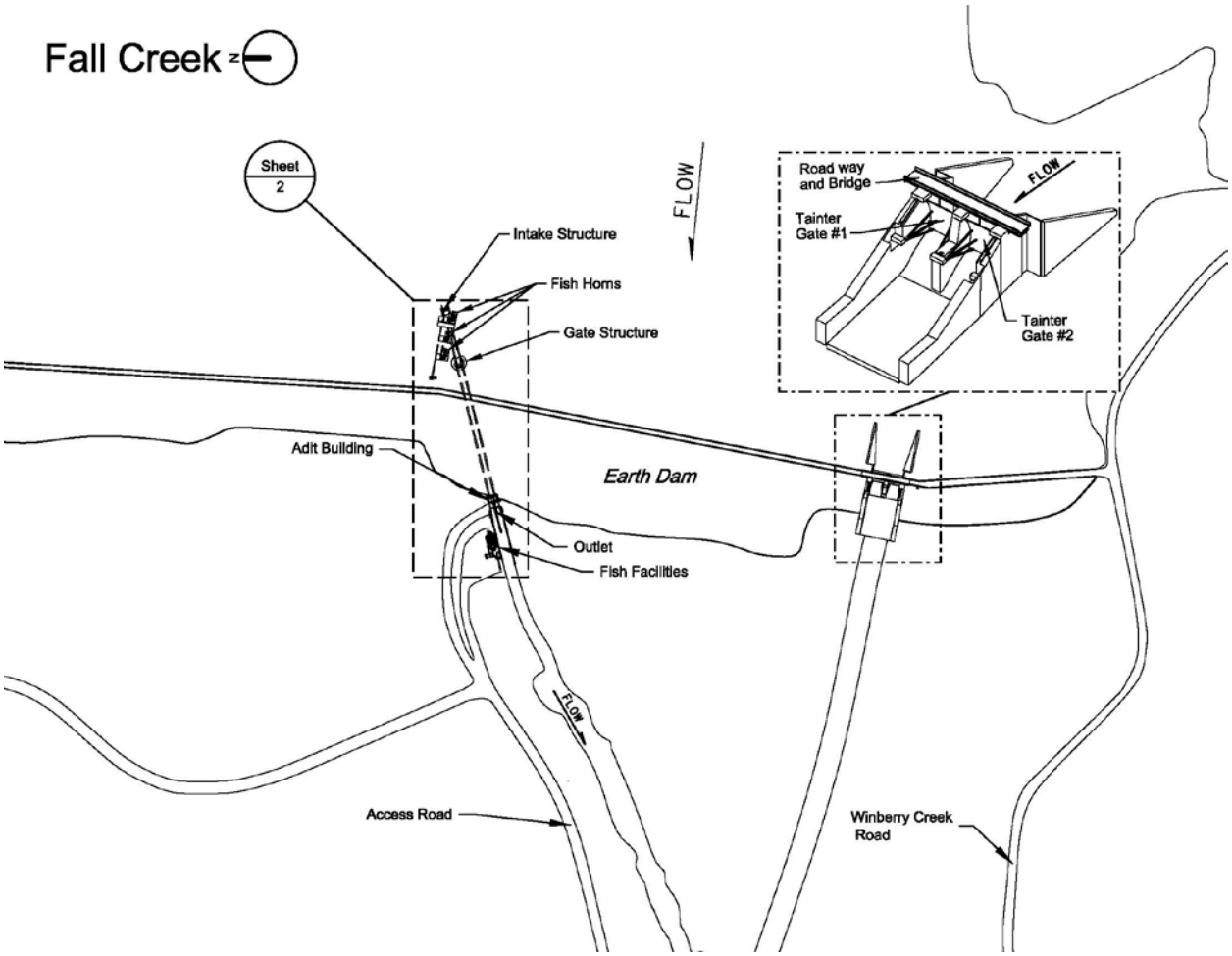


Figure MFW-6. Fall Creek Dam

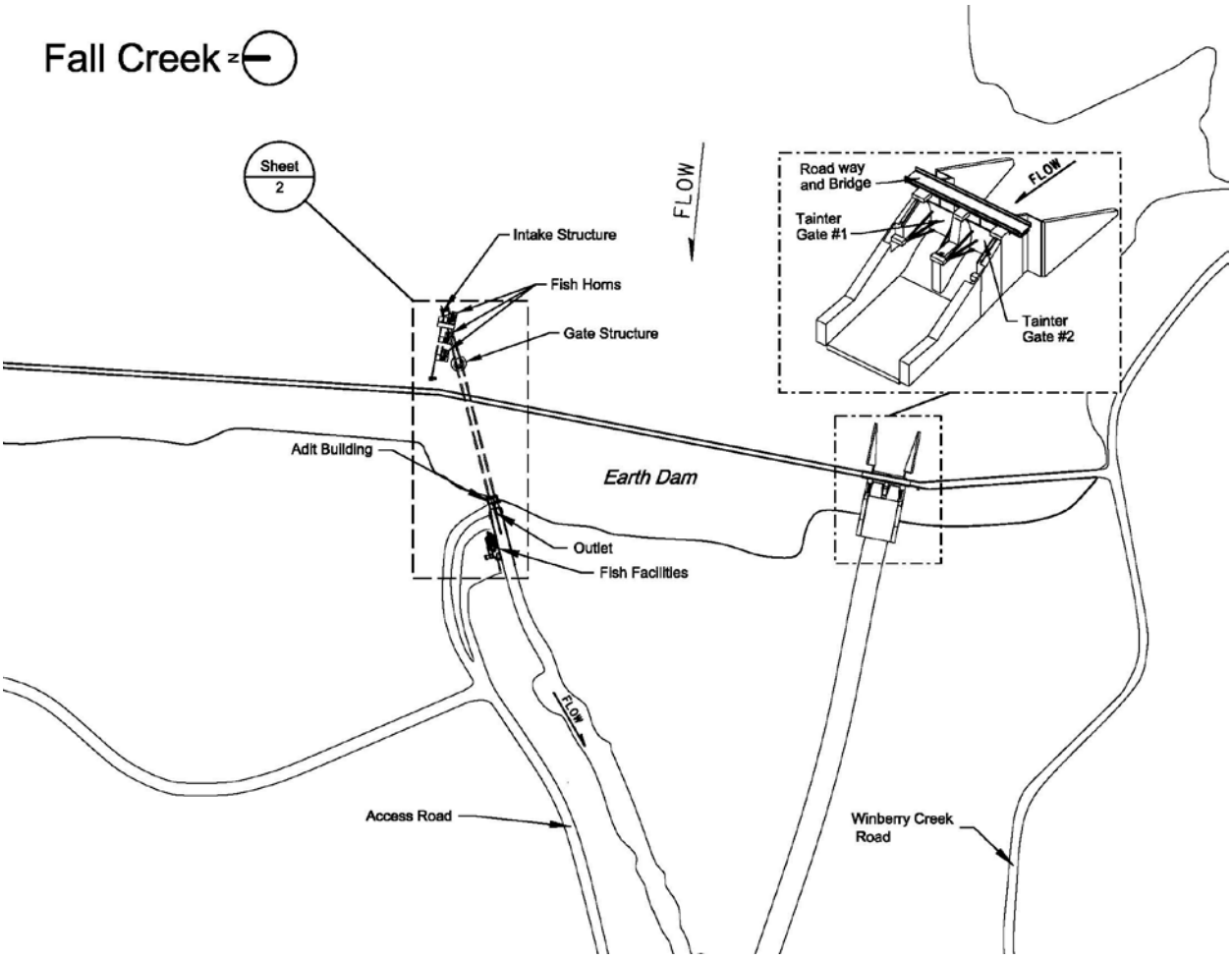
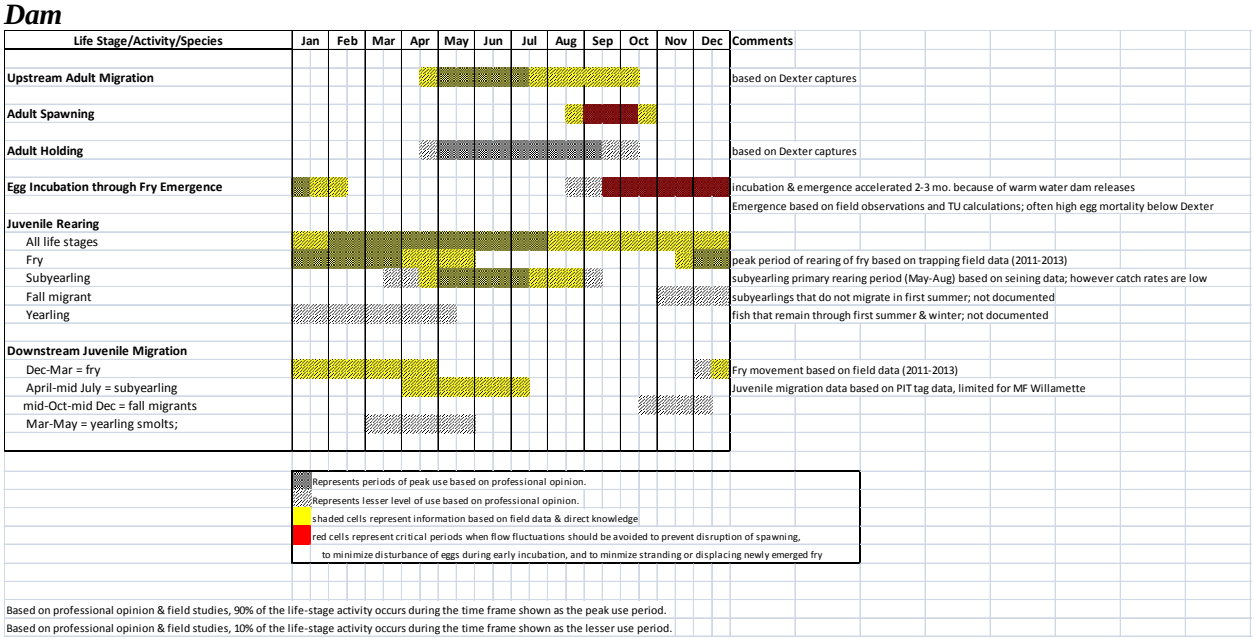


Figure MFW-7. Fall Creek Fish Facility

Table MFW-1. Periodicity Table for Spring Chinook in the Middle Fork Willamette below Dexter Dam



2. FACILITIES

Fall Creek enters the Middle Fork Willamette River below Dexter Dam, while releases from Hills Creek and Lookout Point are reregulated by Dexter Dam on the Middle Fork Willamette. Current conditions below Dexter constrain potential Chinook salmon in-river production due to inadequate spawning and incubation temperatures, a result of water management operations in the subbasin. Fall Creek Dam is operated to assist with juvenile outmigration in the winter months through an enhanced reservoir draw-down. No operations are performed at Dexter, Lookout Point, or Hills Creek to support juvenile downstream fish passage.

Hills Creek, Dexter, and Fall Creek are all operated remotely via the Supervisory Control and Data Acquisition (SCADA) system. Lookout Point does not use the SCADA system and all control is handled locally. The precision of the SCADA controls or equipment are not finely tuned enough to adjust the amount of water through Lookout Point to meet small flow changes as required by the project schedule. Additionally, there can be a lag time (30-60 minutes) from when an operational change is made at and when the control can verify the change recorded at the nearest downstream U.S. Geological Survey (USGS) gages (Dexter gage #14150000, Fall Creek gage #14151000).

2.1. Hills Creek Dam

Hills Creek is a multi-purpose storage project that operates to meet the authorized purposes of flood damage reduction, irrigation, hydropower generation, recreation, navigation, municipal and industrial water supply, and improved downstream water quality. The dam is an earthfill structure with gated concrete spillway containing three tainter gates. Maximum dam height is about 300 feet with the top of dam at elevation 1,548 feet. There are two slide regulating gates and two emergency regulating gates. The powerhouse has two turbines that can produce a total of 30 megawatts (MW). The project is operated using turbines and regulating outlets (RO), if needed. The spillway is only for emergencies. Hills Creek operates as a base load project, conforming to flow limits and ramping rates as described in Table D1. Flow and power generation are primarily functions of reservoir levels

and the amount of storage in Lookout Point, other streamflow requirements, and special project considerations.

2.1.1.Turbines

Hills Creek Dam has two Francis turbines rated at 15 MW each. The combined hydraulic capacity through the turbines at Hills Creek Dam ranges from 1,500 to 1,700 cubic feet per second (cfs) depending on head. Turbines are adjusted by making changes to the wicket gate openings. Small flow changes can be difficult due to wicket gate limitations.

2.1.2.Spillway Gates

Hills Creek Dam has two radial tainter spillway gates and a spillway crest at elevation 1,495.5 feet. The spillway is used only for emergencies.

2.1.3.Regulating Outlets

Hills Creek Dam has two ROs that are controlled with vertically sliding gates either locally or from the control room at Lookout Point. At Hills Creek, an RO gate currently has a set point of 1 foot in case the turbine wicket gate openings go to zero indicating the turbines have tripped off. There is only one speed that the RO gates can be opened or closed. A staff gage is used to measure the opening locally. Readings on the staff gage are spaced at 0.1 foot and the SCADA system dial is set to 0.01-foot increments. The precision of the gate adjustments limits the fine-tuning of RO flows which increases the probability of missing a target flow.

2.2. Lookout Point Dam

Lookout Point is a multi-purpose storage project that operates with Dexter to meet the same authorized purposes as Hills Creek Dam. The dam is earth and gravel-fill with a concrete-gated spillway. The spillway has five spillbays and four regulating outlets.

2.2.1.Turbines

Lookout Point has three Francis turbines rated at 40 MW each. The combined hydraulic capacity through the turbines ranges from 7,200 to 8,100 cfs depending on head. Turbines are adjusted by making changes to the wicket gate openings. Small flow changes can be difficult due to wicket gate limitations.

2.2.2.Spillway Gates

Lookout Point Dam has five radial tainter spillway gates. The spillway crest is at elevation 887.5 feet. The gates can be controlled locally via a control panel with a mechanical dial detailing the spillway gate position. Lookout Point has no set point for the spillway because it is staffed 24 hours a day so the operator on duty takes any necessary actions.

2.2.3.Regulating Outlets

Lookout Point Dam has four ROs. The ROs are not used when the pool level is above 915 ft. There is only one speed that the RO gates can be opened or closed. A staff gage is used to measure the opening locally. Readings on the staff gage are spaced at 0.1 foot. The precision of the gate adjustments limit the fine-tuning of RO flows. The dial used to make RO changes at Lookout Point is highly inaccurate.

2.3. Dexter Fish Facility

The Dexter Fish Facility consists of a fish ladder, adult holding pond, fish lock, and a sorting area. The facility also had 4 raceways and an asphalt pond used for rearing juvenile salmonids.

2.4. Fall Creek Fish Facility

The Fall Creek Fish Facility consists of a fish ladder, presort holding pond, fish crowder, and a hopper.

3. DAM OPERATIONS

3.1. Flow Management

3.1.1. Tributary Flow Targets

Hills Creek operates as a base load project, conforming to flow limits and ramping rates shown in Table D-1. Flow and power generation is primarily a function of reservoir levels and amount of storage in Lookout Point, other streamflow requirements, and any special project considerations. Minimum outflows are set at 400 cfs year-round. The normal high evacuation rate is 6,000 cfs and the maximum evacuation rate is 8,000 cfs (Table D-1). For unusual and sustained storm events, project outflow may be increased gradually above the maximum evacuation rate using a prescribed formula to avoid passing inflow at the storm peak due to a full reservoir. Outflow above about 12,000 cfs (assuming both turbines and ROs are available) would require use of the spillway, which could impact the powerhouse.

Table MFW-2. Flow Rates and Ramp Rate Requirements for Hills Creek Dam

Time Period or Criterion	Target
High Flow (> 2,000 cfs)	
Minimum Flow	1,000 cfs
Normal Maximum Flow* (for evacuation of stored flood water)	17,000 cfs
Normal Rate of Increase per hour	
100-1,000 cfs	500 cfs
1,000-3,000 cfs	1,000 cfs
3,000-17,000 cfs	1,500 cfs
Maximum Rate of Increase per hour	2,000 cfs
Maximum Rate of Decrease per hour	20% of flow
Low Flow (< 2,000 cfs)	
February 1 – March 15	1,000 cfs
March 16 – May 31 (winter steelhead spawning)	1,500 cfs
June 1 – July 15 (winter steelhead incubation)	1,200 cfs
July 16 – Sept 4 (rearing)	1,000 cfs
Sep 5 – Oct 30 (Chinook spawning)	1,500 cfs
Nov 1 – Jan 31 (Chinook incubation)	1,200 cfs
Rate of Change (increase)	
Normal	based on a tailwater change of 0.3 feet/hour (ft/hr) and 0.5 ft/day
Special	use when there is an emergency – power requirements, boating accident; based on a tailwater change of 0.3 ft/hr and 0.5 ft/day
Rate of Change (decrease)	

Time Period or Criterion	Target
Maximum Rate	- 0.1 ft/hr nighttime hrs, -0.2 ft/hr daytime hrs
Maximum Daily	-1.0 ft/day

*Project outflows during major flood events may exceed these levels. Source: USACE 2009.

Fall Creek has a variable seasonal minimum flow. From October to March, the minimum outflow is 50 cfs. It then increases to 80 cfs during April to August and is set at 200 cfs from September 1 through October 15 (Table D-2). The normal evacuation rate during associated with high water events is 3,800 cfs with a maximum evacuation rate of 4,500 cfs. In cases of unusual and sustained storm events, the project outflow at Lookout Point may be increased gradually above the maximum evacuation rate using a prescribed formula to avoid passing inflow at the peak of the storm due to a full reservoir. During the summer flow augmentation season, project maximum outflow is usually capped in order to balance flow from the various projects. For example, in 2009 the recommended cap was no greater than 1,000 cfs with a full pool and was gradually reduced to 50 cfs based on the amount in storage.

Lookout Point has three turbines that are used for power peaking that can result in rapid changes in discharge rates ranging from zero to 8,100 cfs. Dexter re-regulates the discharge fluctuations from load-following operations at Lookout Point. This re-regulating operation causes the elevation of Dexter Lake to fluctuate up to 5 feet daily, while keeping discharge rates to the Middle Fork Willamette much more constant with flow limits and ramping rates. Outflows from Lookout Point are referenced at the Dexter re-regulation dam. The minimum flow from Dexter year-round is 1,200 cfs. During flow augmentation, the maximum flow is set at 2,700 cfs. Under high water conditions, the maximum flow through Dexter is 12,000 cfs (normal evacuation conditions) and 15,000 cfs as a maximum evacuation rate (Table D-3). In cases of unusual and sustained storm events, the project outflow at Lookout Point may be increased gradually above the maximum evacuation rate using a prescribed formula to avoid passing inflow at the peak of the storm due to a full reservoir. This water is then passed through Dexter reservoir.

Table MFW-3. Flow Rates and Ramp Rate Requirements for Fall Creek Dam

Time Period or Criterion	Target
Evacuation of Stored Flood Water	
Normal	3,800 cfs
Maximum*	4,500 cfs
High Flow Period (> 700 cfs)	
Minimum Flow	50 cfs
Rate of Increase per hour	
Normal	
50-1,000 cfs	300 cfs
1,000-4,000 cfs	500 cfs
Maximum Rate of Increase per hour	800 cfs
Rate of Decrease per hour	20% of flow
Low Flow Period (< 700 cfs)	
February 1-March 31	50
April 1-August 31	80
September 1-October 15	200
October 16-January 31	50
Rate of Increase	
Normal	200 cfs/hr
Maximum	200 cfs/ ½ hr
Rate of Decrease	
Nighttime Decrease	
50-500 cfs	50 cfs/hr

Time Period or Criterion	Target
> 500 cfs	0.1 ft/hr
Daytime Decrease	
50-300 cfs	50 cfs/hr
> 300 cfs	0.2 ft/hr
Maximum Total Daily Decrease	1.0 ft/day or 50% of flow

* Project outflows during major flood events may exceed these levels.

Table MFW-4. Flow Rates and Ramp Rate Requirements for Dexter Dam

Time Period or Criterion	Target
High Flow Period (> 3,000 cfs)	
Minimum Flow	500 cfs
Maximum Flow*	15,000
Rate of Increase per hour	
500-1,000 cfs	500 cfs
1,000-4,000 cfs	1,000 cfs
4,000-15,000 cfs	1,500 cfs
Maximum Rate of Increase per hour	2,500 cfs
Rate of Decrease per hour	
Normal	
500-2,000 cfs	700 cfs
2,000-5,000 cfs	1,500 cfs
5,000-10,000 cfs	2,500 cfs
10,000-20,000 cfs	5,000 cfs
Low Flow Period (< 3,000 cfs)	
Minimum	1,200 cfs/hr
Rate of Change	
Increase	0.2 ft/hr and 0.5 ft/day
Daytime Decrease	0.2 ft/hr
Nighttime Decrease	0.1 ft/hr
Total daily Decrease	0.5 ft/day

* Project outflows during major flood events may exceed these levels.

3.1.2.Rates of Flow Change (24 hour, day and night)

Since 2006, the USACE has limited the maximum down-ramping at all three projects on the Middle Fork Willamette River to follow general ramping rate guidelines of 0.1 foot/hour during nighttime and to 0.2 foot/hour during daytime unless such restriction has been infeasible with existing equipment at the dam (Tables D-1 to D-3; USACE et al. 2007). The result has been adherence to these down-ramp rates at designated flow rates. During the winter high inflow period, the projects may ramp down at rates higher than the recommended 0.1- to 0.2-foot/hour guidance. The allowance is for those cases where unanticipated conditions require flow reductions in order to control downstream control points for human health and safety considerations.

Hills Creek Dam may ramp down at 4,000 cfs per half hour with a recommended reduction rate of 20% of the previous hours outflow. Dexter Dam maximum ramp downs are based on a sliding scale. With initial outflows between 1,200 and 2,000 cfs, the maximum ramp down is 700 cfs/hour. From 2,000 to 5,000 cfs, the ramp down is 1,500 cfs/hour, and at 5,000 to 10,000 cfs, the ramp down may be 2,500 cfs. Above 10,000 cfs with a limit to 20,000 cfs, the ramp down is 5,000 cfs/hour. At Fall Creek, there is no set ramp down limit but 20% per hour is the recommended ramp down rate during high flow periods.

Ramp up rates at the projects would generally follow the general ramping guidelines but during the wet season, higher ramp ups are allowed and needed to control reservoir storage for flood damage reduction operations.

3.2. Downstream Fish Passage

Fall Creek Dam is operated to assist with juvenile outmigration in the winter months through an enhanced reservoir drawdown. This provides the juvenile fish access to the release outlet by reducing the overall distance fish must sound to find an egress. No specific operations are performed at Dexter, Lookout Point, or Hills Creek to support juvenile downstream fish passage.

Special, interim, and other operations to provide fish passage are listed below (see Fish Operations Appendix for more detail):

3.2.1. **Hills Creek Dam:** None

3.2.2. **Lookout Point Dam:** None

3.2.3. **Dexter Dam:** None

3.2.4. **Fall Creek Dam:** Reservoir drawdown is implemented during winter months to facilitate downstream passage of juvenile salmonids. During November or December Fall Creek reservoir will be drawn down targeting forebay elevation 680 feet for approximately a week. A gate opening of at least 4 feet for the RO is preferred. Down ramping rates are likely to deviate from the BiOp during this operation when the target elevation is reached in inflow is passed.

3.3. Water Quality Management

3.3.1. Operations to Limit Total Dissolved Gas

Dams in the Middle Fork Willamette River generate TDG supersaturation when their spillways are operated. The extent of TDG saturation is dependent on the type and duration of operations. While spill primarily occurs involuntarily due to high-flow events during winter months, spill also occurs infrequently in other months during powerhouse outages or late spring rainstorms.

Special, interim, and other operations to minimize negative impacts from total dissolved gas levels are listed below:

3.3.1.1. **Hills Creek Dam:** Spill will be spread across bays or other outlets to control TDG when not generating or when flows exceed turbine capacity. Minimum gate openings may restrict this action depending on the desired outflow.

3.3.1.2. **Lookout Point Dam:** Spill will be spread across bays or other outlets to control TDG when not generating or when flows exceed turbine capacity. Minimum gate openings may restrict this action depending on the desired outflow.

3.3.1.3. **Dexter Dam:** Spill will be spread across bays or other outlets to control TDG when not generating or when flows exceed turbine capacity. Minimum gate openings may restrict this action depending on the desired outflow.

3.3.1.4. **Fall Creek Dam:** Spill will be spread across bays or other outlets to control TDG when not generating or when flows exceed turbine capacity. Minimum gate openings may restrict this action depending on the desired outflow.

3.3.1. Operational Water Temperature Management

Special, interim, and other operations to minimize negative impacts from total dissolved gas levels are listed below:

1.1.1.1. **Hills Creek Dam:** Currently, Hills Creek Dam is not designed to be operated for downstream water temperature management, as there are no available surface outlets to discharge warm epilimnetic water from the reservoir.

1.1.1.2. **Lookout Point Dam:** Currently, Lookout Point Dam is not designed to be operated for downstream water temperature management verified by attempts at during previous years.

1.1.1.3. **Fall Creek Dam:** The WVP operates the fish horns combined with the deeper elevation ROs to provide some water temperature management downstream of the dam. Inflow temperatures measured upstream of the reservoir are used as the target temperatures, and operators adjust outflows from the varying outlets to try and achieve similar water temperatures downstream.

Interim temperature control operations may be modified annually based on water availability, meteorological conditions, project constraints/limitations, and from information gathered from prior operating years.

Annual results for operational temperature control are provided in the Willamette Basin Annual Water Quality Report. These annual reports detail periods of non-conformance from the temperature targets, providing the duration and cause of the deviation.

3.4. Spill Management

3.4.1. **Hills Creek Dam:** Spill will be spread across bays or other outlets to control TDG when not generating or when flows exceed turbine capacity. Minimum gate openings may restrict this action depending on the desired outflow.

3.4.2. **Lookout Point Dam:** Spill will be spread across bays or other outlets to control TDG when not generating or when flows exceed turbine capacity. Minimum gate openings may restrict this action depending on the desired outflow.

3.4.3. **Dexter Dam:** Spill will be spread across bays or other outlets to control TDG when not generating or when flows exceed turbine capacity. Minimum gate openings may restrict this action depending on the desired outflow.

3.4.4. **Fall Creek Dam:** Spill will be spread across bays or other outlets to control TDG when not generating or when flows exceed turbine capacity. Minimum gate openings may restrict this action depending on the desired outflow.

4. DAM MAINTENANCE

The annual maintenance periods discussed below for Hills Creek, Lookout Point, or Dexter dams are provided as applicable for the projects and will be adhered to during annual maintenance planning. Potential effects on ESA-listed fish include temperature, TDG, and flow-related impacts. No specified turbine unit maintenance period is needed for Fall Creek as there are no turbine units at the project.

4.1. Hills Creek

Target outage periods:
Mar 1-Jun 30: Primary scheduling period.
Jul 1-Aug 31: Limited outage scheduling due to power valuation considerations.
Sep 1-Oct 31: Secondary scheduling period.
Nov 1-Feb 28: Limited outage scheduling due to power valuation considerations.

4.2.1. Considerations/Rationale for unit outage scheduling:
No fish operations currently affect outage scheduling and therefore power valuations and historical stream flows will be the major factors affecting outage scheduling.

4.3. Lookout Point

Target outage periods:
Mar 1-Apr 30: No limit on number of units simultaneously under outage.
May 1-Sep 30: Limited to one unit at a time in outage status.
Oct 1- Oct 31: No limit to number of units simultaneously under outage.
Nov 1-Feb 28: Limit outages for power demand considerations.

4.3.1. Considerations/Rationale for unit outage scheduling:
May 1-Sep 30: At least one unit is required for temperature management. If all units must being taken off line during this period, the month of May is preferred if temperature management operations are being implemented. However, it has been determined these operations have limited efficacy.
Nov 1-Feb 28: Minimize spill in order to maintain low TDG for sac fry. Spillway gates 1 and 2 are preferred due to TDG concerns. Experience has shown that less TDG flows through Dexter reservoir when spillway gates 1 and 2 at Lookout Point are used.

4.4. Dexter

Target outage periods:
Feb 1-Feb 28: Limit scheduled outages for power demand considerations.
Mar 1-Apr 30: Primary target period.
May 1-May 31: Secondary target period.
Jun 1-Jun 30: Restricted from outage scheduling.
Jul 1-Oct 31: Limit scheduled outages as much as possible in consideration for adult fish facility operations.
Nov 1-Jan 31: Restricted from outage scheduling.

4.4.1. Considerations/Rationale for unit outage scheduling:
Jun 1-Oct 31: Minimize generation outages as much as possible in order to maintain attraction flow to the Dexter fish facility provided by unit flow. If generation outage cannot be avoided, use closest available spillway gate to the unit as possible.

Nov 1-Jan 31: Generation outages are restricted in order to prevent high levels of TDG that has negative impacts on sac fry. Outages may be scheduled after proper coordination as there is limited fish production in the reach below Dexter Dam due to high temperatures causing high mortality of incubating spring Chinook embryos.

5. FISH FACILITY OPERATIONS

The Dexter Fish Facility will operate for fish collection from May 15 to September 30.

The Fall Creek Fish Facility will operate from April 1 to September 30.

5.1. Juvenile Fish

Juvenile hatchery fish will be acclimated at the Dexter Fish Facility for a minimum of 30 days prior to release.

5.2. Adult Fish

Disposition of adult fish will be determined annually at the WATER Hatchery Management Team, vetted through WFPOM, and published or attached in the WFOP upon finalization.

5.2.1. Fish Collection and Handling

5.2.1.1. All adult trapping facilities shall be operated for adult spring Chinook salmon and winter steelhead in a manner that minimizes the duration of holding and delay.

5.2.1.2. All trapping, hatchery, and transport personnel must avoid excessive handling of adult fish to minimize stress and reduce the chance of injury.

5.2.1.3. All transfer of fish shall be completed through water to water transfers, unless logistically infeasible.

5.2.1.4. Sorting of adult spring Chinook salmon and winter steelhead for outplanting shall be completed in manner that minimizes stress and injury.

5.2.1.5. All efforts should be made to sort adult fish a single time and not multiple times as was done in the past.

5.2.1.6. Healthy fish should be used for both broodstock collection and outplanting efforts (to support reintroduction) to increase the probability of survival and should be representative of the run.

5.2.1.7. Sorting shall be completed to separate by species or origin (hatchery or natural origin) to ensure an adequate sex ratio for outplanting and brood production. To the extent possible, adjust the sex ratio of releases based on known differences in pre-spawning mortality between males and females to maximize reproductive success. Ensure an adequate number of females are outplanted to seed available habitat.

5.2.1.8. The Hatchery Management Team will develop the annual guidelines regarding when to outplant fish from each location and will be vetted through the WFPOM team. Collect fish on a regular basis throughout the run and outplant when collected, ensuring temporal outplants are representative of the run. However, pre-spawning mortality of early-released fish may be high and thus should be monitored to ensure effectiveness of this strategy. Fish will not be held longer than the agreed upon time to be developed through the WATER process.

5.2.1.9. During processing/sorting, the anesthetic used will be dependent upon whether a fish will be: for brood, returned to the fishery, outplanted, sampled for RM&E, or surplused (e.g. sold, food bank). Fish will be moved out of the trap quickly and frequently. Fish will be

handled as gently as possible during processing and loading onto the truck, attempting to minimize stress and skin abrasions associated with handling.

5.2.1.10. Once fish are sorted, they will spend no longer than the allotted time that will be agreed to through the WATER process within holding tanks prior to being transported to their destination, which is determined by the fish disposition table. Environmental factors such as flow, fish health, and temperature will be considered.

5.2.1.11. The fish trap will be checked at least twice a day, first in the morning, and then in the late afternoon to avoid having fish spend too much time in the trap and to assess the overall density of fish within the trap.

5.2.1.12. Fish will be removed and placed in holding tanks with a density approximately 25 gallons of water per fish. Adult holding will reflect IHOT and NMFS recommendations.

5.2.1.13. Oxygen levels in the holding tank water should not exceed saturation (100%) or drop below 7 parts per million (7 mg/L), however, spill during the wet and flood risk reduction season may preclude meeting this guideline.

5.2.1.14. Experiment with reduced dependence on, or eliminating prophylactic antibiotic treatments.

5.2.1.15. The fish disposition table, developed collaboratively by HMT and approved by NMFS, will be used to guide the management of anadromous and resident fish as they are encountered in adult fish traps.

5.2.1.16. MS-222/CO_2/AQUI-S 20E. At fish handling facilities in the Willamette Basin operated by ODFW, the ODFW and ODEQ have agreed upon a process of dispersal and evaporation (or volatilization) for the disposal of water treated with anesthetics, which are highly volatile substances. The USACE will continue to use eugenol (clove oil) at USACE-operated adult fish trapping facilities (Cougar and Fall Creek).

5.2.1.17. Avoid multiple handling/anesthesia of fish during sorting for outplanting or brood production.

5.2.2. Transport and Outplanting

5.2.2.1. All transport tanks will be treated with NovAqua® or equivalent per manufacturer's instructions to reduce stress during transport.

5.2.2.2. Transport adult spring Chinook at a density of $\geq$ 25 gallons of water per fish (60 fish/1,500 gallon tank).

5.2.2.3. Oxygen levels above 100% should be minimized in the transport truck or should not drop below 7 parts per million [7 milligrams per liter (mg/L)].

5.2.2.4. All trapping, hatchery, and transport personnel must adhere at all times to existing ODFW policies and procedures to reduce the transfer of pathogens.

5.2.2.5. *No handling* will occur at adult trapping facilities when water temperatures exceed 70°F in the pre-sort pool.

5.2.2.6. In certain situations, the transfer of fish for outplanting or to cooler hatchery waters may occur if fish are being held, or may be held, in waters exceeding 70°F for an extended period of time. Coordination with NMFS prior to transfer and notification to the WFPOM Team is required under these circumstances.

5.2.2.7. When outplanting adult spring Chinook salmon, receiving water temperature shall be less than 68°F *as measured prior to release*.

5.2.2.8. Monitoring of water temperature can be completed using USGS gages or temperature meters, where available.

5.2.2.9. Drivers will measure the temperature of the water in the transport tank and the receiving water prior to releasing the fish.

5.2.2.10. If the temperature difference between the receiving water and tank water is > 7°F, the water will be tempered to a difference of < 5°F at a rate of 1°F/6 minutes.

5.2.2.11. Fish facility personnel are responsible for recording the holding pool water temperature prior to transport, liberation truck water temperatures, and receiving water temperature upon release.

5.2.2.12. If liberation truck waters require tempering, beginning and end temperature as well as time required for acclimation will also be recorded.

5.2.2.13. All outplanting shall be completed at designated outplanting sites consistent with the appropriate disposition table for each subbasin. Releases shall be made in a manner to minimize stress and chance of physical injury. In-season variances to either outplant site use, fish disposition, or other outplanting protocols can be completed with agreement from the WFPOM Team with notification provided to the WATER Steering Team. NMFS must agree to any in-season variances proposed by the WFPOM Team before the action is taken.

5.2.2.14. Release trucks shall have a minimum of a 12-inch opening on all. Discontinue use of collapsible tubes and use 16- to 20-inch smooth walled PVC pipe to convey fish from the truck to the stream. Set pipes at proper discharge angle and use discharge chutes. Use a water spout to flush fish from the truck. Avoid abrupt changes in temperature. Release fish early in the day whenever possible. If receiving waters are known to be too warm at certain times of year, release fish when or where waters are cooler. Investigate the options to improve survival such as holding fish in a hatchery pond and treating with antibiotics until they are ready to spawn, at which time they would be released. Releasing ripe fish may limit numbers outplanted and potentially reduce pre-spawning mortality.

5.2.2.15. Fish liberation truck driver and/or trained volunteer will observe released fish and document any mortality and unusual behavior after release.

5.2.2.16. All truck drivers will complete an adult salmonid outplant form to document oxygen levels, temperatures in the tank and release stream, immediate mortalities, loading densities, and release method. These data will be used to enable better monitoring of outplanted fish.

5.2.2.17. Hauling frequency will depend on factors that include run size, stream temperatures, and transport/ holding constraints. Some fish will likely be held prior to outplanting to some extent depending on these constraints. Unless environmental conditions in areas where fish are to be transported are poor, hauling frequency should be such that it minimizes holding times to no more than 24 hours.

5.2.2.18. It is the intent to reduce holding times and complete outplanting as soon as possible upon a fish's return to the adult trapping facility. Given the typical adult monthly return timing and abundance observed, expected hauling frequencies are:

Transport Period	**Hauling Frequency**
April 1 – May 15	2 times per week
May 16 – June 30	3 times per week
July 1 – September 30	2 times per week

5.2.2.19. The current program involves releasing fish according to the targets identified in Table NS-4. Detailed protocols for the disposition of excess hatchery fish will be contained in the WFOP. These goals will be updated annually by the WATER Hatchery Management Team and vetted through WFPOM team. When numerical adult abundance recovery goals

are established for the North Santiam spring Chinook salmon population through the recovery planning process, these targets will be adjusted accordingly.

Table MFW-5. Number of Adult Spring Chinook to be Outplanted

Location	Target Number of Fish	Origin	
		Hatchery	Natural
Middle Fork Willamette, upstream of Hills Creek Reservoir	1,100	X	0
North Fork Middle Fork Willamette, upstream of Lookout Point Reservoir	1,350	X	0
Fall Creek, upstream of Fall Creek Reservoir	All	0	X

Table MFW-6. Outplanting Release Sites

Release Site
Middle Fork Willamette (upstream of Hills Creek reservoir)
North Fork Middle Fork (15 river miles upstream of Lookout Point Reservoir)
Fall Creek, Site C (8 river miles upstream of Fall Creek Reservoir)

6. FISH FACILITY MAINTENANCE

6.1. Fall Creek Fish Facility

6.1.1. The proposed maintenance period where a shutdown is required for the ladder will be from **September 30 to March 31**. The following will be performed during the maintenance period:

6.1.1.1. All staff gages and water level indicators will be inspected, cleaned, and repaired as necessary.

6.1.1.2. The fish ladder will be dewatered and inspected for debris, projections, or clogged orifices that could injure or impede fish. Necessary repairs will be completed at this time.

6.1.2. The proposed maintenance period where a shutdown is required for the post sort pools will be from **September 30 to March 31**. The following will be performed during the maintenance period:

6.1.2.1. All staff gages and water level indicators will be inspected, cleaned, and repaired as necessary.

6.1.2.2. The pools will be dewatered and inspected for damage, cracks, debris, or projections that could injure fish. Necessary repairs will be completed at this time.

6.1.2.3. Specific maintenance activities listed for monthly, quarterly, and annual actions will be appended to the WFOP.

6.2. Dexter Fish Facility

6.2.1. The proposed maintenance period where a shutdown is required for the ladder will be from **May 1 to May 31**. The following will be performed during the maintenance period:

6.2.1.1. All staff gages and water level indicators will be inspected, cleaned, and repaired as necessary.

6.2.1.2. The fish ladder will be dewatered and inspected for debris, projections, or clogged orifices that could injure or impede fish. Necessary repairs will be completed at this time.

6.2.2. The proposed maintenance period where a shutdown is required for the post sort pools will be from **May 1 to May 31**. The following will be performed during the maintenance period:

6.2.2.1. All staff gages and water level indicators will be inspected, cleaned, and repaired as necessary.

6.2.2.2. The pools will be dewatered and inspected for damage, cracks, debris, or projections that could injure fish. Necessary repairs will be completed at this time.

6.2.2.3. Specific maintenance activities listed for monthly, quarterly, and annual actions will be appended to the WFOP.

7. INSPECTIONS, REPORTING, AND NOTIFICATIONS

7.1. Fish facility inspections will be performed in accordance with guidelines in the operations and maintenance (O&M) manual. These will be developed after construction of new facilities are complete.

7.2. The results of all inspections and the readiness of the facilities for operation will be reported to the Willamette Fish Passage Operations and Maintenance Team (WFPOM) by March 31 for the Fall Creek Fish Facility and May 31 for Dexter Fish Facility.

7.3. More frequent inspections will occur as requested by the WFPOM Team or at any time by facility personnel. During the field season, WFPOM members will visit fish facilities to evaluate adherence to protocols and SOPs. The site visit assessment activities include observing fish sorting and handling procedures. A check sheet will be filled out and initialed indicating whether procedures are or are not being performed according to protocol. Protocol drift for any activity must be reported to the immediate supervisor and corrective actions must be implemented immediately.

7.4. Fish trapping facilities will be initially inspected prior to being removed from service for the year to assess facility condition and maintenance needs.

7.5. Staff gages and other water-level sensors will be installed, cleaned, and/or repaired as required to allow for monitoring facility performance.

7.6. Fish facility personnel shall prepare monthly reports throughout the year summarizing project operations. These monthly reports will provide an overview of how the project operated during the prior month.

7.7. The reports shall cover a monthly period and they shall be provided to WATER stakeholders at monthly WFPOM Team meetings and recorded in a record of the meeting minutes.

7.8. The reports shall include:

7.8.1. Any out-of-criteria situations, observed deviations from the WFOP, and subsequent corrective actions taken.
7.8.2. Any equipment malfunctions, breakdowns, or damage along with a summary of resulting repair activities.
7.8.3. Progress in reaching outplant numbers targeted in the fish disposition table.
7.8.4. Mechanical and/or structural issues preventing optimum facility operation.
7.8.5. General hatchery operations including trap counts, transfer information, juvenile releases, and updates on hatchery research.
7.8.6. Adult outplanting data documenting release locations, numbers released, any observed transport or liberation mortalities, holding, transport and receiving water temperatures, and poaching/harassment issues.
7.8.7. Any adult mortality that occurs within the trapping facility during holding or handling prior to transport and must documents species, origin, size, marks/injuries, cause and time of death, and future preventative measures. When mortality occurs, this should also be reported immediately to USACE that will be included in a memorandum to the Services.
7.8.8. Adult mortalities should be reported as soon as possible to the Services.

7.9. The facility operator will produce an annual report summarizing the species, number, origin, and destination of all fish collected at USACE fish facilities in the Willamette Basin, as well as all BiOp deviatons. This annual report will be a summary of the monthly or quarterly progress reports. The report shall assist in identifying potential operational changes. Reporting may be included in baseline hatchery monitoring or the annual hatchery operations reports and provided at specified dates (WFOP, contract, cooperative agreement).

7.10. Hazardous Spills. Hazardous spill notification will continue to be completed through the Oregon Emergency Response System (OERS). This system provides 24-hour service through Oregon Emergency Management of the Department of State Police. Local public safety agencies such as law enforcement, fire and emergency medical services normally provide the first response to an incident. Access to this local assistance is through 9-1-1. Once notified, local public safety agencies would call OERS at 800-452-0311 or in the Salem area at 503-378-6377. If necessary, responsible parties would then call the National Response Center at 800-424-8802. The USACE operations fisheries biologist will be included as an initial contact to address any immediate fisheries response needs, as well as to provide additional notification directly to the Services. Although the OERS serves to disseminate spill response notification to both the state and federal fisheries agencies, the USACE operations fisheries biologist will notify the Services directly of the incident.

7.11. Any poaching, suspicion of poaching activities or observed harassment of outplanted fish shall be reported immediately to the Oregon State Police at 1-800-452-7888.

7.12. The annual report will be distributed to the members of the WFPOM Team.

8. DEWATERING PLAN

Fish facilities and turbines are drained for regularly scheduled maintenance and sometimes for emergency maintenance. These activities may involve handling fish and could cause other adverse effects on juvenile and adult fish in the watershed (e.g. stranding of fish in the reservoir). This plan is subject to change as improvements are developed and will be revised on an annual basis as part of the WFOP. Not all dewatering efforts will require fish salvage; as such, the need will be determined by USACE and ODFW fish biologists.

8.1. Coordination

8.1.1. Facility outages will be scheduled to minimize impact on fish while accomplishing necessary repairs and maintenance on facilities. Specific outages will be scheduled according to maintenance periods detailed in appendices. Fish facility personnel (either ODFW or USACE) will coordinate these activities with Portland District Operations Division fishery biologists and will ensure that the fisheries agencies, particularly those whose activities may be impacted, are kept informed. Primary points of contact include ODFW, NMFS, and USFWS.

8.1.2. The Willamette Project Supervisory Fisheries biologist coordinates fishway dewatering and salvage activities with the project operations and maintenance supervisor. This includes having the appropriate personnel and equipment on site. The designated fish facility lead, likely the Operations Division project biologist for USACE operated facilities, or an ODFW hatchery manager for ODFW operated facilities, directs execution of the drainage plan at least until fish removal is complete. Before or at the beginning of each draining operation, a pre-work briefing will be held to explain procedures, responsibilities and safety considerations for all participants. After the salvage activity, lead personnel are responsible for reporting species, number, and condition of fish. The reporting template is attached at the end of the document and will be provided to the WFPOM Team.

8.2. Fish Handling

8.2.1. When facilities are drained, a primary objective is to minimize stress and injury to all fish. Generally, the best way to protect fish during facility draining is to avoid having to handle them. Instructions for draining most facilities involve steps, such as operating with low ladder flow just prior to draining, intended to minimize handling fish by encouraging the fish to exit the ladder. When it is necessary to handle fish, they are handled in plenty of fresh water, if possible. Holding fish in nets unnecessarily is avoided (e.g., tank or fish bag not ready). When it is necessary to transport fish in bags, ensure that the salvage bags contain a sufficient amount of water and that fish return to fresh water as soon as possible.

8.2.2. Tanks should be large enough to carry plenty of water with the fish. Tanks should be covered to keep fish from leaping out. When large numbers of fish are placed in a tank, supplemental oxygen will be used to increase the level of dissolved oxygen. Reduce fish concentration when river temperature is greater than 65°F. During warm weather, the temperature in tanks will be monitored and kept within 2°F of the river release point temperature. Further, the time fish are kept in tanks will be minimized and not exceed 2 hours.

8.2.3. Fish will be released at a predetermined site. However, when the tank contains a mixed load, it can be released into the forebay or tailrace depending upon the recommendation of lead personnel.

8.2.4. When it is necessary to prioritize attention to different species, generally ESA-listed species and adult salmonids should be helped first. Lamprey are relatively stress resistant and can be collected as a lower priority. However, their numbers are declining and care should be given to salvage them, as well as the more sensitive fish. All fish are to be salvaged.

8.3. Adult Fish Trap/Ladder

The general procedures for draining the adult fish trapping facilities are described below.

8.3.1. **Prior to Dewatering**

8.3.1.1. 24 to 48 hours before draining, stop attraction flow by minimizing auxiliary water flow.

8.3.1.2. For at least 24 hours before dewatering, but not longer than 96 hours, operate the ladder at orifice flow.

8.3.2. **On Dewatering Day**

8.3.2.1. Convene safety meeting before starting activity. Describe the procedure for all participants and assign responsibilities (ensure clearances are in place)
8.3.2.2. Stage fish bags or transport tank.
8.3.2.3. Place ladder near the pre-sort holding pool
8.3.2.4. The water supply level to the ladder should be reduced to approximately 1" to 2".
8.3.2.5. Begin visual inspection of ladder for stranded fish. Salvage personnel will need to access any pools where fish are stranded and either remove the stranded fish and put into a fish bag or tank or, if the fish is close to the entrance pool, gently guide fish down the ladder to the entrance pool.
8.3.2.6. Drain pre-sort holding pool.
8.3.2.7. Salvage fish with a net and put them into a fish bag
8.3.2.8. Place fish from fish bag into post sort holding raceway for transport or into recovery tank for direct release to the river.
8.3.2.9. Shut down facility water supply when fish salvage is complete.

8.3.3. Fish Salvage Equipment

The following fish salvage equipment is required.

8.3.3.1. Dip nets/buckets
8.3.3.2. Fish salvage bags
8.3.3.3. Seine
8.3.3.4. Extension ladder for access into the fish ladder
8.3.3.5. Fish truck with oxygen bottle
8.3.3.6. Personal protection equipment such as life vests/float coats, fall protection (harness/lanyard), waders w/felt soles, gloves (sealskins), hearing protection, and hardhats
8.3.3.7. Communication devices
8.3.3.8. Submersible pumps

9. FOREBAY DEBRIS REMOVAL

9.1. Debris at projects can adversely impact fish passage conditions. Debris can plug or block trashracks, VBSs, gatewell orifices, dewatering screens, separators, and facility piping resulting in impingement, injuries, and descaling of fish. Removing debris at its source in the forebay is sometimes necessary to maintain safe and efficient fish passage conditions, navigation, and other project activities. Debris can be removed from the forebay by:

9.2. 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;
9.3. Removing the debris from the top of the dam using a crane and scoop;
9.4. Passing debris through the spillway with special powerhouse and/or spill operations; or

9.5. 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).

Cougar Proposed Special Operation
to Improve Downstream Passage & Survival

Implementation Date (approximate)

This special operation should be implemented from 01 November (or whenever water temperature control tower operation has been completed) through 31 December.

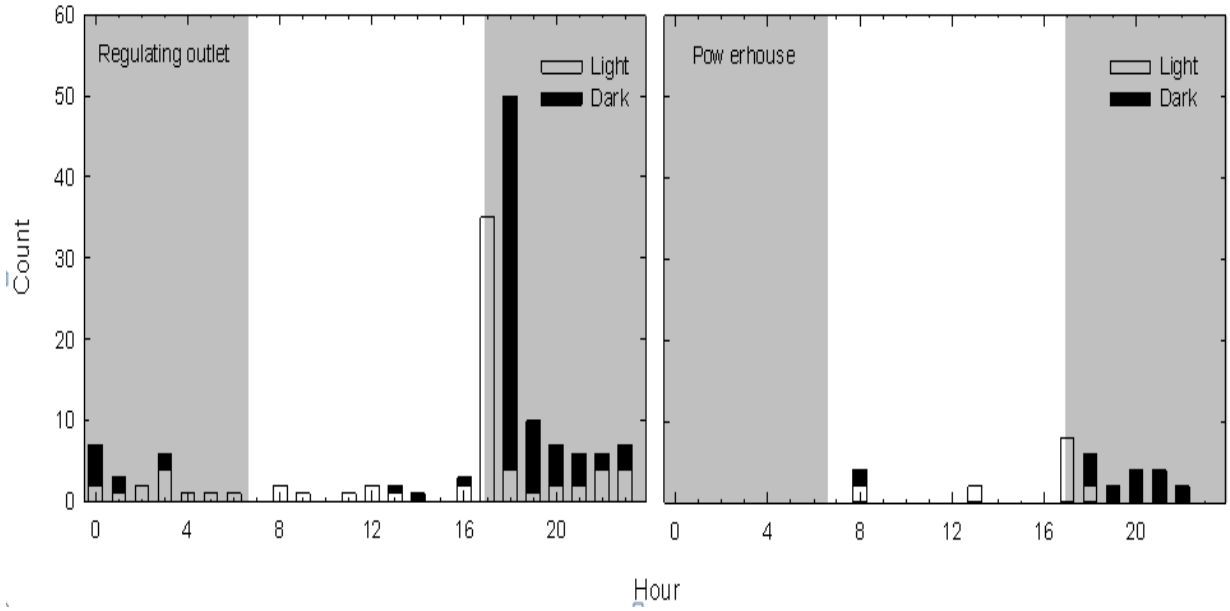
Purpose

The purpose of this proposed operation is to improve fish passage survival of juvenile ESA-listed spring Chinook salmon through Cougar Dam by prioritizing the operation of the regulating outlets (RO). Studies indicate that downstream passage through Cougar Dam is poor (ODFW 2008, Hiesey 2010, ODFW 2010, 2012, Beeman 2012, 2013). This is due to the inaccessibility of downstream passage routes during the conservation season (when the reservoir is full) combined with poor survival through these routes (turbine units) once they become available (shallower) during the flood season.

Biological Justification

Past biological studies have shown that the survival through the RO is about double that of the turbines (~70% for RO & ~35% for turbine). These studies also show that the majority (>87%) of fish pass Cougar Dam during the night (Figure 1.) rather than during the day. For this reason, priority should be given to the RO outlets as the reservoir is drawn down and held low for the winter flood control season. RO priority should be focused at night, from 1600 to 0400 hours, and should target flows of ~1000-1500 cfs through a single RO gate.

Figure 1. Diel passage timing for Radio Tagged Chinook juveniles (Beeman 2012).



Operational Details

This special operation should be implemented from approximately 01 November (or whenever WTC operation has been completed) through 31 December. Exact outflows are uncertain and will depend on inflows and hydrologic conditions. Table 1 (below) shows some potential operations for different discharge levels. This table is presented as a concept only; the actual operations will need to be developed by regulators and managed on a real-time basis, especially during times of high flows. The actual discharge rates are subject to the reservoir level, minimum gate openings, and turbine operating range.

Table 1. Hypothetical operations for juvenile RO survival test.

	NIGHT		DAY	
Mean 24hr Discharge	**RO Flow**	**Powerhouse Flow**	**RO Flow**	**Powerhouse Flow**
500	500	0	0	500
1000	1000	0	0	1000
1500	1500	0	500	1000
2000	1500	500	1000	1000
2500	1500	1000	1500	1000
3000	2000	1000	2000	1000

Research, Monitoring and Evaluation

As in previous years, ODFW will monitor passage with screwtraps. Additionally, dam passage rates and timing can be inferred by the detection of PIT tagged fish at Leaburg and Walterville dams downstream.

Potential Impacts

This operation may cause elevated levels of total dissolved gas (TDG) below Cougar Dam. Real-time information will be measured and monitored during this operation, thus this operation may be suspended or ended all together if warranted.

Daily changes in dam operations may cause possible downstream ramp rate violations, however every effort will be made to minimize these.

During periods of critical power needs, project construction and maintenance, or high flow situations, the operation may be suspended or altered.

Detroit Proposed Special Operation
Temperature Management

Implementation Timeframe (approximate)

01 June - 14 November

Purpose

The purpose of this proposed operation is to provide downstream water temperature management while enhancing downstream juvenile fish passage at Detroit and Big Cliff Dams through strategic use of the spillway, turbines and regulating outlets from 01 June through 14 November. This operation meets Reasonable and Prudent Alternative (RPAs) measures 4.8 and 5.1 of the National Marine Fisheries Service (NMFS) Biological Opinion which calls for implementation of interim operational measures to improve downstream water quality and fish passage for ESA-listed fish.

Background

The construction and operation of Detroit Dam has altered the pre-dam seasonal thermal regimes in the North Santiam River and blocked access to the majority of historic spawning and rearing habitat. During pre-2007 project operations, all water was typically routed through the powerhouse of both Detroit and Big Cliff Dams when the project discharge did not exceed the hydraulic capacity of the powerhouses. During summer months, with Detroit Reservoir at maximum conservation pool, deep (hypolimnetic) water was released through the upper ROs and turbine outlets produced downstream water temperatures 5.4° to 9.0°F cooler than inflow temperatures (June through September). During fall and winter as Detroit Reservoir was drawn down, surface (epilimnetic) water was released through the upper ROs and turbine outlets produced downstream water temperatures up to 18°F warmer than inflow temperatures. It is likely that the increase in downstream water temperatures during fall and winter was exacerbated by the removal of Detroit Reservoir's cold hypolimnetic water throughout the summer, which increased the volume of warm epilimnetic waters for release from October through December (Gore and Petts 1989). This altered temperature regime negatively affected the productivity of ESA-listed spring Chinook salmon and winter steelhead in the lower North Santiam River, and has been identified as one of the most critical limiting factors for species recovery (NMFS 2008).

During temperature operations Research Monitoring and Evaluation (RM&E) studies have found also found high rates of dam passage and survival for juvenile Chinook salmon at Detroit Dam (Beeman et al. 2012, Friesen et. al 2012). Taken together, data indicate that temperature management operations may provide some connectivity to the majority of historic spawning and rearing habitat above the dam – through providing downstream passage benefits – while also improving the seasonal thermal regimes in the North Santiam River below Big Cliff Dam.

Biological Justification for Temperature Improvements

Restoring the natural thermal regimes in the river reach directly below Detroit Dam will provide a benefit to both ESA-listed spring Chinook salmon and winter steelhead. These benefits have been realized over the past six years that water temperature management operations have been performed. Recent RM&E studies also indicate that these temperature management operations promote downstream fish passage during summer spillway operations. Priority should be given to refilling Detroit Reservoir so that both temperature management and fish passage operations can be accomplished to the fullest extent possible.

Operational Details

On 01 June, water temperature management operations will commence. A blend of spillway and turbine releases (a 60%/40% split, respectively) from Detroit Dam should be implemented in order to manage for downstream water temperatures and meet temperature targets (Table 1) throughout the summer. This operation will be carried out until Detroit Reservoir is drawn down below spillway crest.

Once below spillway crest, water temperature management operations will shift to powerhouse-only discharges until mid-October or when outflow water temperatures reach 50°F. From approximately 22 October through 14 November, a blend of powerhouse and regulating outlet flow will be discharged to meet downstream water temperature goals (Table 1). It is estimated that a 30%/70% split in RO to powerhouse discharge will be needed during this time; however, adaptive management should be used to ensure water temperatures stay below 50°F. The RO/powerhouse operation for fall water temperature management is based on water quality modeling results and operations conducted in previous years. A discussion of this modeling effort and justification for RO use in the fall can be found in Section 4.2.2 of the *Willamette Basin Annual Water Quality Report, WY 2010*.

Big Cliff will be used to moderate downstream flows so that they are consistent and meet instream tributary flow requirements. At no time will water temperature management operations be allowed to violate the current engineering and operational restrictions in place for Detroit/Big Cliff Dams and Reservoirs. Continuity of the operation is contingent upon meeting other critical operating purposes, specifically, but not necessarily limited to, flood damage reduction. Flood reduction operations would result in temporary termination of the operation. Should any flow management of dam safety concerns arise during this study, these operations will be modified or suspended.

Table 1. Water Temperature Targets for the North Santiam River below Detroit and Big Cliff Dams.

Month	Temperature Maximum/Minimum	
	°F	°F
January	40.1	40.1
February	42.1	41.0

March	42.1	41.0
April	45.1	43.2
May	49.1	46.0
June	56.1	51.1
July	61.2	54.1
August	60.3	54.1
September	56.1	52.3
October	<50.0	<50.0
November	<50.0	<50.0
December	41.0	41.0

Coordination

Coordination will occur through the Willamette Fish Passage Operations and Maintenance (W-FPOM) team.

Fall Creek Operation
Deep Drawdown to Facilitate Downstream Fish Passage

Background

The Corps' Willamette dams have blocked access to a majority of the historical habitat for ESA-listed fish. Many of these dams were built without downstream fish passage facilities and those facilities that were built have since been abandoned due to lack of functionality. Therefore, many fish are restricted to areas below the dams and subjected to altered flow and water quality conditions by dam operations. Those juvenile fish produced upstream of the dams (from adult salmon and steelhead outplanting) must pass through the dams via turbines, regulating outlets (ROs), or spillways.

Past studies indicate that downstream passage through the Willamette high-head dams is poor. This is likely due to the inaccessibility of downstream passage routes during the conservation season (when reservoirs are full) combined with poor survival through these routes once they become available during the flood season.

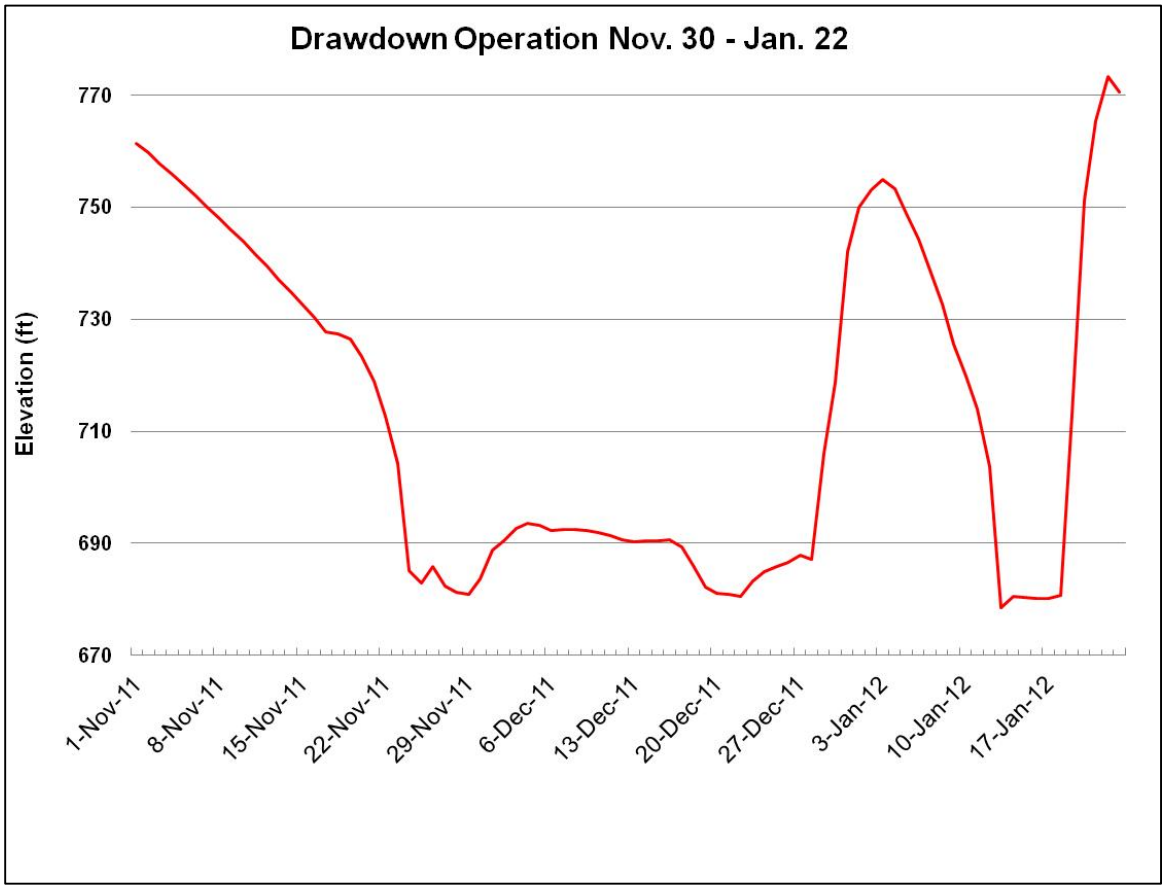
Purpose

The purpose of this proposed operation is to improve downstream volitional fish passage through a drawdown of Fall Creek Reservoir to an elevation ranged of 680 to 685 ft. This operation meets Reasonable and Prudent Alternative (RPA) 4.8 of the National Marine Fisheries Service (NMFS) Biological Opinion which calls for implementation of interim operational measures to improve downstream passage of migrants as safely and efficiently as possible.

Biological Justification

Reservoir drawdown has been shown to significantly increase the passage probability of Chinook salmon smolts at Fall Creek Dam (Taylor et al. 2012). In the winter of 2011, the Corps drew Fall Creek Reservoir down to near the target elevation of 680 ft to increase fish passage efficiency and survival of ESA-listed spring Chinook salmon. Due to varying inflows into Fall Creek Reservoir, forebay elevations ranged from 680 ft to 695 ft during the study timeframe (Figure 1). During drawdown, it was estimated that approximately 20,000 spring Chinook subyearlings were flushed from the reservoir, with the largest proportion outmigrating at the lowest reservoir elevations. Non-native fish species were also flushed from the reservoir, reducing predation and competition for food which should provide better rearing conditions for salmonids in future years.

Figure 1. Fall Creek Reservoir Elevation during Deep Drawdown Special Operation, Winter 2011.



Operational Details

Fall Creek Reservoir is typically operated at or below a water control diagram that provides guidance to the reservoir regulators on how to manage the storage in the reservoir to meet multi-purpose needs. The water control diagram for Fall Creek Dam is shown in Figure 2 below. Fall Creek Reservoir is typically drawn down (i.e., storage evacuated) in the fall to minimum conservation pool (elevation 728 ft) to provide space to store high runoff from winter rain events. In the early spring, the reservoir begins to capture some of the runoff to store water for use in the summer months. Refill back to maximum conservation pool (elevation 830 ft) typically occurs by mid-May.

Under this special operation, it is proposed that Fall Creek Reservoir be drawn down below minimum conservation pool to run-of –river - like conditions. Operations will target an elevation range of between 680 and 685 ft, or approximately 48 feet deeper than the minimum flood control pool elevation (Figure 2) for two weeks during the month of December. The goal is to hold the reservoir near elevation 680 ft. Per Hydraulic Design recommendations the RO gates should be operated between the minimum gate opening of 1 foot and the maximum gate opening is 8 feet when above elevation 682 ft. If the gate needs to be opened greater than 8 feet, it should be fully opened. Once below elevation 682 ft, the 0.65 maximum gate opening restriction should be applied. Table 1, below, gives specific gate openings that should be followed when the reservoir is drawn down below 682 ft elevation. Following

these guidelines will ensure that pressurized flow is maintained the regulating outlet conduit at all times.

Table 1. Maximum Gate Opening (ft) for Specific Low Reservoir Elevations, Fall Creek Reservoir.

Pool Elevation (ft)	Maximum Gate Opening (ft)
682	7.8
681	7.1
680	6.5
679	5.8
678	5.2
677	4.5
676	3.9
675	3.2
674	2.6
673	1.9
672	1.3

Continuity of the operation is contingent upon meeting other critical operating purposes, specifically, but not necessarily limited to, flood damage reduction. Flood reduction operations would result in temporary termination of the deviation operation.

The boat ramps to Fall Creek Reservoir are closed during the winter months by the Oregon Parks and Recreation Department so adverse impacts to recreation by implementing a deeper draft of the reservoir should not be an issue.

During drawdown and refill of Fall Creek Dam, draft and refill rates of 3ft and 5ft per/day, respectively, will be followed. All outlets will be operated within their limits to avoid cavitation and structural damage. Draft rates, ramp rates and downstream flow targets may be missed during this operation, especially if unforeseen meteorological conditions develop. The Corps will coordinate with the agencies throughout implementation of this operation to ensure good communication and transparency.

Figure 2. Fall Creek Reservoir Water Control Diagram

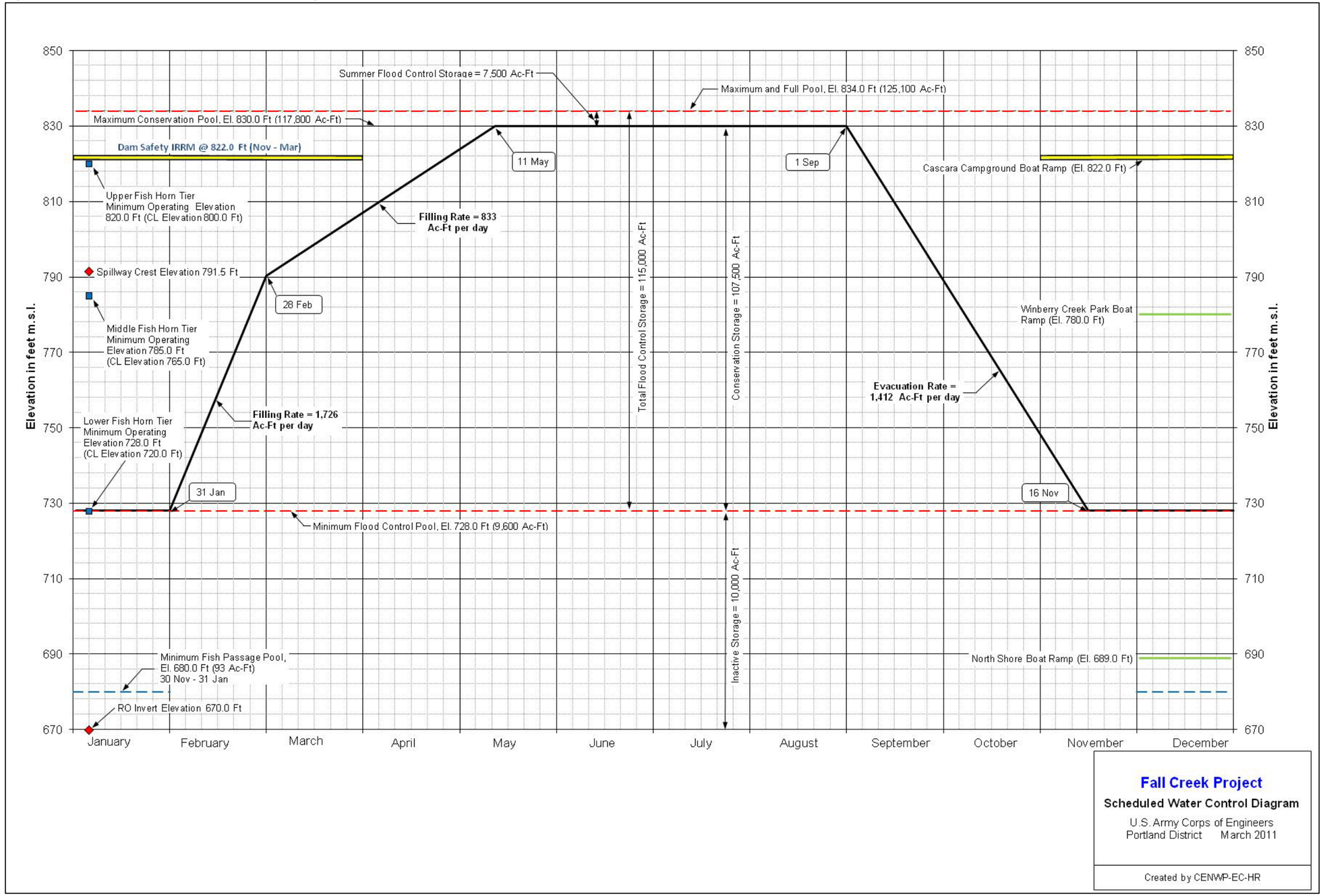
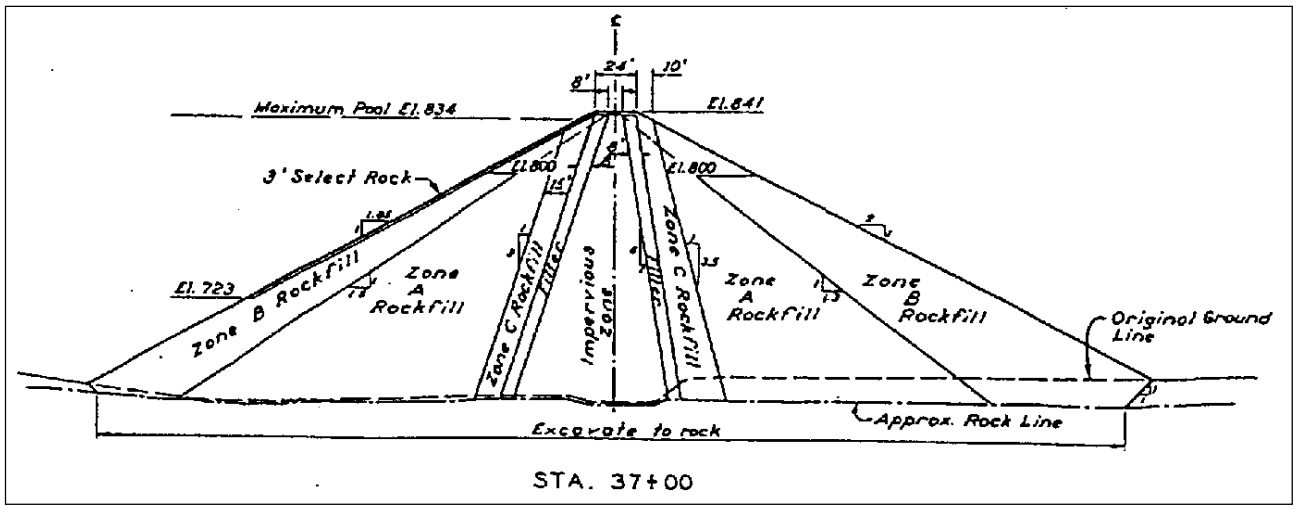


Figure 3. Fall Creek Embankment Cross Section



Coordination

This is a standard operation and will be discussed and coordinated through the Willamette Fish Passage Operations and Maintenance (W-FPOM) Team.

Foster Weir Fish Operation

Description/Intent

The Foster fish weir will be operated for fish passage and RM&E during 2016. The USACE operates the Foster fish weir from April 15th through May 15th annually around reservoir elevation 635 ft, to provide downstream fish passage primarily for emigrating juvenile winter steelhead. The operation provides spill of 0.5 to 1.5 feet (~92-238 cfs). The weir provides a more focused surface passage route which may better facilitate efficiency and survival. Steelhead kelts may also use the weir if operations overlap with their emigration for ocean re-entry. During fall and winter, woster reservoir is drawn down to elevation 616 feet in order to operate the fish weir. Discharges during this operation average 300 cfs through the weir.

Additional details will be added once the study plan is finalized.

Potential Impacts and Mitigation

Because the weir will be in a spill bay during the flood control season, an analysis of potential impacts to flood control operations is required. The project could remove the weir with a two (2) day or less notice, if required.

As a precautionary method, a checklist was developed by Foster Operations in 2013 and will be used again as guidance of when or not to operate the weir during winter months.

After about mid-November, the Project would operate the weir only when no threat of heavy river flows is predicted. That is, if any single condition on the checklist is present, the weir will not be operated and the bay will be closed. If another spill bay is out of service, then the Project will remove the weir and stop logs and return the bay to regular service. If/when we put the weir back in will be determined by all of us after reviewing the circumstances.

Additional details will be added once the study plan is finalized.

Draft Operations Plan for Leaburg Dam Trap: 2016

The purpose of this document is to describe proposed operation of the adult fish trap in the south bank ladder at Leaburg Dam in the McKenzie River in 2016. In recent years, the trap was used to remove hatchery-origin Chinook salmon as part of ODFW's efforts to reduce the proportion of hatchery-origin spawners (pHOS) in the McKenzie River wild fish sanctuary in the river reaches above the dam. We propose to continue the practice but expand the operation to begin earlier and occur more often.

Passage of Chinook salmon at Leaburg Dam is generally characterized by upstream movement of predominantly natural-origin fish, mostly in June and July, with a secondary peak usually dominated by hatchery-origin (adipose-clipped) fish in September (Figure 1). Clearly, we do not want to operate the trap during the main peak (generally in May through early July) because the bulk of the fish moving at that time are naturally-produced; the potential for delaying migration or causing injury to wild fish is greater. However, focusing the trapping operation in August and September greatly reduces the number of wild fish that will be handled.

The goal of the trapping operation is to annually remove 100 or more adipose-clipped Chinook salmon that would otherwise spawn in the wild fish sanctuary above Leaburg Dam. We propose to begin operating the trap when we estimate that > 80 % of the wild run has passed. Historically (2009 – 2014), 80% of the wild run passed in the third or fourth week of July with 90% passing by the third or fourth week of August (Figure 2). It is conceivable that the run thresholds could occur earlier in 2016 so we will use the existing continuous video monitoring of clipped and unclipped fish passing Leaburg Dam and be prepared to begin trapping as early as July 1. When the weekly total and weekly unclipped counts drop precipitously, the trap in the south bank ladder will begin operation. Note that, as shown in Figure 1, in 2013 and 2014 the unclipped count dropped but then rose again as a second pulse of unclipped fish moved upstream. In both cases the early drop in counts occurred in June. In all years, including 2013 and 2014, a drop in counts in the month of July was followed by low numbers of upstream migrants through August and a pulse of migrants in September when counts of clipped fish equaled or, usually, exceeded counts of unclipped fish.

The tentative schedule of operations is shown in Table 1. The schedule will be managed adaptively. If unclipped Chinook salmon abundance exceeds 50% of the total on <u>any</u> day, the trap will be pulled and passive monitoring of relative abundance of clipped and unclipped Chinook salmon will resume. The

trapping operation will only be reinstated when absolute numbers of unclipped fish are low and the relative abundance of clipped fish equals or exceeds that of unclipped fish. The trap will operate every weekday and will be checked at least twice daily, once in the morning and once in the late afternoon. For the morning check, if adult fish are in the trap, then they will be sorted by hand with unclipped fish immediately passed upstream. Adipose clipped fish will be hoisted into an on-site transport tank and delivered to the McKenzie Hatchery to be used for broodstock or one of the other approved uses (outplanting, donation, or sale). The afternoon check will be a visual inspection to guard against the extremely unlikely event whereby substantial numbers of adult fish enter the trap during daylight hours. We intend for the trap to be left open on weekends but are exploring the possibility of finding staff and funds to support operation of the trap on weekends.

The trap counts and timing upon which Figures 1 and 2 are based represent total counts through both the left bank and right bank ladders. It is important to note that only the left bank (south) ladder has a trap in place so there is no access to fish passing through the right bank (north) ladder. Passage through the ladders likely depends largely on flows through the three different roll gates on the dam with fish attracted to the ladder on the side with the most flow.

Reporting on trap operations to the Hatchery Management Team will at a minimum occur weekly with a daily summary of count of Chinook salmon by clip status and disposition. Any unusual outcomes such as mortalities or injuries will be reported in real time to all participants on the Hatchery Management Team.

Figure 1. Passage of clipped and unclipped Chinook salmon at Leaburg Dam, 2009 – 2014. Values are percentages of the total upstream migrant count (clipped plus unclipped fish) over biweekly intervals.

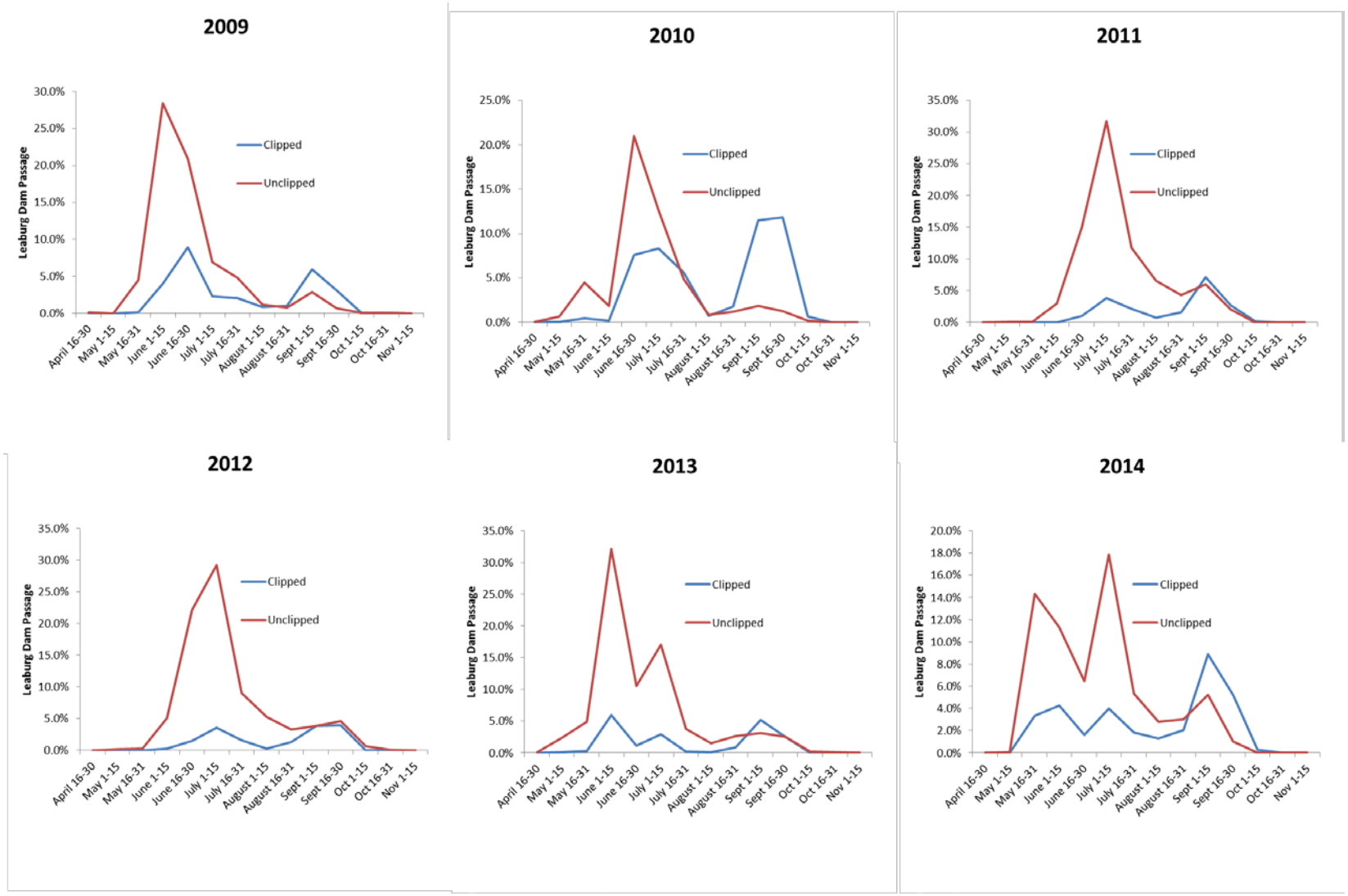


Figure 2. Average percent passage (cumulative) of clipped and unclipped Chinook salmon by two-week interval at Leaburg Dam: 2009 – 2014.

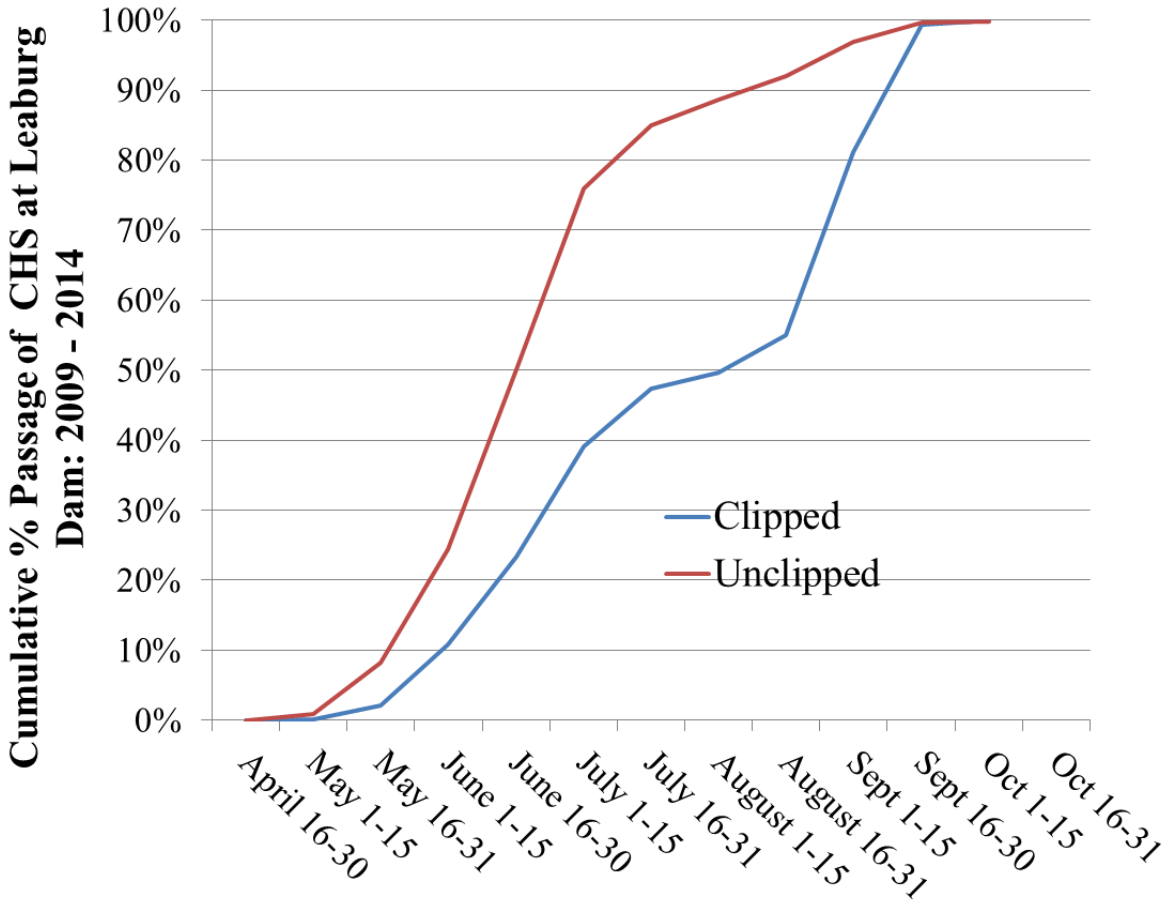


Table 1. Draft schedule for Leaburg Dam trapping operation for Chinook salmon (ChS) in 2016. Ad and NM indicate adipose clipped and non-marked fish. Draft schedule assumes that NM ChS counts drop precipitously in the third week of July. Schedule will shift if that event occurs earlier or later.

Dates			Action
1-Jul	-	10-Jul	Monitor relative abundance of Ad and NM Chinook
13-Jul	-	17-Jul	Install trap. AM and PM trap checks. Trap and transport Ad ChS to McKenzie Hatchery
20-Jul	-	2-Oct	Continue trapping. AM and PM trap checks. Trap and transport Ad ChS to McKenzie Hatchery

Willamette Basin Projects													
Reservoir and Outlet Works Stats													
Revised on October 29, 2015	HCR	LOP	DEX	FAL	COT	DOR	FRN	CGR	BLU	GPR	FOS	DET	BCL
Normal Evacuation Rate (cfs)	6,000	12,000	12,000	3,800	2,500	4,000	4,650	5,000	3,000	10,000	15,000	10,000	10,000
Maximum Evacuation Rate (cfs)	8,000	15,000	15,000	4,500	3,000	5,000	6,000	6,500	3,700	13,000	18,000	17,000	17,000
Elevation Levels (ft)													
Top of Dam (ft)	1548.0	941.0	702.5	839.0		865.0		1705.0	1362.0	1020.0		1579.0	1212.0
Max Pool (ft)	1543.0	934.0	697.4	834.0	802.6	860.0	375.1	1699.0	1357.0	1015.0	641.0	1574.0	1210.0
Full Pool (ft)	1543.0	929.0	695.0	834.0	791.0	835.0	373.5	1699.0	1357.0	1015.0	641.0	1569.0	1205.8
Max. Conservation Pool (ft)	1541.0	926.0	-	830.0	790.0	832.0	373.5	1690.0	1350.0	1010.0	637.0	1563.5	-
IRRM	1529.0	915.0	-	822.0	-	-	-	1685.0	1343.0	1002.0	-	-	-
Spillway Crest (ft)	1495.5	887.5	660.0	791.6	791.0	835.0	358.5	1656.75	1321.0	968.7	596.8	1541.0	1161.5
Min. Conservation Pool (ft)	1448.0	825.0	690.0	728.0	750.0	770.5	353.0	1532.0	1180.0	922.0	613.0	1450.0	1182.0
Min. Power Pool	1414.0	819.0	690.0					1516.0		887.00	609.0	1425.0	1182.0
Storage Levels (ac-ft)													
Top of Dam (kaf)	370.6	>504	-	132.5	-	-		-		446.9	-	-	
Max Pool (kaf)	355.6	472.9	29.7	123.2	47.5	131.1	111.4	200.0	89.5	428.1	60.8	467.0	5.3
Full Pool (kaf)	355.6	451.0	27.3	123.2	32.9	77.6	97.3	200.0	89.5	428.1	60.8	448.5	4.7
Max. Conservation Pool (kaf)	350.0	438.2	-	116.0	31.8	72.1	97.3	189.0	82.8	409.8	55.9	428.8	-
IRRM	319.1	397.4	-	104.1	-	-	-	183.0	76.4	391.6	-	-	-
Spillway Crest (kaf)	242.2	287.9	3.3	59.0	32.9	77.6	12.3	151.2	58.0	275.8	17.9	355.3	1.17
Min. Conservation Pool (kaf)	155.4	113.6	-	9.5	3.1	7.1	2.8	52.2	4.0	159.9	31.1	148.3	2.32
Min. Power Pool	106.7	102.2						43.5		97.3	27.60	111.9	2.32
Power Pool Storage (kaf)	48.7	11.4						8.7		62.6	3.5	36.4	
Is Spillway Used?	No	Yes	Yes	No	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes
Number of Spillbays	3	5	7	2	1	1	6	2	2	2	4	6	3
Capacity of 1 bay at Full Pool (cfs)	42,500	41,862	35,400		40,800	0	(2@ a time)			-	41,100	24,290	59,670
Total Capacity at Min Cons. Pool (cfs)	-			-	-	-	-	-	-	-	40,000	-	-
Total Capacity at Max Cons. Pool (cfs)	130,000	194,000	-	70,000	-	-	45,000		37,500	92,500	170,000	98,580	-
Total Capacity at Full Pool (cfs)	141,500	222,000	242,000	82,500	40,800	0	45,000		53,200	110,000	200,000	145,740	179,000
Total Capacity at Max Pool (cfs)	141,500	270,000	267,000	82,500		97,500			53,200	110,000	200,000	191,640	179,000
Spillway Crest Elevation	1495.5	887.5	660.0	791.6	791.0	835.0	358.5	1656.75	1321.0	968.7	596.8	1541.0	1161.5
Date SW Crest reached on RC	26-Feb	12-Mar		3-Mar			8-Feb	7-Apr	3-Apr	27-Feb		4-Apr	
Number of Regulating Outlets	2	4	0	2	3	5	4	2	2	2	0	4	0
Size of RO	6.5*12.5	6'9"x12'		5'6"x10'	3'9"x6'6"	5'x6'	6'9"x9'8"	6'6"x12'6"	4'9"x8'	5'5"x10'		5'8"x10'	
1 RO @ 10% Open @ Min Cons Pool	300	525		250	83	105	130	340	150	426		520	
1 RO @ 10% Open @ Max Cons Pool	570	745		400	126	176	190	720	327	525		660	
1 RO @ 80% Open @ Min Cons Pool	2,415	3,240		1,930	611	754	955	2,640	1,243	3,600		3,165	
1 RO @ 80% Open @ Max Cons Pool	4,400	4,660		3,120	970	1,336	1,715	5,335	2,773	4,460		5,600	
1 RO @ Full Open @ Min Cons Pool	2,880	4,075		2,440	810	1,077	1,140	2,900	1,855	5,280		4,110	
1 RO @ Full Open @ Max Cons Pool	5,380	6,030		3,860	1,277	1,828	2,065	5,900	4,135	6,540		7,300	
Invert elevation	1,409	724		670	719	739	340	1,479	1,132	745		2 @ 1,340	
												2 @ 1,265	
Number of Turbines	2	3	1	0	0	0	0	2	0	2	2	2	1
Nameplate capacity at full pool (MW/unit)	15	40	15					14		40	10	50	18
Capacity per Turbine at Min Pool (cfs)	850	2,700	4200	-	-	-	-	690	-	2210	1710	2480	3200
Capacity per Turbine at Max Pool (cfs)	750	2,200	4,200	-	-	-	-	455	-	1,800	1,330	1,950	2,810
Total Cap. at Full Load at Min Pool (cfs)	1,700	8,100	4,200	-	-	-	-	1,380	-	4,420	3,420	4,960	-
Total Cap. at Full Load at Max Pool (cfs)	1,500	6,600	4,200	-	-	-	-	910	-	3,600	2,660	3,900	-
Intake, bottom, lake side, Invert elev (ft)	1,384	780	634.0	-	-	-	-	1,253	-	795	583.3	1,395.5	1,130
Top of Secondary Flood Control (ft)	1479.2	856								952		1484.5	
Top of Secondary Flood Control (kaf)	209.4	194.1								229.7		220.2	
Total Amount of Conservation Storage (kaf)	194.6	324.6		106.5	28.7	65.0	94.5	136.8	78.8	249.9	24.8	280.5	
IRRM Elevation	1529	915		822				1685	1343	1002		1568.5	

US Army Corps
of Engineers
Portland District

SYSTEM OPERATION AND MAINTENANCE MANUAL

MINTO FISH COLLECTION FACILITY REBUILD
WILLAMETTE RIVER BASIN
NORTH SANTIAM RIVER, OREGON

MINTO FISH COLLECTION FACILITY REBUILD

FINAL **Sept 2016**

TABLE OF CONTENTS

1. **Chapter 1: General Information**

2. **Chapter 2: System Description**

3. **Chapter 3: Theory of Operation**

4. **Chapter 4: Operations**

5. **Chapter 5: Preventative Maintenance**

6. **Chapter 6: Trouble Analysis**

7. **Chapter 7: Corrective Maintenance and Checkout Procedures**

8. **Appendices**

   8.1. **Appendix A - As-Built Drawings**

   8.2. **Appendix B - Equipment O&M Manuals**

   8.3. **Appendix C – Site Map**

   8.4. **Appendix D – Commissioning Checklists**

   8.5. **Appendix E – Minto Axillary Water Supply (AWS) PLC Operation**

   8.6. **Appendix F – Minto Facility Water Supply (FWS) PLC Operation**

   8.7. **Appendix G – Minto Area Locator Map**

   8.8. **Appendix H – Minto Control System User Guide**

   8.9. **Appendix I – Fish Transfer Procedure**

Abbreviations and Acronyms

ATS	Automatic Transfer Switch
AWS	Auxiliary Water Supply
cfs	cubic feet per second
FCF	Fish Collection Facility
fpm	feet per minute
FWS	Facility Water Supply
GAC	Granular Activated Carbon
HIM	Human Interface Module
IPS	Intake and Pump Structure
kW	kilowatt
LIT or LT	Level Transmitter
NOAA	National Oceanic and Atmospheric Administration
O&M	Operation and Maintenance
ODFW	Oregon Department of Fish and Wildlife
PLC	Programmable Logic Controller
PM	Preventative Maintenance
SCADA	Supervisory Control and Data Acquisition
SOMM	System Operation and Maintenance Manual
VFD	Variable Frequency Drive

Chapter 1 – General Information

1.1. Purpose and Scope

ODFW and the Willamette Project will be responsible for the operation and maintenance of the rebuilt Minto Fish Collection Facility. The new facility is a complex system with many interacting mechanical, electrical, and structural components. In addition, the hydraulic performance must be carefully controlled so that the system operation meets NOAA Fisheries criteria and provides effective fish passage. The System Operation and Maintenance manual provides the necessary guidance in the general system operation and describes the specific operation and maintenance of each component in the system.

1.2. Parts of the Manual

There are seven chapters in this manual including:

1. General Information
2. System Description
3. Theory of Operation
4. Operations
5. Preventative Maintenance
6. Trouble Analysis
7. Corrective Maintenance and Checkout Procedures

Appendices include:

A. As-Built Drawings

B. Equipment O&M Manuals

C. Site Map

D. Commissioning Checklists

E. Minto Auxiliary Water Supply (AWS) PLC Operation

F. Minto Facility Water Supply (FWS) Pumps PLC Operation

G. Minto Area Locator Map

H. Minto Control System User Guide

I. Fish Transfer Procedure

1.3. Project Description

The Minto Fish Collection Facility is located 4 miles downstream of the Big Cliff Reregulating Dam and 7 miles downstream of the Detroit Dam on the North Santiam River. The Minto Fish facility site is located at 44°45’27”N, 122°21’38”W on the boundary between Marion and Linn Counties, Oregon.

The Minto Fish Collection Facility includes the following major features:

a. Fish ladder system including:

   i. Pools separated by weirs and orifices

   ii. Diffusers in lower pools supplied by gravity AWS System

   iii. Fish ladder entrance with two entrance gates

b. Pre-sort pool including:

   i. Crowder, finger weir and false weir

c. Sort Facility including:

   i. Facility office, visitor room, mechanical/electrical room, and storage

d. Post-sort pools including:

   i. 8 post-sort pools

   ii. Sort channel with crowders and hopper pit

   iii. Juvenile return pipe and sort channel drain system

e. Intake and pump structure including:

   i. Pumped Facility Water Supply (FWS) System

   ii. Gravity Auxiliary Water Supply (AWS) System

   iii. Intake screens, porosity plates, bulkheads

f. Fish sorting equipment including:

   i. Fish sorting flumes, anesthetic tank, recovery tank, sort table, adult return to river pipe

g. Fish transfer and loading equipment including:

   i. Hopper crane

   ii. Hopper loading structure

iii. 2 Hoppers

iv. Fish truck

h. East Retaining Wall Structure

i. West Retaining Wall Structure with AWS conduit

j. Abatement Pond

k. Ancillary buildings including:

l. Maintenance building, emergency generator building, site host, 2 shade structures, and 2 IPS stairwell access structures

m. Barrier Dam with flashboards

n. Minto North including sanitary drainfield

Chapter 2: System Description

2.1. SITE MAP

A site map is included in Appendix C.

2.2. FISH LADDER

The fish ladder guides fish from the barrier dam tailrace to the fish collection facility presort pool. This fish ladder is constructed of reinforced concrete, consisting of 52 pools separated by 51 weirs. The ladder channel is 6-feet wide. The ladder is approximately 421-feet long and starting from Pool 1 invert 958.25 feet, the invert is sloped at 1 on 10 feet to rise 38-feet from pool 1 to the presort pool. Discharge down the ladder originates from the presort pool and steps down from pool 52 to pool 1, releasing through the entrance into the tailrace. The FWS pumps supply the presort pool, post-sort pools and upper ladder flow (about 17 cfs). The gravity AWS system provides 80 – 220 cfs to the lower ladder diffuser system to augment the entrance attraction flow.

2.2.1. Fish Ladder Entrance

The fish ladder has two entrances, one for adult and one for juvenile fish, located adjacent to the north end of the barrier dam. A fish barrier screen is located behind (or upstream of) the adult fish entrance gate. The gates close from the top downward. A work platform is located over the fish ladder entrance area allowing workers access to the fish ladder entrance gates and the fish screen gate.

2.2.1.1. Adult and Juvenile Fish Entrance Gates

Figure 2-1

The two entrance gates include a 4-foot wide main adult entrance gate and a 12-inch wide juvenile entrance opening. The gates are 10 feet high and close to invert elevation 958.25 feet. The entrance gates are stainless steel slide plates that are moved by a jack screw and actuator. The juvenile entrance gate leads to a separate channel which has an additional head drop so that the head drop across the juvenile entrance is approximately one half of the entrance head at the main adult entrance. While both gates have separate actuators that can be operated independently, the current plan is to operate them in tandem and monitor the performance. A programmable logic controller (PLC) automatically positions both gates based upon water depth and a differential of the head at the main entrance.

2.2.1.2. Fish Barrier Screen and Support Structure

Figure 2-2

The fish screen gate is used to prevent fish from entering the ladder during commissioning, start up, and shut down operations. The 6-foot wide x 14-foot tall gate is fabricated from stainless steel grating and framed by a hollow structural section. This gate is raised and lowered by a manually-operated electric hoist mounted on the lifting frame.

2.2.2. AWS Diffusion Basins

The AWS system includes 13 diffusion basins and 14 diffuser gates. The entrance pool (pool #1) has 3 diffusers while the remaining diffusers are located in pools 2-11 (Pools 4 and 8 are currently blocked). This water is sourced by gravity from the upstream side of the barrier structure.

2.2.2.1. AWS Diffuser Slide Gates

Figure 2-3

A vertical slide gate is installed at each of the 14 AWS diffuser chamber water inlets. Each gate has an electric actuator that may be automatically positioned by the PLC. Depending upon the tailwater level the gates are either fully open or closed. . The diffuser gates will open one at a time, starting at the ladder entrance and moving up the ladder as tailwater rises. Diffuser gate 7 (pool 4) and diffuser gate 11 (pool 8) are not operated due to the inlets being blocked.

Diffuser gates 13 and 1 are also not operated, and are blocked from automatic operation after an evaluation of hydraulic instability (October 2013) under high total ladder flows. The maximum number of operating diffuser gates is 10. If one of the lower operational diffuser gates becomes disabled, the next higher diffuser gate may replace it in a manual operation sequence. Diffuser Gate 13 or 14 can be operated in the very high tailwater condition when 10 diffuser gates are called upon.

2.2.2.2. Diffuser Screens, Porosity Plate, and Bubbler Beams

The system of baffle blocks, bubbler beams, and porosity plates located between the AWS gates and diffuser screens were designed to dissipate approximately 8 feet of head. The baffle blocks are constructed of reinforced concrete while the bubbler beams, porosity plate, and diffuser screens are constructed of stainless steel.

The AWS diffuser screens are located flush along the ladder wall and are intended to prevent fish from entering the AWS diffusion basins as well as provide a uniform discharge of auxiliary water into the ladder system. Each diffuser screen has a porosity plate behind it. This plate provides a uniform discharge through the diffuser screens by creating most of the hydraulic resistance and head drop between the diffusion basin and the adjacent fish ladder pool.

2.2.3. Ladder Weirs and Orifices

Each ladder weir is constructed of reinforced concrete and has a 4-foot long non-overflow weir as well as a 2-foot long overflow weir located between each fishway pool. A 12-inch wide by 15-inch tall orifice is located on the floor beneath the 2-foot overflow section. The orifice opening is rounded to assist lamprey passage. The crest of the overflow weir is 5-feet above the invert and the non-overflow crest is 2-feet above the overflow crest. The weirs are spaced at 7.5-foot on center from pool to pool and the ladder invert is sloped at 1 vertical to 10 horizontal. The elevation difference between the crest of the weirs up the ladder is 0.75-feet. The FWS pumps must discharge 17-cfs to maintain this 0.75-foot ladder head per design criteria.

2.2.4. Pool 52 – Ladder Head Control with Level Sensor

There are parallel redundant level sensors (LIT-006A/LIT-006B) installed in Pool 52 for monitoring the water level. Adequate ladder flow requires a 9-inch differential between the top of Weir 51 and water elevation in Pool 52. With the FWS system pressure at 12PSI, presort valve 1 is normally preset at 45% open while valve 2 is preset at 100% open. When crowding fish, valve 1 may be set to 100% open while reducing valve 2 to 45% open.

Figure 2-4

2.3. PRE-SORT POOL

Fish jump from the fish ladder, over a finger weir, into the pre-sort pool. The 68-foot long, 13-foot wide, 14-foot tall pre-sort pool is constructed of reinforced concrete. The pre-sort pool is sized to hold a maximum of 750 adult fish. Water is supplied to the pre-sort pool through two floor diffusers. During normal operation, the water is 6-feet deep. If water supply is disrupted, the pre-sort pool will maintain 5-feet of depth.

2.3.1. Finger Weir

Figure 2-5

A finger weir is provided at the transition between the fish ladder and the pre-sort pool. This prevents fish from dropping out of the pre-sort pool back into the fish ladder. The finger weir can be adjusted to match any changes to the pre-sort pool level; typically the pre-sort pool water elevation does not change and the finger weir will not need adjustment once the pre-sort pool water level has been set.

2.3.2. False Weir

The false weir is located at the end of the pre-sort pool and provides a falling water stream that plunges into the pool, stimulating the fish to jump. Under normal conditions the fish will swim over the false weir without the need for a crowder. The false weir's water stream can be changed in two ways; the water supply can be diverted from the floor diffusers in the pre-sort pool, or the total volume of water in the pipe can be changed prior to the diversion valve. These modifications can be done independently or simultaneously. Typically, the operators will adjust these until the fish are swimming into the flume and no further changes are necessary.

2.3.3. Crowder

The crowder is located in the pre-sort pool. If the fish do not respond to the false weir, the crowder is used to move the fish in this direction. The crowder is operated from either the control panel, located on the northeast wall of the pre-sort pool, or the control console, located on the work platform at the east end of the pre-sort pool. During operation the crowder moves along the length of the pre-sort pool forcing the fish to be concentrated next to the false weir. The crowder lower edge can then be moved vertically to push fish into the entrance area of the false weir as necessary to encourage fish to move through the weir.

Figure 2-6

2.3.4. Closure Gate

Figure 2-7

The closure gate is a perforated aluminum slide gate that will allow water to partially pass through when closed. In the event that fish cannot be processed down the flume the gate can be lowered to keep them from jumping into the false weir water stream. The diversion valve actuation is very slow; the closure gate provides a temporary flow disturbance that keeps the fish from entering the flume.

2.3.5. Pre-sort Pool Piping

The pre-sort pool has two 16” diameter stainless steel pipe spools that supply the pool and subsequently the ladder.

Figure 2-8

There are two 8” diameter stainless steel pipe spools embedded in each diffuser pit that allow the pre-sort poll to drain.

2.3.6. False Weir Drain

The False weir has one false weir drain. The drain is a 6 inch butterfly valve located on the left side of the false weir below the platform. The drain valve is manually operated by handle. The drain is used to fine tune the amount of water entering the flume at the backside of the false weir.

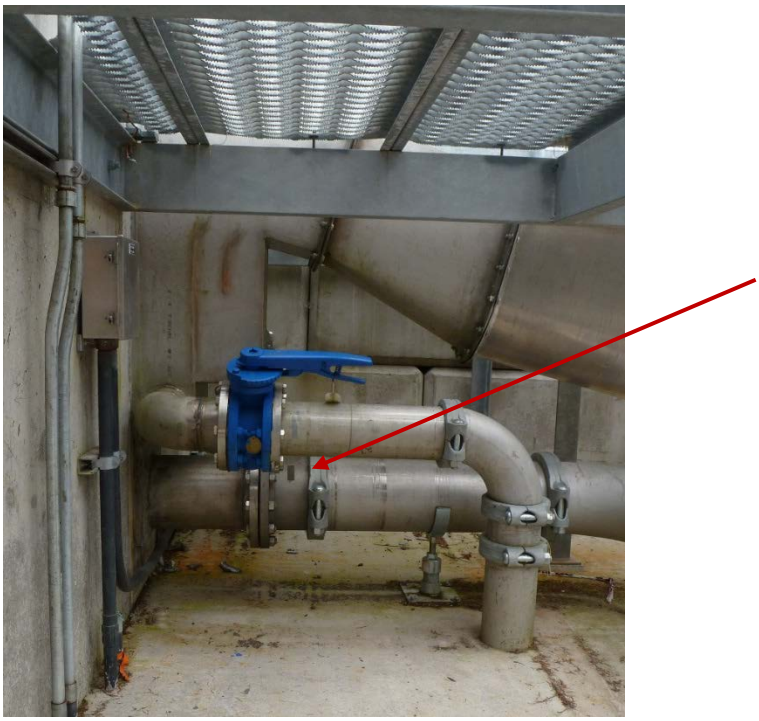


Figure 2-9

2.3.7. Valves

Each 16” supply pipe has an electrically actuated butterfly valve that can be positioned through the HMI for different operations. The valves are within exposed vaults located on the river side of the pre-sort pool.

The pre-sort drain valve is an 8” butterfly valve located in most upstream manhole on the river side.

The false weir pump isolation valve is a 10” butterfly valve and is located in the most upstream vault with the 16” supply valve.

2.3.8. Diffusers

The pre-sort pool diffusers are approximately 2 ft deep and are located at the ends of the pre-sort pool floor. A perforated plate and diffuser grating are located in each diffuser. The perforation plates and diffuser screens are constructed of stainless steel and are 6-ft by 5-ft. The porosity of each perforated plates is about 51 percent. The diffusers are supplied by the FWS pumps and provide hydraulic resistance to flow in order to reduce any jetting flow that may occur near the outlet of a water pipe.

2.4. SORT FACILITY

After jumping out of the pre-sort pool, over the false weir, fish enter a flume to the sort facility. The sort facility is constructed of reinforced concrete and contains a fabricated metal building. The ground level of the structure consists of three rooms, including a mechanical/electrical room and two storage rooms. The fish sorting equipment is also located on the ground floor of the sort structure.

2.4.1. Mechanical/Electrical Room

This room houses the lighting transformer and panelboard for the sort structure electrical loads. Also located here are the communications cabinet, potable water well pump controller, remote I/O cabinet, autodialer, intrusion detection panel, air compressor, potable water tank and the GAC filter. The room also has general and emergency egress lighting plus 120VAC receptacles.

2.4.1.1. Compressed Air and Oxygen

Figures 2-10 and 2-11

The compressed air system is comprised of a Champion VR10-12 compressor with a 120 gallon receiver. The compressor is rated to provide 34.8 CFM @ 175PSI. Compressed air pipe is copper type K. There are two connections; one at the anesthetic tank and one at the service building.

The oxygen pipe is also copper type K pipe cleaned for oxygen service. This pipe services the post sort pools and the anesthetic tank. There are 3 valves at each pool with Schrader connections that will act as

quick disconnects for aquarium stones. The oxygen cabinet is located near the crane beneath the platform access stairs. The oxygen system is designed to operate from 20 to 60 PSI. A flow meter is located in the cabinet to adjust oxygen infusion rates; the operator must manually regulate flow as the system will not self-adjust based on oxygen concentration.

2.4.1.2. GAC Filter

Figure 2-12

The GAC filter uses activated charcoal to remove contaminates from the anesthetic water. An operator using the anesthetic tank will choose where to drain the tank based on the anesthetic being used. The GAC filter should only be used when MS-222 (Tricaine Methanesulfonate) is utilized to anesthetize fish. Operators need to log the amount of fluid that passes through the filter as its media has a limited life span. Occasionally the filter will need to be back flushed; see operation section for additional details. The GAC filter is located in the mechanical room; Siemens PG500.

2.4.2. General Storage and Fish Food Rooms

Figure 2-13

A general storage room and fish food storage room are located on the lower floor of the sort structure. The general storage room is for equipment and supplies for operation of the facility to be stored near the work areas. The fish food room is for storage of fish food used during juvenile acclimation. Normal lighting (plus an emergency egress light) and 120VAC receptacles are provided in each room.

2.4.3. Office and Conference Room

An office and a conference room are located on the upper floor of the sort structure.

2.4.4. Plumbing

Piping is soldered copper pipe. Fixtures are composed of corrosion and vandal resistant materials such as stainless steel or vitreous china. Fixtures are designed to have reduced flow to conserve water. For each fixture, refer to the manufacturer's operation manual for care and maintenance.

2.4.5. HVAC

Occupied areas are thermostatically controlled spaces. Spaces that house temperature and humidity sensitive equipment are also thermostatically controlled. Refer to equipment specific operations manual for additional information.

2.5. POST-SORT POOLS, SORTING CHANNEL, AND HOPPER PIT

The post-sort pools, sort channel, and hopper pit are constructed of reinforced concrete. There are 8 post-sort holding pools that are 10-foot wide by 75-foot long. Water enters and exits the post-sort pools through floor diffusers. The post-sort pools are sized to hold a maximum of 350 adult fish per pool

and 87,500 juvenile fish per pool. There is a 6-foot wide by 139-foot long sort channel located on the south end of the post-sort pools. A hopper pit is located on the east end of the sort channel. Fish are crowded from the post-sort pools to the sort channel and then to the hopper for truck loading.

Figure 2-14

2.5.1. Post-Sort Pool Crowders

Figure 2-15

Two fish crowders are provided for the eight post-sort pools. The post-sort pool crowders are used to move fish from the post-sort pools to the sorting channel. During operation the crowder moves along the length of the post-sort pools, forcing fish to exit the pool and enter the sorting channel. The crowders are "ride-on" and are operated by a console on the crowder. Crowders are powered by DC (batteries), which are charged from 120VAC receptacles on each pool. One crowder is intended for Pools 1-4 and the other for Pools 5-8, even though it is possible to use either crowder on any of the Pools. The crowders can be moved between pools with the crowder trolley. The trolley can hold one crowder at a time and is operated using the controls located on the trolley.

2.5.2. Sorting Channel Crowder

Figure 2-16

A single crowder is provided for the sorting channel. It is used to move adult fish from the sorting channel to the fish hopper. During operation the crowder moves along the length of the crowding channel and forces fish into the fish hopper. During hopper operations, the crowder screen acts as the fourth wall of the hopper pit. The sorting channel crowder is "ride-on" and operated by a console on the crowder.

2.5.3. FWS Piping

The facility water supply piping provides water to the presort pool, sorting area, hopper loading area. The water is pumped and the supply piping is maintained at 12 PSI.

2.5.4. Diffusers

There is one post-sort pool floor diffuser per pool. The diffuser openings are 6-foot wide by 12-foot long. The diffuser opening is covered by grating and a perforation plate is located under the grating, both constructed of stainless steel.

2.5.5. Removable Fish Screens and Overflow Stoplogs

Figures 2-17 and 2-18

There are 8 removable screens at the end of the post sort pools and 2 removable screens in the juvenile release conduit area. The removable screens are constructed of an aluminum frame and expanded aluminum mesh. The porosity of the removable screens is 70%. Timbers are used to regulate the water surface elevation in the pools.

2.5.6. Juvenile Fish Return Pipe

Juvenile fish are released from the sort channel through the juvenile fish return pipe. The juvenile fish return pipe is made from 30-inch diameter HDPE pipe. The pipe connects the west end of the sort channel to the juvenile fish outfall near the fish ladder entrance. The pipe alignment is show on drawing C-015. There is an 18” schedule 40 PVC pipe that supplies water to the lower half of the juvenile return pipe. This is used as the drain when juvenile fish to be evacuated from the Sort Channel by operators.

2.5.7. Sort Channel Drain System

The sort channel is drained to the tailrace of the river and discharge near the ladder entrance. There are two main outlets to the Sort Channel located at the west end of the sort channel (see sheet SC745):

- Upper outlet to 30-inch Juvenile Return Pipe on north side, crest invert 983 feet

- Lower outlet to 18-inch juvenile drain pipe on south side, crest invert 979 feet (I.E. of sort channel). The 18-inch pipe drains to the 30-inch pipe to discharge to the tailrace.

  The upper outlet is used for normal drainage and volitional juvenile passage to the tailrace. The lower outlet is used for draining removing juveniles from the sort channel.

2.6. INTAKE AND PUMP STRUCTURE (IPS)

IPS Road Deck Load Rating: All members & slabs are designed to meet 2010 AASHTO HL-93 Design Vehicle Loads. For any crane that exceeds a gross vehicle weight (GVW) of 72,000 lbs or an axial weight of 32,000 lbs the structure must be checked by CENWP-EC-DS for capacity.

2.6.1. FWS Pump System

Figure 2-19

There are 5, 125 HP FWS pumps and each is controlled by a variable frequency drive (VFD) with a minimum speed setting of 1425 RPM. Four FWS pumps are considered essential for normal operation, while the remaining is a backup or standby unit. During automatic FWS Pump System control the VFD's operate in unison as required to maintain adequate water elevation in ladder pool #52. If a VFD is switched to manual, then starting, stopping, and speed control must be performed by a local operator. Automatic FWS Pump System control is not permitted when any VFD is running in manual mode.

2.6.2. FWS Piping

The FWS piping reducers within the Intake and Pump Structure (IPS) increases in diameter as the piping progresses along the FWS pump system. At FWS Pump No. 1, the pipe diameter is 18" schedule 40 steel pipe. The piping increases to 24" diameter pipe at Pump No. 2, and increases again to 36" diameter

schedule 80 pipe at Pump No. 3. Steel are provided at pipe transitions. The piping remains at 36” diameter along the remaining pumps and a manual drain is provided between FWS pumps No. 4 and No. 5.The FWS flowmeter and air valve are located along the piping inside the IPS before mating up to Sorting Pool Piping.

2.6.3. FWS Flowmeter

A flowmeter (FIT-001) provides flow monitoring of the FWS header pipe. The flow signal connects to the PLC, but is only used for monitoring and hydraulic calculation checks.

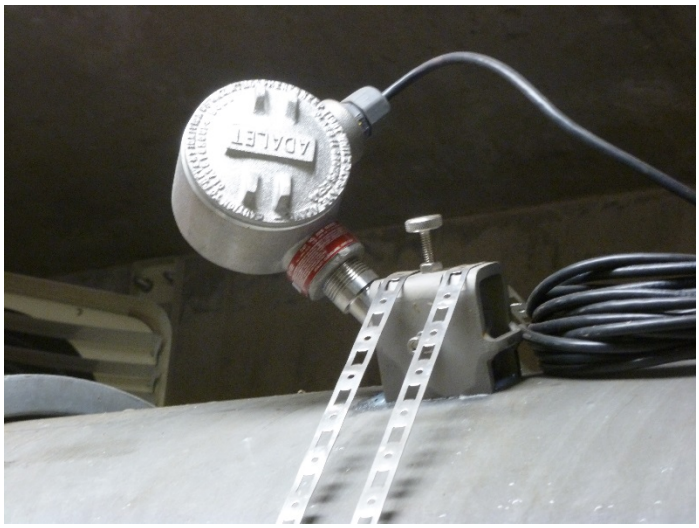


Figure 2-20

2.6.4. AWS Valve and Sump Pump System

The AWS Valve is a gate valve that allows and disallows water to flow into the AWS diffuser basins. The gate valve is a fabricated steel plate with frame. The gate valve is lifted by a dual-rod lifting system driven by an electric drive or manually operated. A slide gate is located at the upstream end of the AWS channel, inside the intake and pump structure. The slide gate closes the AWS supply for times when the fish ladder is not in operation. The gate vertical actuating stem penetrates the floor through a packing gland and has a pedestal-mounted electric actuator with integral local controls for gate operation.

Figure 2-21

Figure 2-22

The Sump Pump System has two submersible pumps. The pumps operate in al lead/lag configuration. Normally only one pump is required unless it cannot keep up with sump level. The pumps operate to remove water from the sump by pumping it into the tailrace to the tailrace. The sump is subject to drainage from the air burst system receivers, structural drainage via trench drain, and is the low point for any other unexpected sources of water infiltration.

2.6.5. Washdown Pipe System

Figure 2-23

A pump control panel is provided to allow automatic operation of the washdown water pump motor based upon water level in the hydropneumatic tank.

2.6.6. Intake Screens

The purpose of the intake screens is to prevent the entrainment of juvenile salmon and other small resident fish into the sump, pumps and discharge pipe system. The intake screens also prevent debris from entering the intake structure that may damage the pumps or other equipment in the system. There are 15 FWS pump intake screens and they are fabricated from stainless steel vertical profile bars. The gaps between the bars are 1.75 mm, sized for juvenile fish per NOAA Fisheries Criteria. Each screen is 6 ft wide, framed with hollow structural sections, and with structural supports between sections.

Figure 2-24

2.6.7. Porosity Plates

There are 15 porosity plates, fabricated from stainless steel, located directly upstream of each intake screen. The purpose of the porosity plates is to cause the flow to pass through the screens more uniformly and prevent the occurrence of velocity hot-spots on the fish screen that could endanger juvenile fish. This is accomplished by having the porosity plate create much more hydraulic resistance than the fish screens. The perforated plates have a porosity of 12.8% in Intake Screens 1-7 (1 starting at upstream or east end) and 10% in Intake Screens 8-15 (downstream or west screens). The porosity is lower at the downstream screens because of higher head differential due to the drawdown of the water surface inside the IPS towards the downstream direction. (See Drawings SO102 for Screen locations & SO525 for Porosity Plate details).

2.6.8. Dewatering Bulkheads

There are 15 bulkheads that can be used to dewater the FWS and AWS systems that are fabricated from stainless steel. When not in use, the bulkheads will be stored in the vertical position. The bulkheads have permanent rigging attached and are raised and lowered using a 5-ton boom truck. A rental 5-ton boom truck can be used to lower and lift the bulkheads.

Figure 2-25

2.6.9. Airburst System

There are total of fifteen (15) airburst screens, each screen is subdivided into four zones. Zone 1 is the lowest in the water while zone 4 is the highest. Each screen has four solenoid valves, one for each zone within each vertical screen. The cleaning cycle shall blow one screen at a time, starting at upstream end, from Zone 1 to Zone 4 and sequence shall be timed so that the debris is carried downstream by the nominal system flow and does not re-impinge on the screens. The system startup will be automatically initiated by a timer or preset pressure differential that would be measured across the screens. Automated control is provided by the PLC, and manual control is performed through the HMI.

2.7. FISH SORTING EQUIPMENT

2.7.1. Fish Transport Flume

Figure 2-26

The transport flume provides fish passage from the pre-sort false weir to the first downstream switch gate. It is fabricated using aluminum and has a U profile. Square bottom to U bottom transitions are provided for the false weir and downstream switch gates.

2.7.2. Switch Gates

Figure 2-27

The switchgates are downstream from the fish transport flume. They are fabricated using aluminum and have Composite bushings at hinge points and a single pneumatic cylinder for actuation. There are three switchgates that allow the operator to choose where a fish is deposited; anesthetic tank, return-to-river pipe, and post-sort pool 8. All switchgates can be operated from a pushbutton pendant located on the pre-sort platform. As well, the return-to-river switchgate can be operated from the control console located on the pre-sort platform.

2.7.3. Anesthetic Tank

Figure 2-28

The anesthetic tank is a 3’ by 8’ stainless steel tank used to anesthetize fish prior to sorting/spawning. A fish brail forms a false bottom in the anesthetic tank and can be actuated up to lift anesthetized fish out of the water for processing. The fish transport flume and the hopper return flume both run through a dewatering screen before connecting to the anesthetic tank. Another flume also connects the anesthetic tank with the spawning table.

The anesthetic tank has a 2” fill pipe and a 3” drain pipe. The drain pipe has a three way valve used to route the effluent to the appropriate discharge area. Drainage from the tank can be routed through the GAC filter to a holding (septic) tank or to the abatement pond. If drained through the GAC filter a pump must be used to move the fluid through the media.

2.7.4. Sort Table

Figure 2-29

The sort table is a large, V-shaped table used for sorting anesthetized fish. The sort table is connected to all 8 of the post sort pools through watered fish pipes coming through the back wall of the table. One end of the sort table also connects to the recovery tank. 2-inch table supply valves feed water to the surface of the table through two perforated plate diffusers. This table water is controlled by ball valves located beneath the table, directly beneath each plate diffuser. Each of the 8 fish types have a dedicated 5-inch water supply line which is controlled by a 5-inch butterfly valve directly beneath each fish pipe opening on the table.

2.7.5. Recovery Tank

Figure 2-30

The recovery tank's purpose is to provide a place for fish to recuperate from their anesthetized state before being returned to the river. The tank is stainless steel with an aluminum fish brail located inside. Fish can volitionally exit the recovery tank by way of the false weir, or can be brailed out of the tank together. The aluminum brail is actuated using an electric motor on a worm gear box, attached to a wire rope drum. Wire ropes attach to the drum and the four corners of the brail, lifting it vertically out of the water.

2.7.6. Recovery Tank False Weir

Figure 2-31

The recovery tank has a false weir mounted to the front end to provide volitional exit for the fish, and recirculation water for the recovering fish. The false weir takes water from the recovery tank, and uses a centrifugal pump run by a variable frequency drive (VFD) to provide the attraction flow and recirculation water. A separate supply line on the flume side of the false weir provides flume water to the return to river fish pipe. A drain box between the two supplies is controlled by a 6” butterfly valve and can be used to fine tune the attraction and flume flow. A control panel is provided for operation of the brail and false weir pump motor.

2.7.7. Spawning Table

Figure 2-32

The spawning table is a 3-foot by 5-foot stainless steel table used for spawning fish. A short-walled fish flume connects the spawning table to the anesthetic tank and sort table. The spawning table has a 2-inch drain located in the middle of the table.

2.8. FISH TRANSFER AND LOADING EQUIPMENT

2.8.1. Hopper Hoists

Figure 2-33

The hopper crane is a pendant controlled class 2, monorail hoist rated for 7.5 TONS. The hoist has been set up with multiple limits; upper over travel, upper stop, upper slow down, and lower stop. The hoist will travel the length of the beam with bump stops at either end to stop the hoist. The hoist will traverse at 65 fpm and will hoist at 12.2/2.1 fpm. A second hoist identical hoist is installed for hopper 2.

2.8.2. Hopper Loading Structure

The hopper loading structure is fabricated using A992 structural steel shapes and A572 Grade 50 for fabricated brackets and bracing. Stainless steel wire ropes with adjustable turnbuckles are used to shore up the structural bracing. A325 structural bolts used in combination with load sensing washers are used for the structural component assembly.

2.8.3. Hopper 1 – Fish Truck

Figure 2-34

Hopper 1 is primarily used to transport ESA fish from the sorting channel to the truck by "water to water" transfer. The Hopper is primarily fabricated from 6061-T6 aluminum. The hopper footprint is 5-foot by 10-inch square with a height of 15-feet-7½-inch. A storage frame is located at the river side of the crane when hopper 2 is being used. General use of the hopper is as follows:

- The hopper is lowered into the sorting channel hopper pit
- Fish are crowded into the hopper
- The hopper is lifted out of the pit and lowered onto the truck
- Hopper valve is opened to equalize pressure across the hopper door
- Hopper door actuation lever is pulled down, opening the hopper door located at the bottom of the hopper
- Drain valve on the truck is opened until proper water level in the truck is reached

2.8.4. Hopper 2 – Spawning (Return to Anesthetic Tank)

Figure 2-35

This Hopper is used exclusively to process broodstock. It's fabricated using 6061-T6 aluminum and its footprint is the same as hopper 1 and its height is 15-feet-7-inches. This hopper has an interior brail and screen that is actuated by pneumatic cylinders. The bottom of the hopper has a bell receptacle with a check valve so that water from the inside of the hopper can be pumped from the bottom of the hopper through the false weir and back into the hopper. General use of the hopper is as follows:

- The hopper is removed from the pedestal and placed into the sorting channel hopper pit
- Broodstock are crowded into the hopper
- The hopper is moved back to the pedestal
- The false weir is turned on; water begins to flow into the hopper through the screen
- Screen is lifted to allow volitional passage into the false weir
- In the event the fish do not self-pass, the brail is lifted forcing fish into the false weir
- Broodstock enter the anesthetic tank return pipe

2.8.5. Hopper False Weir

Figure 2-36

Hopper 2 interfaces with the hopper false weir when it is placed on the hopper 2 pedestal. The hopper false weir is primarily ¼-inch aluminum plate. The false weir attraction water is taken from the base of hopper 2, sent through a centrifugal pump powered by a variable frequency drive, and returned to hopper 2. A facility water supply line is used to supply the return to anesthetic tank fish pipe. A drain box between the two supplies is controlled by a 6-inch butterfly valve and can be used to fine tune the attraction flow and flume flow. A control panel is provided for operation of the false weir pump motor.

2.8.6. Fish Truck

Figure 2-37

The transport truck is a Freightliner FF3789, 33,000 lb GVW rated tank truck. The wheel base is 208 inches, with 138 inches from back of cab to rear wheel centerline (CA=138 inches). The tank is a West-Mark 1500 gallon stainless steel tank, mounted on the truck. The tank has external sight gauges, oxygen sensors, aerators, a top loading port to match the transfer valve system, and a rear release valve. The tank has an anti-siphon overflow pipe and vents.

2.9. EAST RETAINING WALL STRUCTURE

The east retaining wall is constructed from reinforced concrete and spans between the intake and pump structure and gravity block wall on the east side of the facility.

2.10. WEST RETAINING WALL STRUCTURE

The west retaining wall is constructed from reinforced concrete and spans between the intake and pump structure and the fish ladder entrance. An AWS conduit is attached to the north side of the retaining wall.

2.10.1. AWS Conduit

The AWS conduit is fabricated from reinforced concrete. The conduit is 10-foot high by 5-foot wide and is attached to the north side of the west retaining wall. The conduit starts at the west side of the intake and pump structure and ends at the fish ladder entrance diffusion chambers.

2.11. ABATEMENT POND

Figure 2-38

The facility includes an abatement pond. A 12-inch diameter pipe will be used to convey the drainage into an underwater gravel bed about 200 feet downstream of the facility.

The abatement pond will accept inflow from two main sources: the eight post-sort pools and storm water runoff from Catch Basin #2.

2.12. ANCILLARY STRUCTURES

2.12.1. EMERGENCY GENERATOR STRUCTURE

Figure 2-39

A prefabricated metal structure houses the diesel generator and automatic transfer switch. Fuel storage is adjacent to the structure.

2.12.1.1. Diesel Generator

The Emergency Generator by MTU Onsite Energy is rated at 600 KW. The engine portion, manufactured by MTD Detroit Diesel, is Model DS600D6SRA. The Generator Portion, manufactured by Marathon, is Model 572RSL4031. The total oil system capacity is 19.3 Gal.

2.12.1.2. Fuel Storage System

Fuel tank is a 3,000 gallon, double walled precast concrete tank manufactured by Oldcastle Precast. This tank is equipped with leak detection monitoring as well as with a kidney loop filtering system, manufactured by Fuel Technologies International. The purpose of this system is to filter the fuel through a 2 micron filter to remove any contaminates, including water prior to the fuel being needed for the generator.

2.12.1.3. Automatic Transfer Switch (ATS)

An ATS automatically transfers power between the normal (Pacific Power) and emergency (diesel generator) sources.

Figure 2-40

2.12.2. MAINTENANCE BUILDING

The maintenance building is a prefabricated metal structure and a reinforced concrete slab on grade. Normal lighting plus an emergency egress light are provided. Welding receptacles (240VAC) and convenience/maintenance (120VAC) receptacles are provided.

2.12.3. SITE HOST STRUCTURE

The site host structure includes a prefabricated metal structure and a reinforced concrete slab on grade.

Figure 2-41

2.12.3.1. Power Pedestal

The power pedestal provides receptacles for RV usage.

2.12.3.2. Potable Water

Potable water is provided at the site host structure. A hose bib is provided as part of the power pedestal.

2.12.4. IPS STAIRWELL ACCESS STRUCTURES

2.12.4.1. East Access Stairwell Enclosure

The east access stairwell enclosure is a prefabricated metal cover structure. The enclosure is provided to prevent rainwater and debris from entering the intake and pump structure. There is a set of galvanized metal stairs to the lower level of the intake and pump structure. Normal and emergency egress lighting are provided.

Figure 2-42

2.12.4.2. West Access Stairwell Enclosure

The west access stairwell enclosure is a prefabricated metal cover structure. The enclosure is provided to prevent rainwater and debris from entering the intake and pump structure. There is a set of galvanized metal stairs to the lower level of the intake and pump structure. Normal and emergency egress lighting are provided.

Figure 2-43

2.12.5. POST-SORT SHADE STRUCTURES

Figure 2-44

There are two prefabricated metal shade structures covering the post-sort pools. The purpose of the shade structure is to provide a shaded area for the fish in pools.

2.13. STORM WATER ABSORPTION SWALE

The majority of the storm water runoff generated from the East side of the site (East side of post-sort pools) will discharge to the storm water absorption swale, including runoff from the asphalt access road

and the paved parking area. The pond functions as an infiltration swale with approximately 1 ac-ft of storage capacity. The pond has an overflow culvert which discharges to the abatement pond. The pond has adequate capacity for the 10-year 24-hour event.

Figure 2-45

2.14. KAYAK PORTAGE PATH

A kayak take-out landing, portage trail, and put-in was constructed to facilitate safe kayak portage around the barrier dam. The take-out is located on the North shore of the North Santiam River approximately 400 feet upstream of the barrier dam. The take-out consists of a cleared area along the bank. The portage traverses the perimeter of the project directly along the outside of the security fencing from the take out, up to the railroad grade and then back down to the river on the downstream side of the facility. A steel staircase descends the final step portion of the hillside to the put-in landing.

Signage alerting the public to the dangers of the barrier dam and the availability of the portage trail includes one floating sign, two buoys located mid-stream and two signs along the northern bank. The buoys and the embankment signs are directly upstream of the take-out platform. The floating sign is located closer to the North bank than the buoys and is slightly downstream of the take-out platform.

2.15. SANITARY SEWER SYSTEM

2.15.1. Septic Tank

The septic tank is located near the sort structure. A pressurized system pumps the sewage to a drain field located across State Highway 22 at Minto North.

Figure 2-46

2.15.2. Pressure Sewer Line and Pumps

The pressure sewer system is comprised of a 1500 gallon holding tank, pump, distribution pipe and drain field. Waste from the sorting facility office and anesthetic tank is directed to the holding tank. The holding tank houses 2 effluent pumps that are triggered by float switches.

2.15.3. Controls

A control panel provides automatic duplex pump operation through float switches located in the tank. Pumps can also be operated manually if necessary for maintenance purposes. The control panel provides alarms for high tank level and pump failure. The control panel is located on the exterior wall (southeast corner) of the sort structure.

Figure 2-47

2.16. POTABLE WATER SYSTEM

2.16.1. Water Well

A new pump, hydro-pneumatic tank, and pump control panel were added to the existing water well.

Figure 2-48

2.16.2. Hydro-pneumatic Tank

The hydro-pneumatic tank capacity is 317 gallons and is pressurized to provide a service water pressure up to 125 PSI. The system pressure is maintained at 60 PSI.

Figure 2-49

2.16.3. Valves and Piping

Valves and piping are designed for potable water use. Refer to manufacture's operation and maintenance manual for specific material composition and care instructions.

2.16.4. Controls

A control panel provides automatic pump operation based upon system pressure. The control panel also provides alarms for numerous system malfunctions and is located in the sort structure mechanical/electrical room.

2.17. FACILITY ENTRANCE GATES

Vehicle access to the facility is restricted by two gates (bar gate and security gate). Each gate is operated by a motor operator. Motor operators are controlled either through a wireless remote control or keypads for both entry and exit. Facility personnel are able to open the gates with remote controllers without leaving their vehicles. Others are required to leave their vehicle and enter a code on the keypads to gain entry and to exit. The outer most gate (bar gate) has the capability to remain open during operation hours and then shut for afterhours security.

2.18. POWER

2.18.1. Primary Metering Cabinet

Electrical service is provided to the facility from PacifiCorp's 3-phase 20.8kV aerial distribution line to the Primary Metering Cabinet. The service conductors between the pole and the Primary Metering Cabinet will be owned and maintained by PacifiCorp. The Primary Metering Cabinet will be operated and maintained by PacifiCorp. The service conductors provide between the Primary Metering Cabinet and transformer FTQ1 will be operated and maintained by USACE.

A MV disconnect switch was added in a follow on contract.

2.18.2. Transformer FTQ1

The facility transformer is rated 750KVA, 20.8KV-480V, and is fed from the Primary Metering Cabinet. FTQ1 provides the "normal" source of power to the ATS in the Generator Building. The access doors to the primary/secondary compartments will be padlocked and accessible by authorized maintenance personnel.

2.18.3. Backup Power System

The stationary diesel generator provides backup power in the event normal power from the utility (PacifiCorp) is interrupted. The generator is rated 600KW, 480V, 3-phase. It has the capacity for full operation of the facility. Upon loss of normal power, the ATS commands the generator to start, then connects facility power to the generator. Following restoration of normal power the generator will re-transfer facility power back to the utility feed, following a preset time-delay.

Since the ATS is an open transfer type, all operating loads will momentarily lose power when switching between normal and emergency sources. Indirect monitoring of the facility power by the PLC is accomplished through a digital power meter. Since this monitoring is dependent on an Ethernet network and slow to reconnect following power transfers, it is recommended a 3-phase voltage relay be added for PLC monitoring of facility power within the IPS structure for automated FWS pump restarting.

2.18.4. Metering, Protection, and Grounding

Electrical system parameters (voltage, current, power factor, etc.) are processed by a digital power meter and displayed on the touchscreen displays. Arc-flash protection labeling is provided on all electrical equipment operating at 480V plus 208V panelboards. All exposed metal on the site is bonded to the ground system.

2.19. SCADA

2.19.1. Touchscreens

The touchscreens are used to control and monitor various devices and systems of the fish collection system.

2.19.2. Water Level Sensors

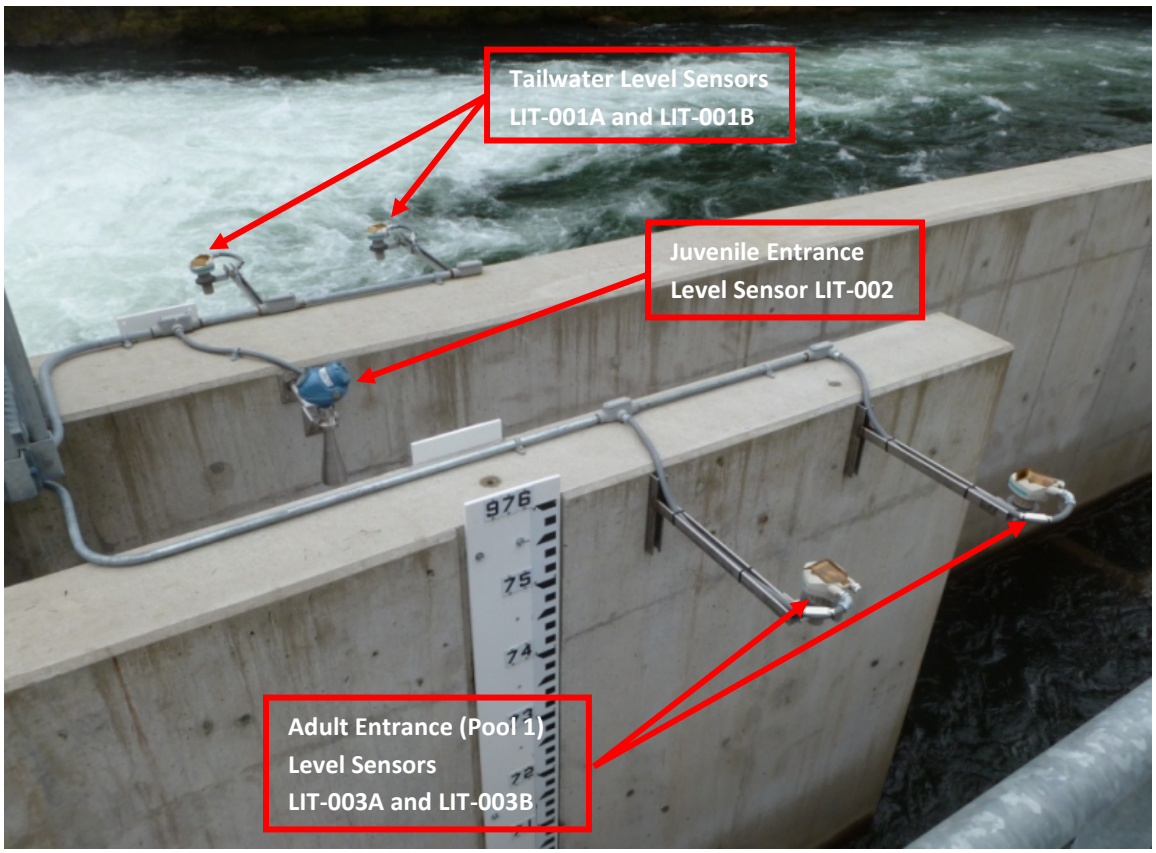


Figure 2-50

Level sensors are provided for both monitoring and/or control. There are a total of 6 submersible level sensors in the IPS. LT-008 and LT-012 measure river level at the downstream and upstream boundaries of the IPS. LT-009 and LT-011 measure level on the backside of the intake screens (Screen 15 and Screen 1, respectively). These sensors are used to calculate the differential across the intake screens for automated operation of the air burst (screen cleaning) system. LT-007 and LT-010 measure level in the IPS AWS chamber and are used only for monitoring/calibration purposes.

There are a total of 7 level sensors at the ladder entrance. Five of the sensors are ultrasonic (LIT-001A, LIT-001B, LIT-003A, LIT-003B and LIT-004) and one is radar (LIT-002). One sensor (LT-005) is a submersible. LT-005 measures pressure/level in the AWS conduit and is only used for hydraulic calculation checks. LIT-001A and 001B are redundant sensors used to measure river level at the ladder entrance. LIT-002 measures the level in the Juvenile Fish entrance. LIT-003A and 003B are redundant sensors used to measure the level in the Adult Fish entrance (Pool 1). LIT-004 is measures the level in diffuser chamber 1. LIT-001A, 001B, 002, 003A and 003B are used for control of the ladder entrance gates. LT-005 measures level (pressure) in the AWS conduit and is used only for monitoring/calibration purposes. Due to the narrow width of the Juvenile entrance, ultrasonic type sensors would not operate properly so a radar type was used (LIT-002).

There are 2 (redundant) ultrasonic level sensors (LIT-006A and LIT-006B) at the Pre-Sort Pool. These sensors measure the level in ladder Pool 5

ANALOG SENSORS CONNECTED TO CONTROLLER

SENSOR ID	TYPE	MFR	DESCRIPTION
FIT.001	Magnetic Flow	Rosemount	FWS Pump Out (CFS)
LIT.001A	Ultrasonic Level	Rosemount	Tailrace (Ft)
LIT.001B	Ultrasonic Level	Rosemount	Tailrace (Ft)
LIT.002	Radar Level	Siemens	Juvenile Chnl (Ft)
LIT.003A	Ultrasonic Level	Siemens	Ladder Pool 1 (Ft)
LIT.003B	Ultrasonic Level	Siemens	Ladder Pool 1 Sensor Data (Ft)
LIT.004	Ultrasonic Level	Siemens	Diffusion Chamber (Ft)
LIT.006A	Ultrasonic Level	Siemens	Ladder Pool 52 (Ft)
LIT.006B	Ultrasonic Level	Siemens	Ladder Pool 52 (Ft)
LIT.008	Ultrasonic Level	Siemens	W.Forebay (El.)
LIT.012	Ultrasonic Level	Siemens	E.Forebay (El.)
LIT.099	Unknown	Unknown	Diesel Fuel Level
LT.005	Submersible Level	GE (Druck)	AWS Conduit (PSI)
LT.007	Submersible Level	GE (Druck)	W.Intake Conduit (El.)
LT.009	Submersible Level	GE (Druck)	W.IntakeScreen (El.)
LT.010	Submersible Level	GE (Druck)	E.Intake Conduit (El.)
LT.011	Submersible Level	GE (Druck)	E.IntakeScreen (El.)
LT.013	Submersible Level	GE (Druck)	Raceway 1 (Ft)
LT.014	Submersible Level	GE (Druck)	Raceway 2 (Ft)
LT.015	Submersible Level	GE (Druck)	Raceway 3 (Ft)
LT.016	Submersible Level	GE (Druck)	Raceway 4 (Ft)
LT.017	Submersible Level	GE (Druck)	Raceway 5 (Ft)
LT.018	Submersible Level	GE (Druck)	Raceway 6 (Ft)
LT.019	Submersible Level	GE (Druck)	Raceway 7 (Ft)
LT.020	Submersible Level	GE (Druck)	Raceway 8 (Ft)
PIT.001A	Pressure	Rosemount	FWS Pump Outlet PSI
PIT.001B	Pressure	Rosemount	FWS Pump Outlet PSI
PIT.020A	Pressure	Rosemount	Air Tank1 (PSI)
PIT.020B	Pressure	Rosemount	Air Tank2 (PSI)
PIT.020C	Pressure	Rosemount	Air Tank3 (PSI)

2.19.3. Other Instrumentation and Sensors

ANALOG SENSORS - STANDALONE

SENSOR ID	TYPE	MFR	DESCRIPTION
FIT.001	Magnetic Flow	Rosemount 3051SF	Post Sort Pool 1
FIT.002	Magnetic Flow	Rosemount 3051SF	Post Sort Pool 2
FIT.003	Magnetic Flow	Rosemount 3051SF	Post Sort Pool 3
FIT.004	Magnetic Flow	Rosemount 3051SF	Post Sort Pool 4
FIT.005	Magnetic Flow	Rosemount 3051SF	Post Sort Pool 5
FIT.006	Magnetic Flow	Rosemount 3051SF	Post Sort Pool 6
FIT.007	Magnetic Flow	Rosemount 3051SF	Post Sort Pool 7
FIT.008	Magnetic Flow	Rosemount 3051SF	Post Sort Pool 8
FIT.009	Magnetic Flow	Rosemount 3051SF	Hopper Area
FIT.010	Magnetic Flow	Rosemount 3051SF	Upstream Bypass
FIT.011	Magnetic Flow	Rosemount 3051SF	Presort Pool

Chapter 3: Theory of Operation

See the Minto Fish Collection Facility Rebuild Design Documentation Report No. 1 for a detailed design discussion.

The fish barrier across the river prevents upstream migration of fish past the Minto fish ladder. The upstream migrating fish are guided into the fishladder entrances by means of attraction flow discharge through the two entrance gates. The fish progress up the fish ladder through ladder orifices or over ladder weirs that rise in increments of 0.75 feet. At uppermost ladder pool 52, the fish must pass over a finger weir into the Pre-sort Pool. The finger weir discourages fish from returning to the ladder downstream.

When operators are ready, the false weir pump is activated to entice fish to exit the Pre-sort Pool at the opposite end of the pool from the Finger Weir. If needed, the Presort Crowder is activated to compel the fish to exit the pre-sort pool. As the fish pass over the false weir, they land in the main transportation flume. Once a fish is sent down the flume, the operator may choose to select one of 4 destinations by application of switch gates. Switch gate 1 leads to Post Sort Pool 8, Switch gate 2 leads to the hopper pit, Switch gate 3 leads to the Return to River flume. During the return of ESA Winter Steelhead, the Return-to-River switchgate can be left open so these fish can directly return to the river for spawning (without being handled). The default setting (no Switch gates open) is the final destination: the Anesthesia Tank. Anesthetized fish are handled at the Sort Table and sent via Sort Flumes to designated Post-sort Ponds (8 total) or to the recovery flume, which leads to the Return to River flume. The Return–to-River Flume discharges to river upstream of the barrier, and is used for a volitional Winter Steelhead Bypass over the barrier during winter months.

Fish directly sent to the Hopper can be loaded into the holding tank of a Fish Truck by raising the hopper via crane, connection to the top of the truck tank and then water-to water transfer into the truck tank from the hopper (by slowly draining the truck tank). When time for transport, the fish in holding ponds are crowded from a Post-Sort Pond to the Sort Channel. Once in the sort Channel, the fish will be crowded again toward the Hopper for truck transport. The Truck will deliver fish (depending on species) upriver above Detroit Dam, to Marion Fork Hatchery, or ‘recycled‘ downriver for sports fishing.

The Minto Adult Fish Collection system is made possible by the strategic management of water that is directed to specific locations of different elevations. All facility water supply is withdrawn from the river upstream of the fish barrier through fish screens (sized to omit juvenile fish) at the IPS structure. Five FWS pumps are available to draw from the IPS sump inside the structure through pressure pipes to deliver up to 52 cfs to the higher elevated Pre-sort Pool, Flumes, Anesthesia tank, Recovery tank, 8 Post-sort Pools, and other miscellaneous uses. Discharge (17 cfs) sent to the Presort-pool discharges over the Finger Weir to establish the ladder flow down to the entrances. The ladder head is operated at 0.75 feet (± 0.08 feet) over the crest at Weir 52.

In the lower ladder section, the ladder flow is augmented by auxiliary water (AWS) through wall diffusers. The AWS flow is discharged via gravity flow from the IPS sump. The AWS discharge is controlled by the number of open Diffuser gates (between 3 - 10 operational gates, 14 total), which are in turn open or closed as a function of the tailwater elevation in the river. The entrance gates are adjusted as a function of entrance head (1.1 -1.4 feet), the difference between Pool 1 (upstream of the gates) and tailwater elevation. The purpose of the smaller juvenile entrance is to provide approximately half the entrance head applied at the larger adult entrance.

Flow from the FWS pumps is piped into the holding ponds to maintain fish health. The post-sort pool flow ultimately discharges over weirs to the Sort Channel. Flow in the Sort Chanel is drained through the 30-inch diameter Juvenile Fish Return Flume to the Tailrace. The Juvenile Fish Return Flume is used to release acclimated juvenile fish to the river.

Chapter 4: Operations

4.1. System Operations

4.1.1. General

This section describes general policies applicable to all areas. Efficient operation of the facility requires that all areas be kept neat, clean, and organized. Typical housekeeping tasks are listed below:

- Clean debris from fish screens and porosity plates.
- Mechanically clean debris from intake pump structure screens annually.
- Keep the cooling surfaces of electric motors clean.
- Replace failed lamps.
- Keep general area clean and free of obstacles.
- Clean and touch up paint.
- Keep all grating, access covers, and safety shields in place.
- Keep all water hoses and power cords rolled up and properly stored.

4.1.2. Facility Startup

To startup the Minto Fish Collection Facility, follow the procedures in the Automatic Startup section. When automatic startup is not possible or desirable, the Minto Fish Collection Facility startup can be done manually.

4.1.2.1. Manual Startup

Manual operation pertains to either the use of the HMI touch screen or local gate or valves actuators or pump controls. If HMI is unavailable, water level measurements need to be taken from staff gages. (Note: Automatic Startup should be used when possible.)

1. Ensure the fish screen gate is down.
2. Record tailwater level from HMI touch screen or the staff gage. Determine target diffuser gate settings (see Table 4, Table 5 and/or Figure 1 in section 4.1.3.1).
3. Place both adult and juvenile entrance gate actuators into manual using HMI touch screen or switching actuator into local.
4. Open both entrance gates to the setting shown in Table 1 for the given tailwater elevation.

Table 1 – Expected Entrance Gate Opening Versus Tailwater Elevation (feet)

TABLE OF EXPECTED ENTRANCE GATE OPENING VERSUS TAILWATER ELEVATION											
TW Tailwater Elevation (ft)	Qaws AWS Discharge (cfs)	DH Target Entr Head (ft)	Qent Entrance Discharge (cfs)	GO Gate Opening (ft)	% of Max GO		TW Tailwater Elevation (ft)	Qaws AWS Discharge (cfs)	DH Target Entr Head (ft)	Qent Entrance Discharge (cfs)	GO Gate Opening (ft)	% of Max GO
963.0	80	1.25	97	3.1	31%		966.3	138	1.25	155	4.9	49%
963.1	80	1.25	97	3.1	31%		966.4	138	1.25	155	4.9	49%
963.2	80	1.25	97	3.1	31%		966.5	157	1.25	174	5.5	55%
963.3	80	1.25	97	3.1	31%		966.6	157	1.25	174	5.5	55%
963.4	80	1.25	97	3.1	31%		966.7	157	1.25	174	5.5	55%
963.5	80	1.25	97	3.1	31%		966.8	157	1.25	174	5.5	55%
963.6	80	1.25	97	3.1	31%		966.9	157	1.25	174	5.5	55%
963.7	100	1.25	117	3.7	37%		967.0	157	1.25	174	5.5	55%
963.8	100	1.25	117	3.7	37%		967.1	157	1.25	174	5.5	55%
963.9	100	1.25	117	3.7	37%		967.2	157	1.25	174	5.5	55%
964.0	100	1.25	117	3.7	37%		967.3	157	1.25	174	5.5	55%
964.1	100	1.25	117	3.7	37%		967.4	157	1.25	174	5.5	55%
964.2	100	1.25	117	3.7	37%		967.5	157	1.25	174	5.5	55%
964.3	100	1.25	117	3.7	37%		967.6	157	1.25	174	5.5	55%
964.4	100	1.25	117	3.7	37%		967.7	176	1.25	193	6.1	61%
964.5	100	1.25	117	3.7	37%		967.8	176	1.25	193	6.1	61%
964.6	100	1.25	117	3.7	37%		967.9	176	1.25	193	6.1	61%
964.7	100	1.25	117	3.7	37%		968.0	176	1.25	193	6.1	61%
964.8	119	1.25	136	4.3	43%		968.1	176	1.25	193	6.1	61%
964.9	119	1.25	136	4.3	43%		968.2	176	1.25	193	6.1	61%
965.0	119	1.25	136	4.3	43%		968.3	176	1.25	193	6.1	61%
965.1	119	1.25	136	4.3	43%		968.4	195	1.25	212	6.7	67%
965.2	119	1.25	136	4.3	43%		968.5	195	1.25	212	6.7	67%
965.3	119	1.25	136	4.3	43%		968.6	195	1.25	212	6.7	67%
965.4	138	1.25	155	4.9	49%		968.7	195	1.25	212	6.7	67%
965.5	138	1.25	155	4.9	49%		968.8	195	1.25	212	6.7	67%
965.6	138	1.25	155	4.9	49%		968.9	195	1.25	212	6.7	67%
965.7	138	1.25	155	4.9	49%		969.0	195	1.25	212	6.7	67%
965.8	138	1.25	155	4.9	49%		969.1	195	1.25	212	6.7	67%
965.9	138	1.25	155	4.9	49%		969.2	195	1.25	212	6.7	67%
966.0	138	1.25	155	4.9	49%		969.3	214	1.25	231	7.3	73%
966.1	138	1.25	155	4.9	49%		969.4	214	1.25	231	7.3	73%
966.2	138	1.25	155	4.9	49%		969.5	214	1.25	231	7.3	73%

5. Open diffuser gates using HMI or local actuators to settings for given tailwater elevation) as listed in Table 4, Table 5 and/or Figure 1.

6. Determine expected total flow demand on FWS Pumps
    a. Determine which ponds and flumes will be operating
    b. Compute total expected demand of FWS system (See Table 2 for methodology and final equation at bottom)

Table 2 – Estimated FWS Flow Demands

		Number of Ponds			
	Presort and Ladder	Purpose 1 Juvenile Acclimation	Purpose 2 Adult holding	Bypass Flume to River	Misc. Uses
Number	1	J	A	1	
unit rate	17*	2.5	1.5	1.5 or 8**	2 or 8 ***
Total Q	17	J X 2.5	A x 1.5	1.5 or 8	1.5 or 8
* Assumed design flow for Presort Pool and Ladder is 17 cfs, actual rate may be as high as 20 cfs ** 8 cfs for winter steelhead bypass, 1.5cfs for normal *** 8 cfs if holding adults, 2 cfs if winter steelhead bypass only **** Sum of bypass + misc. uses ≈ 9.5 cfs regardless of adult or winter operation					
TOTAL FWS DEMAND = 17* + J x 2.5 + A x 1.5 + 9.5****					

7. Activate FWS Pumps (see section 4.2.5.1 on how to operate the pumps). Determine required number of pumps for start-up based on the estimated FWS Flow requirement determined. To determine the number of pumps: See Table 3. (The initial number of pumps is based on a goal of setting the operation as near as possible to midway between minimum and maximum pump speeds)

Table 3 – Number of Pumps at Startup versus Estimated FWS Flow Demand

FWS Demand (cfs)		Number of pumps
minimum	Maximum	
8.0	13.0	1
16.0	25.0	2
25.1	36.0	3
36.1	52.0	4

8. Use Pump Startup Addendum to get the system charged and purged of air. This will be using ONE pump in manual mode to get the whole network filled and ready for system startup.

9. Start-up selected number of FWS pumps (one at a time) at least 5% lower than max RPM.
    a. After two FWS pumps come on line, open all valves for ponds and flumes that were selected for operation in step 8 above.

10. Allow at least 15 minutes to fill the ladder system.

11. Begin recording ladder head (LDH) from the HMI or weir 52 staff gage if HMI is unavailable.

a. If ladder head < 0.67 feet: increase pump rpm. If rpm is at maximum for the current number of pumps, then start an additional pump. If pump capacity is at a maximum with the number of available pumps, then increase one or both Pre-sort Valve openings.

b. If ladder head >0.83 feet: decrease pump rpm. If rpm is at minimum for the current number of pumps, then shut off one of the pumps. If pump capacity is at a minimum with the number of available pumps, then decrease one or both Pre-sort Valve openings.

12. Check or adjust Entrance Head
    a. Adjust both adult and juvenile Entrance gates based on entrance head (DH) readings
        1. DH = LT-003 – LT-001 from HMI OR
        2. DH = Pool 1 staff gage – Tailrace staff gage
    b. The target entrance head (DH) is the maximum of the following two values:
        - 1.25 feet ± 0.15 feet (typically governs)
        - 958.0+ 5.0 – LT-001
    c. NO Change if the following conditions hold:
        i. Pool 1 water depth at least 5 feet deep (30 minutes)
        ii. Entrance head (DH) between 1.1 feet - 1.4 feet (30 minutes)
    d. Opening both gates will reduce entrance head or pool 1 level for a given flow rate
    e. Closing both gates will increase entrance head or Pool 1 level for a given flow rate
    f. Use Table 6 for manual both entrance gate adjustments.

13. Open fish screen at entrance once the ladder is operating in criteria.

14. After 60 minutes: check ladder head, tailwater elevation, and entrance head.
    a. If no change from previous readings or measured conditions, then no action is required with FWS pumps, diffuser gates, or entrance gate otherwise go back to step 13.

4.1.2.2. Automatic Startup

Follow the procedures below to start up the Minto Fish Collection Facility automatically.

1. Ensure the fish screen gate is down.
2. Using the HMI touch screen start the pumps

4.1.3. Normal Facility Operation

4.1.3.1. Normal Operating Criteria

The following information details operational criteria for operation of the facility. Any deviation observed should be reported to the Portland District Design Branch, CENWP-EC-D.

LADDER

- Ladder entrance head is 1.25 ft (between 1.0 – 1.5 feet)
  - Entrance head is difference between water surface elevations in Pool 1 (LT-003) and Tailwater (LT-001): DH = entrance head = LT-003 – LT-001
  - Operational entrance head (DH) is between 1.1 – 1.4 feet (average 1.25 feet)
- Entrance Gate Opening Limits
  - Minimum Gate Opening (GO) with FWS only = 0.75 feet = 7.5% GO
  - Minimum GO with AWS + FWS = 1.5 feet = 15% GO (Fisheries criteria)
  - Maximum GO = 10 feet = 100% GO (Physical limits)
- Minimum Pool 1 depth = 5 ft
  - Pool 1 depth = LT-003 – 958.0 feet
- Ladder pool differential at Pool 52 = 0.75 ft (or 9 inches) between 0.67 – 0.83 feet
  - Pool 52 ladder head (LT-006a) is between 0.67 – 0.83 feet
  - Pool 52 depth = 5.75 ft +/- 0.08 ft

- AWS Diffuser Gates open and close as function of tailwater elevation as shown in Table 4 and Figure 1.

Table 4 – Tailwater Elevation (LT-001a) Setpoints for Opening or Closure of Diffuser Gates

Gate No.	OPEN above TW (ft)	Total Open	Gate No.	OPEN above TW (ft)	Total Open
Diffuser 1	ALWAYS OPEN	1	Diffuser 8	966.4	7
Diffuser 2	ALWAYS OPEN	2	Diffuser 9	967.7	8
Diffuser 3	ALWAYS OPEN	3	Diffuser 10	968.3	9
Diffuser 4	963.7	4	Diffuser 11	*ALWAYS BLOCKED*	9
Diffuser 5	964.7	5	Diffuser 12	969.3	10
Diffuser 6	965.4	6	Diffuser 13	*ALWAYS BLOCKED*	10
Diffuser 7	*ALWAYS BLOCKED*	6	Diffuser 14	*ALWAYS BLOCKED*	10

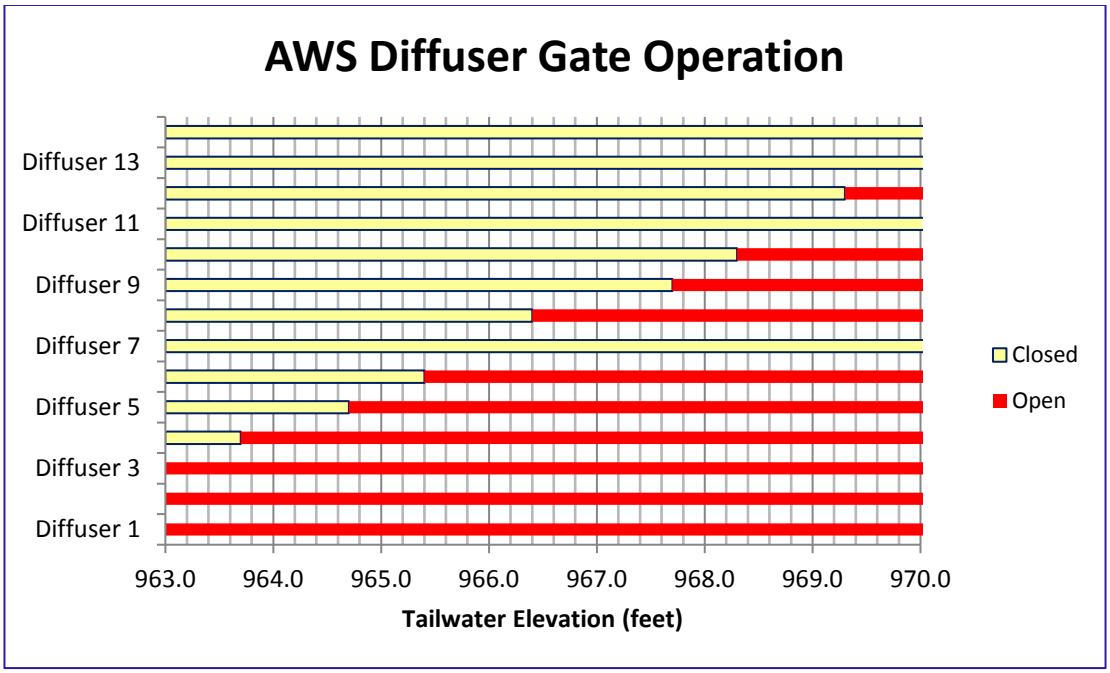


Figure 1 – AWS Diffuser Gates Open versus Tailwater Elevation

- Note: if screen differentials exceed 3.0 feet at the IPS, the PLC will start closing AWS diffuser gates if the AWS system is running in automatic mode. If operating in manual under the same conditions, start closing AWS diffuser gates from the top (or upstream) end until the screen differential is less than 1 foot.

The combined operation of the AWS diffuser gates and estimated AWS discharge rates as a function of tailwater level is further illustrated in Table 5. This table can be used for quick reference in a manual operation.

Table 5 – Combined Table of AWS Discharge and Maximum Open Diffuser Gate versus Tailwater Elevation

COMBINED TABLE FOR AWS DISCHARGE AND GATE SETTING VERSUS TAILWATER ELEVATION								
Tailwater Elevation (ft)	AWS Discharge (cfs)	Maximum Diffuser Gate Open	Number of Diff Open		Tailwater Elevation (ft)	AWS Discharge (cfs)	Maximum Diffuser Gate Open	Number of Diff Open
963.5	80	3	3		966.5	157	8	7
963.6	80	3	3		966.6	157	8	7
963.7	100	4	4		966.7	157	8	7
963.8	100	4	4		966.8	157	8	7
963.9	100	4	4		966.9	157	8	7
964.0	100	4	4		967.0	157	8	7
964.1	100	4	4		967.1	157	8	7
964.2	100	4	4		967.2	157	8	7
964.3	100	4	4		967.3	157	8	7
964.4	100	4	4		967.4	157	8	7
964.5	100	4	4		967.5	157	8	7
964.6	100	4	4		967.6	157	8	7
964.7	100	4	4		967.7	176	9	8
964.8	119	5	5		967.8	176	9	8
964.9	119	5	5		967.9	176	9	8
965.0	119	5	5		968.0	176	9	8
965.1	119	5	5		968.1	176	9	8
965.2	119	5	5		968.2	176	9	8
965.3	119	5	5		968.3	176	9	8
965.4	138	6	6		968.4	195	10	9
965.5	138	6	6		968.5	195	10	9
965.6	138	6	6		968.6	195	10	9
965.7	138	6	6		968.7	195	10	9
965.8	138	6	6		968.8	195	10	9
965.9	138	6	6		968.9	195	10	9
966.0	138	6	6		969.0	195	10	9
966.1	138	6	6		969.1	195	10	9
966.2	138	6	6		969.2	195	10	9
966.3	138	6	6		969.3	214	12	10
966.4	138	6	6		969.4	214	12	10

4.1.3.2. Manual Normal Operation

When automatic operation is not possible or desirable, Minto Fish Collection Facility operation can be done manually. To operate the Minto Fish Collection Facility manually, follow the procedures below.

(Note: Automatic Normal Operation should be used when possible.) For the facility to operate satisfactorily, the normal operating criteria in section 4.1.3.1 must be met.

In the event the PLC is unable to control the pumps for automatic operations, there are a number of staff gauges for manual verification of water levels. Operations personnel will need to verify the facility is running within ESA fish criteria during this time.

4.1.3.2.1 FWS Pumps

Each VFD permits manual or automatic control of an FWS pump by setting the Hand-Off-Auto selector switch. The normal or default setting is "Auto".

OFF: When the selector switch is set to "Off" the VFD is disabled.

HAND: When the selector switch is set to "Hand" a pump may be operated manually by pressing the green run button on the digital human interface module "HIM". The unit may be stopped by pressing the red button on the digital human interface module. The pump speed may also be controlled through the HIM by pressing the up or down arrows. If the *FWS Pump System* is running in automatic from the main HMI touch screen and a VFD is manually started, the *FWS Pump System* will switch to manual mode and automatic control will cease.

Pump Speed (RPM) Control via IPS Main Header Discharge:

The FWS pump discharge rates are a function of pump speed and pump head (the head at the pump minus the sump level in the IPS required to deliver the flow to all points in the system including head losses from the pipeline system). So even if there is no change in the operation over a period, there is still a possible need to adjust pump speed due to changes in pump head caused by changes in forebay elevation or changing losses at the intake screen. For a given constant pump speed, the pump discharge will rise with reduced pump head and drop with increased pump head. For a given constant pump head, the discharge is proportional to the ratio of the squares of the pump speeds. The pump speeds are governed by a variable frequency drive (VFD).

The system controller (PLC), maintains the FWS discharge pressure between 11.0 – 11.5 psi at pressure transmitter FWSP-007 on the main 36-inch FWS pipe in the IPS when operating in automatic mode. (This pressure range was established through multiple tests covering a range of system demands during a PDT site visit on Oct 15, 2014. The tests confirmed the ladder head at pool 52 would stay within criteria if the FWS pressures were maintained between 11.0 -11.5 psi and the presort valves were left fully open.) The PLC automatically determines the number of pumps to operate and their speed.

Pump Speed Adjustments for Pressure Discharge

The FWS pumps will controlled by the selected discharge pressure based on the as-built system. The pressure discharge required is a result of the demand on the system, and will fluctuate depending on the amount of flow traveling through the pipe. As a valve downstream is opened, the pressure at the node will decrease, causing the pumps to speed up. This will increase the discharge head and flow rate to meet whatever the flow through said valve needs to be. Alternatively, when a valve is closed, the

pressure at the node will increase and the pumps will slow down. After the change in pump number, the pumps speed will need to be adjusted to avoid excessive flow changes.

The location of demand will also have influence on the amount of pressure change seen by the node. For example, opening a valve at the pools to receive an additional 2.5 cfs of flow will have a different effect than turning on 2.5 cfs worth of flumes at the sort structure due to the differing frictional losses through each of those respective pathways. Also, turning on pool 8 when 7 pools are already running will have a different effect than turning on pool 2 when only one other pool is running, even though they will be passing the same flow rate through each pathway. For this reason, it will be prohibitively difficult to design set speeds for every different flow scenario. Instead, the required pressure at maximum flow will be used as the baseline. This won't be perfectly efficient but it will simplify operations greatly.

Number of Pumps Control:

Total system flow requirements have been estimated to vary between 24.5 – 58 cfs depending on the month, number of ponds, and other uses. Therefore the number of operating pumps will vary between 2 to 4. The need to add or remove a pump from operation should only occur when there is a significant change in system flow demand, such as a change in one or two ponds under operation. The pumps will have minimum and maximum RPM settings based on the factory tests shown in Figure 2 with a small safety factor. As a result, the pumps will be allowed to operate between 1425 and 1785 RPM. When the system flow demand changes such that the pump speed will need to go outside the allowable range, the number of operating pumps will also change. Note*: It is important to note that the system should never be manually overridden to operate with the presort valves above 85% open as the pumps will runout to their maximum speed with other flows being insufficient for fish survival.*

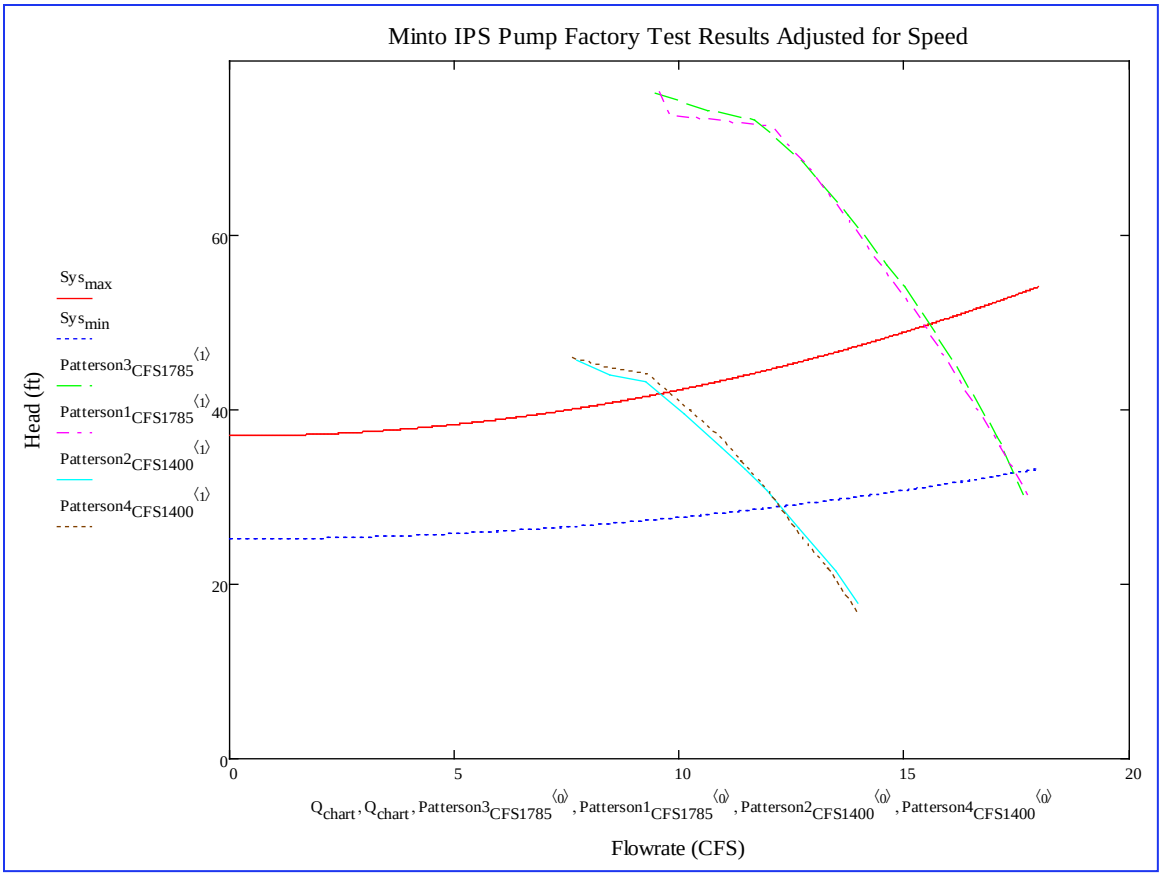


Figure 2 - Minto IPS Pump Factory Test Bracketing

If the FWS system is operating in automatic mode via the HMI touch screen, the PLC will attempt to maintain the FWS supply pressure between 11.0 -11.5 psi.

- If the PLC command to each VFD remains at the upper limit (100.0% speed) for 30 seconds, then additional pumps are started until the system speed is decreased and the setpoint pressure is attained.

If the PLC command to each VFD remains at the lower limit (80.0% speed) for 15 seconds, then one or more pumps are stopped until the system speed is increased and the setpoint pressure is attained. Since two pumps always operate in automatic mode, there may be times when the system operates at pressure higher than the setpoint.

4.1.3.2.2 Ladder Head Control

The ladder head should be monitored at Weir 52 (just downstream of Pre-sort Pool) to assure it is meeting the criteria in section 4.1.3.1. The water level at Weir 52 should be maintained at 0.75Ft +/- 0.08 feet (between 0.67 – 0.83 feet). The HMI touch screen or staff gage at Weir 52 or can be used to verify compliance.

Both pre-sort valves are permanently set in fully open position and are not meant to be changed, so that system power requirements can be kept to a minimum.

West Valve (MTF-FWS-PRE01) 86% Open
East Valve (MTF-FWS-PRE02) 100% Open

In situations where system demands are low and the pump capacity exceeds the ladder level requirements (such as a 2 pump operation), then either activate an additional pond or temporarily throttle Pre-sort valves. However once normal operating conditions have resumed, the pre-sort valves must be set back to 100% open.

If the Weir 52 water level is beyond normal operating conditions or outside of criteria then:

If the water level at weir 52 is low, incrementally increase Pumps RPM.
If the RPM is at maximum, add an additional operating pump.

If the water level at weir 52 is high, incrementally decrease Pumps RPM.
If the RPM is at minimum, remove an operating pump.

Check again after about 2 -5 minutes after adjusting, and adjust further if needed.

4.1.3.2.3 AWS Diffuser Gates

The AWS diffuser gates can be operated in manual through the HMI touch screen or locally if needed. Unless there are high screen differentials recorded at the IPS, Table 4 , Figure 1 and/or Table 5 should be applied to determine the number of open diffuser gates as a function of tailwater elevation. If the tailwater level sensors LT-001a or b are not available, check the tailwater staff gage for tailwater levels.

4.1.3.2.4 Entrance Gates

If the entrance gates need to be operated in manual through the HMI touch screen or locally, Table 6 can be used as a guideline to meet entrance criteria. The goal is to operate with an entrance head between 1.1 – 1.4 feet. If either sets of Level sensors (LT-001, LT-003) are not available, use staff gages in Pool 1 and Tailwater to estimate the entrance head as needed.

Entrance head = LT-003a - LT-001a = Pool 1 Staff gage - Tailwater Staff gage (if needed)

Table 6 – Manual Adjustments for Entrance Gate Operation

Manual Adjustments for Entrance Gate Operation								
DH = Entrance head = LT-003 - LT-001								
Change Condition:					Action	Change in GO	
IF DH ≤	0.5	ft			Reduce gate opening	-1.9	feet
IF DH is between	0.5	ft and	0.8	ft	Reduce gate opening	-0.8	feet
IF DH is between	0.8	ft and	1.0	ft	Reduce gate opening	-0.5	feet
IF DH is between	1.0	ft and	1.1	ft	Reduce gate opening	-0.2	feet
IF DH is between	1.1	ft and	1.4	ft	no change		
IF DH is between	1.4	ft and	1.5	ft	Increase gate opening	0.2	feet
IF DH is between	1.5	ft and	1.7	ft	Increase gate opening	0.3	feet
IF DH is between	1.7	ft and	2.0	ft	Increase gate opening	0.4	feet
IF DH ≥	2.0	ft			Increase gate opening	0.5	feet
NOTES:							
* Minimum Allowable GO = 1.5 feet; Maximum Allowable Go = 10.0 feet.							
Y = Pool 1 Depth = LT-003a - Invert Elevation 958.0 feet							
Change Condition:					Action	Change in GO	
IF Y ≤	4.5	ft			Reduce gate opening	15%	
IF Y is between	4.5	ft and	4.8	ft	Reduce gate opening	10%	
IF Y is between	4.8	ft and	5.0	ft	Reduce gate opening	5%	

4.1.3.3. Automatic Normal Operation

To operate the Minto Fish Collection Facility, follow the procedures below. For the facility to operate satisfactorily, the normal operating criteria in section 4.1.3.1 must be met.

4.1.3.3.1 FWS Pumps

-SITE MAP AREA F3, F4-

Each VFD permits manual or automatic control of an FWS pump by setting the Hand-Off-Auto selector switch. The normal or default setting is “Auto”.

OFF: When the selector switch is set to “Off” the VFD is disabled.

AUTO: When the selector switch is set to “Auto” the VFD digital human interface module (HIM) is locked out, except for the stop button. A VFD/pump may start, stop, or change speed at any time while the FWS Pump System is in automatic mode, as configured through an HMI touch screen.

VFD HIM OPERATION: Reference the full O&M manual for complete instructions.

Figure 3 Fish Pump VFD

AUTO EXERCISE: Each pump should be operated for at least 30 minutes every 30 days. Automatic exercising is achieved by swapping a standby pump with a running pump. Automatic pump swapping will occur under normal operating conditions while the FWS Pump System is in automatic mode. Note that automatic exercising is based on computed standby time and not run-time hours as reported by the VFD. If a VFD is placed in "Manual" or "Off" it is not in standby and excluded from auto exercise tracking. The VFD standby counter is reset after the pump is operated.

STATUS

- RUN LIGHT (RED): Indicates VFD is supplying electrical power to the pump motor.
- POWER LIGHT (GREEN): Indicates 120VAC control power at VFD is available.
- HIM STATUS: Reference the full O&M manual for viewing VFD data.

4.1.4. Normal Facility Shutdown

To shut down the Minto Fish Collection Facility AWS system, follow the procedures in section 4.1.4.1 AWS System Shutdown. The dewatering procedure is described in section 4.1.4.2 Dewatering Procedure.

4.1.4.1. AWS System Shutdown

To shut down the Minto Fish Collection Facility AWS system, follow the procedures below.

1. Place the AWS gate system in manual control from a touch screen.
2. Close all diffuser gates from the touch screen or locally at each actuator.
3. Close the AWS gate in the IPS.

4.1.4.2. Dewatering Procedure

After completing the Facility Shutdown procedures follow the procedures below to dewater the Minto Fish Collection Facility.

1. Shut off the AWS system 24 to 48 hours prior to facility dewatering and raise the entrance gates located at the fishway entrance out of the water.
2. When ready to dewater the facility, drop the fish screen gates at the fishway entrance to prevent any additional fish from entering the fishway. Continue to operate the fishway, if necessary, long enough to allow fish in transit to reach and enter the per-sort pool. Laser counting devices at the fishway entrance and at the per-sort pool finger weir can be used to monitor fish presence in the fishway.
3. Place pumps in local control and initiate drawdown of the fishway flow from 17 cfs to a level allowing visual inspection for fish presence and fish recovery (approximately 6 to 10 cfs in the ladder). The operation should be reduced to a single pump operation to achieve 8 -13 cfs.
4. Recover any remaining fish as necessary. Flow level in the fishway can be adjusted by changing the output of pumps (down to approximately 6 cfs—which will provide about a foot of flow depth at the orifice openings) and by diverting flow from the pre-sort pool through an overflow line leading to the diffuser chambers. These procedures will also permit control of the water level in the pre-sort pool while retaining function of other fish handling facility features.
5. Process any fish in the pre-sort pool or recovered from the fishway. Processed fish may be released above the barrier dam via the return flume or moved to the holding ponds.
    a. Load fish retained in the holding ponds for transport to a release site.
    b. Drain the pre-sort pool and the holding ponds. Wash down and clean the entire fish handling facility.

4.1.4.3. Winterization

Winterization of the facility will protect specific systems from freezing temperatures. Winterization occurs after the facility has been dewatered (See section 4.1.4.3. for dewatering procedure).

WARNING: The pre-sort valves are equipped with flap gate valves that prevent the pre-sort pool from completely dewatering. The diffuser pit drains will be the only way to dewater the pre-sort pool.

Figure 4 Diffuser Pit Flap Gate Valve

1. Verify the appropriate lock-out/tag-out procedures are in place.
2. Open one sorting table supply valve. Partially open pre-sort flap valve; this will allow water to drain down to the pump supply header pipe in the Intake Pump Structure.
3. Locate the low point drain on the IPS header pipe; attach a Garden hose to the valve and open the valve. CAUTION: Ensure hose outlet is <u>secured</u> so that flow is directed into the facility drainage sump. Note the locations of the high point vacuum breaker/air release valves.

Figure 5 IPS Low Point Drain Valve

As the level of water moves below the elevation of each valve, air should begin to enter the piping through the valve. Air entering the header pipe will likely be audible in the IPS. Air entering the piping can be used to track the rate and general elevation of water leaving the piping. This process may take up to 5 hrs.

4. Each pump check valve will need to be opened to drain the remaining water from the pump riser pipes. CAUTION: Do not open the pump check valves until verifying that the pressure is equalized in the piping.

5. The facility has a number of low point drains that allow the piping to fully drain. Once the header has been drained, open the low point drains to verify that the remaining water has left the system.

CAUTION: Prior to facility restart verify plugs are installed and each valve is in the operation position.

CAUTION: During winter facility operation, when freezing temperatures are expected, it is required that water supply valves are cracked open allowing water movement through the piping.

4.1.5. Emergency Operations

4.1.5.1. Power Outage

-SITE MAP AREA F2, G2-

The emergency diesel generator will automatically start following the loss of utility company power. , and stop after a cool down period following the restoration of utility power. Generator fuel consumption is listed by the manufacturer as the following:

- 100% load - 40 Gallons per hour
- 75% load - 30.2 Gallons per hour
- 50% load - 21.2 Gallons per hour

Fuel storage capacity is 3000 Gallons this amount of fuel will provide 3 days of continuous use. Due to intermittent power outages operators should check the fuel level every two weeks.

Figure 6 Diesel Fuel Tank

4.2. Equipment Operations

4.2.1. Fish Ladder

-SITE MAP AREA B4, A4, A3, B3, C3, C2-

4.2.1.1. Fish Ladder Entrance

-SITE MAP AREA B4-

4.2.1.1.1. Adult and Juvenile Fish Entrance Gates

The adult and juvenile fish entrance gates at the fish ladder entrance are operated by their own lift motor, see Figure3. The motors can be operated locally or remotely by setting the local/remote/off switch to the desired mode. When local operation is selected, each gate can be opened and closed using the open/close switch. Remote operation is controlled through a touch screen as shown in Figure 8.

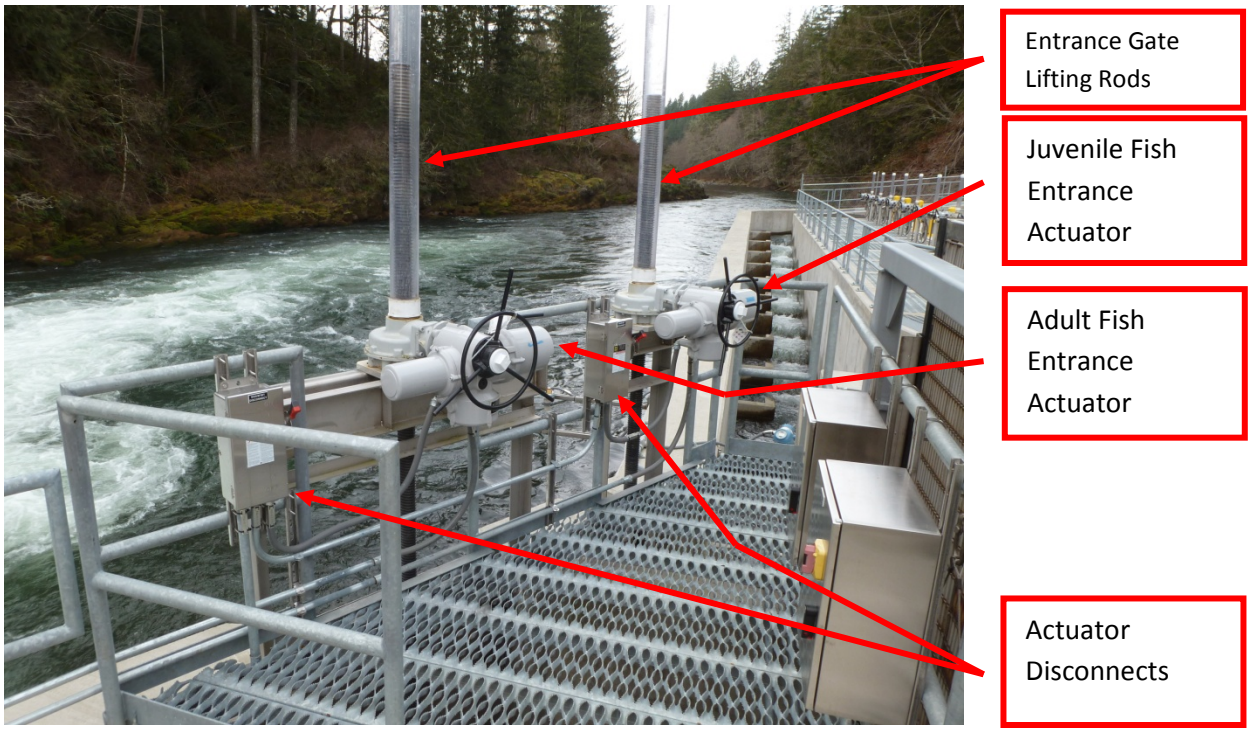


Figure 7 - Fish Ladder Entrance Gates

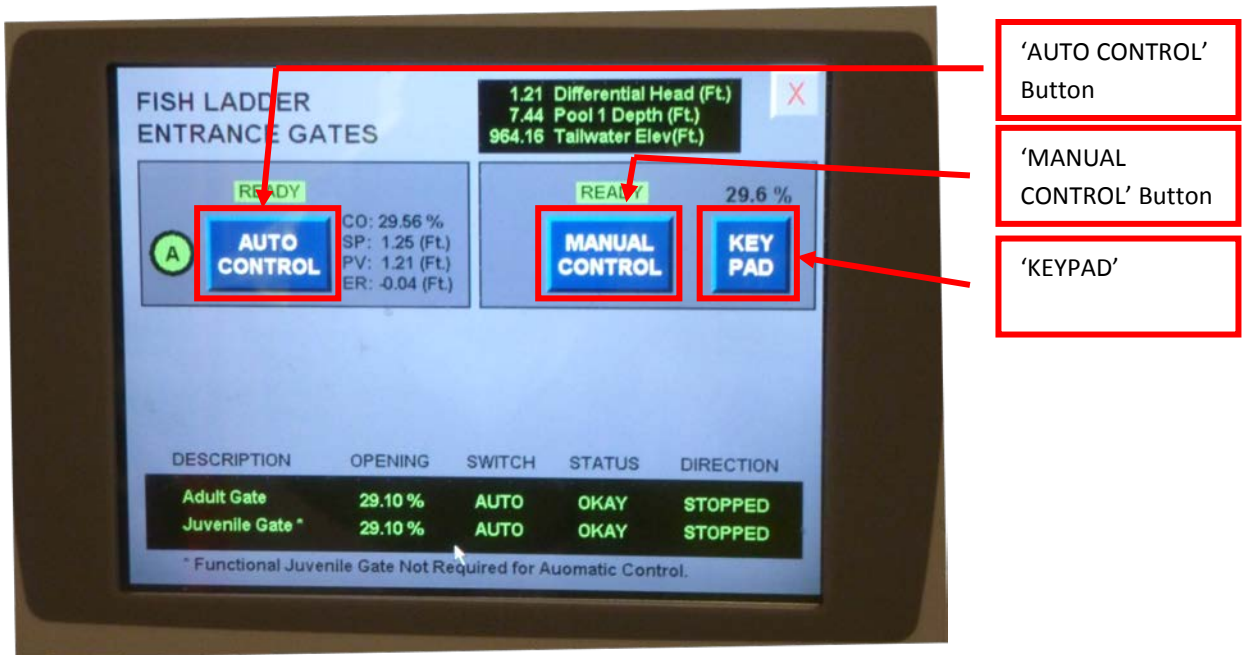


Figure 8 - Touch Screen, Fish Ladder Entrance Gates

Reference the Contractor provided O&M manual Volume 2 for complete operating instructions

4.2.1.1.2. Fish Barrier Screen and Support Structure

The fish barrier is used to keep fish from entering the ladder while the ladder is running. Typically the screen will be used during initial start-up and shut-down operations. The screen is operated by hoist pendant control.

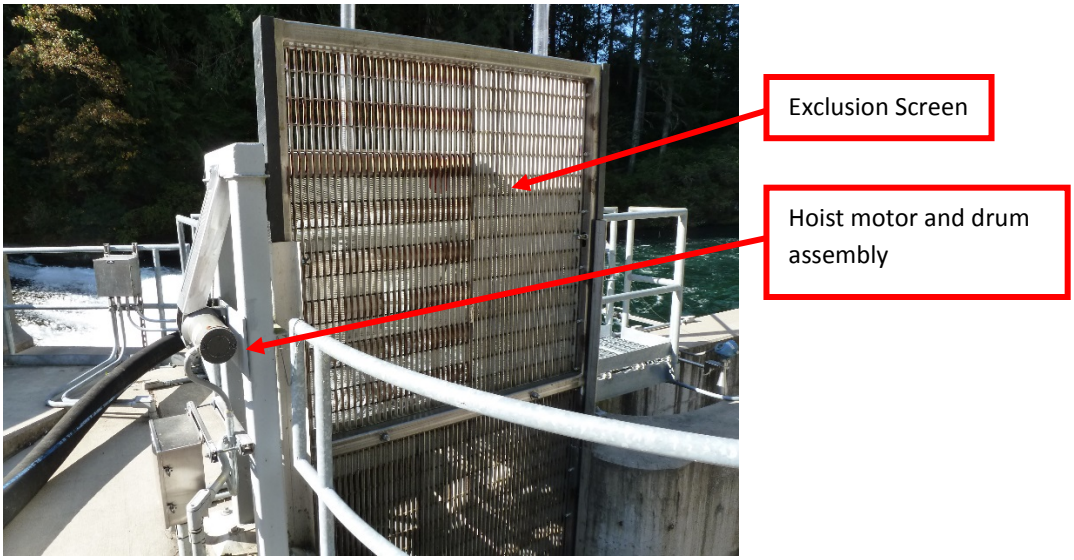


Figure 9 – Fish Barrier screen

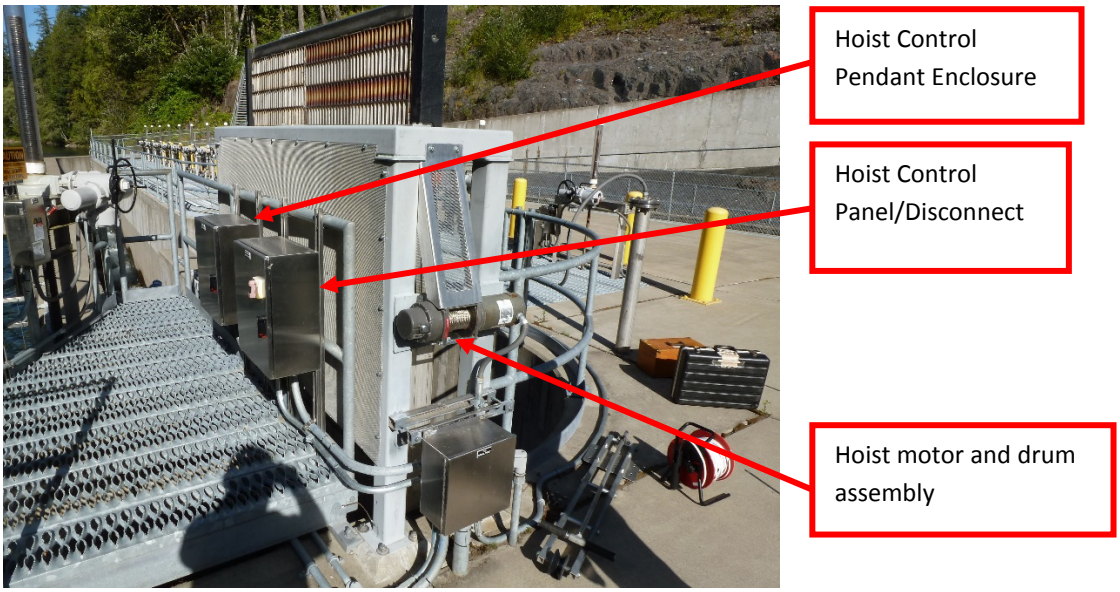


Figure 10 – Fish Barrier screen disconnects

Reference the Contractor Provided O&M manual Volume 2 for complete operating instructions

4.2.1.2. AWS Diffusion Basins

-SITE MAP AREA A4, B4-

4.2.1.2.1. AWS Diffuser Slide Gates

The AWS Diffuser Slide Gates may be manually operated or automatically positioned by the PLC. For automatic positioning each unit's selector switch must be set to "remote" and the HMI AWS Diffuser Gate screen set to "Auto Control". Under automatic operation, the gates will be opened and closed according to Figure 1-AWS Diffuser Gate Operation. Water level transmitters are shown in Figure 5.

Each AWS Diffuser Slide Gate can be operated manually using the actuator's open/close switch or remotely using the Touch Screen, shown in Figure 14. See Contractor provided Operation and Maintenance manual for instructions regarding hand wheel operation.

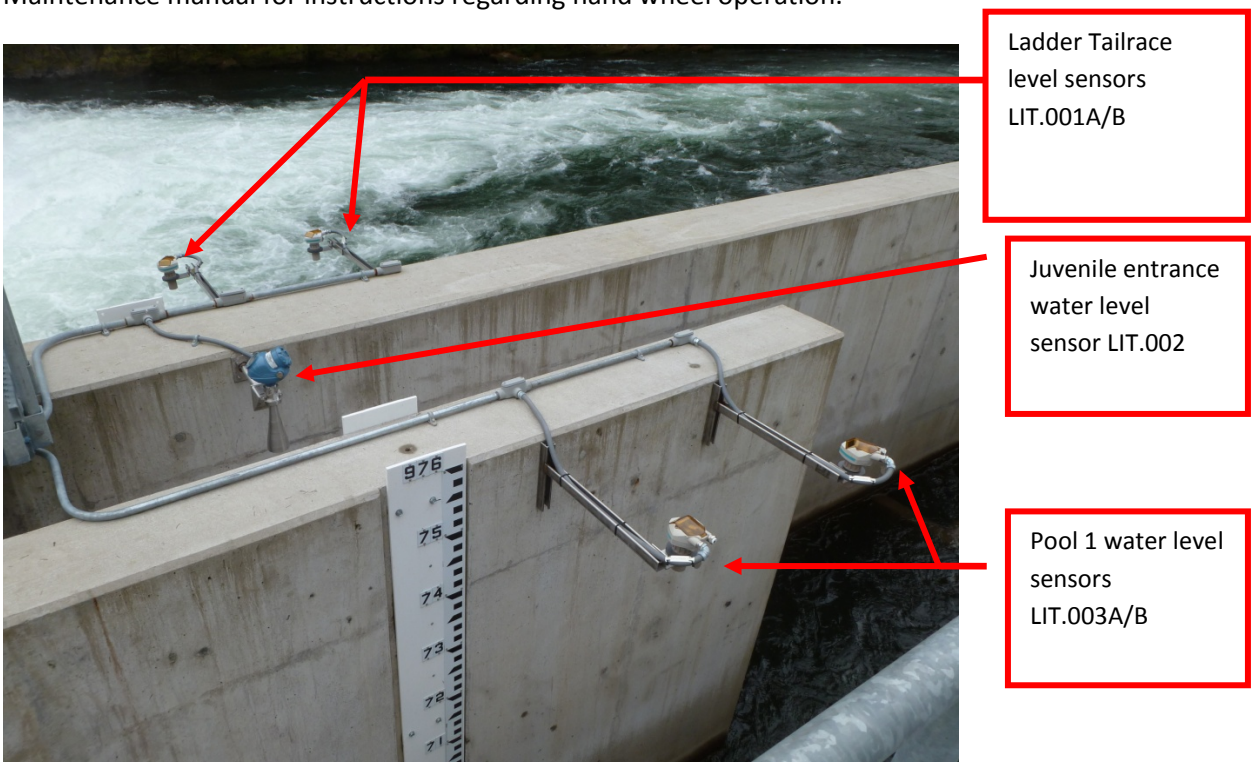


Figure 11 – Entrance level Sensors

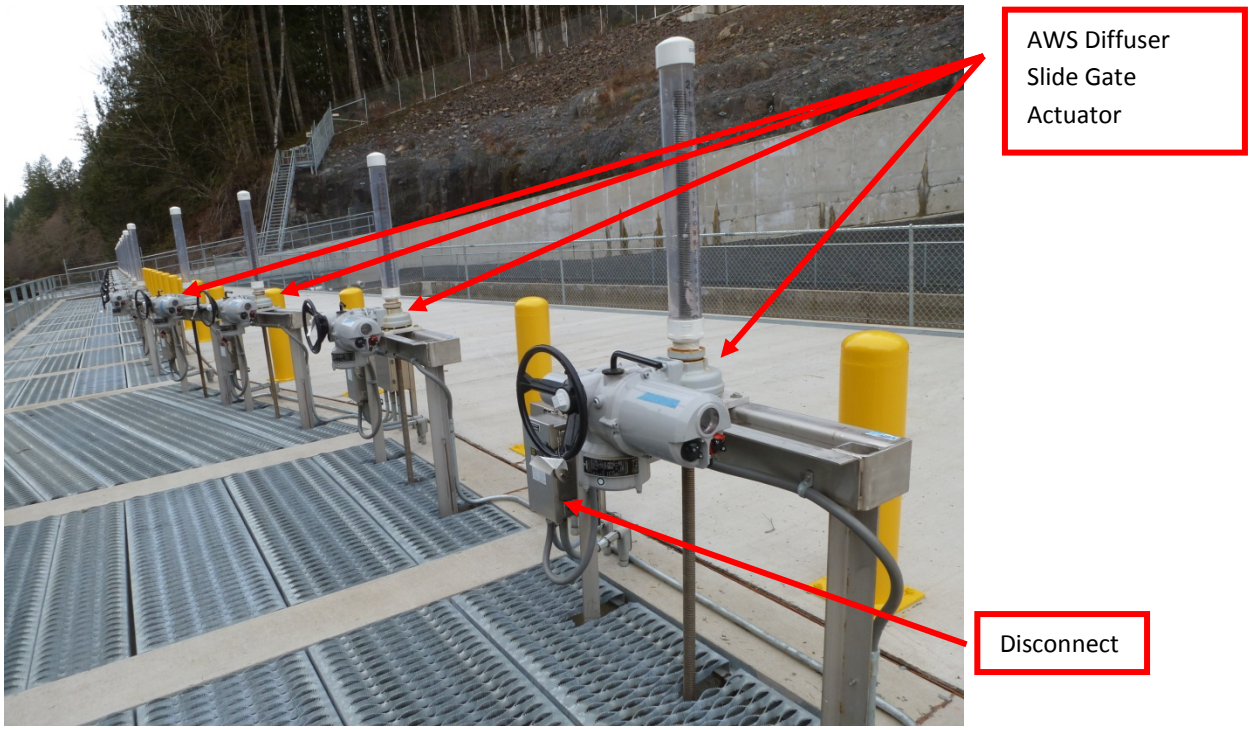


Figure 12 - AWS Diffuser Slide Gate Motors

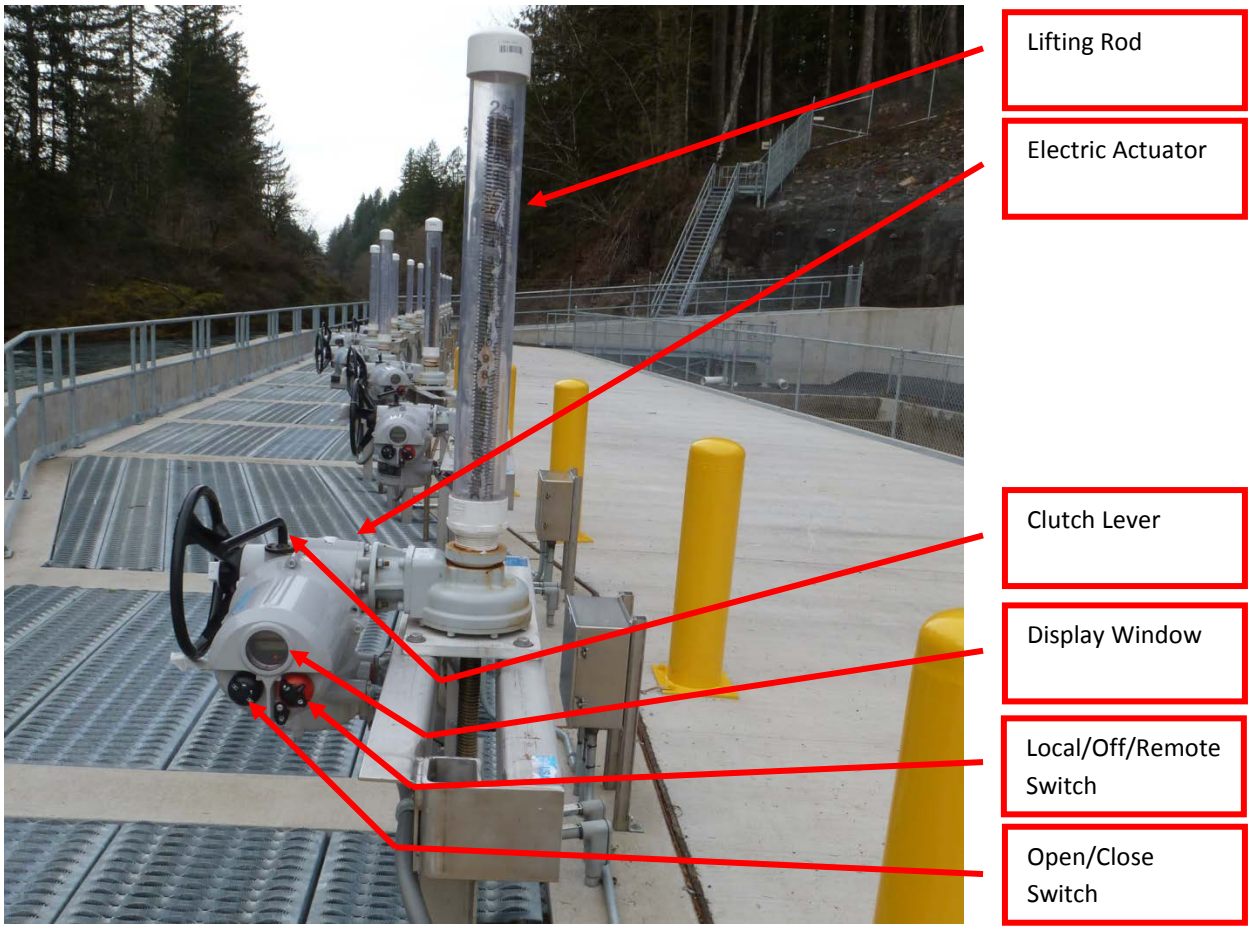


Figure 13 - AWS Diffuser Gate Motor

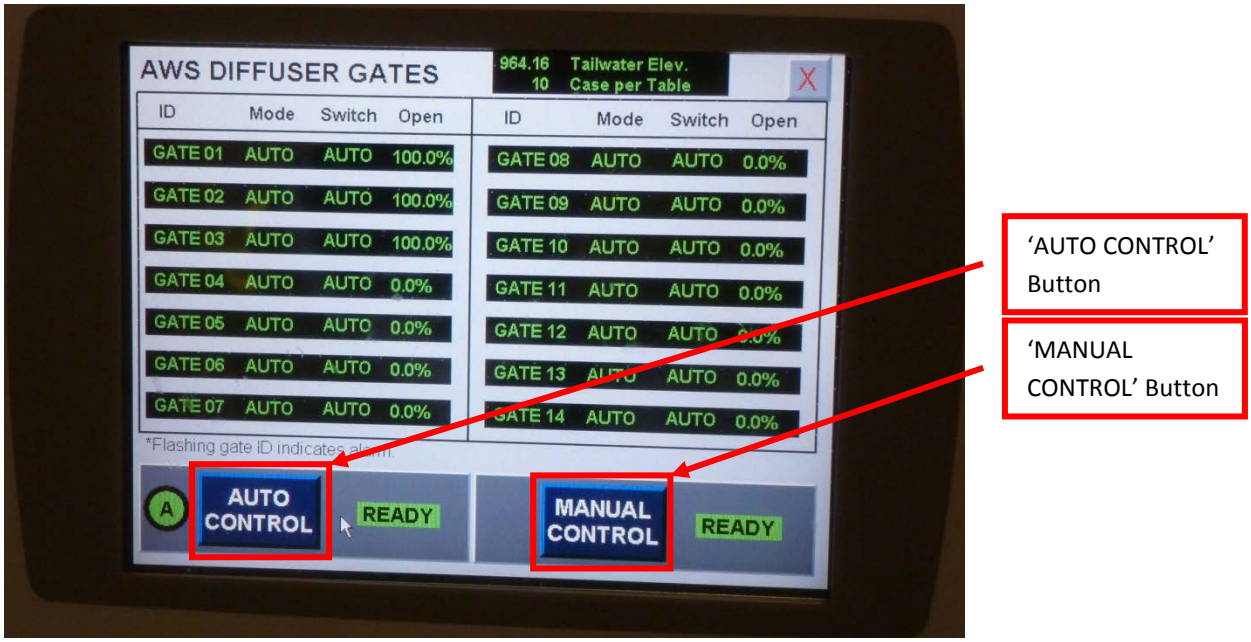


Figure 14 - Touch Screen, AWS Diffuser Gate

Reference the Contractor Provided O&M manual Volume 2 for complete operating instructions

4.2.1.3. Pool 52 – Ladder Head Control with Level Sensors

-SITE MAP AREA C2-

Redundant sensors LIT-006A/B transmit the water level in pool 52 to the PLC. The pool level should be maintained at 0.75' +/- 0.08', and a process alarm provides notification if the pool level remains out of criteria for a preset period of time. If a level sensor fails an alarm is also activated, and the PLC will use the backup sensor if available.

Reference the Contractor Provided O&M manual Volume 6 for complete operating instructions for level sensors

4.2.2. Pre-Sort Pool

-SITE MAP AREA C2, D2-

4.2.2.1. Pre-Sort Pool Control Console

This is the holding pool where fish are stored for future processing. The control console and panel are located on the east side of the pre-sort pool.

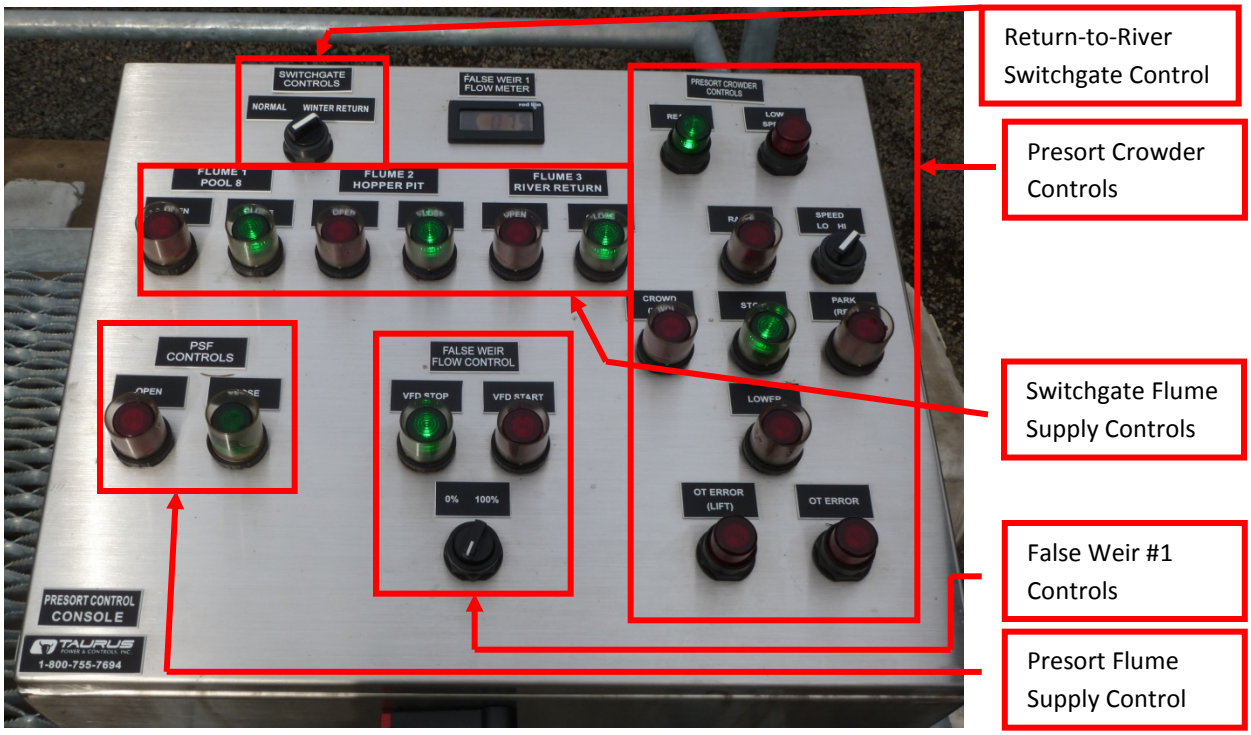


Figure 15 – Presort Control Console

4.2.2.2. Finger Weir

The finger weir (Figure 16) is raised and lowered based upon pre-sort pool water level to prevent fish from re-entering the fish ladder. The finger weir can be operated by a winch, shown in Figure 17.

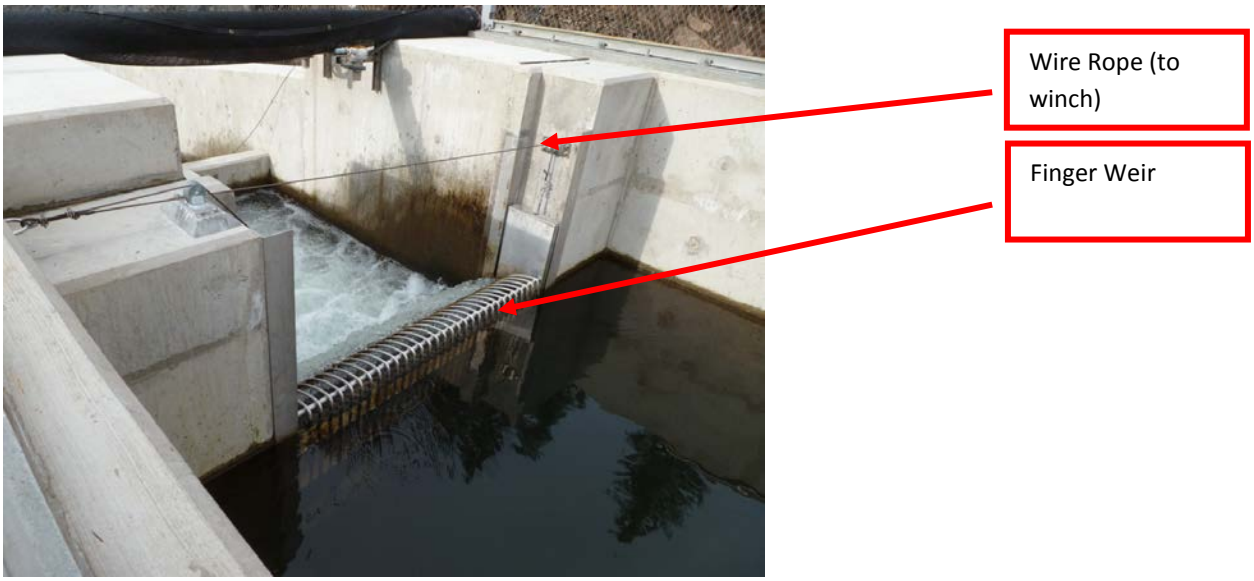


Figure 16 - Finger Weir

Figure 17 - Finger Weir Winch

4.2.2.3. Pre-Sort Crowder

The pre-sort crowder can be operated at the either the Presort Control Console or the Presort Crowder Control Cabinet, shown in Figure 18. A description of each button function is provided below:

SPEED: Select between two crowder speeds, 'Lo' and 'Hi'.

RAISE: Raises crowder screen.

LOWER: Lowers crowder screen.

CROWD (FWD): Moves crowder forward toward false weir (east).

PARK (REV): Reverses crowder away from false weir (west).

STOP: Stops all crowder operation.

ENABLE: This button must be pressed in the event and E-STOP button is actuated.

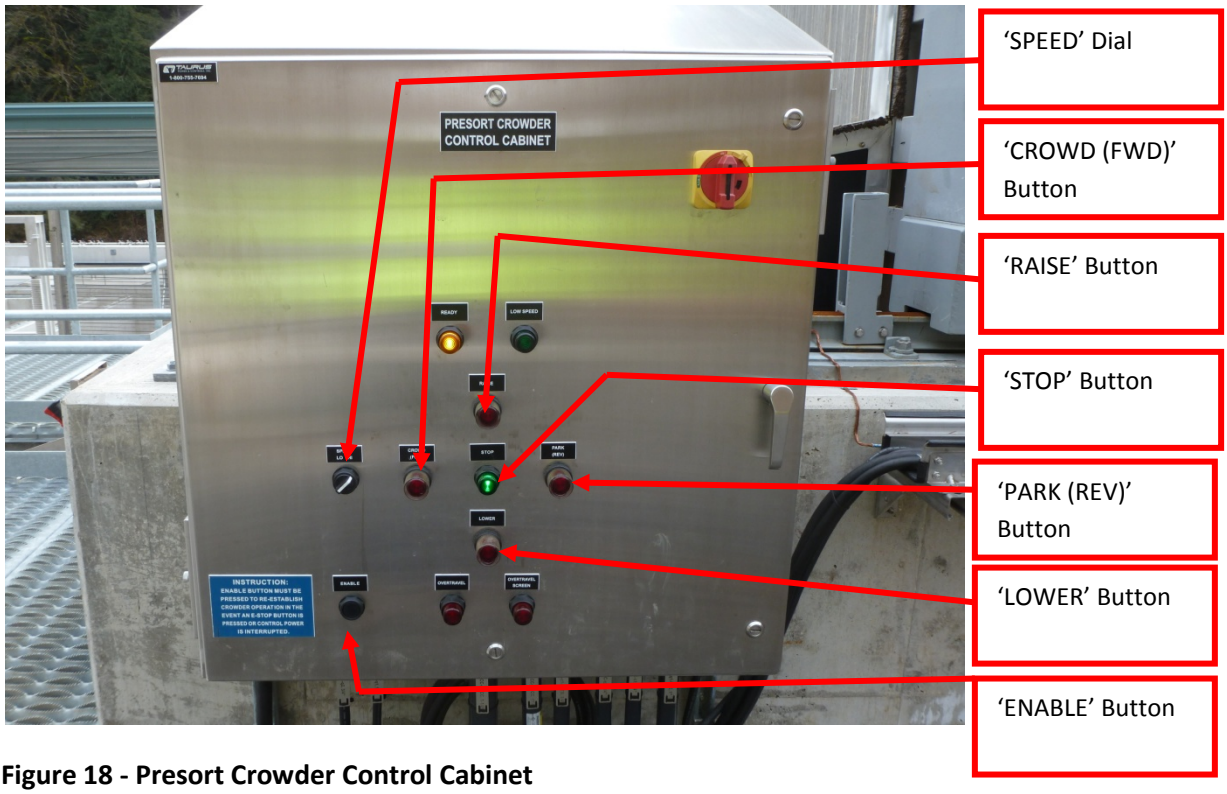


Figure 18 - Presort Crowder Control Cabinet

4.2.2.4. False Weir

The false weir attraction flow is supplied by pump. Operate the false weir at the Presort Control Console (Figure 15). The false weir controls are shown in more detail in Figure 19. To turn the false weir on, push

the 'VFD START' button. Flow can be regulated using the turn dial, set dial to 0% for minimum flow and 100% for maximum flow. To turn the false weir off and stop flow, push the 'VFD STOP' button.

Figure 19– False Weir Flow Control

4.2.2.5. False Weir Drain

This is a 6" drain pipe and is regulated by a lever operated butterfly valve. This drain prevents excess water from spilling into the transport flume. Normally this valve is adjusted in concert with the false weir attraction flow and the transport flume water supply to establish ideal fish passage conditions.

Figure 20 – False Weir Drain Control

4.2.2.6. Transport Flume Water Supply

This is a 6" diameter water supply pipe sourced from the FWS. A 6" actuated valve regulates the water traveling down the transport flume. Up to 1.25 CFS can be supplied for passage operation.

Figure 21 False weir supply pipe

4.2.2.7. Closure Gate

The Closure Gate prevents the fish from entering the false weir and flume when processing is temporarily suspended. The closure gate is operated by a winch with an automatic brake. The winch is located adjacent to the gate and is operated manually to open and close the gate. The winch can be seen in Figure 22 below.

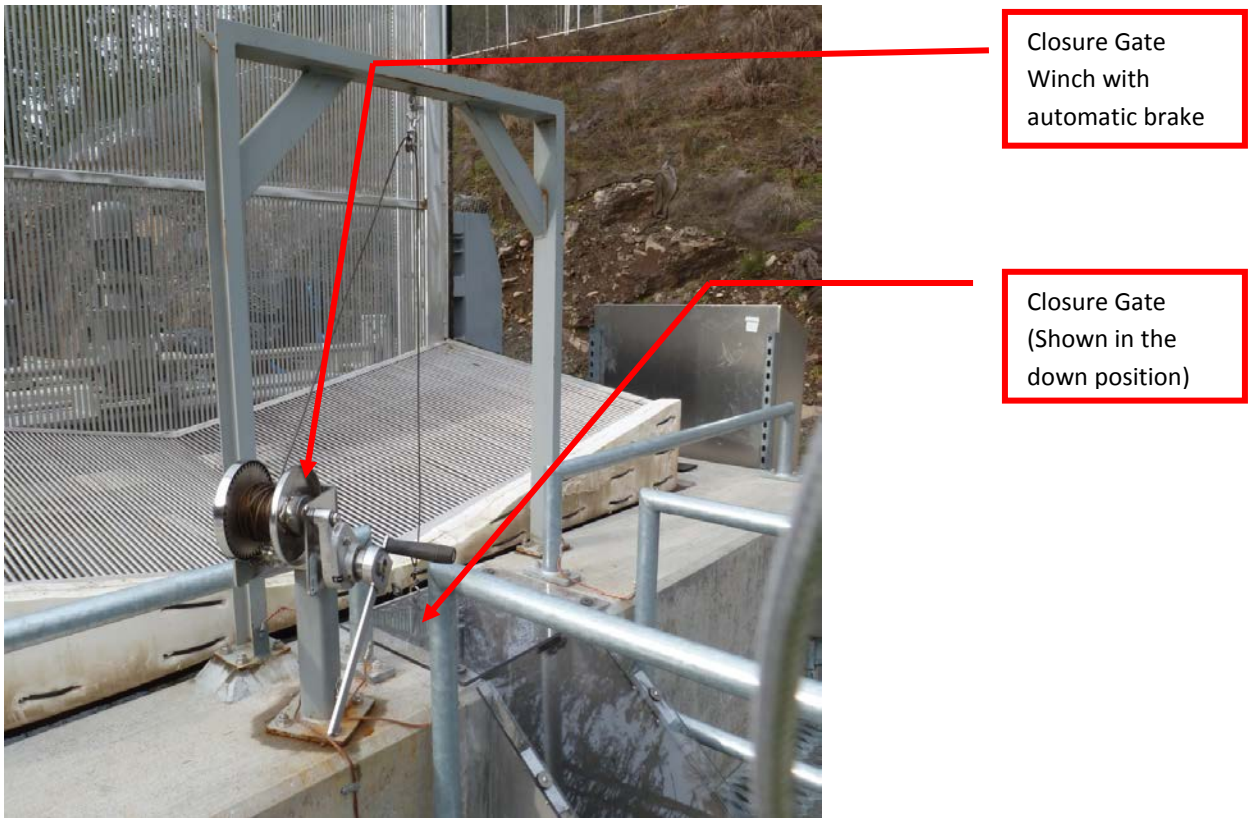


Figure 22 - False Weir 1 Closure Gate

4.2.2.8. Pre-sort Pool Piping

The primary portions of this pipe are buried or embedded. The pipe material is schedule 40/80 PVC and the pipe embedded in concrete is stainless steel. System pressure is 12 PSI.

4.2.2.9. Valves

Process valves in the Pre-sort area are butterfly valves operated by lever or electric actuator.

Figure 23 Pre-sort Pool Valve Vaults

4.2.2.10. Diffusers

There are two Pre-sort diffusers. Each diffuser is supplied by 16” diameter pipe as part of the FWS piping system. The FWS supply pressure is 11 -11.5 PSI. Diffusers require bi-annual maintenance. Occasionally the river conditions will allow abnormally high amounts of sediment to inundate the facility. The screen for each pool should be removed and pressure washed to remove debris. Remove the porosity plates located below the diffuser grating and pressure wash them to remove debris. Sediment and debris should also be removed from the pit area below the porosity plate. The pit drain can be used to divert sediment to the abatement pond however, it is recommended that the majority of the debris is removed and disposed of in accordance with local laws and regulations.

4.2.3. Sort Facility

-SITE MAP AREA E2, F2-

4.2.3.1. Mechanical/Electrical Room

4.2.3.1.1. Granular Activated Carbon (GAC) Filter

The GAC filter and piping are shown in Figure 124 and Figure 25, respectively. The GAC filter is used to filter MS222 prior to discharge to septic tank system. MS222 is not currently used, Aqui-S is the preferred anesthetic.

Figure 24 GAC Filter Tank

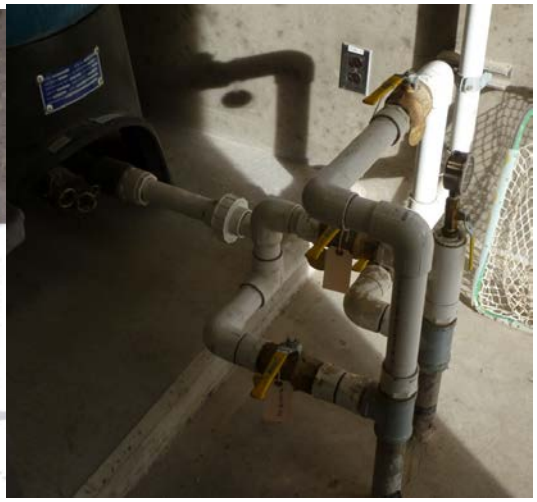


Figure 25 GAC Filter Piping

4.2.3.1.2. Facility Compressed Air

The compressed air system will control air pressure by pressure switch. Each air access point should see a pressure between 90 and 110 PSI.

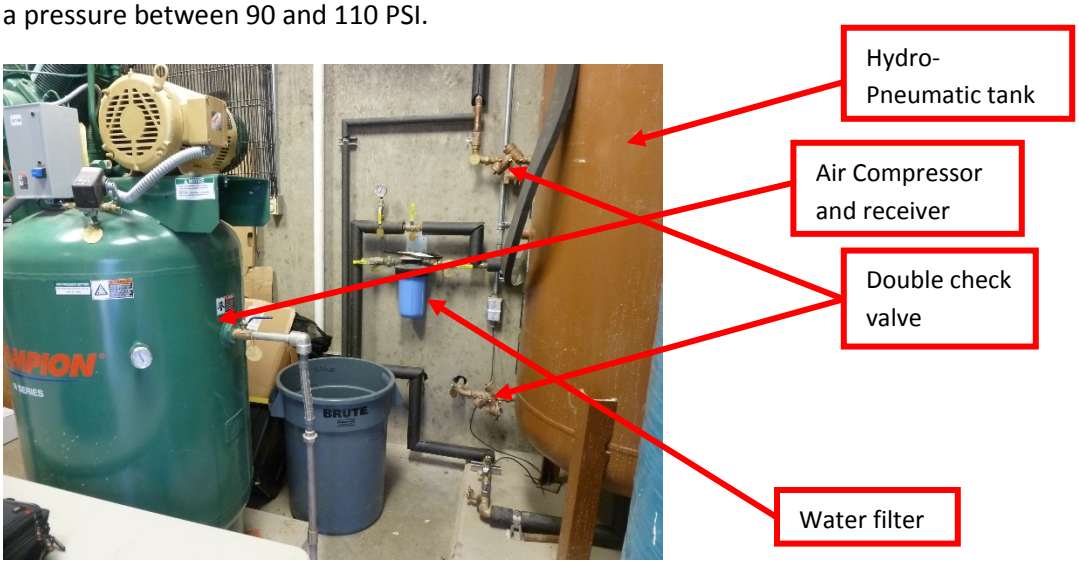


Figure 26 Mechanical Room

4.2.3.1.3. Hydro-Pneumatic Tank

Potable water tank should not require maintenance however there are two double check valves that may require periodic testing. Testing should occur per county requirements. The hydro-pneumatic tank capacity is 317 gallons and is pressurized to provide a service water pressure up to 125 PSI. The system pressure is maintained at 60 PSI.

4.2.4. Post-Sort Pools, Sorting Channel, and Hopper Pit

-SITE MAP AREA E3, F3-

4.2.4.1. Post-sort Pool Crowders

There are two post-sort pool crowders that are operated with individual control consoles. A trolley is provided to move a single crowder from pool to pool; only one crowder can be moved by the trolley at a time. The trolley must be aligned with the pool rails using the hand alignment-brake illustrated in Figure 27.

Trolley: The Trolley is operated with the Trolley Control Console. The trolley is controlled by the speed throttle switch. The trolley will move at the speed and direction as indicated on the console. An indicator light will also illuminate corresponding to the current operation of the trolley.

Crowder: The crowder is controlled by the speed throttle switch. The crowder will move at the speed and direction as indicated on the console. An indicator light will also illuminate corresponding to the current operation of the crowder.

'START': Key switch to allow operation of crowder

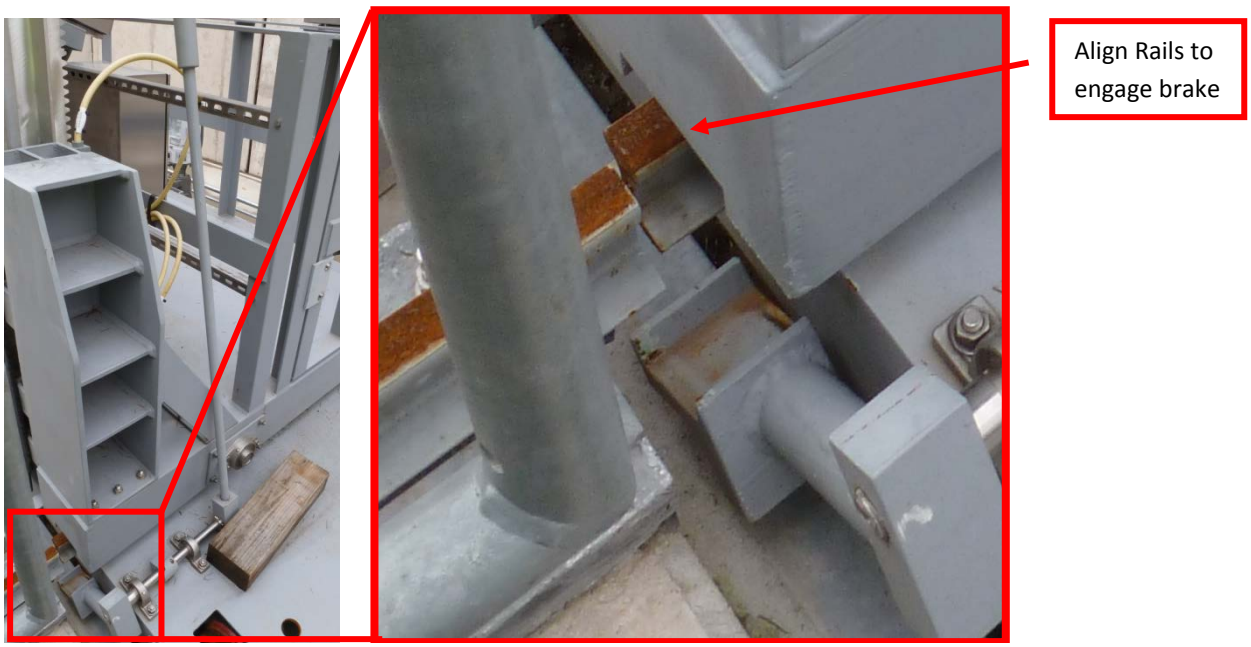
'REVERSE OVERRIDE': Allows travel onto trolley once crowder reaches upstream wall.

'E-STOP': Emergency stop button. Stops all crowder operations.

'RAISE': Raises the crowder screen.

'LOWER': Lowers the crowder screen.

'STOP': Stops crowder screen operation.



(a) **(b)**

Figure 27 – (a) Post-sort Trolley Hand Brake; (b) Rail Alignment

Figure 28 – Post-sort Crowder Platform

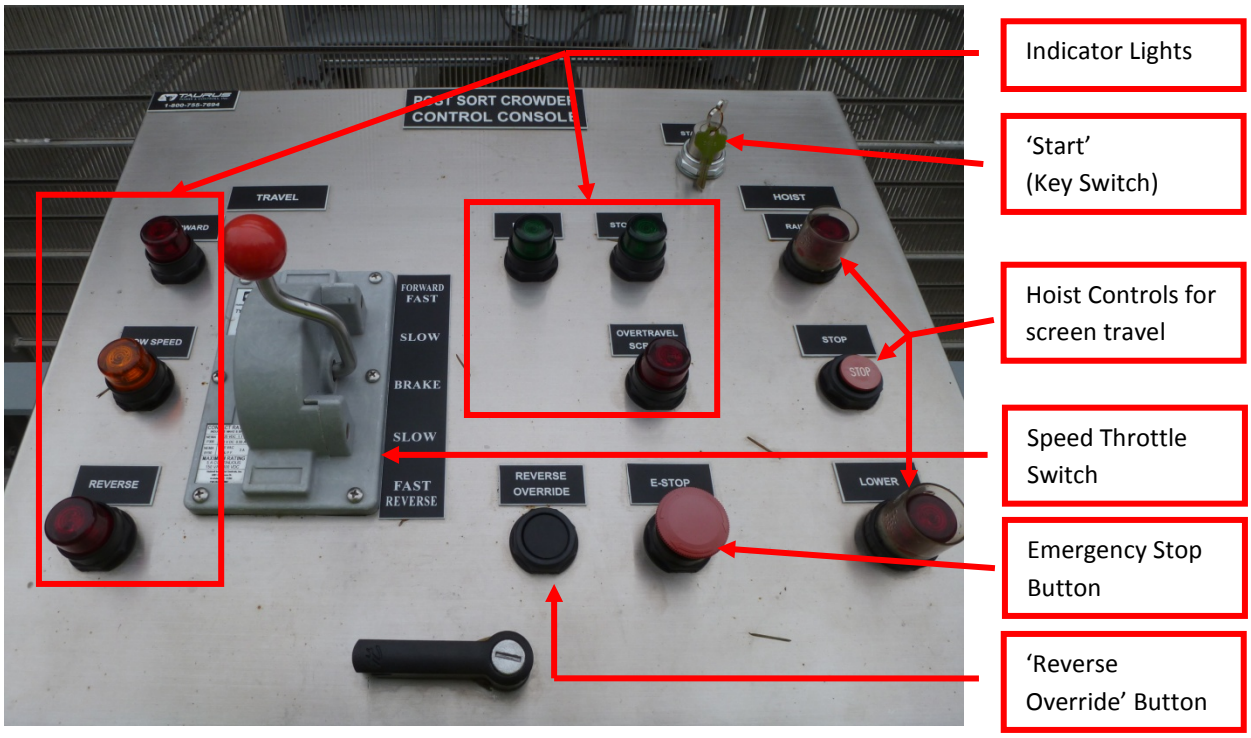


Figure 29 – Post-sort Crowder Control Console

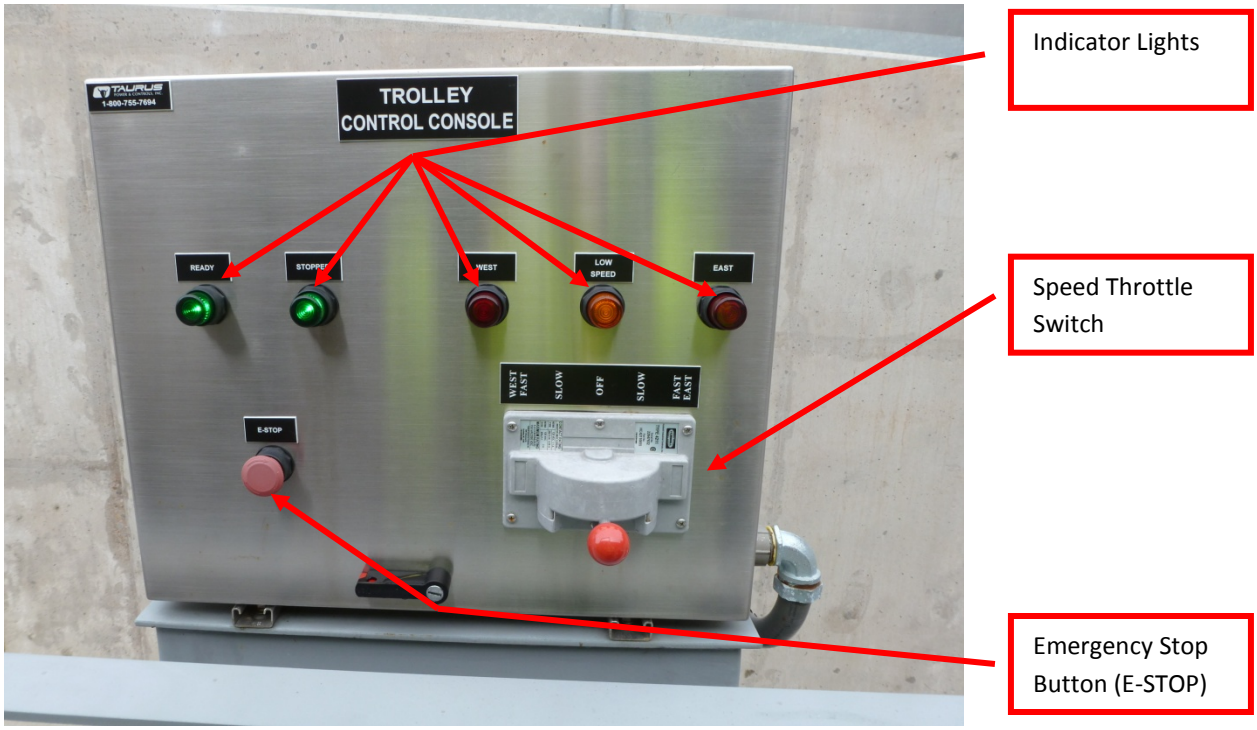


Figure 30 - Trolley Control Console

4.2.4.2. Sorting Channel Crowder

The Sorting Channel Crowder is operated from the Sorting Channel Crowder Control Console, Figure 31, located on the crowder platform. The crowder is operated similarly to that of the post-sort crowder. The crowder is controlled by the speed throttle switch. The crowder will move at the speed and in the

direction as indicated on the console. Indicator lights will also illuminate corresponding to the current operation of the crowder. The button functions are summarized below.

‘RAISE’: Raises crowder screen.

‘STOP’: Stops crowder screen operation.

‘LOWER’: Lowers crowder screen.

‘E-STOP’: Emergency stop. Stops all crowder operations.

In addition to the Sorting Channel Crowder, the sorting channel is equipped with a bridge, see Figure 23. The sorting channel bridge is manually operated and a bridge step is provided to allow for access to the fish barrier screens. The bridge step can be removed using the handles provided to gain access to the weir boards (overflow stoplogs).

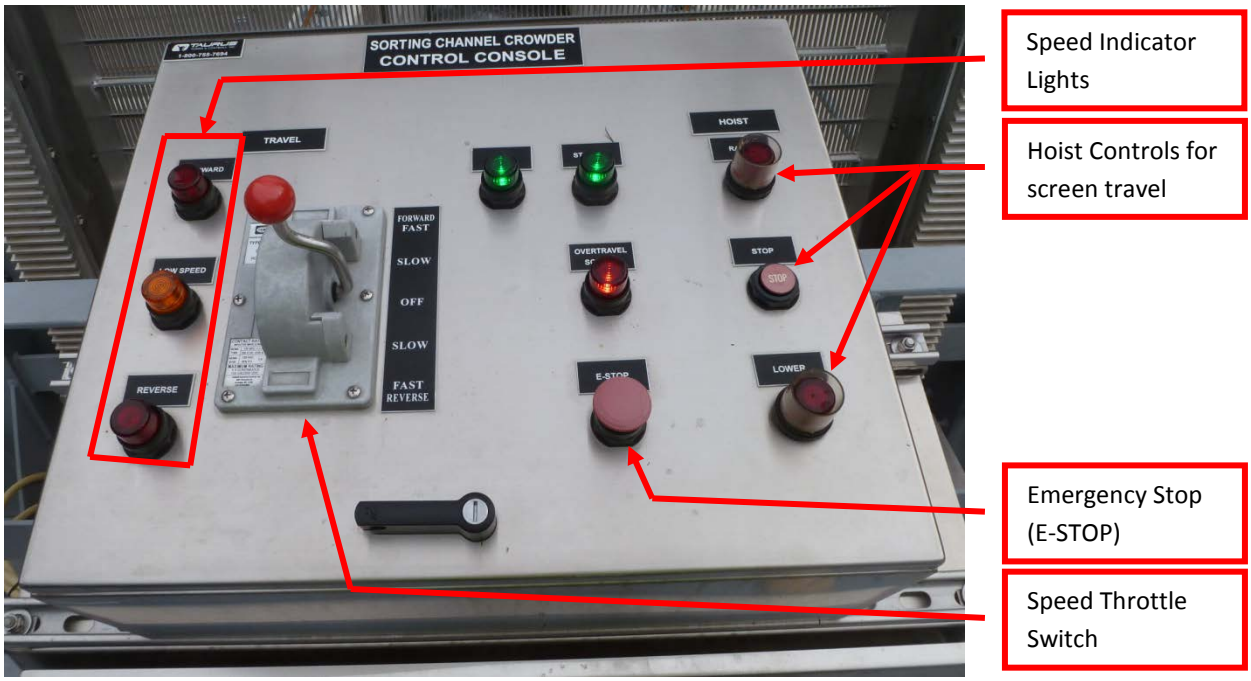


Figure 31 - Sorting Channel Crowder Control Console

Figure 32 - Sorting Channel Bridge

4.2.4.3. Post-Sort Pool Spray Nozzles

Each wall of the post sort pool has multiple spray nozzles that act to calm fish by disturbing the surface of the water. Activation for each pool is done by valve hand wheel. Periodic nozzle maintenance may be necessary remove and clean as needed.

Figure 33 Post sort sprayers

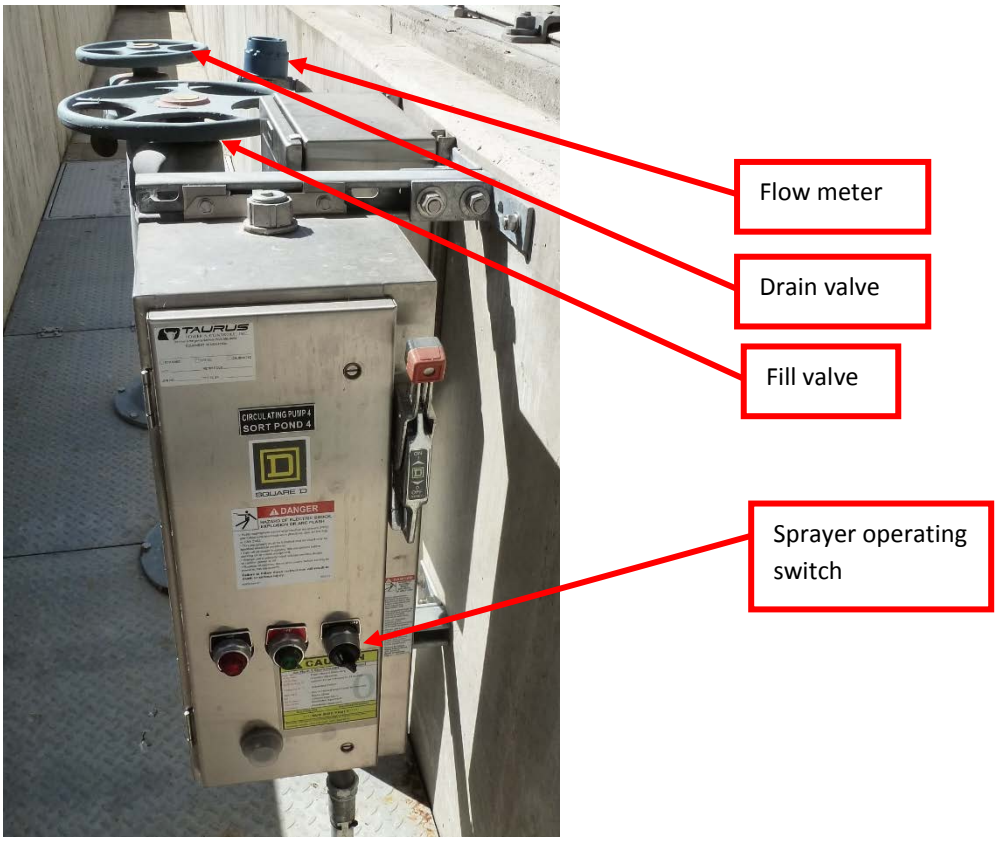


Figure 34 Circulation Pump Control

4.2.4.4. Post-Sort Pool Oxygen System

The oxygen system is designed to be used when pools lose circulating flow. Its design allows for a system pressure of 20-60 PSI. Oxygen used by the fish must be monitored and matched to the oxygen inflow.

Figure 35 – Oxygen Cabinet Location

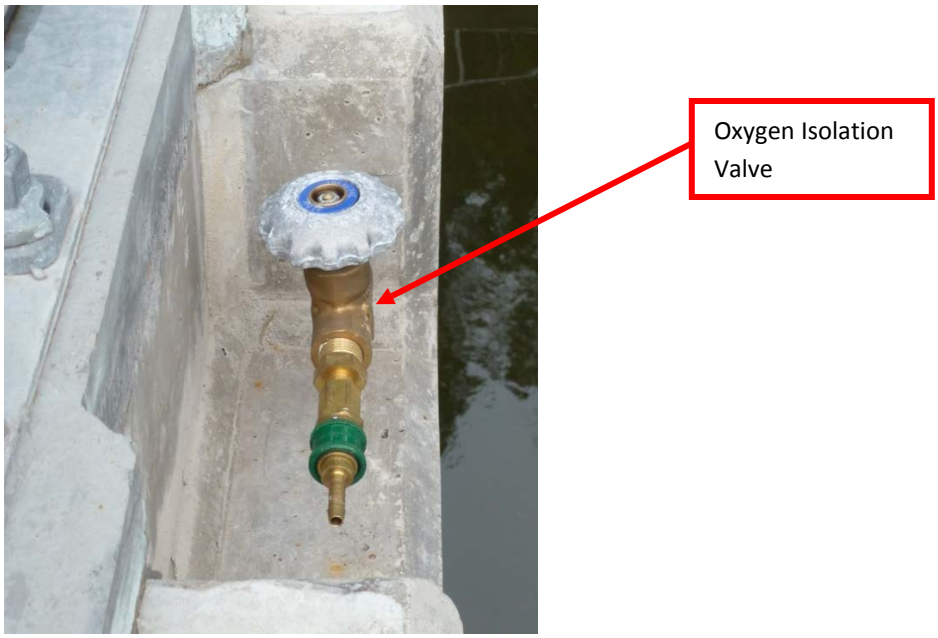


Figure 36 - Post-sort Pool Oxygen Connection

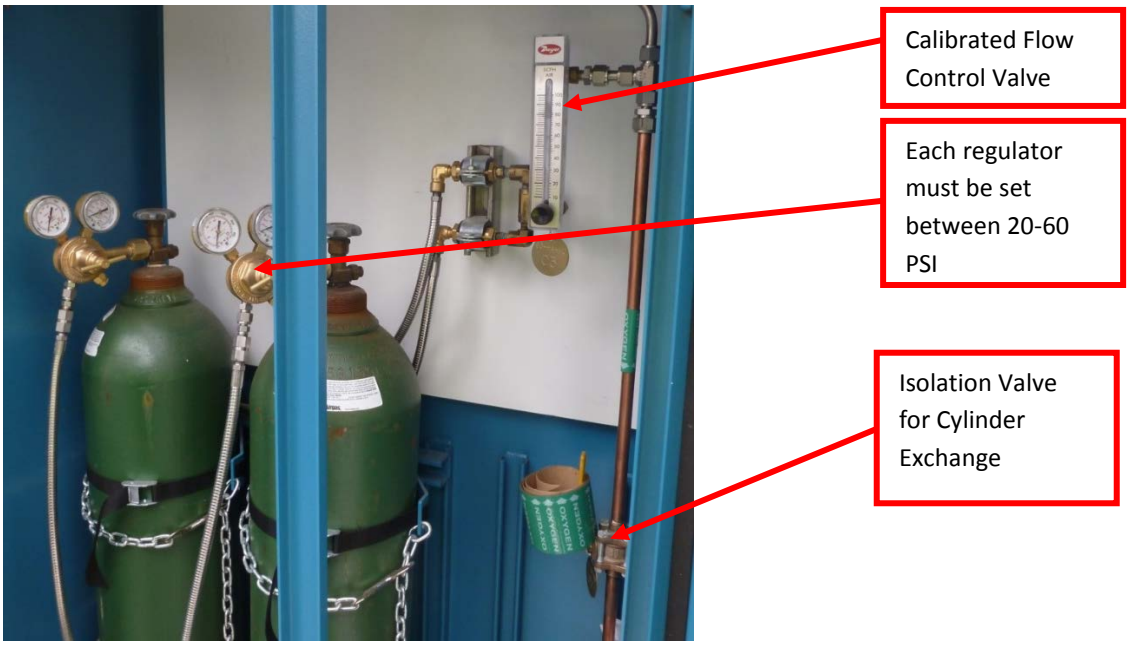


Figure 37 – Oxygen Cabinet Details

4.2.4.5. Post-Sort Pool Recirculation System

When juvenile fish are cared for in the facility; periodically they require medication to avoid large die-offs. While medicating the fish pool inflow and outflow ceases and recirculation pumps are used to maintain medication concentration and dissolved oxygen.

CAUTION: Medication may be atomized and dispersed via sprayers. Use appropriate protective gear if medicating fish.

4.2.4.6. FWS Piping

Exposed FWS piping is primarily composed of galvanized steel with stainless steel spools used for piping that must pass through concrete.

4.2.4.7. Diffusers

Diffusers require maintenance at six month intervals. The screen for each pool should be removed and pressure washed to remove debris. Remove the porosity plates located below the diffuser grating and pressure wash them to remove debris. Sediment and debris should also be removed from the pit area below the porosity plate. The pit drain can be used to divert sediment to the abatement pond however, it is recommended that the debris is removed and disposed of in accordance with local laws and regulations.

Figure 38 Diffuser Pit

4.2.4.8. Removable Fish Screens and Overflow Stoplogs

Figure 39 – Post-sort Exit to Sorting Channel

4.2.4.9. Juvenile Return Pipe

The entrance to the pipe is at the western end of the sorting channel. Juvenile fish that are ready for introduction to the river system are moved from the holding pool to the sorting channel. In the sorting channel they are moved down to the western end of the sorting channel. A fish screen is removed providing access to the pipe.

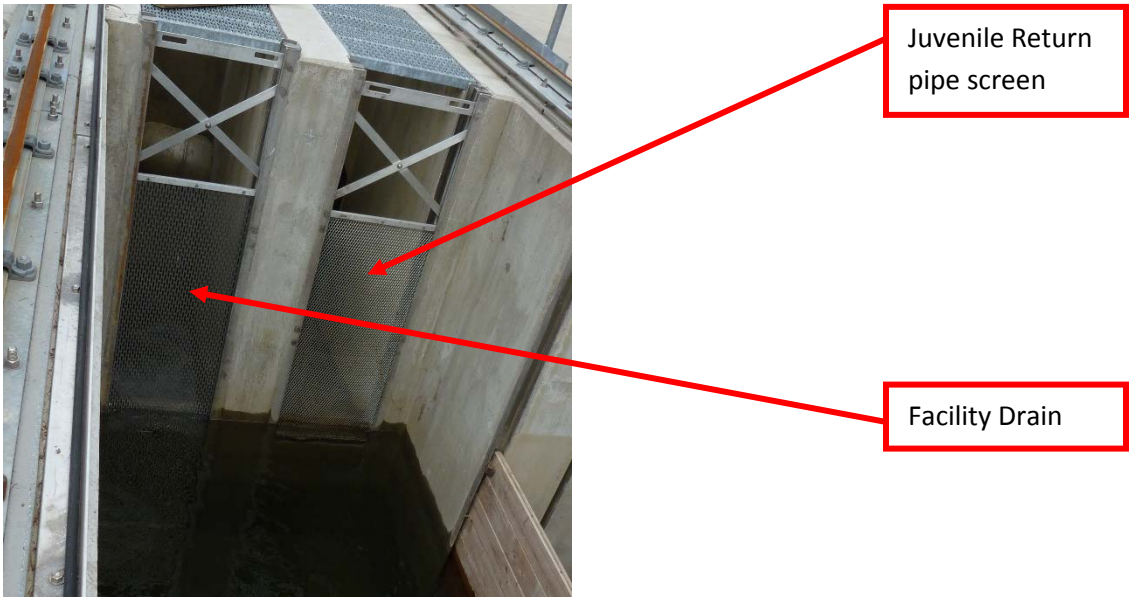


Figure 40 Sorting Channel Drain Screens

4.2.4.10. Sort Channel Drain System

There are two main outlets to the Sort Channel located at the west end of the sort channel (see sheet SC745):

- Upper outlet to 30-inch Juvenile Return Pipe on north side, crest invert 983 feet
- Lower outlet to 18-inch juvenile drain pipe on south side, crest invert 979 feet (I.E. of sort channel)

  Both outlets have guides. The upper outlet can have a picket lead or stop logs (to raise the water level in the sort channel if the pond discharge is low.) Stop logs or weirs are placed in the guides for lower outlet, normally to block the flow into the lower outlet. However, the stop logs are incrementally removed during a fish removal operation.

Normally the Sort Channel discharges back to the tailrace through upper intake at the downstream end of the channel and down the 30-inch diameter juvenile return flume. When juvenile fish are not being released, a picket lead is placed upstream of the upper outlet for the juvenile return pipe so that the pipe continues to release the post-sort pool discharges. Otherwise the picket lead is removed and fish are allowed to leave the sort channel volitionally. The juvenile return pipe discharges into the tailrace near the entrance to the fish ladder.

When the sort channel is to be drained with juvenile fish in the channel, the lower outlet to the 18-inch juvenile drain pipe is opened and the water level in the sort channel is lowered incrementally by means of weirs. The 18-inch juvenile drain pipe connects to the main 30-inch juvenile return pipe to discharge to the tailrace. The 18-inch flushing valve (MTF-FWS-JDS76) for the upper outlet must opened to flush

fish that may have been stranded in the upper juvenile return pipe after the lower outlet was opened. As the last weirs are removed and the sort channel is nearly drained, the 12-inch flushing valve (MTF-FWS-JDS77) for the lower outlet needs to be opened to flush the remaining fish down the 18-inch drain pipe.

When the sort channel needs to be drained and there are no juvenile fish, then the sort channel drain pipe to the abatement pond should be used.

4.2.5. Intake and Pump Structure (IPS)

-SITE MAP AREA E3, F3, E4, F4

4.2.5.1. FWS Pump System

Each FWS pump is controlled by its own VFD; the VFD interface is shown in Figure 42. The mode (H-O-A) selector switch should be placed in 'A' for automatic operations. To select manual operation, place the switch in 'H', and to turn the pump off, place the switch in 'O'. The PLC controls the pump speed only in automatic mode. To operate the pumps, login from the main screen (Figure 43) then navigate to 'FWS Pumps'. Figure 44 shows the operator interface for the FWS pump system. The operator can control the FWS Pump System, and the following information can be found: pump speed (percentage of max); pump power (kilowatts); pump motor current (amps); time on standby (hours); total lifetime runtime (hours). Information for all five pumps is displayed; when pump name is red, the pump is currently running, when the pump name is green, the pump is currently on standby.

Under normal conditions, the FWS Pump System should be operated in automatic mode. This is done by selecting 'AUTO CONTROL' from the touch screen. This feature can only be selected when no VFDs are switched to manual and at least 2 VFDs are switched to automatic. If any of the five VFDs are switched to manual the PLC will not adjust pump speeds or start/stop pumps and the FWS system must be operated manually.

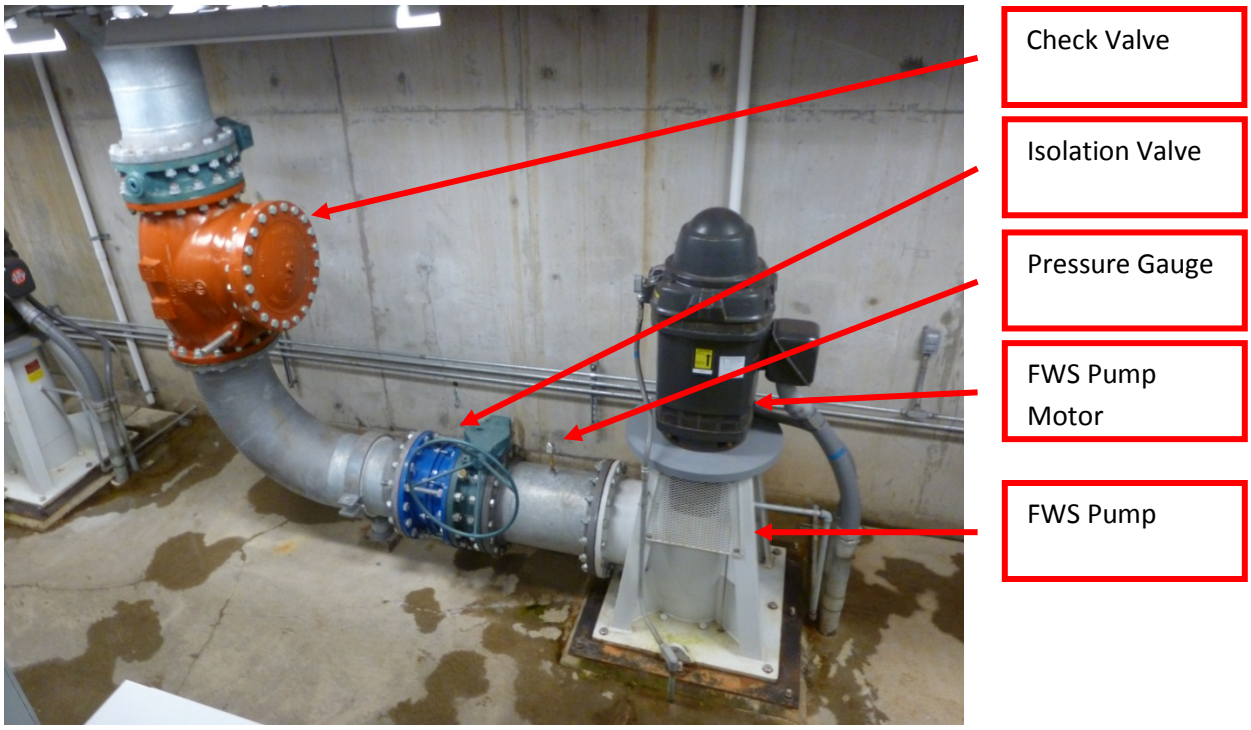


Figure 41 - FWS Pump

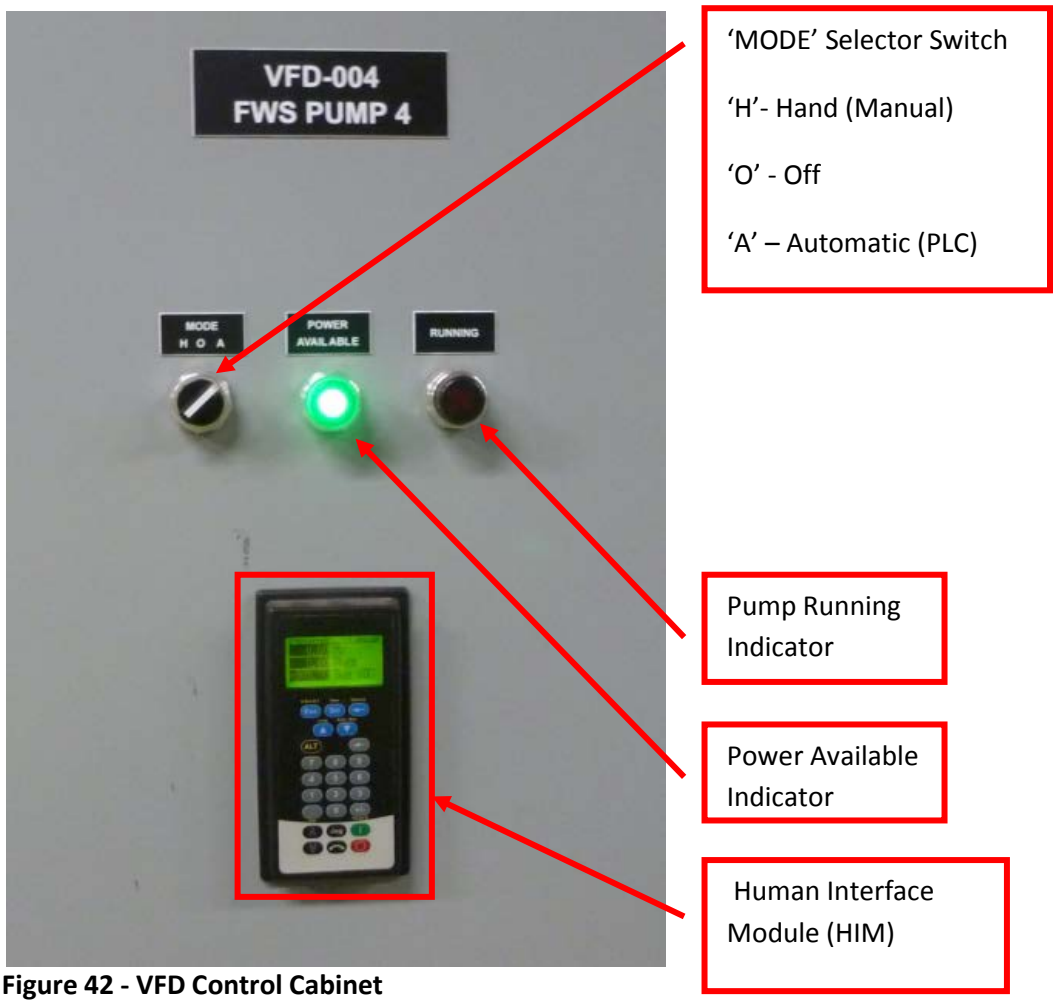


Figure 42 - VFD Control Cabinet

Figure 3 - Touch Screen, Main Screen

Figure 44 – Touch Screen, FWS Pumps

4.2.5.2. IPS Intake Screen Differential

When the intake and pump structure (IPS) screen becomes plugged on the upstream (river) face of the screens with debris, there is a corresponding increase in head differential across the screen from forebay to pump sump inside the IPS. Six level sensors are positioned around and inside the IPS structure to monitor the water surface elevations in the forebay (LT-008 and LT-012), between screens and porosity plates (LT-009 and LT-011), and general pump sump (LT-007 and LT-010). The screen differential at each end of the IPS is determined by the following differences in recorded levels:

LT-009 – LT-008 (west end of IPS)
LT- 012 – LT-011 (east end of IPS)

The pump sump level will be the lowest level in the IPS since the intake flow must pass through the porosity plates downstream of the IPS screens before reaching the sump.

Large screen differentials represent potential impingement and injury threats to passing juvenile fish and place the operating FWS pumps at risk. As the FWS represent the critical water supply of the fish ladder and ponds, AWS diffuser gates are systematically closed as the screen differential becomes higher.

<u>PLC rules for IPS screen differential:</u>

The programmable logic control (PLC) has the following rules governing the operation of the AWS system:

1. IF: Screen Differential > 3 feet; THEN: Close all AWS Diffuser Gates
    a. The PLC will automatically close all AWS diffuser gates.

2. Alarms (both horn and dialer) are sent out if the following conditions are detected by the PLC:
    a. If screen differential > 1 foot for at least 5 continuous minutes
    b. If screen differential > 2 feet for at least 5 continuous seconds
    c. If screen differential > 3 feet for 30 continuous seconds, alarm will signal the automatic shutdown of the AWS diffuser gates

FWS Pump Operations under Low River Flow Conditions

For safe operation of the FWS pumps, the water level in the pump sump (inside the IPS) should not drop below elevation 972 feet. Based on the rating curve for the river levels outside the IPS and accounting for headlosses through the porosity plates, the following screen differentials should not be exceeded as a function of river flow rate:

Table 7 – Maximum Allowable IPS Screen Differential during Low River Flow Conditions

Forebay Elevation feet	Approximate River Discharge cfs	Maximum Allowable Screen Differential (feet)
975.6	2500	3.0
974.5	1500	2.2
974.0	1000	1.7
973.6	750	1.3
973.3	500	1.1
973.0	350	0.8
962.0	300	0.5

The above conditions must be monitored and addressed by the facility operators as the PLC will not take action, except where screen differential alarms are triggered.

4.2.5.3. FWS Piping

The facility water flows through the header pipe and is monitored and regulated by a pair of pressure transmitters. A flow meter is included on the western end of the pump header pipe to verify the facility flow demands. The header pipe is equipped with a manual drain and air release valve.

Figure 45 - FWS Header Pipe Manual Drain

Figure 4 - FWS Header Pipe Air Release/Vacuum Breaker Valve

4.2.5.4. FWS Flowmeter

A General Electric (GE) *DigitalFlow™ DF868* ultrasonic flowmeter (FIT-001) is provided to monitor flow in the FWS header pipe. The flow signal is input into the PLC for monitoring only. See Volume 6 Contractor's O&M Manual for manufacturer's O&M data.

Figure 5 - FWS Header Pipe Flowmeter

4.2.5.5. Sump Pump System

The Sump Pump System is controlled at the Sump Pump Control Panel shown in Figure 48. Normal Operation should set the 'HOA' selector switch to 'A' for automatic operation. When operating automatically, a single pump will run with the other pump as a backup (lead/lag), unless the inflow exceeds the capacity of the single pump, in which case both pumps will run simultaneously. When the 'Run' indicator light is illuminated on the control panel, the corresponding pump is currently operating. Controls provide an alternator circuit so a different (lead) pump is started each time there is demand.

CAUTION: The sump pump discharges to the river. Any amount of hazardous liquid within the IPS that may enter the sump should be remediated immediately.

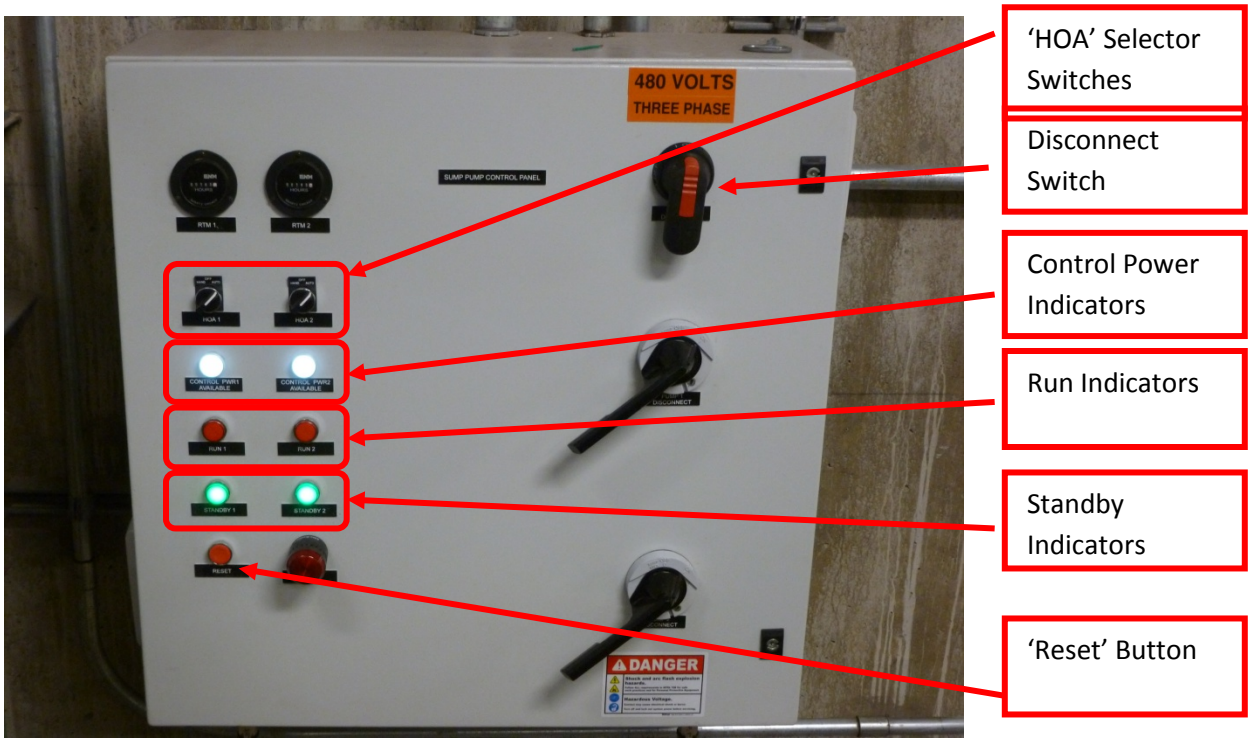


Figure 68 - Sump Pump Control Panel

4.2.5.6. Washdown Pipe System

The washdown pipe system can be operated at the Washdown Water System Cabinet.

Figure 7 - Washdown Water System

(a) (b)

Figure 8 - (a) Washdown Water Hydropneumatic Tank; (b) Opposite View

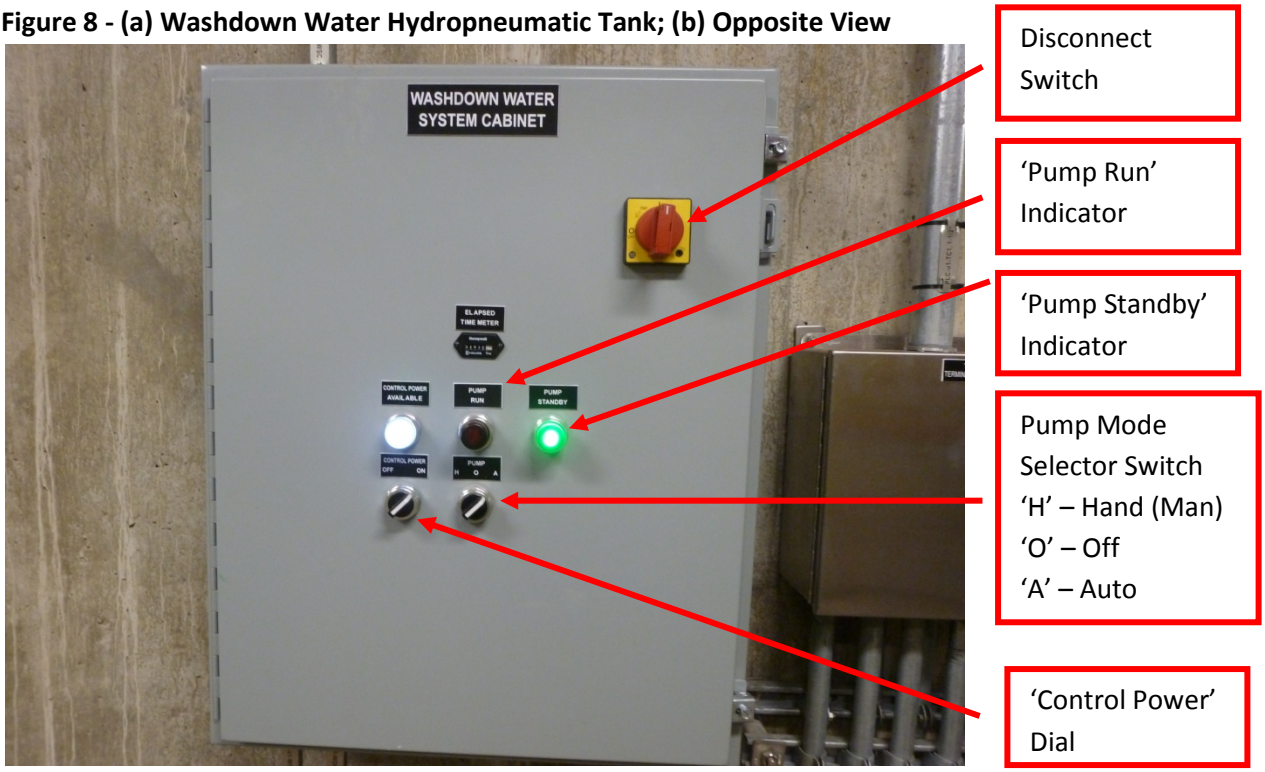


Figure 51 - Washdown Water System Cabinet

4.2.5.7. Dewatering Bulkheads

The dewatering bulkheads are normally stored dogged off in their slots while the facility is operating. A 5 Ton mobile crane is used to install and store the dewatering bulkheads.

Figure 52 Pump Intake Structure, Intake bulkhead

4.2.5.8. Airburst System

The airburst system is normally operated automatically based upon the difference in water level detected between the forebay and well within the IPS. The air for the airburst system is stored in the air receiver tanks. These tanks are filled by the air compressor; pressure within the tanks are monitored and regulated by pressure gauges and pressure transmitters. See section 4.2.5.2 IPS Intake Screen Differential.

4.2.5.9. IPS Ventilation System

The HVAC system is controlled from the HVAC control panel, illustrated in Figure 53.

Figure 53 - HVAC Control Panel

4.2.5.9.1. IPS Air Compressor

The air compressor can be operated at the IPS Air Compressor Control Cabinet (Figure 54). Ensure that the 'Control Power Available' indicator light is illuminated.

Figure 54 – IPS Air Compressor Control Panel

-To operate air compressor automatically, turn the 'Compressor HOA' selector switch to 'A'.

-To operate air compressor manually, set the selector switch to 'H'.

-To turn the compressor off, set the dial to 'O'.

Refer to the air compressor manufacturer's O&M data for manual operating instructions, see Volume 3.

The Airburst System is operated through a touch screen. From the main screen, login and navigate to the FWS Screen Cleaner screen (Figure 58).

The compressor has an air filtration system, filters should be changed at regular intervals per manufacturer's recommendation. The compressed air system will control air pressure by pressure switch. The airburst system should see a pressure between 90 and 110 PSI.

The compressor filters are designed to collect oil and condensate generated by the air compressor. Each filter discharges to the oil water separator. Oil is removed from the discharged slurry and collected. The cleaned water is discharged to the trough on the north wall. The oil water separator should be maintained in accordance with the manufacturer's recommendations.

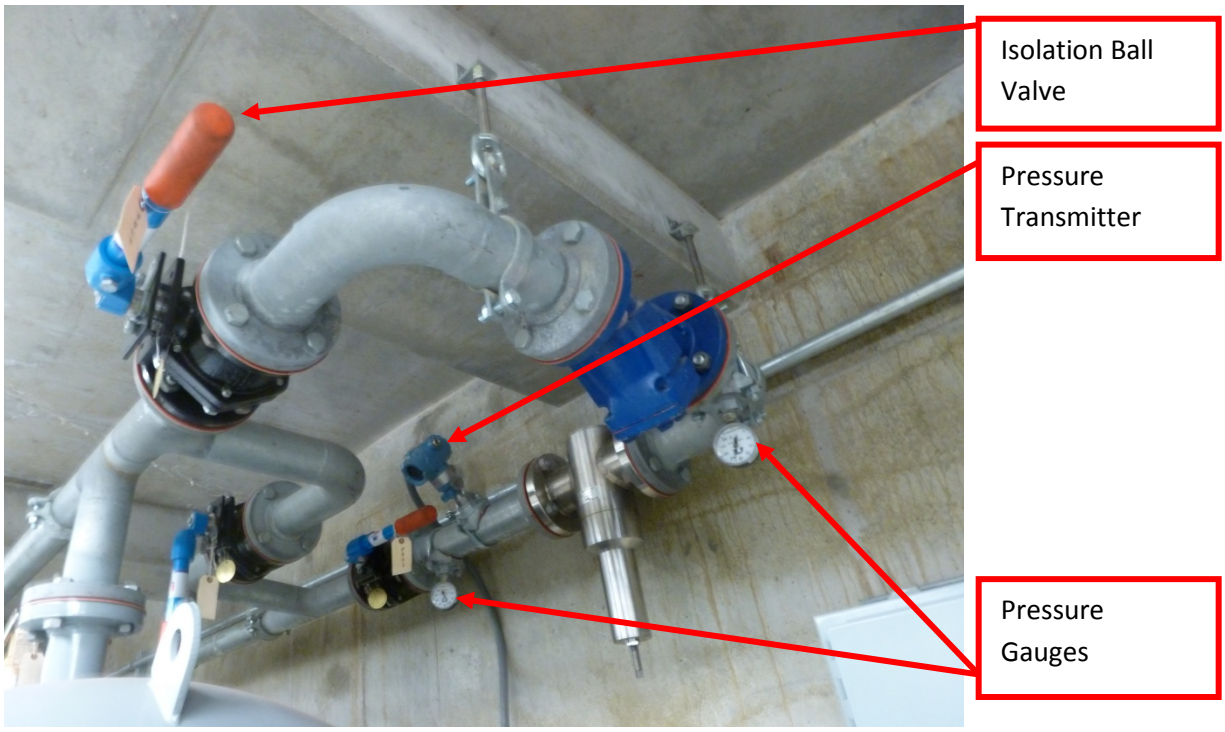


Figure 55 – Compressed Air Pipe at Receiver

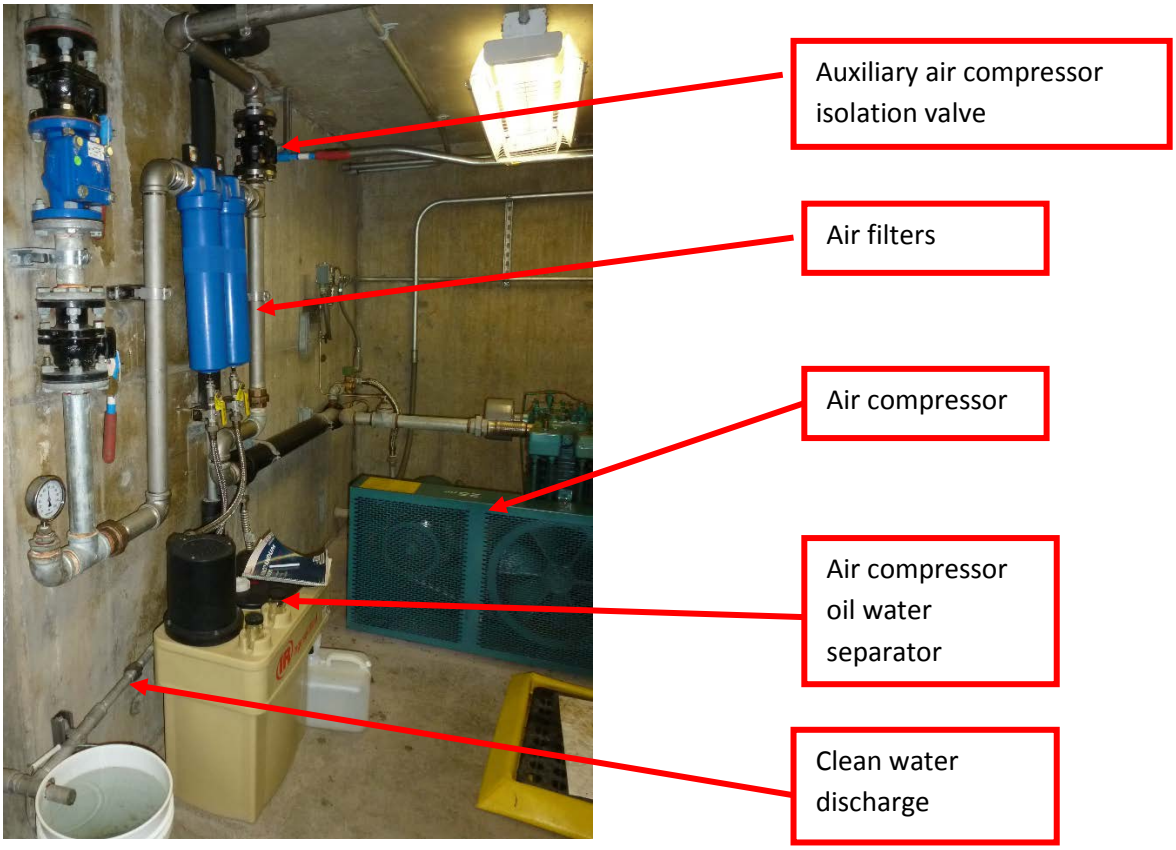


Figure 56 – IPS Compressor Room

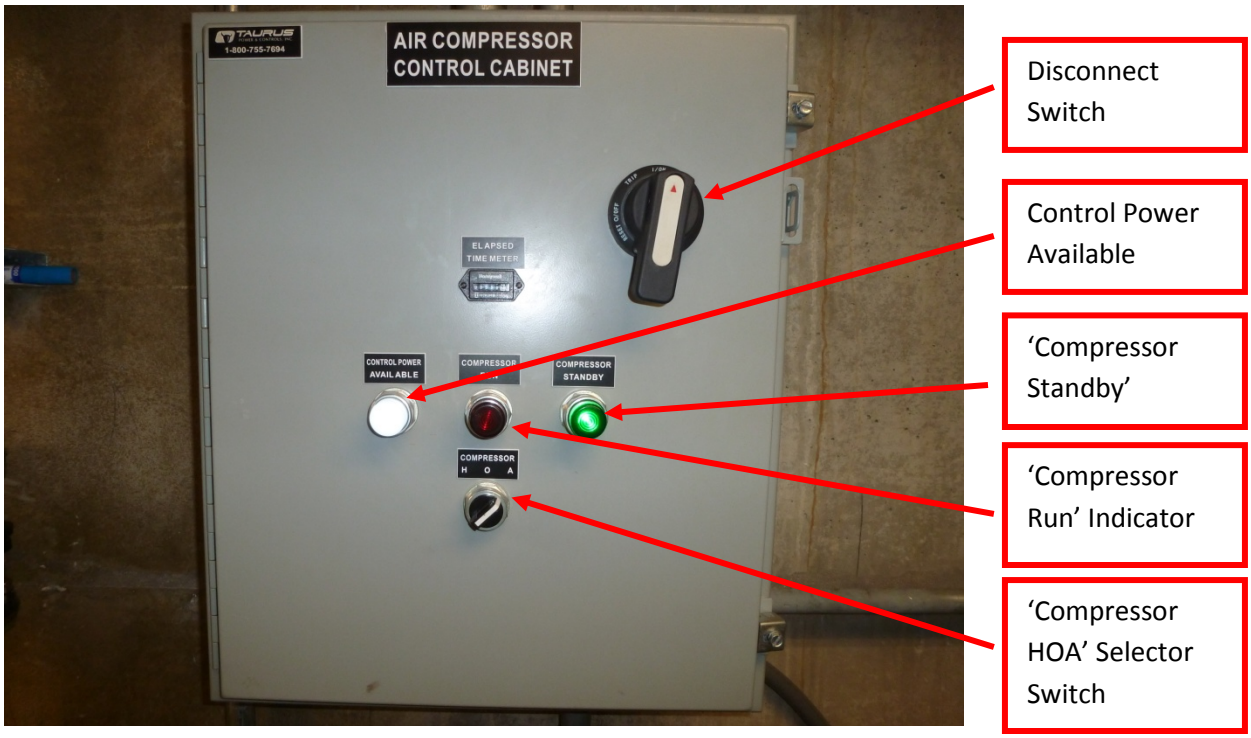


Figure 57 - Air Compressor Control Cabinet

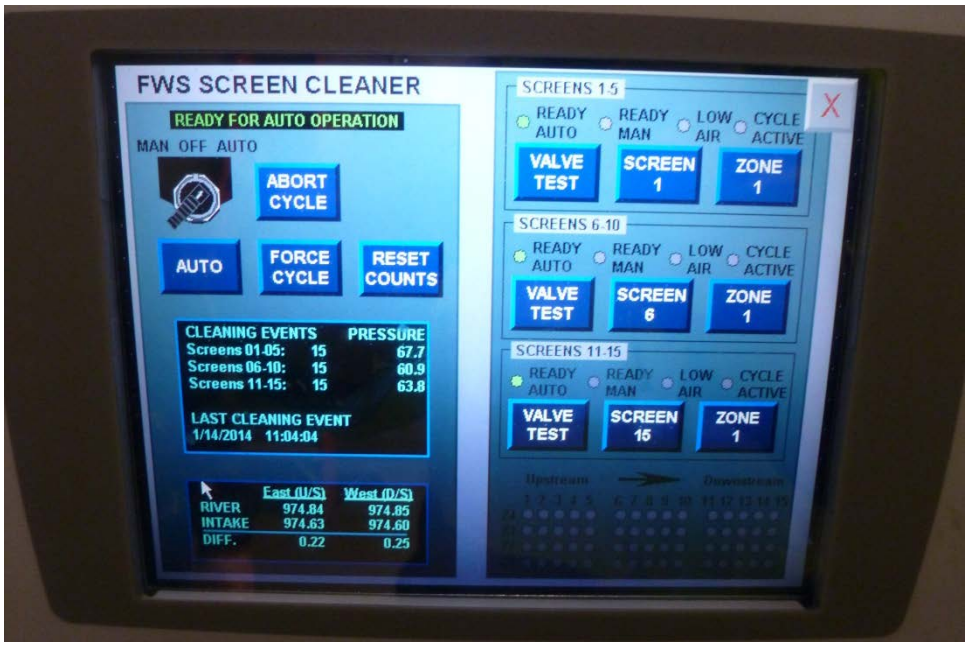


Figure 58 – Touch Screen, FWS Screen Cleaner

4.2.5.9.2. IPS Air Auxiliary Compressor

In the event that the air compressor cannot supply air to the air burst system an auxiliary air compressor is provided. The compressor is moved by fork lift from the maintenance building to a suitable location for connection to the air supply system.

CAUTION: Prior to making connections ensure piping is depressurized and disconnect is in the off position.

CAUTION: Once connections are made and prior to starting the auxiliary air compressor, ensure auxiliary valve is open so that system can be pressurized

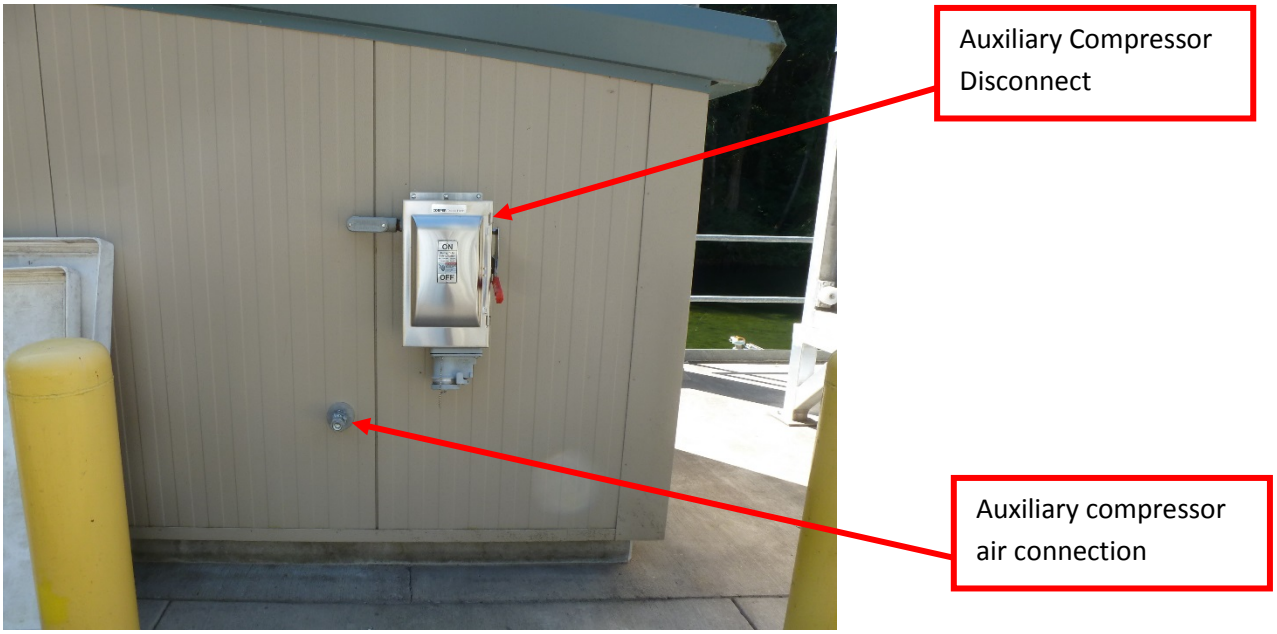


Figure 59 – Touch Screen, FWS Screen Cleaner

4.2.5.10. AWS Head Gate

When the fish ladder is in use, the AWS head gate is opened when attraction water is desired at the entrance. The AWS headgate must always be fully raised or lowered. Never operate in an intermediate position. The digital display on the electric actuator indicates a percentage open or closed The AWS head gate can be locally operated by electric actuator or manual hand wheel (Figure 61). To use the electric actuator, place the Local/Remote/Stop switch in 'LOCAL' and use the 'OPEN/CLOSE' switch to operate the gate. There is no control function associated with the 'REMOTE' mode. For manual operation, engage the clutch and use the hand wheel to open and lower the gate. Refer to the manufacturer's O&M data for actuator maintenance information, see Volume 3.

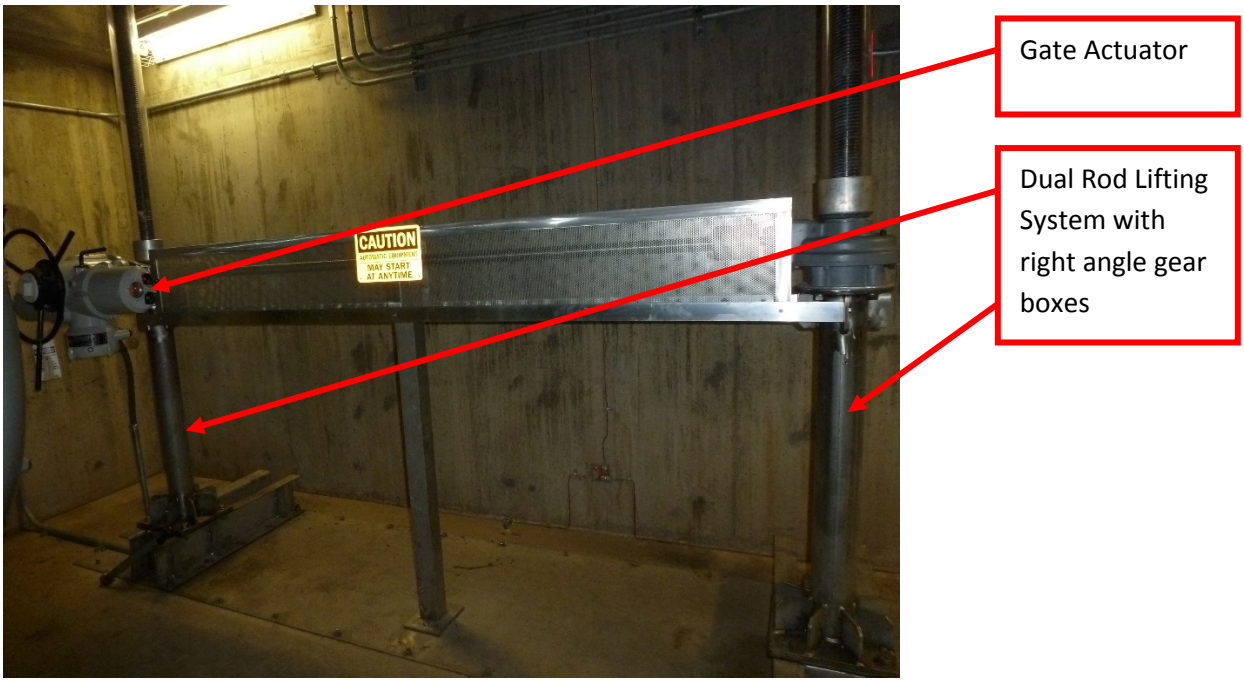


Figure 60 - AWS Head Gate

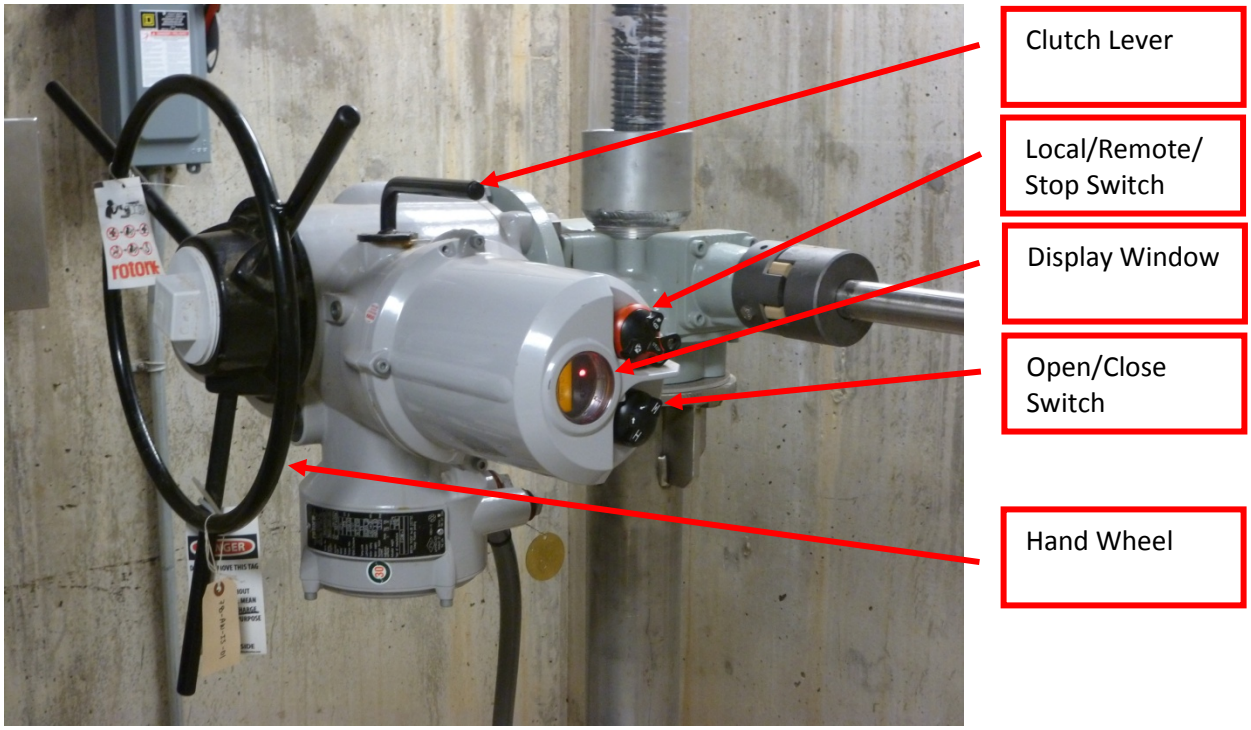


Figure 61 - AWS Head Gate Actuator

4.2.6. Fish Sorting Equipment

-SITE MAP AREA D2, E2, F2-

4.2.6.1. Fish Transport Flume

Fish travel from the pre-sort pool, down the flume toward the switch gates and anesthetic tank. See Figure 20.

4.2.6.2. Switch Gates

Switch gates are used to direct incoming fish to desired locations. The label above each button indicates the location where each fish will be deposited. Momentarily press the desired pushbutton to open the switch gate. Switch gate will close upon release of the pushbutton. The "Return-to-River" switch gate can be held open indefinitely by switching the "SWITCHGATE CONTROLS" selector switch (on the Pre-sort Control Console) to "WINTER RETURN" (Figure 15, para. 4.2.2). This selector switch should normally be in the "NORMAL" position. The switch gate speed can be adjusted by needle valve. Switch gate operation should only be set to a minimum actuation speed as faster speeds increase wear and tear on the switch gates. Refer to the manufacturer's O&M data for full operation information, see Volume 2.

Figure 62 – Switch gate Controls

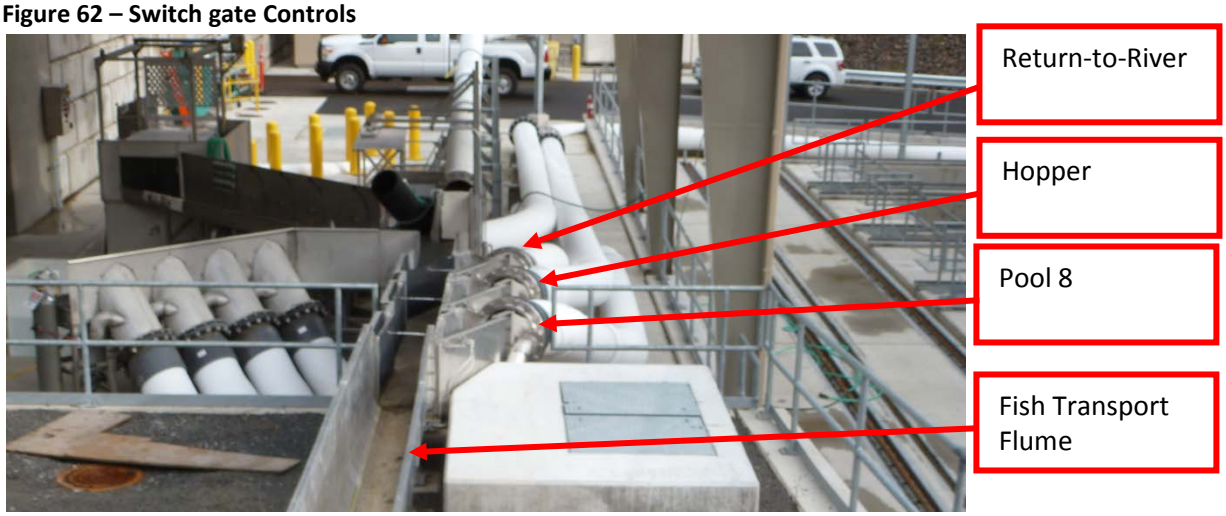


Figure 63 – Switch gates

4.2.6.3. Anesthetic Tank

Figure 64 Anesthetic Tank

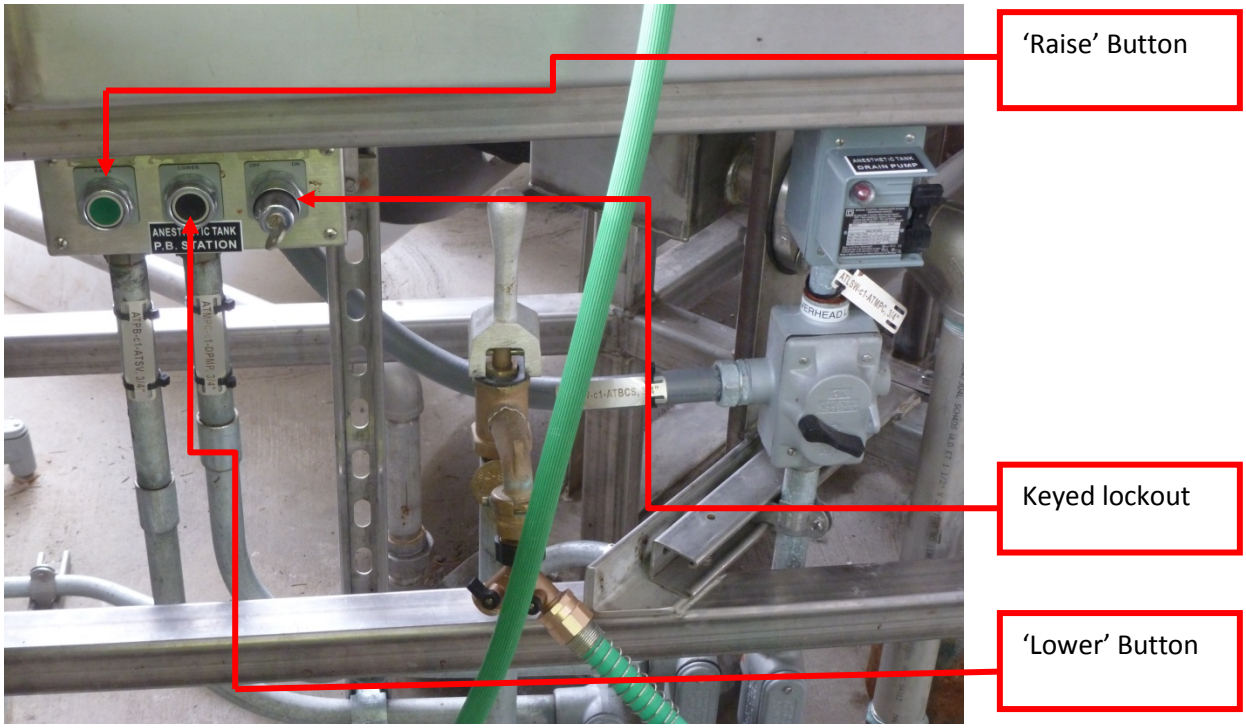


Figure 65 - Anesthetic Tank Brail Controls

RAISE: Raised the pneumatically operated brail

LOWER: Lowers the Brail

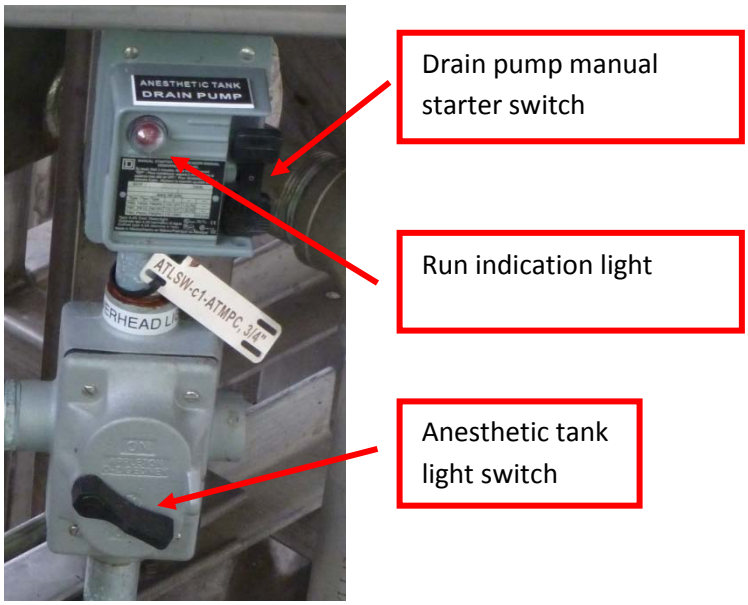


Figure 66 - Anesthetic Tank Drain Pump Controls

4.2.6.4. Sorting Table

The sorting table allows the operator to move fish from the anesthetic tank to various pools by way of fish pipe. The operator must decide which pipes will be used prior to processing fish and the then open the water supply valve for the desired fish pipe(s). Prior to processing fish the flushing water supply should be on keeping the working surface wetted to ensure fish can be moved easily and damage to scales is minimized.

Figure 67 – Sorting table

4.2.6.5. Recovery Tank

The recovery tank allows anesthetized fish to regain consciousness. Once awake the false weir should attract the fish to the tank exit taking the fish to the return to river outlet. Refer to the manufacturer's O&M data for miscellaneous equipment maintenance information, see Volume 2.

Figure 68 - False Weir 2 and Recovery Tank Brail Control Cabinet

4.2.6.6. Recovery Tank False Weir

The false weir flow is controlled at the cabinet and can be varied from 0 to 100 percent flow (Figure 70). To turn the false weir on, press the 'START VFD' button. Flow can be controlled by rotating the flow control dial; 0% for lowest flow and 100% for maximum flow. To turn the false weir off and stop flow, push the 'STOP VFD' button.

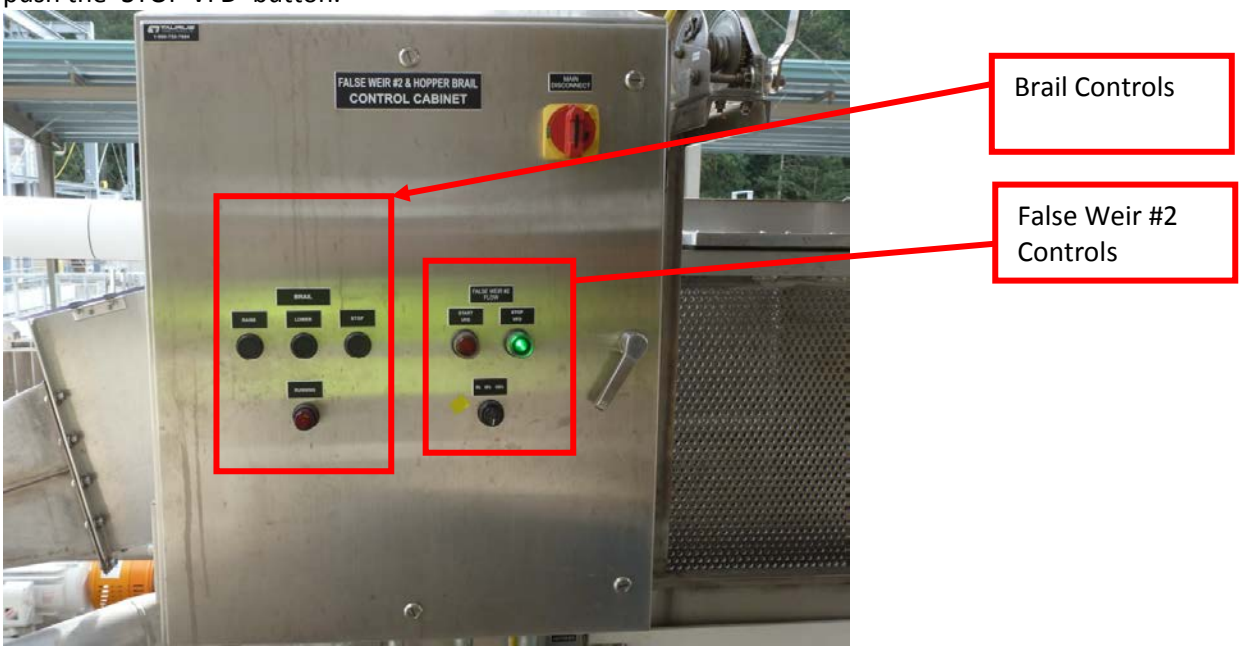


Figure 69 False Weir and Brail Control Panel

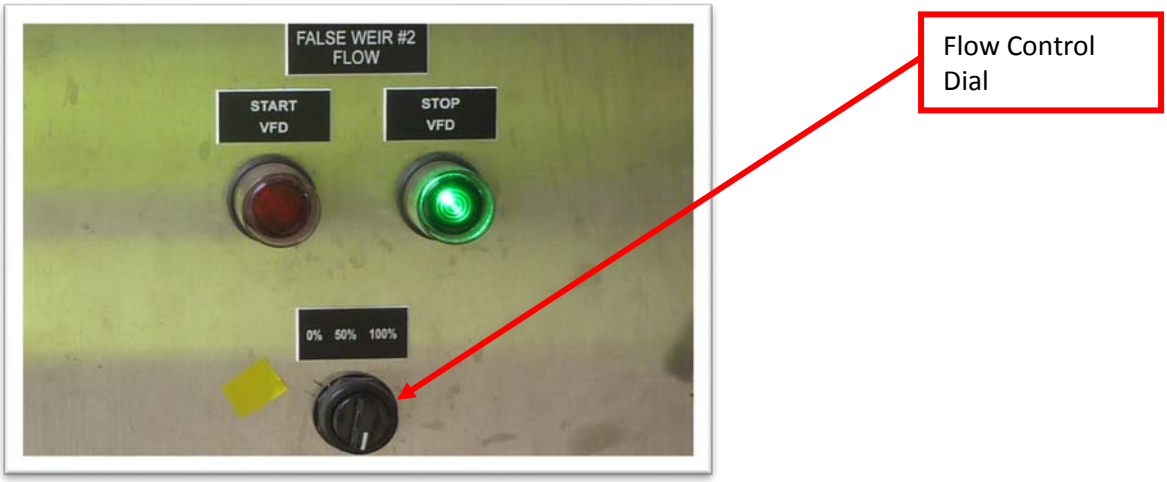


Figure 70 - False Weir 2 Flow Controls

4.2.6.7. Recovery Tank Brail

The recovery tank brail is used only if the fish remain in the recovery tank for an extended period of time. Operators should make an effort to "bump" the brail up, without fully dewatering the fish, in an effort to persuade the fish to jump or swim out of the tank on its own.

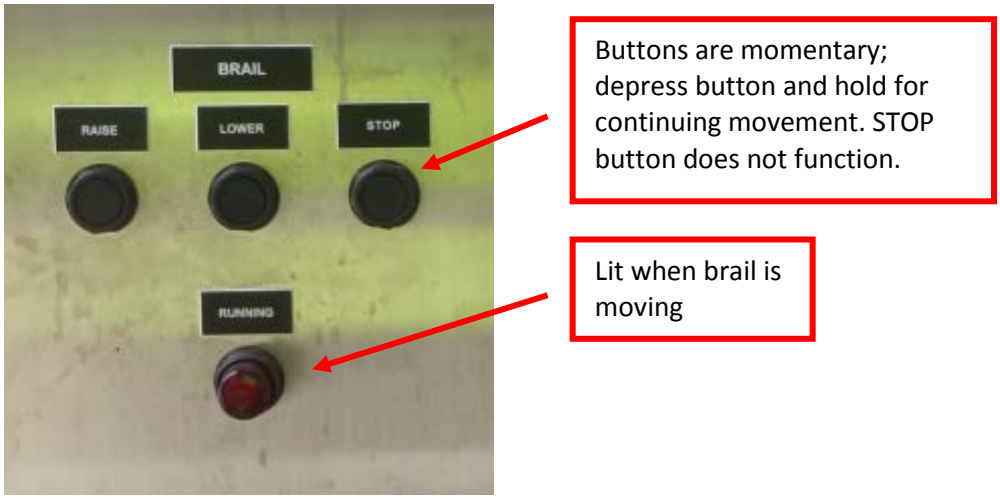


Figure 71 – Brail Control Panel

4.2.6.8. Spawning Table

This table is used to process fish for egg/sperm extraction.

Figure 72 – Spawning Table

4.2.7. Fish Transfer and Loading Equipment

-SITE MAP AREA F2, F3-

4.2.7.1. Hopper Crane

The hopper crane has two hoists. The first hoist is connected to hopper 1 and functions to move ESA listed fish in hopper 1 from the sorting channel pit to the fish transport truck. The second hoist is connected to hopper 2 and functions to move brood stock from the sorting channel pit to the hopper 2 support stand.

Hopper hoist 1 can be operated from the control cabinet (Figure 74) or from a pendant (Figure 75).

Hopper hoist 2 can be operated from the control cabinet (Figure 74) or from a pendant (Figure 75).

OPERATE BY AUTHORIZED PERSONNEL ONLY: Crane may only be operated by personnel with class 2 crane training. Contact the safety office for additional information and requirements.

CAUTION: No person may enter the area beneath a hanging load; only attempt the water transfer after the hopper is seated on the fish transport truck transfer opening.

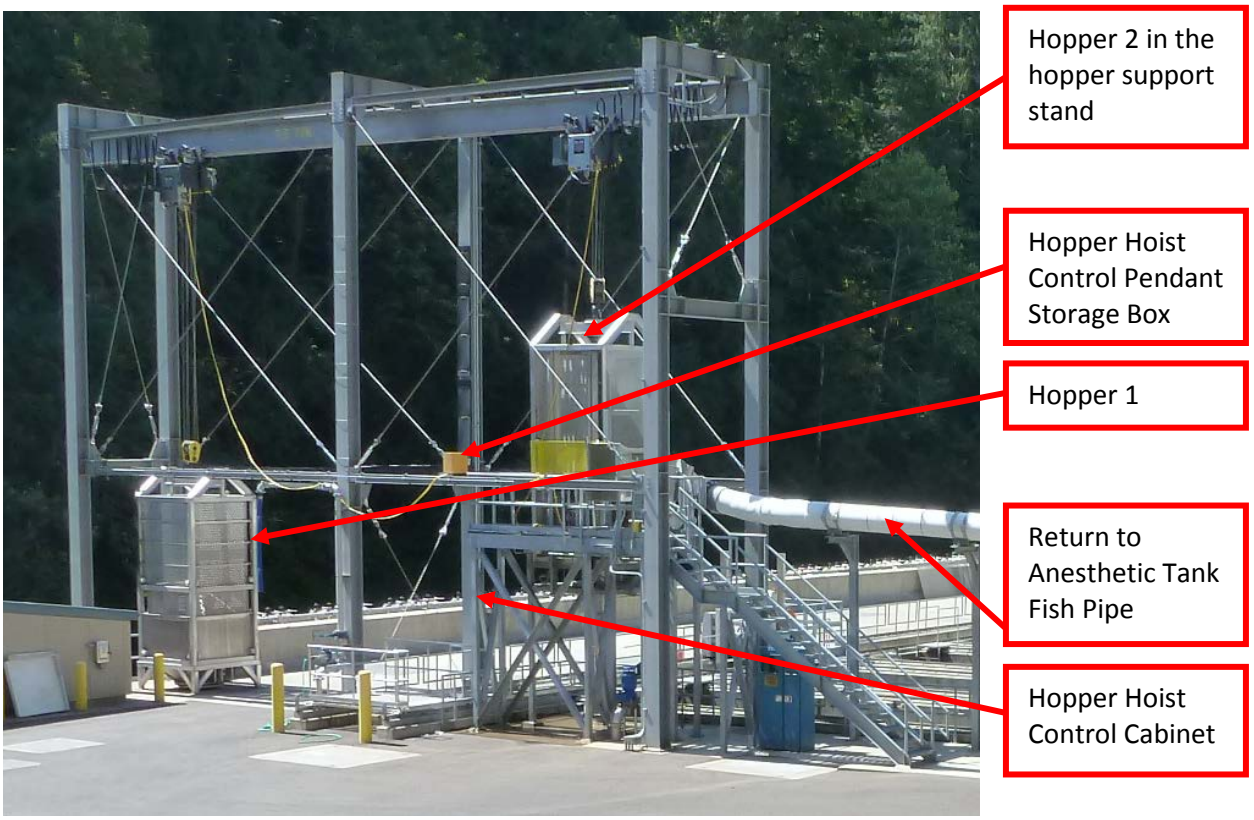


Figure 73 - Crane Assembly

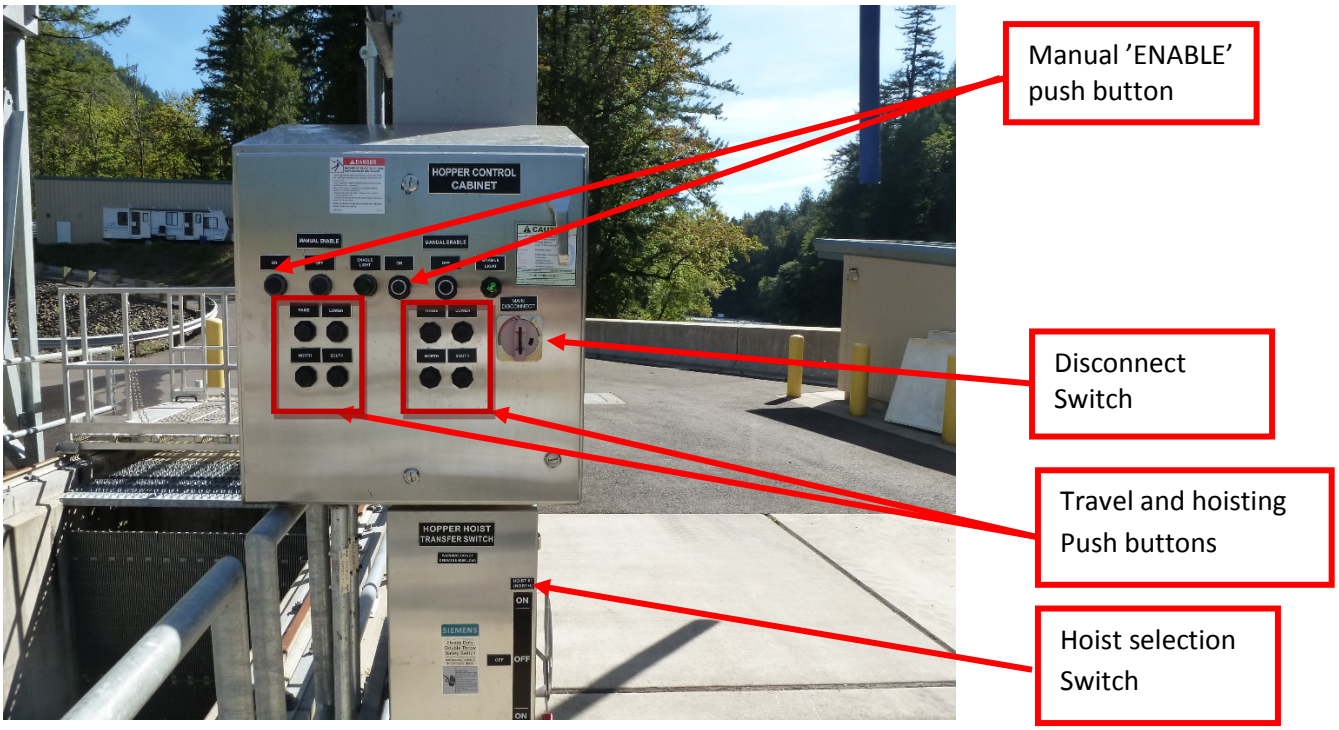


Figure 74 - Hopper Hoist Control Cabinet

Figure 75 Hopper 1 and Hopper 2 Pendant Controls

4.2.7.2. Hopper 1 – Fish truck

Hopper 1 is used to transfer fish to the fish truck using a water to water transfer method. The water to water method used to transfer fish into the truck is described in Appendix I. The hopper is designed to support 30 Chinook, this is the recommended maximum number of fish per transport event.

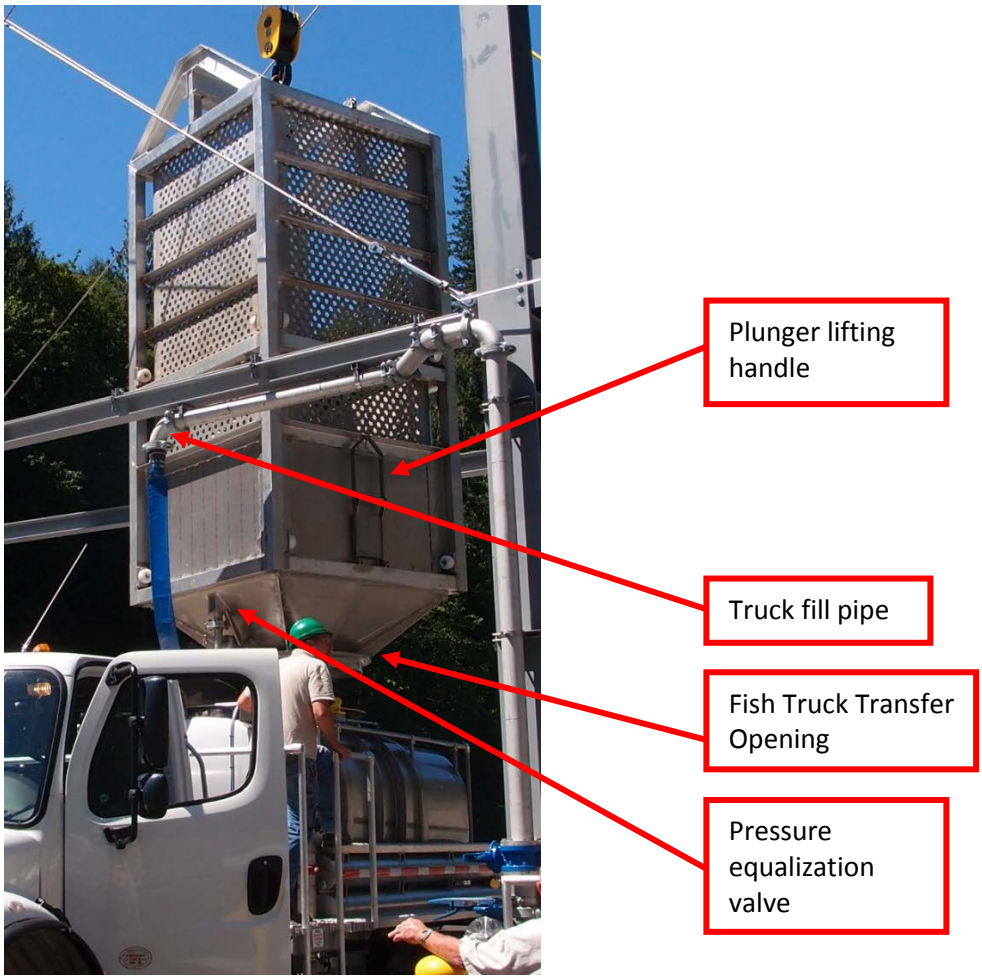


Figure 76 Hopper 1 and Fish Truck Transfer Operation

4.2.7.3. Hopper 2 – Spawning

Fish are moved from the pools to the sorting channel and then into hopper 2 positioned in the hopper pit. The hopper is lifted out of the pit and moved to the position shown in figure 71. The false weir is modified to drain water only. The VFD and pump was removed to improve the brood stock processing based on operator feedback. Hopper 2 is designed to hold 50 chinook fish, this is the recommended maximum number of fish per transport event

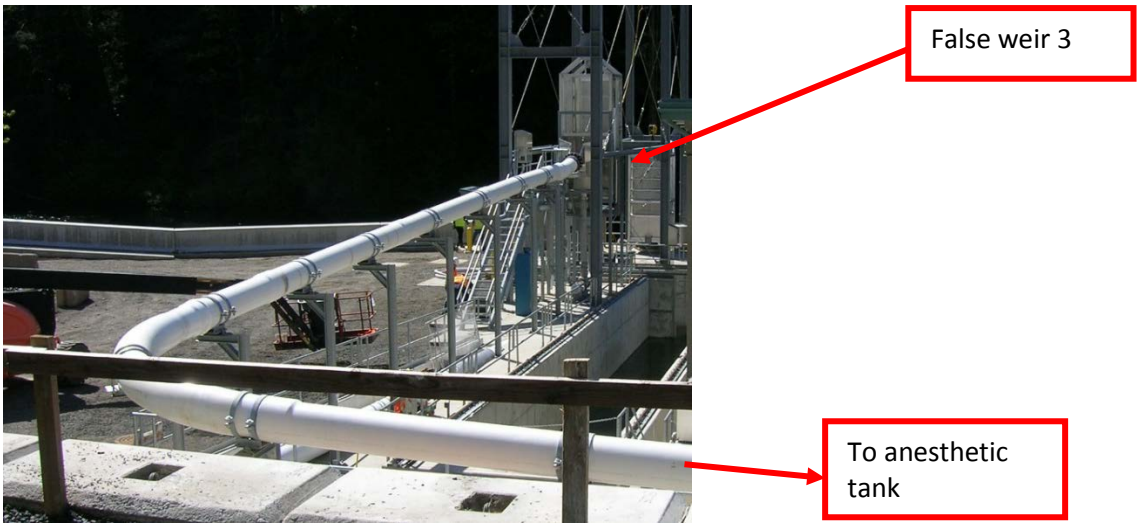


Figure 77 Hopper 2 Platform

4.2.7.4. Hopper 2 – False Weir 3

After decommissioning the false weir its water supply piping was rerouted so that water would up well from within the hopper. The amount of water is controlled using the valve shown in figure 76. Once the water out flow is set and the false weir drain is open to allow the desired fish pipe flow. Once the operator is satisfied with the processing conditions the closure gate is opened and the brail is moved upward to allow the desired number of fish to exit the hopper for processing.

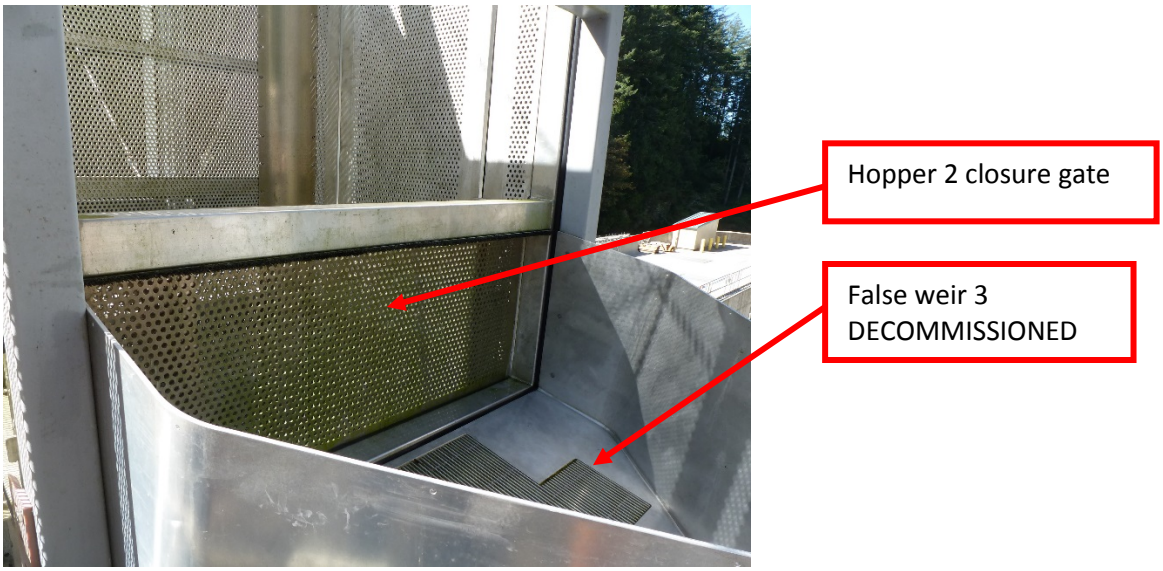


Figure 78 - False Weir 3 & Hopper Brail Control Console

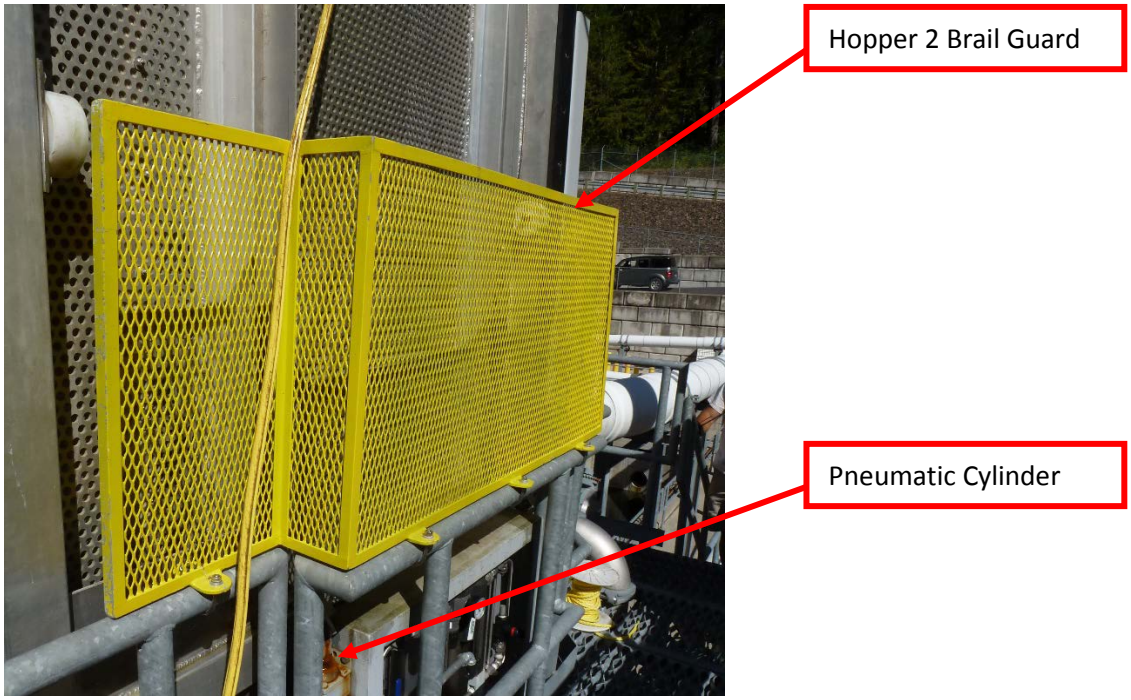


Figure 79 - False Weir 3 & Hopper Brail Control Console

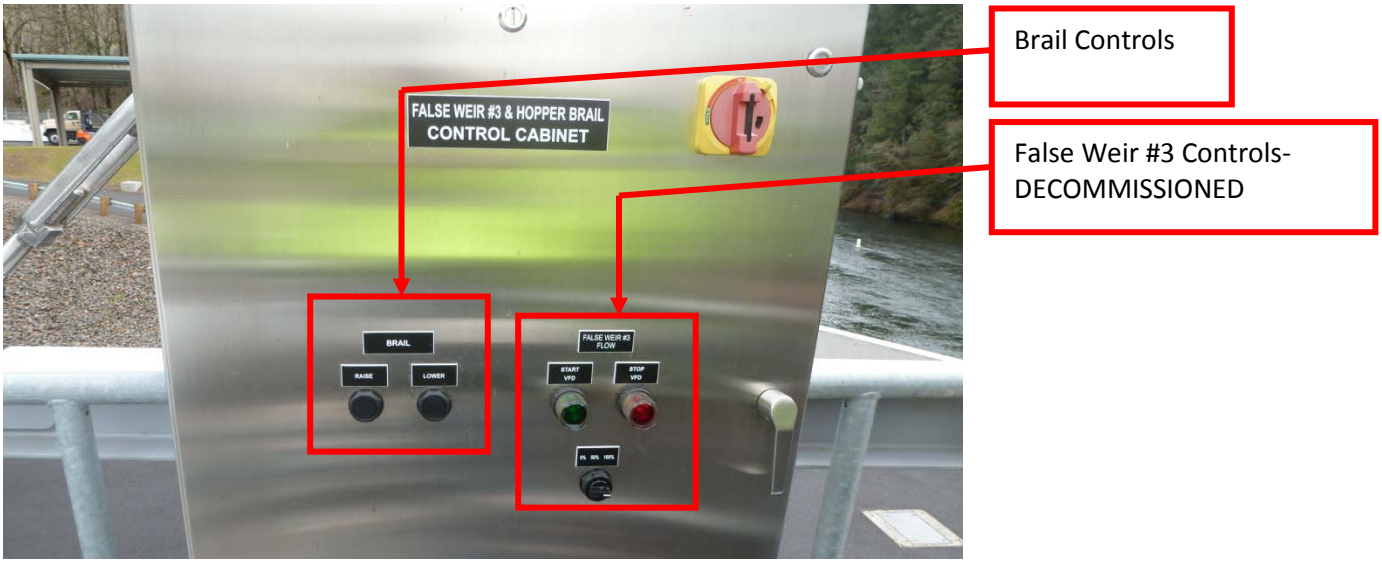


Figure 80 - False Weir 3 & Hopper Brail Control Console

Figure 81 – Hopper Water Supply Valve

4.2.7.5. Fish Truck

Used to move fish from hopper one to designated out plant sites.

Figure 82 - Fish Truck

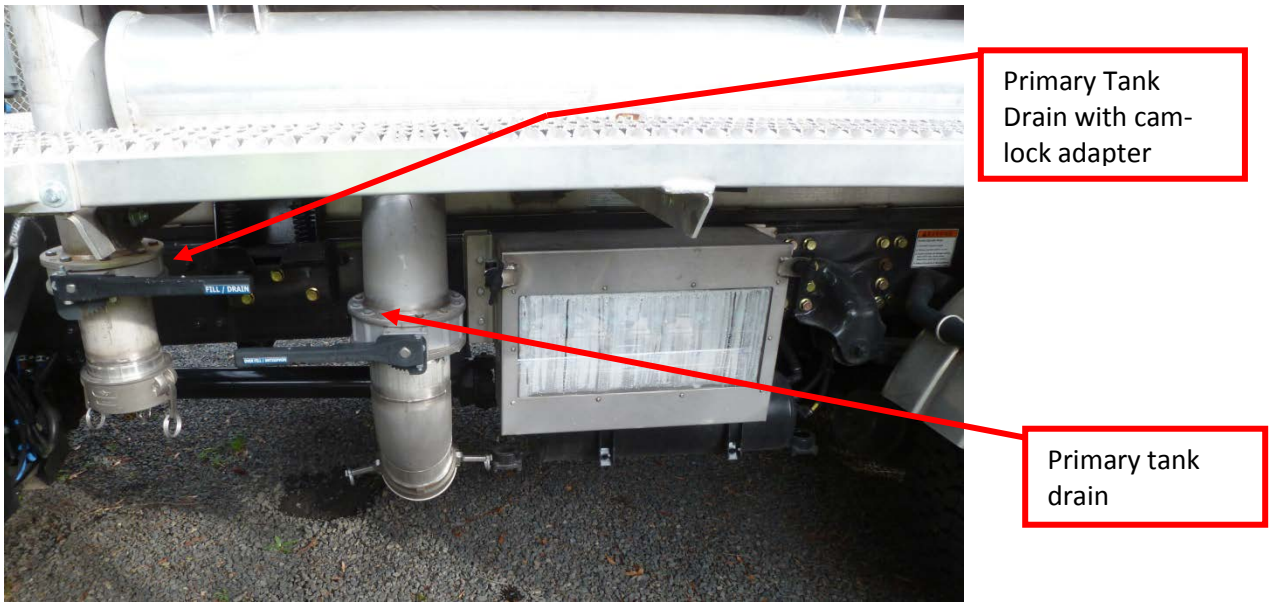


Figure 83 - Fish Truck, Driver Side

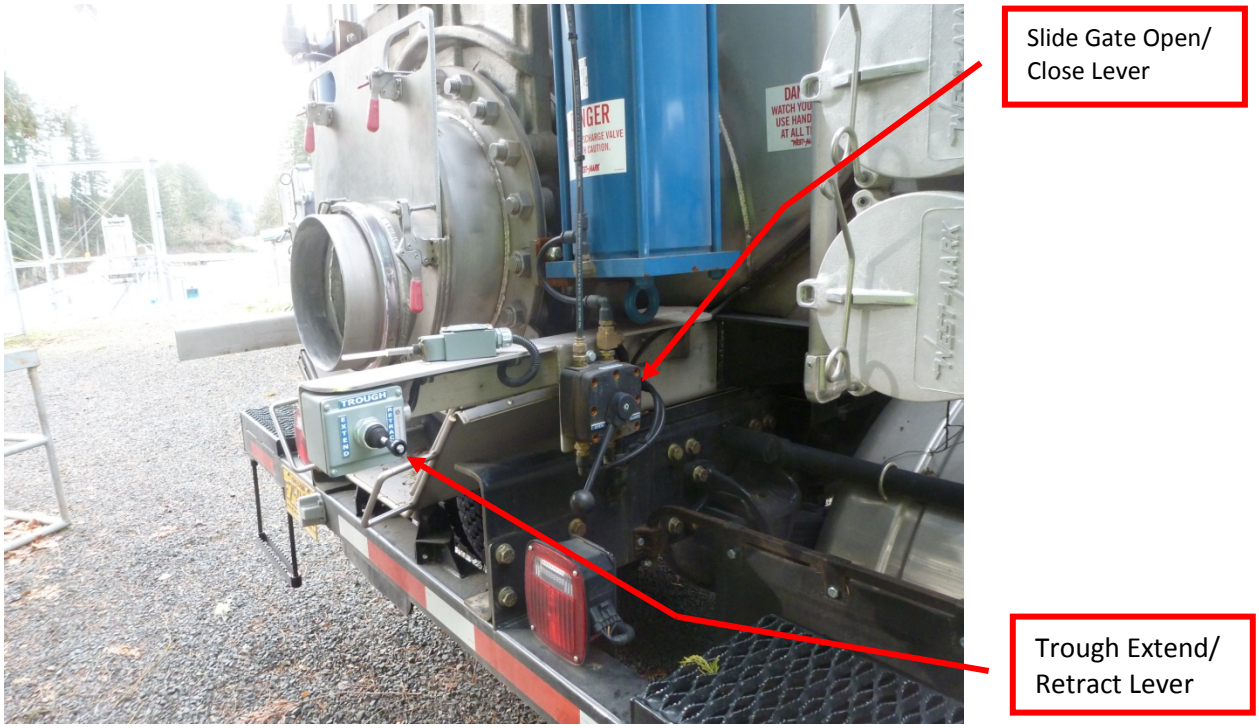


Figure 84 - Fish Truck, Rear

Figure 85 - Fish Truck, Passenger Side

4.2.8. Abatement Pond

-SITE MAP AREA A3, B3-

Figure 86- Abatement Pond

4.2.9. Ancillary Structures

-SITE MAP AREA F2, G2, D3, H2-

4.2.9.1. Emergency Generator Structure

Figure 87 - Generator Structure and Fuel Tank

4.2.9.1.1. Diesel Generator and Automatic Transfer Switch

The automatic transfer switch will allow the generator to feed power to the facility. Refer to the Contractor O&M manual volume 4.

Figure 88 - ATS transfer Switch

Figure 89 - Generator Control Panel

4.2.9.1.2. Fuel Storage System

The fuel tank capacity is approximately 3000 gallons allowing for continuous operation at full load for three days. Secondary containment is provided for the fuel piping and should be periodically checked for leaks. A serious leak will create a pool in the generator building, see figure xxx.

The kidney loop controller should run long enough to filter the entire quantity of fuel. Refer to manufacturer's operations and maintenance manual for recommended run times and filter changes.

Figure 90 - Fuel tank Volume

Figure 91 - Kidney Loop Filtration Controller

Figure 92 - Secondary Containment Trough Termination

4.2.9.2. Maintenance Building

The facility has a prefabricated metal building for general maintenance needs. The building is provided with a thermostatically controlled unit heater. This unit should be periodically inspected for dust buildup and any unusual operation should be reported immediately.

Due to the proximately of the building to river and various site drain sources any hazardous materials spilled should be abated immediately.

Figure 93 - Maintenance Building

4.2.9.3. Site Host Structure

Figure 94 - Site Host Structure

4.2.9.3.1. Power Pedestal

Power to the site host is provided from mini-power center MPC-2 (located in the IPS). The power pedestal provides receptacles for 50A (240V) and 30A (120V) service as well as a duplex 20A, 120V convenience receptacle. Circuit breakers are provided in the pedestal for each circuit. The pedestal also provides a jack for telephone service.

4.2.9.3.2. Potable Water

Potable water supply is provided as part of the site host structure.

4.2.10. Kayak Portage Path

The portage path will be maintained annually at minimum. The path and the area around the portage platforms down to the water will be free of encroaching vegetation with a vertical clearance of at least eight feet and side clearances of four to eight feet. Vegetation will be cleared at least once per year in April. Cleared vegetation will be removed; otherwise, it shall be spread on the ground to promote decomposition. There will be no piles of cleared vegetation left on-site. Vegetation spread on the ground will not be spread on the portage path, but several feet off so remaining growth hides the cut plants. Signage will remain legible and maintain location and alignment. Any signs that are removed or become more than 20% unreadable must be replaced.

4.2.11. Sanitary Sewer System

-SITE MAP AREA F2-

4.2.11.1. Septic Tank

In order to maximize system functionality, users shall adhere to the following guidelines:

- Do not put too much water into the septic system; typical water use is about 50 gallons per day for each person in the family.
- Do not add materials (chemicals, sanitary napkins, applicators, and so on) other than domestic wastewater.
- Restrict the use of your garbage disposal.

- Do not pour grease or cooking oils down the sink drain.
- Keep automobiles and heavy equipment off the system.
- Do not plan any building additions, pools, driveways, or other construction work near the septic system or the repair area.

In order to prevent the overflow of solids and the subsequent clogging of the drain field, the tank will be pumped every several years. The size of the installed septic tank is 1500 gallons. The following table will be used to determine the frequency of pumping.

Table 8 – Septic Tank Pumping Frequency

Estimated Septic Tank Inspection and Pumping Frequency in Years					
Tank Size (gallons)	**Number of People Using the System**				
	1	**2**	**4**	**6**	**8**
1,500	19	9	4	3	2
Source: Adapted from "Estimated Septic Tank Pumping Frequency," by Karen Mancl, 1984. *Journal of Environmental Engineering*. Volume 110.					

The surface area of the drain field will be inspected semi-annually for erosion. Ground not vegetated will be re-planted.

4.2.11.2. Controls

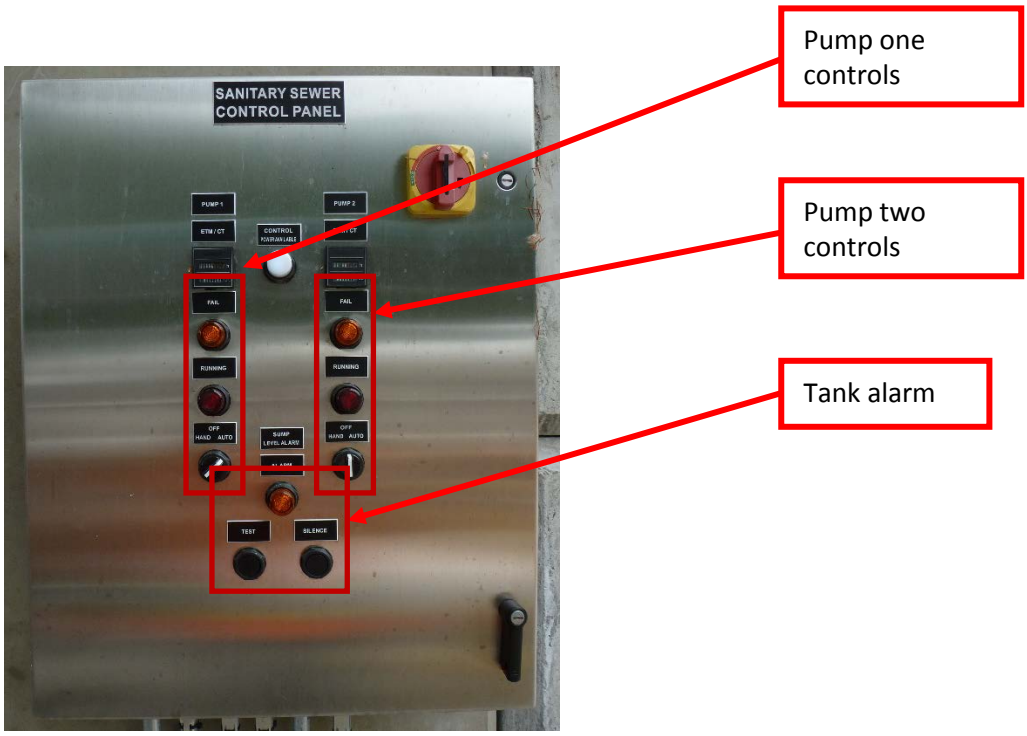


Figure 95 - Sewer Pump Control Panel

4.2.12. Potable Water System

-SITE MAP AREA D3-

4.2.12.1. Water Well

Figure 96 - Water Well

Figure 97 - Water Well Disconnect

4.2.13. SCADA

See Appendix H for the Minto Control System User Guide.

4.2.14. Intrusion Detection

Intrusion detection monitors for unauthorized access to all doors at the sorting/office building, generator building, maintenance building and intake structure. It also monitors for tampering of the vehicle entrance gates keypads. Any alarm from this system will initiate a general alarm on the SCADA system. Reference the full O&M manual for more detailed system description.

Chapter 5: Preventative Maintenance

5.1. System Maintenance

5.1.1. General Maintenance Policies

This section describes the equipment and routine operation and maintenance procedures for the Minto Fish Collection Facility. Additional reference data and revised procedures and parameters should be inserted into the manual as dictated by changing conditions and operator experience with this particular facility.

5.1.1.1. Contractor Supplied O&M Manual

All employees should become familiar with the equipment and the respective manufacturer's operation and maintenance (O&M) literature before performing the procedures described in this section. The equipment O&M manuals are located in Appendix B and contains 7 volumes. All equipment should be maintained in accordance with the manufacturer's recommendations. Detailed information is provided in the manufacturer-supplied O&M manual, such as operation, maintenance, adjustment, troubleshooting, lubrication, startup, shutdown, assembly, spare parts, and storage. The manufacturer-supplied O&M manual should be kept current by inserting or replacing information as equipment items are added or replaced.

5.1.1.2. Pre-startup Procedure

The following basic procedures are recommended before starting and operating all processes and equipment:

- Be sure that the appropriate HAND/OFF/AUTO switches, ON/OFF switches, etc. are turned OFF prior to energizing equipment electrical supply.
- Be sure all grating, equipment safety shields, and floor hatches are in place. Always keep grating, equipment shields, and floor hatches in place, except during maintenance procedures; then replace immediately upon completion of task.
- Check that all clothing, tools, etc. are removed from control panels and equipment.
- Check that all electrical junction boxes and control panels are properly closed.
- Valves and gates should work smoothly and seat properly.
- Valves and gates should be set in the correct position prior to start-up. Verify that all lock-out/tag-out procedures are completed.
- Make any needed repairs or adjustments prior to startup.
- Check that all equipment is properly lubricated and ready to operate. (Follow manufacturer's instructions.)
- Check that all foreign objects have been removed from equipment and piping.
- Check all equipment frequently during the first day of operation, after repair, replacement, or seasonal startup. If a malfunction occurs, do not continue to operate. Minor problems can often cause serious damage if not corrected.

5.1.2. Basic Maintenance Procedures

The operation and maintenance of equipment and structures is important for effective performance. The result of good maintenance is lower operating costs, better morale for staff, and better visitor image. To assist in achieving these objectives, the recommendations in this chapter should be followed. This chapter contains maintenance procedures common to many of the Minto Fish Collection Facility elements. For specific procedures for the various elements, see section 5.2 Equipment Maintenance and Contractor supplied O&M manuals. An overall inspection should be made twice a year for determination of maintenance work required for each element. Inspections and maintenance of specific elements should be made on the schedule noted herein, or as noted in the manufacturer's instructions. The best policy is to complete maintenance work as it is required. Delaying maintenance work will only increase the cost and amount of work required, and decrease the life of the equipment. This policy should not preclude more frequent inspections and resulting maintenance. The material used for maintenance repairs shall conform or be equal to the original construction contract specification requirements.

5.1.3. Preventative Maintenance Management

5.1.3.1. General

Proper and efficient maintenance of equipment and structures will extend the useful life. The use of a maintenance management program will help to ensure that all equipment is maintained at the required intervals.

5.1.3.2. Equipment Inspection and Maintenance

Visual and physical observations of the machinery and equipment should be performed by the operators on a regular basis. All unusual conditions are to be reported immediately to the facility manager. If the operator feels that damage to the piece of equipment and/or a safety hazard is created by this condition, the piece of equipment should be taken out of service immediately and the facility manager notified.

5.2. Equipment and Structure Maintenance

5.2.1. Fish Ladder

The fish ladder should be visually inspected annually to see that no objects and debris are present anywhere within the fish ladder. Visual inspection should also include the condition of concrete surfaces and the various steel items such as fish screens, diffusers, lifting frame, personnel guardrails and walkways located near the entrance. Connector machine bolts and concrete anchors should be visually inspected for corrosion and replaced in kind as needed.

5.2.1.1. Fish Ladder Entrance

5.2.1.1.1. Adult and Juvenile Fish Entrance Gates

Each gate and actuator should be visually inspected for damage and corrosion. Ensure Lead screw is lubricated per manufacturer’s recommendations. Do not attempt to repair damage. Exercise each actuator (open completely and close completely) every two weeks.

5.2.1.1.2. Fish Barrier Screen and Support Structure

A visual inspection should include the condition of various steel items such as fasteners, wire rope, and connection points on the screen. The lifting frame should not show significant corrosion clean the screen as needed to remove corrosion. Bolted connections and concrete anchors should be visually inspected for corrosion and replaced in kind as needed. Exercise the gate hoist from the full up position to 6 inches above the water surface, three times every two weeks.

5.2.1.2. AWS Diffusion Basins

A visual inspection of the basins should be performed during the annual ladder outage. Report any large concrete cracks or unusual surface erosion.

5.2.1.2.1. AWS Diffuser Slide Gates

Each gate and actuator should be visually inspected for damage and corrosion. Do not attempt to repair damage. Ensure Lead screw is lubricated per manufacturer's recommendations. Exercise each actuator (full open to full closed) every two weeks. Actuators that cannot be regularly exercised should be removed and placed in storage per manufacturer's recommendations.

See Contractor provided Operation and maintenance manual Volume 2

5.2.1.2.2. Diffuser Screens, Porosity Plate, and Bubbler Beams

Each diffuser screen and porosity plate should be cleaned annually. It may be necessary to perform the cleaning more frequently. Cleaning frequencies will fluctuate based on the quantity and type of river debris.

5.2.1.3. Pool 51 – Ladder Head Control with Level Sensor

5.2.2. Pre-Sort Pool

Visually inspect the concrete surface for surface damage annually. All steel features such as work platforms, walkways, personnel guard rails, Crowder rails, metal doors and the steel stairs should be inspected for corrosion. All connection fasteners for the work platforms and walkway system should be inspected and any corroded bolts replaced in kind as needed. Repaint or repair galvanizing as needed.

5.2.2.1. Finger Weir

Visually inspect the aluminum frame work for cracks and damage. All bolted connections, wire ropes, and sheaves should be inspected monthly and any deficiencies should be reported immediately. Operate the finger weir monthly through its full range of motion and ensure winch brake holds the weir at various elevations. The winch is sealed and does not require periodic lubrication however, it should be inspected for corrosion and damage; replace if inoperable or if operating is unsafe.

5.2.2.2. Crowder

Visually inspect the chassis for corrosion, cracks, and damage every two weeks. Items that are heavily corroded or damaged should be reported and replaced as needed. After the visual inspection, if the crowder has not been operated in the previous two weeks, the crowder should be exercised. Three cycles of screen Travel should be performed, observe the operation and report any problems. Three traversing cycles should be performed with the screen in the up position.

See Contractor provided Operation and maintenance manual Volume 2.

5.2.2.3. False Weir

Visually inspect for corrosion, cracks, leaks, and damage on a monthly basis. Items that are damaged should be reported and replaced as needed. Monitor leaks and report if deemed excessive or a threat to equipment or operator safety. The false weir pump should be exercised every two weeks if left idle for an extended period. This operation should be performed with the closure gate in the down position to avoid attracting fish into the flume. Unusual performance or noise should be reported immediately.

See Contractor provided Operation and maintenance manual Volume 2

5.2.2.4. Closure Gate

Visually inspect the frame for cracks and damage. All bolted connections, wire ropes, and sheaves should be inspected monthly and any deficiencies should be reported immediately. Operate the closure gate monthly through its full range of motion and ensure winch brake holds the gate at various elevations. The winch is sealed and does not require periodic lubrication however, it should be inspected for corrosion and damage; replace if inoperable or if operating is unsafe.
.

5.2.2.5. Pre-sort Pool Piping

Exposed pre-sort piping should be visually inspected for leaks on a month to month basis. Leaks should be reported and monitored. Graveled areas that experience erosion should be reported as this could indicate a buried pipe is leaking.

5.2.2.6. False Weir Drain

Visually inspect the false weir drain annually for leaks and damage to its coating system. The valve should be exercised on a month to month basis.

5.2.2.7. Valves

The valves in pre-sort piping area should be visually inspected for leaks and corrosion on a month to month basis. Leaks and significant corrosion should be reported and monitored. Valves should be exercised, full open to full closed, on a month to month basis. Unusual difficultly opening or closing the valve should be reported.

5.2.2.8. Diffusers

Diffuser maintenance is only performed during the annual facility shutdown period. The diffuser grating should be removed and cleaned annually. The diffuser pit should be inspected for debris accumulation and the low point drain should drain freely.

5.2.3. Sort Facility

The cover structure should be visually inspected for corrosion spots or peeling paint in the metal roof and support columns and beams. Corrosion on metal items should be cleaned and metal surfaces recoated with materials as needed to match the initial coating. All fasteners shall be checked for corrosion and replaced in kind as needed.

See Contractor provided Operation and maintenance manual Volume 1.

5.2.3.1. Mechanical/Electrical Room

5.2.3.1.1. Compressed Air and Oxygen

The air compressor and any exposed compressed air pipe should be visually inspected monthly. The Operator should note any unusually significant increase in compressor operation and report it to the appropriate personnel.

Visually inspect the oxygen system for corrosion and damage. Pressurize the system annually and individually operate each pool supply valve. Report any problems with flow delivery to the authorizing authority; *DO NOT ATTEMPT REPAIRS OR HAVE OPEN FLAMES IN AN OXYGEN RICH ENVIROMENT. CREATING SPARKS, SMOKING, AND OTHER ACTIVITIES THAT PROVIDE AN IGNITION SOURCE MAY CREATE AN UNSAFE WORK ENVIRONMENT.*

5.2.3.1.2. GAC Filter

The Granulated Activated Carbon filter should be visually inspected for leaks and damage every six months. The filter media requires back flushing after every use. If the back flushing does not immediately follow use, it is very likely the media will be rendered ineffective and will need to be replaced. Outflow should be tested at regular intervals to ensure the discharge meets DEQ standards. The system is designed for a carbon consumption rate of 1.8 pounds of media per 1000 gallons of waste water processed. Refer to the manufacturer's instructions for media replacement. Two factory supplied media replacements have been purchased for the fish facility.

See Contractor provided Operation and maintenance manual Volume 1.

5.2.3.2. Plumbing

The mechanical room piping should be visually inspected for leaks and damage every six months. Report or perform authorized repairs for any significant leak.

5.2.3.3. HVAC

The heater units should be inspected and cleaned per manufacturer's recommended interval.

The office heat pump should be inspected for debris infiltration and insect infestation every three months. Perform maintenance per manufacturer's recommendations.

5.2.4. Post-Sort Pools, Sorting Channel, and Hopper Pit

Visually inspect the concrete surface for surface damage annually. All steel features such as work platforms, walkways, personnel guard rails, Crowder rails, metal doors and the steel stairs should be inspected for corrosion. All connection fasteners for the work platforms and walkway system should be inspected and any corroded bolts replaced in kind as needed. Repaint or repair galvanizing as needed.

5.2.4.1. Post-sort Pool Crowders

Visually inspect the chassis for corrosion, cracks, and damage every two weeks. Items that are heavily corroded or damaged should be reported and replaced as needed. After the visual inspection the crowder should be exercised. Three cycles of screen Travel should be performed, observe the operation and report any problems. Three traversing cycles should be performed with the screen in the up position. If long term inactivity is expected park the crowder under the post sort pool shade structure.

See Contractor provided Operation and maintenance manual Volume 2

5.2.4.2. Sorting Channel Crowder

Visually inspect the chassis for corrosion, cracks, and damage every two weeks. Items that are heavily corroded or damaged should be reported and replaced as needed. After the visual inspection the crowder should be exercised. Three cycles of screen Travel should be performed, observe the operation and report any problems. Three traversing cycles should be performed with the screen in the up position.

See Contractor provided Operation and maintenance manual Volume 2

5.2.4.3. FWS Piping

Visually inspect exposed piping for leaks and damage once every 6 months. Report leaks and damage to the appropriate authorities.

5.2.4.4. Diffusers

Diffuser maintenance is only performed during the annual facility shutdown period. The diffuser grating should be removed and cleaned annually. The diffuser pit should be inspected for debris accumulation; clean debris as necessary. Pit drains should drain freely.

5.2.4.5. Removable Fish Screens and Overflow Stoplogs

The removable fish screens should be cleaned weekly; the change in water height across the screen should not exceed 6 inches between cleanings.

Overflow stoplogs are tongue and groove 2 inch by 6 inch boards. Replace like in kind as leakage or damage becomes excessive.

5.2.4.6. Juvenile Return Pipe

The pipe should be flushed prior to use. Annual inspections should be performed to ensure the interior of the pipe is not damaged.

5.2.4.7. Sort Channel Drain System

The pipe should be flushed prior to use. Annual inspections should be performed to ensure the interior of the pipe is not damaged.

5.2.5. Intake and Pump Structure (IPS)

Visually inspect the concrete surface for surface damage annually. All steel features such as work platforms, walkways, personnel guard rails, Crowder rails, metal doors and the steel stairs should be inspected for corrosion. All connection fasteners for the work platforms and walkway system should be inspected and any corroded bolts replaced in kind as needed. Repaint or repair galvanizing as needed.

5.2.5.1. FWS Pump System

Each Patterson 12x18 SAFV Vertical Pump should be inspected and/or serviced at 4,000, 8,000, and 40,000 hours of run time (or 6, 12, and 60 months of calendar time, whichever comes first) in accordance with the manufacturer's maintenance schedule.

See Contractor provided Operation and maintenance manual Volume 3

5.2.5.2. FWS Piping

The FWS pipe in the IPS should be visually inspected for damage, leaks, and corrosion. It is normal for the pipe to have condensed water dripping from the bottom of the pipe; the leak should be actively dripping water. If a leak is found report it to the appropriate authorities.

5.2.5.3. FWS Flowmeter

The flow meter should not require regular maintenance. Function is purely electronic in nature.

5.2.5.4. AWS Valve and Sump Pump System

The actuator and gearboxes should be inspected for leaks every 3 months. Exercise the gate every month to ensure components receive lubrication. Sump pumps operate are configured for lead-lag

See Contractor provided Operation and maintenance manual Volume 2

5.2.5.5. Washdown Pipe System

Visually inspect for corrosion, leaks, and damage on a bi-annual basis. Items that are damaged should be reported and replaced by authorized personnel. Monitor leaks and report if deemed excessive or a threat to equipment or operator safety. Each hose bib should be used at least once every three months. Washdown pump function should be verified while running the hose bibs.

See Contractor provided Operation and maintenance manual Volume 3

5.2.5.6. Intake Screens

Visually inspect for corrosion, cracks, and damage on an annual basis. Perform Power washing on each screen prior to the annual inspection. It is unlikely that repairs can be made at the facility; report the damage so it can be evaluated and replaced as necessary.

5.2.5.7. Porosity Plates

Visually inspect for corrosion, cracks, and damage on an annual basis. Perform Power washing on each screen prior to the annual inspection.

5.2.5.8. Dewatering Bulkheads

Inspect per HSS requirements.

5.2.5.9. Airburst System

Visually inspect for corrosion, cracks, compressed air leaks, and damage on a monthly basis. Items that are damaged should be reported and replaced by authorized personnel. Airburst solenoids should be exercised once a month. The operator should verify the function of each solenoid and report non-functioning solenoids.

Annual maintenance should also include airburst manifold inspection. Occasionally airburst nozzles loosen and are lost. A visual inspection of the nozzle array when the intake screens are removed for maintenance is necessary. Report missing nozzles to authorized repair personnel; lost nozzles should be replaced prior to placing the airburst system back into service.

5.2.5.10. AWS Gate

Inspect per HSS requirements.

5.2.6. Fish Sorting Equipment

5.2.6.1. Fish Transport Flume

Visually inspect for corrosion, cracks, leaks, and damage on a monthly basis. Items that are damaged should be reported and replaced as needed. Monitor leaks and report if deemed excessive or a threat to equipment or operator safety.

5.2.6.2. Switch Gates

Visually inspect for corrosion, cracks, leaks, and damage on a monthly basis. Items that are damaged should be reported and replaced as needed. Monitor water leaks and report if deemed excessive or a threat to equipment or operator safety. Report compressed air leaks for immediate repair. Cycle each switch gate three times every month.

5.2.6.3. Anesthetic Tank

Visually inspect for corrosion, cracks, leaks, and damage on a monthly basis. Items that are damaged should be reported and replaced as needed. Water leaks should be repaired immediately as it could lead to accelerated anesthetic dilution or fish un-watering and low dissolved oxygen levels. Report compressed air leaks for immediate repair. If freezing temperatures are expected crack the tank fill valve to keep pipe from freezing. Cycle the anesthetic tank brail three times every two weeks with water in the tank. Empty the tank using the drain pump this will serve to exercise the pump.

5.2.6.4. Sort Table

Visually inspect for corrosion, cracks, leaks, and damage on a monthly basis. Items that are damaged should be reported and replaced as needed. If freezing temperatures are expected crack each flume supply valve to keep the pipes from freezing.

5.2.6.5. Recovery Tank

Visually inspect for corrosion, cracks, leaks, and damage on a monthly basis. Items that are damaged should be reported and replaced as needed. If freezing temperatures are expected crack the tank fill valve to keep the pipes from freezing. Cycle the recovery tank brail three times every two weeks.

5.2.6.6. Recovery Tank False Weir

Visually inspect for corrosion, cracks, leaks, and damage on a monthly basis. Items that are damaged should be reported and replaced as needed. Monitor leaks and report if deemed excessive or a threat to equipment or operator safety. The recovery tank false weir pump should be exercised every two weeks. Unusual performance or noise should be reported immediately. If freezing temperatures are expected crack the flume supply valve to keep the pipe from freezing. Cycle the recovery tank brail three times every two weeks.

See Contractor provided Operation and maintenance manual Volume 2

5.2.6.7. Spawning Table

Visually inspect for corrosion, cracks, and damage on a monthly basis. Items that are damaged should be reported and replaced as needed.

5.2.7. Fish Transfer and Loading Equipment

5.2.7.1. Hopper Hoist

Visually inspect for corrosion, cracks, and damage on a monthly basis. Items that are damaged should be reported and replaced by authorized personnel. The hopper hoist maintenance is performed per manufacturer's recommendations. Reference EM 385-1-1 for additional requirements related to safe operation of a monorail crane.

See Contractor provided Operation and maintenance manual Volume 2

5.2.7.2. Hopper Loading Structure

Visually inspect for corrosion, cracks, and damage on a monthly basis. Items that are damaged should be reported; items are replaced by authorized personnel only.

5.2.7.3. Hopper 1 – Fish truck

Visually inspect for corrosion, cracks, leaks, and damage on a monthly basis. Items that are damaged should be reported and replaced as needed. Monitor leaks and report if deemed excessive or a threat to equipment or operator safety.

5.2.7.4. Hopper 2 – Spawning

Visually inspect for corrosion, cracks, leaks, and damage on a monthly basis. Items that are damaged should be reported and replaced as needed. Monitor leaks and report if deemed excessive or a threat to equipment or operator safety. Report compressed air leaks for immediate repair. Cycle the brail three times every two weeks.

5.2.7.5. Hopper #2 – False Weir

Visually inspect for corrosion, cracks, leaks, and damage on a monthly basis. Items that are damaged should be reported and replaced as needed. Monitor leaks and report if deemed excessive or a threat to equipment or operator safety. The false weir pump should be exercised every two weeks. Unusual performance or noise should be reported immediately. If freezing temperatures are expected crack the flume supply valve to keep the water supply pipe from freezing.

See Contractor provided Operation and maintenance manual Volume 2

5.2.7.6. Fish Truck

5.2.8. East Retaining Wall Structure

Visually inspect the concrete surface for surface damage annually. All steel features such as work platforms, walkways, personnel guard rails, Crowder rails, metal doors and the steel stairs should be inspected for corrosion. All connection fasteners for the work platforms and walkway system should be inspected and any corroded bolts replaced in kind as needed. Repaint or repair galvanizing as needed.

5.2.9. West Retaining Wall Structure

Visually inspect the concrete surface for surface damage annually. All steel features such as work platforms, walkways, personnel guard rails, Crowder rails, metal doors and the steel stairs should be inspected for corrosion. All connection fasteners for the work platforms and walkway system should be inspected and any corroded bolts replaced in kind as needed. Repaint or repair galvanizing as needed.

5.2.9.1. AWS Conduit

Visually inspect the interior concrete surface for surface damage annually.

5.2.10. Ancillary Structures

5.2.10.1. Emergency Generator Structure

The structure should be visually inspected for corrosion spots or peeling paint in the metal roof and support columns and beams. Corrosion on metal items should be cleaned and metal surfaces recoated with materials as needed to match the initial coating. All fasteners shall be checked for corrosion and replaced in kind as needed.

5.2.10.1.1. Diesel Generator

Visually inspect the generator and piping for leaks.

See Contractor provided Operation and maintenance manual Volume 4

5.2.10.1.2. Fuel Storage System

Visually inspect for corrosion, cracks, leaks, and damage on a monthly basis. Items that are damaged should be reported and only replaced by authorized personnel. Report and remediate hazardous materials. The Fuel level should not get below 2/3 full. Water will accumulate in the fuel supply system drain periodically per generator manufacturer recommended interval.

See Contractor provided Operation and maintenance manual Volume 4

5.2.10.2. Maintenance Building

The structure should be visually inspected for corrosion spots or peeling paint in the metal roof and support columns and beams. Corrosion on metal items should be cleaned and metal surfaces recoated with materials as needed to match the initial coating. All fasteners shall be checked for corrosion and replaced in kind as needed.

5.2.10.3. Site Host Structure

The cover structure should be visually inspected for corrosion spots or peeling paint in the metal roof and support columns and beams. Corrosion on metal items should be cleaned and metal surfaces recoated with materials as needed to match the initial coating. All fasteners shall be checked for corrosion and replaced in kind as needed.

5.2.10.3.1. Power Pedestal

This pedestal should be visually inspected on an annual basis. Report any unusual damage or functionality.

5.2.10.3.2. Potable Water

5.2.10.4. IPS Stairwell Access Structures

The structures should be visually inspected for corrosion spots or peeling paint in the metal roof and support columns and beams. Corrosion on metal items should be cleaned and metal surfaces recoated with materials as needed to match the initial coating. All fasteners shall be checked for corrosion and replaced in kind as needed.

5.2.10.5. Post-Sort Shade Structures

The structures should be visually inspected for corrosion spots or peeling paint in the metal roof and support columns and beams. Corrosion on metal items should be cleaned and metal surfaces recoated with materials as needed to match the initial coating. All fasteners shall be checked for corrosion and replaced in kind as needed.

5.2.11. Storm Water Absorption Swale

The storm water absorption swale should be regularly cleared of trash, debris, poisonous plants and an overgrowth of vegetation. Regularly check the overflow culvert for debris blockage at a minimum of once after every large storm event. Any pollutants, specifically oil, should be immediately cleaned with absorbent pads and disposed of properly. Sedimentation greater than 0.16 feet (2 inches) needs to be cleaned out to designed pond shape and depth. In the case of sedimentation, specific attention needs to be focused on keeping the catch basin clear. If erosion more than two inches deep occurs, slopes need to be stabilized through rock reinforcement, planting of grass or compaction. Most likely the only erosion that will occur will be the relocation of the conveyance ditch aggregate. If the aggregate begins to mound, it should be redistributed to a thickness of six inches over the whole swale, including the side slopes. If six inches is not achievable with the remaining material, more aggregate similar to the original (3/4 inch to 3 inch diameter) should be brought in and placed. Rodent holes should be repaired and the rodents removed. If settlement of four inches or more than the design elevation occurs, the source needs to be determined by a licensed civil engineer and resolved.

5.2.12. Sanitary Sewer System

5.2.12.1. Septic Tank

Refer to manufacturers O&M manual for pump maintenance.

See Contractor provided Operation and maintenance manual Volume 2

5.2.12.2. Pressure Sewer Line and Pumps

See Contractor provided Operation and maintenance manual Volume 2

5.2.13. Potable Water System

5.2.13.1. Water Well

See Contractor provided Operation and maintenance manual Volume 1

5.2.13.2. Hydro-pneumatic Tank

Periodic testing of double check valves may be required by Lane County. Replace filters as required.

See Contractor provided Operation and maintenance manual Volume 1

Chapter 6: Trouble Analysis

6.1. Alarms

See Table 6.1 for the Minto Fish Collection Facility Alarm Summary.

6.2. Outside Plant Alarms

See Table 6.2 for the Outside Plant Alarms.

6.3. Trouble Shooting

See Contractor supplied O&M manual volumes 1-7 for troubleshooting procedures.

MINTO FISH COLLECTION FACILITY ALARM SUMMARY

Draft Version. Last Updated September 27 2016

GRAPHIC TERMINAL (HMI) ALARM TEXT	ALARM DESCRIPTION	POSSIBLE CAUSE OR ADDITIONAL INFORMATION	ALARM DELAY	HORN	* AUTO DIALER
ANALOG SENSORS					
LIT.001A Error (Tailrace)	Ultrasonic Water Level Transmitter Trouble	No Power, Broken wire, Signal Out-of-Range, Out-of-Calibration, Device Failure, etc	Instant		
LIT.003A Error (Pool 1)	Ultrasonic Water Level Transmitter Trouble	No Power, Broken wire, Signal Out-of-Range, Out-of-Calibration, Device Failure, etc	Instant		
LIT.006A Error (Pool 52)	Ultrasonic Water Level Transmitter Trouble	No Power, Broken wire, Signal Out-of-Range, Out-of-Calibration, Device Failure, etc	Instant		
PIT.001A Error (FWS Pump Outlet)	Pressure Transmitter Trouble	No Power, Broken wire, Signal Out-of-Range, Out-of-Calibration, Device Failure, etc	Instant		
FIT.001 Error (FWS Pump Outlet)	Flow Transmitter Trouble	No Power, Broken wire, Signal Out-of-Range, Out-of-Calibration, Device Failure, etc	Instant		
LIT.002 Error (Juvenile Chnl)	Ultrasonic Water Level Transmitter Trouble	No Power, Broken wire, Signal Out-of-Range, Out-of-Calibration, Device Failure, etc	Instant		
LIT.012 Error (E.Forebay)	Ultrasonic Water Level Transmitter Trouble	No Power, Broken wire, Signal Out-of-Range, Out-of-Calibration, Device Failure, etc	Instant		
LIT.008 Error (W.Forebay)	Ultrasonic Water Level Transmitter Trouble	No Power, Broken wire, Signal Out-of-Range, Out-of-Calibration, Device Failure, etc	Instant		
LT.011 Error (E.IntakeScreen)	Submersible Water Level Transmitter Trouble	No Power, Broken wire, Signal Out-of-Range, Out-of-Calibration, Device Failure, etc	Instant		
LT.009 Error (W.IntakeScreen)	Submersible Water Level Transmitter Trouble	No Power, Broken wire, Signal Out-of-Range, Out-of-Calibration, Device Failure, etc	Instant		
LT.010 Error (E.IntakeConduit)	Submersible Water Level Transmitter Trouble	No Power, Broken wire, Signal Out-of-Range, Out-of-Calibration, Device Failure, etc	Instant		
LT.007 Error (W.IntakeConduit)	Submersible Water Level Transmitter Trouble	No Power, Broken wire, Signal Out-of-Range, Out-of-Calibration, Device Failure, etc	Instant		
LIT.004 Error (Diffusion Chamber)	Ultrasonic Water Level Transmitter Trouble	No Power, Broken wire, Signal Out-of-Range, Out-of-Calibration, Device Failure, etc	Instant		
LT.005 Error (AWS Conduit)	Submersible Water Level Transmitter Trouble	No Power, Broken wire, Signal Out-of-Range, Out-of-Calibration, Device Failure, etc	Instant		
Unused Analog Input Ch1.14	n/a	n/a	n/a		
Unused Analog Input Ch1.15	n/a	n/a	n/a		
LIT.001B Error (Tailrace)	Ultrasonic Water Level Transmitter Trouble	No Power, Broken wire, Signal Out-of-Range, Out-of-Calibration, Device Failure, etc	Instant		
LIT.003B Error (Pool 1)	Ultrasonic Water Level Transmitter Trouble	No Power, Broken wire, Signal Out-of-Range, Out-of-Calibration, Device Failure, etc	Instant		
LIT.006A Error (Pool 52)	Ultrasonic Water Level Transmitter Trouble	No Power, Broken wire, Signal Out-of-Range, Out-of-Calibration, Device Failure, etc	Instant		
PIT.001B Error (FWS Pump Outlet)	Pressure Transmitter Trouble	No Power, Broken wire, Signal Out-of-Range, Out-of-Calibration, Device Failure, etc	Instant		
PIT.020A Error (Air Receiver Tanks 1)	Pressure Transmitter Trouble	No Power, Broken wire, Signal Out-of-Range, Out-of-Calibration, Device Failure, etc	Instant		
PIT.020B Error (Air Receiver Tanks 2)	Pressure Transmitter Trouble	No Power, Broken wire, Signal Out-of-Range, Out-of-Calibration, Device Failure, etc	Instant		
PIT.020C Error (Air Receiver Tanks 3)	Pressure Transmitter Trouble	No Power, Broken wire, Signal Out-of-Range, Out-of-Calibration, Device Failure, etc	Instant		
LIT.099 Error (Diesel Fuel Tank)	Fuel Level Transmitter Trouble	Model #TMS2000 Diesel Leak Detection System never configured correctly during construction	Disabled		
LT.013 Error (Raceway 1)	Submersible Water Level Transmitter Trouble	No Power, Broken wire, Signal Out-of-Range, Out-of-Calibration, Device Failure, etc	Instant		
LT.014 Error (Raceway 2)	Submersible Water Level Transmitter Trouble	No Power, Broken wire, Signal Out-of-Range, Out-of-Calibration, Device Failure, etc	Instant		
LT.015 Error (Raceway 3)	Submersible Water Level Transmitter Trouble	No Power, Broken wire, Signal Out-of-Range, Out-of-Calibration, Device Failure, etc	Instant		
LT.016 Error (Raceway 4)	Submersible Water Level Transmitter Trouble	No Power, Broken wire, Signal Out-of-Range, Out-of-Calibration, Device Failure, etc	Instant		
LT.017 Error (Raceway 5)	Submersible Water Level Transmitter Trouble	No Power, Broken wire, Signal Out-of-Range, Out-of-Calibration, Device Failure, etc	Instant		
LT.018 Error (Raceway 6)	Submersible Water Level Transmitter Trouble	No Power, Broken wire, Signal Out-of-Range, Out-of-Calibration, Device Failure, etc	Instant		
LT.019 Error (Raceway 7)	Submersible Water Level Transmitter Trouble	No Power, Broken wire, Signal Out-of-Range, Out-of-Calibration, Device Failure, etc	Instant		
LT.020 Error (Raceway 8)	Submersible Water Level Transmitter Trouble	No Power, Broken wire, Signal Out-of-Range, Out-of-Calibration, Device Failure, etc	Instant		
AWS GATE ACTUATORS (01 through 14)					
AWS Gate 01 PLC Rejected Stop Command	HMI or PLC generated command blocked.	Missing permissive from actuator or equipment malfunction. Contact software developer.	Instant		
AWS Gate 01 Actuator Rejected Stop Command	Actuator failed to halt within allotted time	Verify Rotork actuator general operation	5 Sec		
AWS Gate 01 PLC Rejected Close Command	HMI or PLC generated command blocked.	Missing permissive from actuator or equipment malfunction. Contact software developer.	Instant		
AWS Gate 01 Actuator Rejected Close Command	Actuator did not move within allotted time	Verify Rotork actuator general operation	5 Sec		
AWS Gate 01 Close Failure within Allotted Time	Actuator close cycle did not complete within allotted time	Verify Rotork Actuator limit switch settings and general operation	120 Sec		
AWS Gate 01 PLC Rejected Open Command	HMI or PLC generated command blocked.	Missing permissive from actuator or equipment malfunction. Contact software developer.	Instant		
AWS Gate 01 Actuator Rejected Open Command	Actuator did not move within allotted time	Verify Rotork actuator general operation	5 Sec		
AWS Gate 01 Open Failure within Allotted Time	Actuator open cycle did not complete within allotted time	Verify Rotork Actuator limit switch settings and general operation	120 Sec		
AWS Gate 01 Actuator Rejected Setpoint Mode	Command for Setpoint Positioning Mode Rejected.	Alarm could occur due to signal loss at 0 & 100% setpoint or when fully open/closed.	5 Sec		
AWS Gate 01 Actuator Internal Alarm	Actuator Internal Alarm Active While in Remote	Rotork Actuator Obstructed, Jammed, Thermal Overload, Low Battery, or Monitor Error.	Instant		
AWS Gate 01 Actuator Network Error	DeviceNet Communications Error	Cycle power at actuator before checking Devicenet bus power supply & PLC module.	30 Sec		
AWS Gate 01 Actuator Not in Remote	Actuator Selector Switch Not In Remote	Rotork Actuator Selector Switch in Stop or Local position	Instant		
ENTRANCE GATE ACTUATORS (01 through 02)					
Entrance Gate 01 Close Failure within Allotted Time	Actuator close cycle did not complete within allotted time	Verify Rotork Actuator limit switch settings and general operation	600 sec		
Entrance Gate 01 Open Failure within Allotted Time	Actuator open cycle did not complete within allotted time	Verify Rotork Actuator limit switch settings and general operation	600 sec		
Entrance Gate 01 Actuator Rejected Setpoint Mode	Command for Setpoint Positioning Mode Rejected.	Alarm could occur due to signal loss at 0 & 100% setpoint or when fully open/closed.	2 Sec		
Entrance Gate 01 Actuator Internal Alarm	Actuator Internal Alarm Active While in Remote	Verify Auma Actuator limit switch settings and general operation	Instant		
Entrance Gate 01 Actuator Network Error	DeviceNet Communications Error	Cycle power at actuator before checking Devicenet bus power supply & PLC module.	30 Sec		
Entrance Gate 01 Actuator Not in Remote	Actuator Selector Switch Not In Remote	Rotork Actuator Selector Switch in Stop or Local position	Instant		

PRESORT POOL VALVE ACTUATORS (01 through 02)					
Presort Valve 01 Actuator Internal Fault (Type 1)	Actuator Type 1 Fault (medium priority)	Check general operation of Limitorque actuator	Instant		
Presort Valve 01 Actuator Internal Fault (Type 3)	Actuator Type 3 Fault (high priority)	Check general operation of Limitorque actuator	Instant		
Presort Valve 01 Actuator Internal Alarm	Actuator Internal Alarm (low priority)	Check general operation of Limitorque actuator	Instant		
Presort Valve 01 Actuator Not in Remote	Actuator Selector Switch Not In Remote	Limitorque Actuator Selector Switch in Stop or Local position	Instant		
Presort Valve 01 Actuator Network Error	DeviceNet Communications Error	Cycle power at actuator before checking Devicenet bus power supply & PLC module.	30 Sec		
AIR BURST (SCREEN CLEANER) SYSTEM					
Airburst Rsvd Alarm	Reserved for Future	N/A	N/A		
Airburst Not in Auto	Screen Cleaning System not in Automatic Mode	Place Screen Cleaning System in Automatic Mode from Graphic Terminal	Instant	YES	YES
Airburst Cleaning Cycle Aborted	Screen Cleaning System Cycle Aborted	System switched from Automatic Mode, PLC I/O Error, Incomplete Sequence Occurred, Stop Cmd Rec'd	Instant		
Airburst Rsvd Alarm	Reserved for Future	N/A	N/A		
Airburst Invalid Zone Elevation	Forebay Level Sensor Error or Out of Range.	Verify Sensor LIT.012 is functioning correctly.	Instant		
Airburst #1 Sustained Very Low Pressure	Receiver Tank 1 Pressure is less than 35 psi	Verify Air Compressor is operable and confirm pressure transmitter is functioning correctly.	60 Sec	YES	YES
Airburst #2 Sustained Very Low Pressure	Receiver Tank 2 Pressure is less than 35 psi	Verify Air Compressor is operable and confirm pressure transmitter is functioning correctly.	60 Sec	YES	YES
Airburst #3 Sustained Very Low Pressure	Receiver Tank 3 Pressure is less than 35 psi	Verify Air Compressor is operable and confirm pressure transmitter is functioning correctly.	60 Sec	YES	YES
Airburst #1 Sustained Low Pressure	Receiver Tank 1 Pressure is less than 55 psi	Verify Air Compressor is operable and confirm pressure transmitter is functioning correctly.	120 Sec		
Airburst #2 Sustained Low Pressure	Receiver Tank 2 Pressure is less than 55 psi	Verify Air Compressor is operable and confirm pressure transmitter is functioning correctly.	120 Sec		
Airburst #3 Sustained Low Pressure	Receiver Tank 3 Pressure is less than 55 psi	Verify Air Compressor is operable and confirm pressure transmitter is functioning correctly.	120 Sec		
Airburst #1 Incomplete Sequence	Group 1 Cleaning Cycle did not complete within allotted time	Verify correct operation of Air Compressor. System may hang waiting for tanks to recharge.	180 Sec		
Airburst #2 Incomplete Sequence	Group 2 Cleaning Cycle did not complete within allotted time	Verify correct operation of Air Compressor. System may hang waiting for tanks to recharge.	180 Sec		
Airburst #3 Incomplete Sequence	Group 3 Cleaning Cycle did not complete within allotted time	Verify correct operation of Air Compressor. System may hang waiting for tanks to recharge.	180 Sec		
Airburst #1 PLC or Power Supply Fault	Group 1 Screen Cleaner Cabinet Power Missing	Check Cabinet No.1 120VAC supply. Otherwise check PLC Input Modules Local:6 and Local:10	Instant		
Airburst #2 PLC or Power Supply Fault	Group 2 Screen Cleaner Cabinet Power Missing	Check Cabinet No.2 120VAC supply. Otherwise check PLC Input Modules Local:6, Local:10, & Local:11	Instant		
Airburst #3 PLC or Power Supply Fault	Group 3 Screen Cleaner Cabinet Power Missing	Check Cabinet No.3 120VAC supply. Otherwise check PLC Input Modules Local:6 and Local:11	Instant		
Airburst Diff-Pressure Out of Tolerance	East of West Screens: Differential outside range -3.0 to +3.0 Ft.	Check East Level Transmitters (LIT.012 and LT.011) and West Level Transmitters (LIT.008 and LT.009)	300 Sec		
Airburst Screen Dirty High Differential	East or West Screens: River to Intake Differential > 1.0 ft	Temporarily close AWS gates and perform airburst cleaning. Otherwise perform mechanical cleaning	300 Sec	YES	YES
Airburst Screen Dirty Very High Differential	East or West Screens: River to Intake Differential > 2.0 ft	Temporarily close AWS gates and perform airburst cleaning. Otherwise perform mechanical cleaning	5 Sec	YES	YES
Airburst Screen Dirty AWS Auto-Shutdown	East or West Screens: River to Intake Differential > 3.0 ft	Temporarily close AWS gates and perform airburst cleaning. Otherwise perform mechanical cleaning	30 Sec	YES	YES
POST SORT POOLS (RACEWAYS 1 through 8)					
Raceway 1 Water Level Low	Water Depth Below Setpoint	Check Pond Water Level, adjust setpoint, or disable alarm if raceway not in use	30 Sec	YES	YES
Raceway 1 Water Level High	Water Depth Above 7.0 Feet	Check Pond Water Level or disable alarm if raceway not in use	60 Sec	YES	YES
FWS PUMP VARIABLE SPEED DRIVE (VFD 001 through VFD 005)					
VFD.001 Network Error	Ethernet Error	Check VFD power & Ethernet switch within main PLC cabinet	30 Sec		
VFD.001 Internal Alarm/Fault	Internal Alarm or Fault Detected	Check VFD fault and alarm logs for specific error code(s)	Instant		
VFD.001 Disabled or SW not in Auto	Unit without power or Unit switch not in AUTO.	Check VFD Selector Switch and 480VAC power supply	5 Sec		
VFD.001 Stop Failure Timeout	Unit not at zero speed within allotted time	Verify general operation of VFD. Drive active feedback includes deceleration (controlled stop)	35 Sec		
VFD.001 Start Failure Timeout	Unit did not run within allotted time	Verify general operation of VFD. Drive power stage enabled and run command accepted	1.1 Sec		
DIESEL GENERATOR AND TRANSFER SWITCH					
Genset Bkr Invalid State	Circuit Breaker Status Conflict	Check device & wiring, as unit cannot be both open & closed at the same time	1 Sec		
Genset Not In Auto Mode	Selector Switch not in Auto position	Check generator circuit breaker selector switch	Instant		
Genset Not Ready	Diesel Generator not Ready to Run	Check general operation of diesel generator. Reference OEM manual	Instant		
Genset Running	Diesel Generator Running	Check normal utility power source	Instant		
Genset Battery Low	Diesel Generator Battery Low	Check battery voltage	Instant		
Genset Internal Alm	Diesel Generator Internal Alarm	Check unit for cause of alarm. Reference OEM manual	Instant		
Genset Internal Fault	Diesel Generator Internal Fault	Check unit for cause of fault. Reference OEM manual	Instant		
Genset High Temp	Diesel Generator High Temperature	Check unit for cause of alarm. Reference OEM manual	Instant		
Genset Low Oil Pressure	Diesel Generator Low Oil Pressure	Check unit for cause of alarm. Reference OEM manual	Instant		
Genset Overcrank Lockout	Diesel Generator Lockout on Overcrank Attempts	Check unit for cause of lockout. Reference OEM manual	Instant		
ATS Not in Auto	Automatic Transfer Switch not in Automatic Mode	Check unit selector switch	Instant		
ATS Switched to Emergency	Automatic Transfer Switch switched to Diesel Generator	Normal condition after utility power has been lost	Instant		
ATS Invalid State	Automatic Transfer Switch Status Conflict	Check device & wiring, as unit cannot be both open & closed at the same time	1 Sec		
ENTRANCE GATE CONTROL					
Entrance Gate Controller at Limit	PLC Output is at Upper (100%) or Lower Limit (20%)	The position command to the gate actuator is stuck at the upper limit (100%) or lower limit (20%)	300 Sec		
Entrance Gate Forced to Manual	Unscheduled event caused jump from Auto to Manual Mode	LIT.001 or LIT.003 error, DeviceNet error, Actuator alarm, Power loss, or Selector switch not in remote	Instant		
Entrance Gate Level Out of Tolerance	System Water Level is at Upper or Lower Limit	Pool 1 Water Level (LIT.003) is less than 1.0 Ft or greater than 1.5 Ft (SP=1.25 Ft.)	300 Sec	YES	
Entrance Gate Operating in Manual	System is being operated in manual instead of automatic mode	Place Entrance gate control in automatic mode	60 Sec		
Entrance Gate Return to Auto Attempted	Return to Auto Mode attempted after System Forced to Man	Power restored, Actuator & DeviceNet errors cleared, LIT.001/.003 functional, Actuator in "Remote"	240 Sec		
FWS PUMP CONTROL					

FWS Pumps Controller at Limit	PLC Output is at Upper (100%) or Lower Limit (78%)	If held at upper limit ensure addition pumps are available to run. If at lower limit only 2 pumps should run	600 Sec		
FWS Pumps Forced to Manual	Unscheduled event caused jump from Auto to Manual Mode	At least 1 pump running in hand, total pumps running /avail less than 2, PIT.001, VFD, or Ethernet Error(s)	Instant		
FWS Pumps PLC Rejected Start Cmd	PLC Reject Start Command from Graphic Terminal	No pumps shall be running in manual and at least one pump must be available when starting system	Instant		
FWS Only 1 Pump Running	Only 1 pump is running after system has been started.	Ensure at least two VFD's are energized with their selector switch in "auto" position	60 Sec	YES	YES
FWS No Pumps Running	No FWS pumps are running after system has been started.	Ensure at least two VFD's are energized with their selector switch in "auto" position	60 Sec	YES	YES
FWS Pressure Out of Tolerance	System Water Pressure is at Upper or Lower Limit	System Water Pressure (PIT.001) is less than 10 psi or greater than 14.0 psi	300 Sec	YES	YES
FWS Operating in Manual	System is being operated in manual instead of automatic mode	Place FWS pump control in automatic mode	60 Sec		
FWS Return to Auto Attempted	Return to Auto Mode attempted after System Forced to Man	480VAC Power Restored, PIT.001, VFD, & Ethernet Errors Cleared, no units running in hand/manual	60 Sec		
PRESORT POOL CONTROL					
Presort Pool 52 Level Out of Tolerance	Presort Pool Water Level at Upper or Lower Limit	Pool 52 Water Elev (LT.006) is less than 0.6 Ft or greater than 0.9 Ft	8 Hrs	YES	
AWS GATE CONTROL					
AWS Gates/Table Mismatch	Gate Position data does not match Controller Settings.	Check tailrace water level transmitters (LIT.001) & Gate Actuators for correct operation	1 Sec		
AWS Gates Forced to Manual	Unscheduled event caused jump from Auto to Manual Mode	Any Actuator has a loss of power , internal alarm, DeviceNet error, switch not remote, or LIT.001 error	Instant		
AWS Gates Invalid Case or State	Tailrace level outside allowed elevation (956.0 -- 975.0 Ft)	Check tailrace water level transmitters (LIT.001) for accurate measurement.	Instant		
AWS Gates Out of Sequence	Tailrace level has jumped beyond single increment/decrement	Check tailrace water level transmitters (LIT.001) for error or very sudden change in water level measurement	180 Sec		
AWS Gates Operating in Manual	System is being operated in manual instead of automatic mode	Place AWS Diffuser Gate system in automatic mode	60 Sec		
AWS Gates Return to Auto Attempted	Return to Auto Mode attempted after System Forced to Man	Power restored, All 14 Gate Actuator & DeviceNet errors cleared, LIT.001 functional, all actuator in "Remote"	180 Sec		
MISCELLANEOUS HARDWARE ALARMS					
PLC I/O Module Fault	Main PLC cabinet I/O module has faulted	Possible PLC hardware failure. Examine Modules in Chassis and go on-line with PLC to determine cause	Instant		
PLC 24VDC Power Supply Off	Main PLC cabinet Power Supply Not Detected	Check power supply plus fuses and/or circuit breakers	Instant		
PLC UPS Battery Low	Main PLC cabinet UPS Battery is Low.	Check UPS Battery	30 Sec		
Sewage Lift Station Pump Failure	Sewage Lift Station Pump Tripped or Failed to Run	Check Overload Relay and Current Sensing Relay within Lift Station Cabinet	60 Sec		
Sewage Lift Station High Level	Sewage Lift Station High Level	Check Lift Station Level	60 Sec		
IPS Sump Lag Pump On	Intake Pump Structure Sump Lag Pump Running	Investigate why lead pump cannot keep-up with sump in-flow	120 Sec		
IPS Sump High	Intake Pump Structure Sump High Water Level	Check IPS for flooding	120 Sec	YES	YES
IPS Sump Pump1 Overload	Intake Pump Structure Lead Sump Pump Tripped on Overload	Check motor for overload condition. Pump/motor shaft may not freely rotate	120 Sec	YES	YES
IPS Sump Pump2 Overload	Intake Pump Structure Lag Sump Pump Tripped on Overload	Check motor for overload condition. Pump/motor shaft may not freely rotate	120 Sec	YES	YES
IPS Sump Pump1 Not in Auto	Intake Pump Structure Lead Sump Pump Not in Auto Mode	Check power and selector switch on sump pump controller cabinet door	120 Sec	YES	YES
IPS Sump Pump2 Not in Auto	Intake Pump Structure Lag Sump Pump Not in Auto Mode	Check power and selector switch on sump pump controller cabinet door	120 Sec	YES	YES
Washdown Pump Not in Auto	Washdown Pump Not in Automatic Mode	Check power and selector switch on washdown pump controller cabinet door	5 Sec		
Washdown Pump Overload	Washdown Pump Tripped on Overload	Check motor for overload condition. Pump/motor shaft may not freely rotate	Instant		
Compressor Not in Auto	Air Compressor Not in Automatic Mode	Place Air Compressor in Automatic Mode	5 Sec	YES	YES
Compressor Trouble	Air Compressor Tripped on Overload or Phase Monitor Relay	Check Overload Relay, Input Voltage, and Phase Monitor Relay within Compressor Cabinet	60 Sec	YES	YES
Forebay Redundant Level Sensor Trouble	Trouble with Forebay Sensors East (LIT.012) & West (LIT.008)	Variation between sensors greater than 1.0 ft or measured elevation less than 972 or greater than 988 Ft	30 Sec		
Tailrace Redundant Level Sensor Trouble	Trouble with Redundant Sensors (LIT.001A/B)	Variation between sensors greater than 0.5 ft or measured elevation less than 956 or greater than 976 Ft	120 Sec	YES	
Pool 1 Redundant Level Sensor Trouble	Trouble with Redundant Sensors (LIT.003A/B)	Variation between sensors greater than 0.75 ft or measured elevation less than 956 or greater than 976 Ft	120 Sec	YES	
Pool 52 Redundant Level Sensor Trouble	Trouble with Redundant Sensors (LIT.006A/B)	Variation between sensors greater than 0.5 ft or measured elevation less than 955 or greater than 1005 Ft	120 Sec	YES	
Power Meter Trouble or Network Error	Internal Power Meter Error or Ethernet Error	Check Ethernet Switches, Power Supply, Fiber Optic Cables, Patch Cables, etc	Instant		
River Level Low	River Water Level below 973.7 Ft.	Verify River Level and operation of Forebay Sensors East (LIT.012) & West (LIT.008)	30 Sec		
River Level High	River Water Above below 985.0 Ft.	Verify River Level and operation of Forebay Sensors East (LIT.012) & West (LIT.008)	30 Sec		
Fuel Cleaning System Trouble	Diesel Fuel Maintenance System Trouble	Check OEM drawings and manual	60 Sec		
Remote I/O Trouble	Remote I/O cabinet PLC module has faulted	Possible PLC hardware failure. Examine modules and go on-line with PLC to determine cause	Instant		
Remote I/O UPS Battery Low	Main PLC cabinet UPS Battery is Low.	Check power supply and OEM manual	90 Sec		
FWS Redundant Pressure Sensor Trouble	Trouble with Redundant Sensors (PIT.001A/B)	Variation between sensors greater than 0.50 psi or measured pressure less than -1.0 or greater than 20 ps	30 Sec		

* 5 Minute Delay after horn before autodialing phone numbers

Minto FCF Outside Plant Alarms 9/27/2016

Process Alarms	Setpoint	Alarm Condition 1	Alarm Condition 2	Alarm Condition 3	Delay	HORN	** DIALER
Entrance Gate Differential Out of Tolerance	1.25 ft	1.0 Ft Low	1.5 ft High	N/A	5 Min	Y	N
PreSort Pool 52 Level Out of Tolerance	0.75 ft	0.6 ft Low	0.9 ft High	N/A	8 Hrs	Y	N
FWS Pressure Out of Tolerance	12.0 psi	10.0 ft Low	14.0 psi High	N/A	5 Min	Y	Y
Analog Sensor Alarms							
Tailrace Redundant Level Sensor Trouble		both sensors failed or at limits	Varition > 0.50 ft	956 > Elev > 0976	2 Min	Y	N
Pool 1 Redundant Level Sensor Trouble		both sensors failed or at limits	Varition > 0.75 ft	956 > Elev > 0976	2 Min	Y	N
Pool 52 Redundant Level Sensor Trouble		both sensors failed or at limits	Varition > 0.75 ft	955 > Elev > 1005	2 Min	Y	N
Discrete Alarms							
FWS No Pumps Running		Pumps Running = 0			1 Min	Y	Y
FWS Only 1 Pump Running		Pumps Running = 1			1 Min	Y	Y
Airburst #1 Sustained Very Low Pressure	35 Psi	Receiver Tank 1 Pressure < 35 Psi			1 Min	Y	Y
Airburst #2 Sustained Very Low Pressure	35 Psi	Receiver Tank 2 Pressure < 35 Psi			1 Min	Y	Y
Airburst #3 Sustained Very Low Pressure	35 Psi	Receiver Tank 3 Pressure < 35 Psi			1 Min	Y	Y
Airburst Screen Dirty High Differential	1.0 Ft	East or West Screens: River to Intake Diff > 1.0 ft			5 Min	Y	Y
Airburst Screen Dirty Very High Differentia	2.0 Ft	East or West Screens: River to Intake Diff > 2.0 ft			5 Sec	Y	Y
Airburst Screen Dirty AWS Auto-Shutdown	3.0 Ft	East or West Screens: River to Intake Diff > 3.0 ft			30 Sec	Y	Y
Airburst Not in Auto		Screen Clearning System not in Automatic Mode			None	Y	Y
Compressor Not in Auto		Air Compressor not in Automatic Mode			5 Sec	Y	Y
Compressor Trouble		OL Trip	Phase Monitor Trip	MCP Trip or No Pwr	1 Min	Y	Y
IPS Sump High		High Water Level			None	Y	Y
IPS Sump Pump1 Overload		Motor Overload			None	Y	Y
IPS Sump Pump2 Overload		Motor Overload			None	Y	Y
IPS Sump Pump1 Not in Auto		Selector Switch not in Auomatic Mode	No Power		None	Y	Y
IPS Sump Pump2 Not in Auto		Selector Switch not in Auomatic Mode	No Power		None	Y	Y
Raceway "X" Water Level Low	Variable	Water Depth Below Adjustable Setpoint			30 Sec	Y	Y
Raceway "X" Water Level high	7.0 Ft	Water Level > 7.0 Ft			60 Sec	Y	Y

** 5 Minute Delay after horn sounds before autodialing telephone numbers

Chapter 7: Corrective Maintenance and Checkout Procedures

Commissioning checklists are located in Appendix D and the Contractor supplied O&M manual Volume 8.

US Army Corps
of Engineers
Portland District

SYSTEM OPERATION AND MAINTENANCE MANUAL

FOSTER DAM AND RESERVOIR
ADULT FISH FACILITY UPGRADE
WILLAMETTE RIVER BASIN
MIDDLE & SOUTH SANTIAM RIVER

September 14, 2016 **DRAFT FINAL**

SYSTEM OPERATION AND MAINTENANCE MANUAL CONTENTS

Chapter 1: General Information

Chapter 2: System Description

Chapter 3: Theory of Operations

Chapter 4: Operations

Chapter 5: Preventative Maintenance

Chapter 6: Industrial Control System

Appendices

Appendix A: As-Built Drawings

Appendix B: Contractor's O&M Manuals

Appendix C: Graphic Terminal Alarm Summary

Appendix D: Historical Temperature Data Collection

Appendix E: Stormwater Facilities O&M Manuals

Appendix F: Maintenance Check List and Job Plans

Table of Contents

1. Chapter 1: General Information 1

Purpose and Scope 1

1.1. Parts of the Manual 1

1.2. Project Description 1

2. Chapter 2: System Description 4

2.1. Project Description 4

2.2. FISH LADDER 4

2.2.1. Fish Ladder Entrance 5

2.2.2. Auxiliary Water Supply (AWS) System 11

2.2.3. Transport Channel 19

2.2.4. Ladder Weirs and Orifices 20

2.2.5. Pool 35 – Ladder Head Control with Level Sensor 23

2.3. GRAVITY FOREBAY WATER SUPPLY SYSTEM 23

2.2.6. Forebay Intake Screen 23

2.2.7. Forebay Intake Bulkhead 24

2.2.8. Valve Room 24

2.2.9. Piping to Side Entrance (AWS) 26

2.2.10. Piping to Headbox (FWS) 28

2.3. HEADBOX 31

2.3.1. General Description 31

2.3.2. Packed Columns 31

2.3.3. Instrumentation 32

2.3.4. Slide Gates 32

2.4. PRE-SORT POOL 32

2.4.1. Finger Weir 33

2.4.2. Crowder 33

2.4.3. Pre-Sort Pool Brail 34

2.4.4. False Weir 35

2.4.5. Pre-Sort Pool Piping (Headbox to Pre-Sort Pool) 36

2.5. SORT FACILITY 37

2.5.1. Mechanical/Electrical Room 38

2.5.2. Pre-Sort Flume to Anesthetic Tank 40

2.5.3. Switch Gates 40
2.5.4. Anesthetic Tank 40
2.5.5. Sort Table 41
2.5.6. Fish Transport Pipes 41
2.5.7. Recovery Tank 43
2.5.8. Return to River Pipe 44
2.5.9. Sort Area Water Supply Piping, Valves, and Appurtenances 45
2.6. POST-SORT POOLS, SORTING CHANNEL, FISH LOCK AND HOPPER PIT 45
2.6.1. Post-Sort Pool Crowders 45
2.6.2. Crowding Channel Crowder 46
2.6.3. FWS Piping (Headbox to Post-Sort Pools) 46
2.6.4. Recirculation Water System 47
2.6.5. Diffusers 47
2.6.6. Removable Fish Screens and Weir Boards 47
2.6.7. Post-Sort Pool Bulkheads and Hoists 48
2.6.8. Fish Lock Bulkhead and Hoist 49
2.6.9. Fish Lock Brail and Hoist 50
2.6.10. Crowding Channel Drain System 51
2.7. FISH TRANSFER SYSTEM AND LOADING EQUIPMENT 52
2.7.1. Hopper Crane 52
2.7.2. Hopper Loading Structure 53
2.7.3. Fish Hopper 53
2.7.4. Fish Truck 55
2.7.5. Truck Fill Station 57
2.8. Drainage System 58
2.8.1. Outfall Structure 58
2.8.2. Facility Drains 59
2.8.3. Rain Gardens 59
2.8.4. Anesthetic Pond 62
2.8.5. Water Quality Catch Basins 62
2.9. Sanitary Sewer 63
2.9.1. Oil/Water Separator 63
2.10. Potable Water System 63

2.11. Fire Protection Water System 63
2.12. Ancillary Structures 63
2.12.1. Maintenance Building 63
2.12.2. Site Host Pad 64
2.12.3. Chemical Storage Building 66
2.13. FACILITY ENTRANCE GATES 67
2.14. POWER 68
2.14.1. Station Service Supply 68
2.15. Industrial Control System (ICS) 71
2.15.1. Programmable Logic Controller (PLC) 71
2.15.2. Graphic Terminals 71
2.15.3. Water Level Sensors 71
2.16. Pavement 71
2.16.1. Asphalt Concrete 71
2.16.2. Portland Cement Concrete 71
2.16.3. Gravel 71
2.16.4. Grass Pavers 71
2.17. Landscaping 71
3. Chapter 3: Theory of Operation 3
3.1. Theory of Operation 3
3.1.1. Forebay Water Supply System 3
3.1.2. Facility Water Distribution System (FWDS) 4
3.1.3. Auxiliary Water Supply (AWS) System 5
3.1.4. Fish Ladder Gates 6
3.1.5. Pumphouse Dewatering and Filling 7
4. Chapter 4: Operations 2
4.1. System Operations 2
4.1.1. Facility Startup 2
Table 1 – Operating Setpoints for Tailwater Elevation (LT-003) for AWS Pumps and FB Water Supply Discharge to Side Entrance 7
Table 3 – Manual Operation of Entrance Weir Gate to Regulate Entrance Head (DH) and Minimum Pool 1 Depth 11
4.1.2. Normal Facility Operation 14
4.1.3. Normal Facility Shutdown 24

4.1.4. Emergency Operations 27
4.2. Equipment Operations 28
4.2.1. Fish Ladder 28
4.2.2. Headbox 28
4.2.3. Pre-Sort Pool 28
4.2.4. Sort Facility 31
4.2.5. Post-Sort Pools, Crowding Channel, and Hopper Pit 36
4.2.6. Fish Transfer and Loading Equipment 40
4.2.7. Fire Protection Water System 43
4.2.8. Maintenance Building Office/Maintenance Building 43
4.2.9. Power 44
5. Chapter 5: Preventative Maintenance 45
5.1. System Maintenance 45
5.1.1. General Maintenance Policies 45
5.1.1.1. Contractor Supplied O&M Manual 45
5.1.1.2. Routine Maintenance Policies 45
5.1.1.3. Pre-startup Procedure 45
5.1.2. Basic Maintenance Procedures 46
5.1.3. Preventative Maintenance Management 46
5.2. Equipment and Structure Maintenance 1
5.2.1. Fish Ladder 1
5.2.1.1. Fish Ladder Entrance 1
5.2.1.2. AWS Pump Structure 1
5.2.2. Pre-Sort Pool 1
5.2.2.1. Finger Weir 1
5.2.2.2. Crowder 2
5.2.2.3. False Weir 2
5.2.2.4. Closure Gate 2
5.2.2.5. Pre-sort Pool Piping 2
5.2.2.6. False Weir Drain 2
5.2.2.7. Valves 2
5.2.2.8. Diffusers 3
5.2.3. Sort Facility 3

5.2.3.1. Mechanical/Electrical 3
5.2.3.2. Plumbing 3
5.2.3.3. HVAC 3
5.2.4. Post-Sort Pools, Sorting Channel, and Hopper Pit 3
5.2.4.1. Post-sort Pool Crowders 3
5.2.4.2. Sorting Channel Crowder 3
5.2.4.3. FWS Piping 4
5.2.4.4. Diffusers 4
5.2.4.5. Removable Fish Screens and Overflow Stoplogs 4
5.2.4.6. Sort Channel Drain System 4
5.2.4.7. FWS Piping 4
5.2.4.8. FWS Flowmeter 4
5.2.4.9. AWS Valve and Sump Pump System 4
5.2.4.10. Washdown Pipe System 4
5.2.4.11. Intake Screen 4
5.2.5. Fish Sorting Equipment 5
5.2.5.1. Fish Transport Flume 5
5.2.5.2. Switch Gates 5
5.2.5.3. Anesthetic Tank 5
5.2.5.4. Sort Table 5
5.2.5.5. Recovery Tank 5
5.2.6. Fish Transfer and Loading Equipment 5
5.2.6.1. Hopper Hoist 5
5.2.6.2. Hopper Loading Structure 6
5.2.6.3. Hopper 6
5.2.6.4. Fish Truck 6
5.2.6.5. Maintenance Building 6
5.2.6.6. Site Host Structure 6
5.2.7. Storm Water Facilities 7
5.2.8. Sanitary Sewer System 7
5.2.9. Facility Vehicle Entrance Gates 7
5.2.10. Power 7
5.2.10.1. Primary Metering Cabinet 7

5.2.10.2. Transformer FTQ1 7
5.2.10.3. Backup Power System 7
5.2.10.4. Metering, Protection, and Grounding 7
5.2.11. Industrial Control System (ICS) 7
5.2.12. Intrusion Detection 7
6. Chapter 6: Industrial Control System 8
6.1. General 8
6.2. MAIN OVERVIEW SCREEN 8
6.3. AUXILLARY WATER PUMPS 9
6.4. FACILITY WATER SYSTEM 11
6.5. SIDE ENTRANCE WATER SUPPLY 12
6.6. PRESORT POOL WATER SUPLY 13
6.7. DIGITAL POWER METERS 14
6.8. INSTRUMENTATION 15
6.9. MAIN FISH ENTRANCE GATE 16
6.10. SIDE FISH ENTRANCE GATE 17
6.11. TRANSPORTATION CHANNEL GATE 19
6.13. PORT SORT RACEWAYS 21
6.14. DIAGNOSTICS, I/O, & CONFIGURATION 22
6.15. SORT FACILITY - DISCRETE I/O 23
6.17. HATCHERY - DISCRETE I/O 25
6.18. PLANT OVERVIEW 26
6.19. KEY PAD 27
6.20. LOGIN 27
6.21. ALARM HISTORY 28
6.22. ACTIVE ALARM STATUS 29
6.23. ALARM MANAGEMENT - ANALOG SENSORS 30
6.24. ALARM MANAGEMENT - ACTUATORS AND PROCESS CONTROL 31
APPENDIX 32

Abbreviations and Acronyms

- ATS Automatic Transfer Switch
- AWS Auxiliary Water Supply
- CFS Cubic Feet per Second
- FCV Flow Control Valve
- FIT Flow Indicating Transmitter
- FWS Facility Water Supply
- GAC Granular Activated Carbon
- HMI Human Machine Interface (Graphic Terminal)
- HOA Hand-Off-Auto Selector Switch
- ICS Industrial Control System
- IPS Intake and Pump Structure
- LT Level Transmitter
- LOA Local-Off-Remote Selector Switch
- LSR Local-Stop-Remote Selector Switch
- NOAA National Oceanic and Atmospheric Administration
- O&M Operation and Maintenance
- PLC Programmable Logic Controller
- PM Preventative Maintenance
- SCADA Supervisory Control and Data Acquisition
- SOMM System Operation and Maintenance Manual
- VFD Variable Frequency Drive
- WSEL Water Surface Elevation

1. Chapter 1: General Information

Purpose and Scope

ODFW and the Willamette Project will be responsible for the operation and maintenance of the Foster Dam and Reservoir Adult Fish Facility Upgrade. The new facility is a complex system with many interacting mechanical, electrical, and structural components. In addition, the hydraulic performance must be carefully controlled so that the system operation meets NOAA Fisheries criteria and provides effective fish passage. The System Operation and Maintenance manual provides the necessary guidance in the general system operation and describes the specific operation and maintenance of each component in the system.

1.1. Parts of the Manual

There are seven chapters in this manual including:

1. General Information
2. System Description
3. Theory of Operation
4. Operations
5. Preventative Maintenance
6. Trouble Analysis
7. Corrective Maintenance and Checkout Procedures

Appendices include:

A. Special Tools and Test Equipment List
B. Repair Parts List
C. Vendor Data/Acceptance Tests
D. Warranty Data Information
E. Master Equipment List
F. As-Built Drawings
G. Contractor's O&M Manuals

1.2. Project Description

Foster Dam is located 34 air miles northeast of Eugene, Oregon, on the South Santiam River, which is a tributary of the Willamette River. The dam is located at river mile 37.9 on the South Santiam River.

The Foster Adult Fish Facility includes the following major features:

a. Fish ladder system including:
   i. Pools separated by weirs and orifices

ii. Two fish ladder entrance locations, each with an entrance gate

iii. AWS pump system and floor diffusers

iv. Transport channel (with telescoping weir) separating lower and upper fish ladder

b. Pre-sort pool including:

i. Finger weir, crowder, brail, and false weir

c. Sort Facility including:

i. Mechanical/electrical room and storage

ii. Fish flume and switch gates

iii. Anesthetic tank

iv. Sort table

v. Recovery tank

vi. Fish transport pipes including return to river pipe

d. Post-sort pools including:

i. Nine post-sort pools

1. Four short term ponds

2. Five long term ponds

ii. Common crowding channel with crowder, and hopper pit, and fish lock

iii. Two drain channels

1. Short term pond drain channel

2. Long term pond drain channel

e. Water Supply System including:

i. Gravity forebay water supply (FWS) System

1. Forebay intake trash rack

2. Piping and valving to headbox

3. Headbox

4. Piping from headbox to pre-sort pool, post-sort pools, flumes, etc.

ii. Pumped auxiliary water supply (AWS) system

1. Pump intake trash rack

2. Four AWS pumps

3. Piping and valves to existing conduits

4. Floor diffusers

f. Fish transfer and loading equipment including:

i. Hopper crane

ii. Hopper loading structure

iii. Fish hopper

iv. Fish truck

v. Fish lock brail

g. Drainage System

i. Piping and manholes

ii. Drainage outfall structure

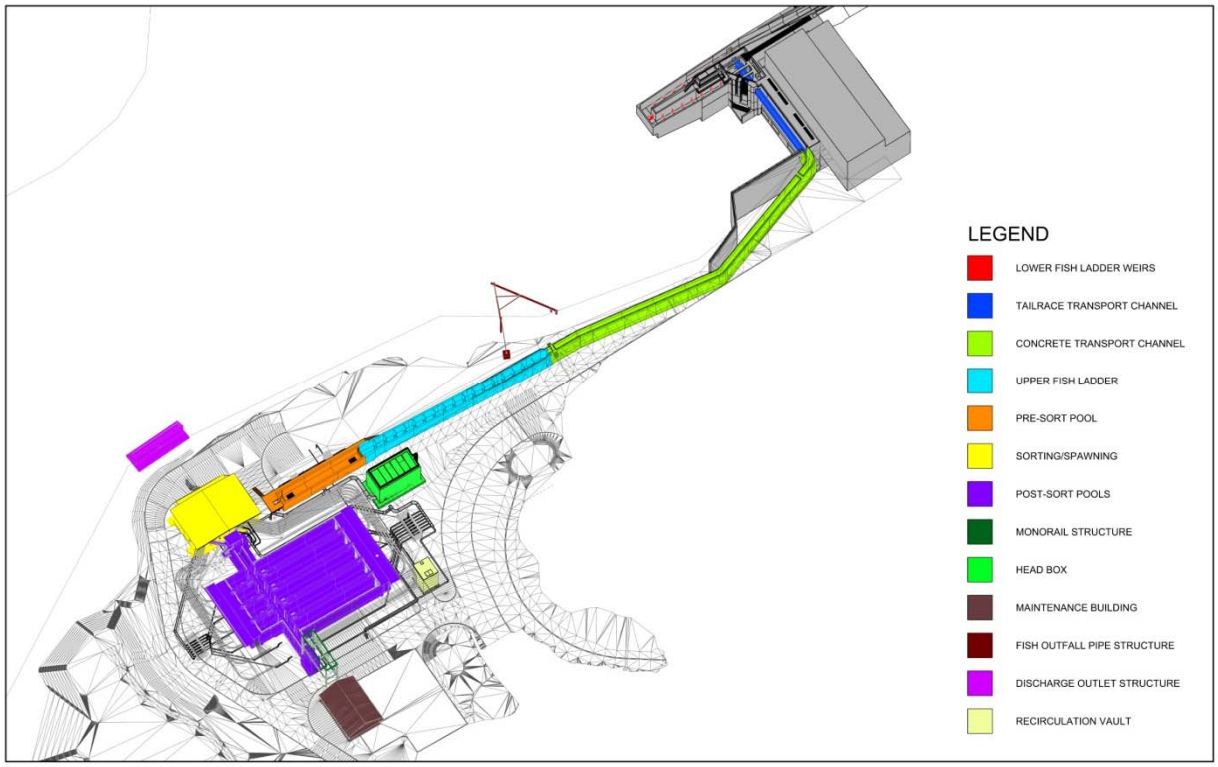
h. Ancillary buildings including:

i. Office/Maintenance building, site host, two shade structures, chemical storage building

DRAFT

2. Chapter 2: System Description

2.1. Project Description



2.2. FISH LADDER

The fish ladder guides fish from the Project tailrace and stilling basin to the fish collection facility Presort Pool. This fish ladder is constructed of reinforced concrete. There are two fish ladder entrances: the main entrance (pool 1) discharges to the Powerhouse tailrace and the side entrance discharges to a spillway stilling basin. In raising the fish from pool 1 to the presort pool, the fish ladder consists of three main segments: the modified existing lower ladder, the transport channel, and the new upper ladder segment connecting to the Presort Pool. The ladder consists of 35 pools separated by 33 weirs total. The weir sections of ladder are approximately a 340-foot long in total and the invert is sloped at 1 on 10 feet, rising 33.9-feet from pool 1 to the presort pool. Connecting the two ladder segments, the transport channel is a horizontal section 494 feet long. Discharge down the ladder starts at the top from the pre-sort pool and steps down from pool 35 to pool 1 and releases out the entrances to the tailrace and stilling basin. The gravity Forebay Water Supply (FWS) System supplies the pre-sort pool and upper ladder flow (about 30 cfs). The auxiliary water system (AWS) pumps fish attraction water at 45-180 cfs to the lower ladder diffuser system to amend entrance flows. Figure 2-X and Figure 2-Y present flow schematic diagrams for the forebay water, auxiliary water, and fish ladder systems (see drawings M-608 and M-609).

2.2.1. Fish Ladder Entrance

The fish ladder has two entrance areas with one entrance gate at each location (see drawing MB510):

1. Main entrance (pool 1) is located at the north side of Powerhouse tailrace;
2. Side Entrance is located in the south wall of the spillway stilling basin.

The side entrance is not operated during large spill operations or when the water reservoir is low. The entrance opening invert elevation at both locations is 522.6 NAVD 88. The original 64-foot long transportation channel connects the side entrance with pool 1 and the main entrance. The base of the lower fish ladder weirs start from the west side of pool 1.

2.2.1.1. Fish Entrance Gates

The entrance gates consist of orifice openings that operate as weirs and are raised to close off the entrance. The invert of the opening will typically be operated to maintain a differential between the upstream and downstream water surfaces as established by operator entered setpoints. A fish barrier Picket Gate can be positioned in a slot upstream of each fish entrance gate to exclude fish when maintenance is being conducted. Access to the entrance gate machinery is located on the tailrace deck for the main entrance and on a platform above the spillway for the side entrance. The entrance gates are coated carbon steel slide plates that are moved by electrically-operated, wire-rope drum hoists. The

position of the gates will be modulated automatically by the facility control system to maintain the water differential setting.

2.2.1.1.1. Main Entrance Gates

The main entrance gate has an opening of 5 feet wide x 9 feet high (see drawings MB512 and MB513). The main entrance gate is designed for a water surface differential operating range of between 6 inches and 2 feet but normally 1 foot. The invert of the main entrance gate orifice can range between entrance invert 522.6 up to 532 feet, but will typically operate between 525 and 531. The entrance gate is designed to function as a submerged weir.

2.2.1.1.2. Side Entrance Gate

The side entrance gate has an opening of 4 feet wide x 9 feet high (see drawings MB515 and MB516). The side entrance gate is designed for a water surface differential operating range of between 6 inches and 2 feet but normally 9 inches. The invert of the side entrance gate orifice can range between entrance invert 522.6 up to 532 feet, but will typically operate between 525 and 531.

2.2.1.1.3. Telescoping Weir (Transportation Channel Gate)

The transportation channel gate consists of two adjacent, overlapping and interconnected weir plates, an "upper leaf" and "lower leaf", which telescope into position (see drawings MB510 and MB511). The gate and channel are 5 feet wide with a 39-inch high concrete weir wall on the upstream side of the gate. The transportation channel gate is designed for a water surface differential operating range of between 0 inches and 2 feet but normally 3 inches. The invert of the gate can range between channel weir invert 525.83 up to 535.83 feet, but will typically operate between 526 and 534. Similar to the entrance gates, the invert of the weir gate will typically be automatically modulated to maintain a differential between the upstream and downstream water surfaces as established by the operator entered setpoint.

2.2.1.1.4. Gate Hoisting Systems

New gate hoisting systems have been provided for the main entrance, side entrance, and transportation channel gates. The hoisting systems consist of new electric, wire-rope drum hoists and new wire rope and hardware. Existing wire-rope sheaves were refurbished for reuse. The entrance gates are positioned in their

guides using wire ropes attached at the two top outer corners, which routes the wire ropes within the gate guide space, thus, avoiding the water flow path and fish passageway. For the main entrance gate, sheaves at the deck level translate the wire ropes horizontally for coiling on either end of the two-section hoist drum. For the side entrance gate, the two wire ropes are coiled directly onto tandem drums positioned over either side of the gate opening but operated by one hoist. For the transportation channel gate, two sets of sheaves at the deck ceiling level translate the wire ropes up and over from the gate slot to the either end of the two-section hoist drum at floor level. All hoists are electric-motor driven through a multi-turn, worm-gear actuator with manual handwheel for backup. The actuator incorporates electronic controls with user interface through the control mode (Local/Off/Remote) selector switch, pushbuttons, and digital display for configuring, monitoring, and troubleshooting the actuator. Actuator controls include position control and indication, data logging, indication lights, fault status, and diagnostics. The gate hoists will automatically modulate the position of the gates in response to control system input. Gates will be regulated by the control system to maintain the water surface differentials based on the level outputs from respective level sensors (tailrace, main entrance pool, and transportation channel) and the setpoints entered by operators.

DRAFT

2.2.1.1.5. Instrumentation

Entrance gate controls are based on water levels in the tailrace, pool 1, transportation channel, and stilling basin. New level elements were installed at the existing stilling wells located in a sump off of pool 1 and accessible from the pump room and at the side entrance (see drawings EC403, EC404, and EC501). The gates are controlled automatically based on the water level signals connected to the control system.

2.2.1.2. Fish Barrier Screens (Picket Gates)

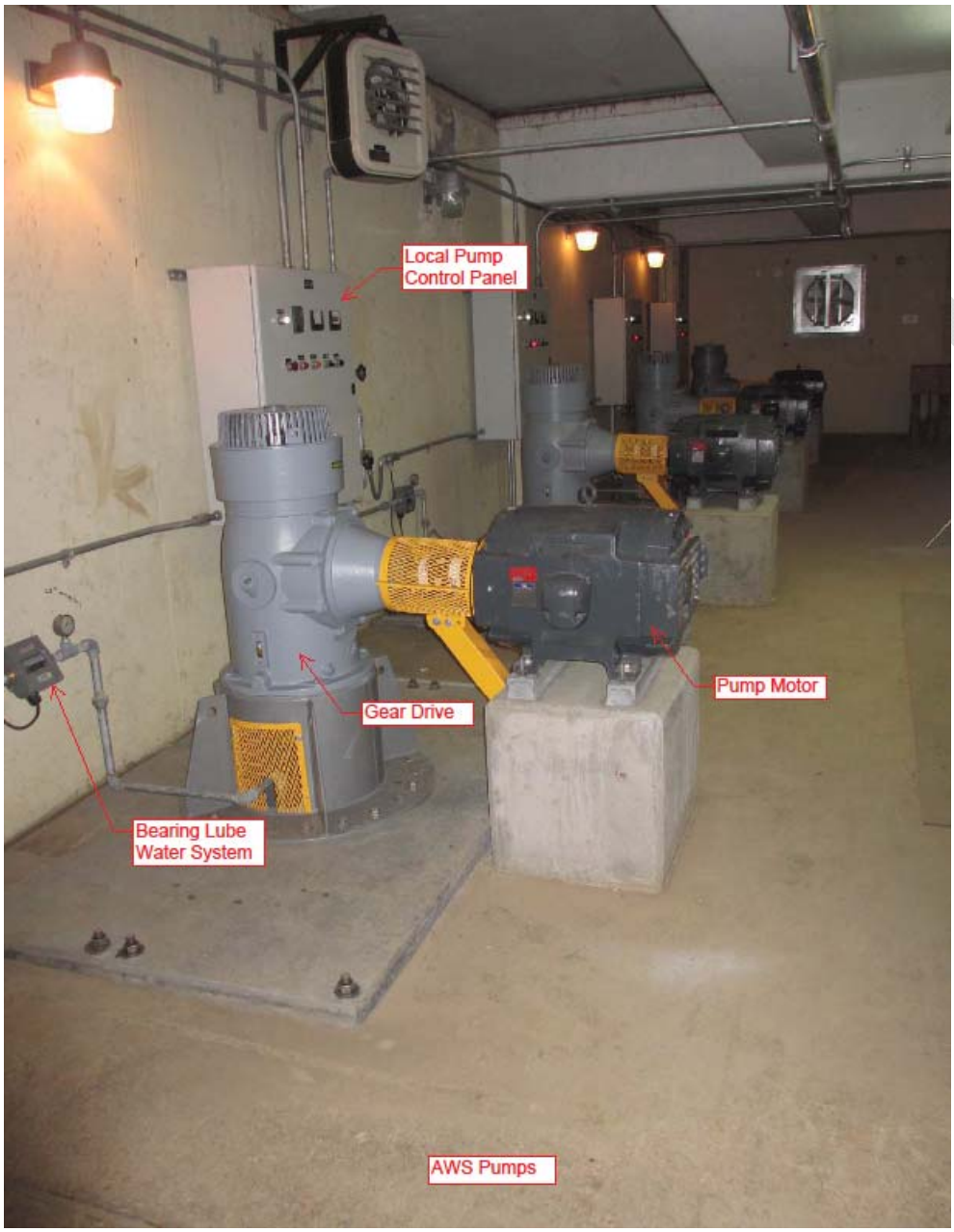
The picket gates are used to keep fish from entering the fish ladder during commissioning, start up, and shut down operations. The original 6-foot wide picket gate and lifting mechanism for the main entrance was refurbished during construction (see drawing MB514). A similar picket gate and lifting mechanism was installed for the side entrance. Each picket gate is raised and lowered by a manual winch-style hoist that is post-mounted at worker level.

2.2.2. Auxiliary Water Supply (AWS) System

The AWS system is supplied with tailrace water by the AWS pumps that discharge directly into the main entrance pool (pool 1) through diffusion grating in the floor. This fish attraction water amends the fish ladder flow with all flows exiting pool 1 through the main entrance gate and/or the side entrance gate.

2.2.2.1. AWS Pumps

There are four AWS pumps with approximately 45 cfs capacity per pump, or 180 cfs total. Each pump is installed in a separate pump bay fed by a common pump intake channel located below the pump bays (see drawings MB102 and MB301). Each pump has separate discharge piping including a cast iron flap gate check "valve" with the discharges commingled in the existing concrete AWS upper and lower supply channels.



There is a vacant fifth pump chamber with provisions for a potential additional 35 cfs pump as per the original facility design.

2.2.2.2. Pump Intake Screen

The pump intake trashrack is located under the main entrance and is designed to prevent debris and adult fish from entering the AWS pump system. The channel opening dimensions for the trashrack are 10 feet 6 inches wide by 10 feet 7 inches high. The screen openings are 5/8 inch with ¼ inch wide x 1.5 inch deep bars. There are two lifting eyes for removing the trashrack for maintenance purposes.

2.2.2.3. Pump Intake Channel and Sump

After passing through the trashrack, AWS flows are drawn through the pump intake channel located on the bottom level of the pumphouse. AWS flows pass up through openings in the bottom level ceiling to the pump intake level and turn horizontally into the pump bays. These passages were upgraded to improve the flow hydraulics and include horizontal and vertical vanes within each opening to better direct the flow to the pump intakes.

After removing the trashrack, a bulkhead can be inserted in the trashrack guides to seal off the channel. With the bulkhead in place, the pump intake and supply channels can be emptied through horizontal drains to a sump below the floatwells that can be drained to the Powerhouse.

2.2.2.4. Pump Intake Bays

The original pump bays were modified to address issues regarding non-conformance to Hydraulic Institute Standards for vertical pump intakes (see drawings MB501 through MB505). In addition to the turning vanes installed in the pump channel openings, each pump bay had fillets and a flow splitter with perforated vane installed to promote flow into the pump intake and reduce the potential for vortex formation.

2.2.2.5. Pump Discharge Piping and Flap Valves

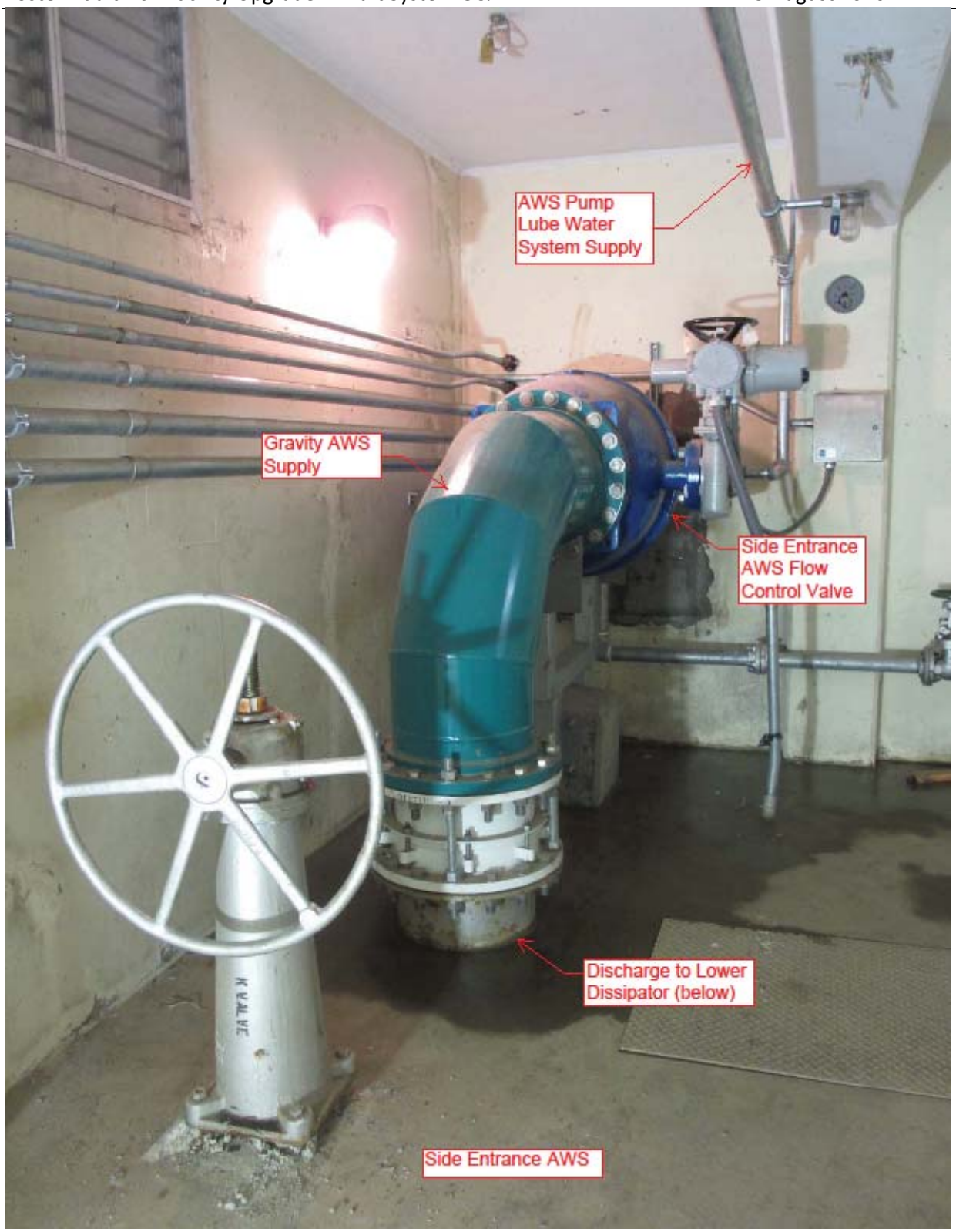
Each pump discharges through a 30-inch discharge pipe into one of the supply channels (Pump No. 1 into the upper supply channel; Pumps Nos. 2-4 into the lower supply channel). The discharge pipe connects to the pump discharge elbow with a restrained flexible pipe coupling at the upstream end. The other end is bolted to a steel closure plate that seals off the supply channel wall opening while providing a solid surface for mounting the discharge flap gate, which prevents backflow into non-operating pumps.

2.2.2.6. AWS Conduits and Diffusion Chamber

The pumped AWS flow passes through the supply channels and discharges into the diffusion chamber below the floor diffuser screen in pool 1. The upper supply channel discharges into the east side of the north wall of the diffusion chamber. The lower supply channel discharges both into the west side of the north wall and the east wall of the diffusion chamber.

2.2.2.7. Gravity AWS to Side Entrance

Attraction water is also supplied directly to the side entrance from the dedicated 24-inch gravity FWS, also called AWS, supply pipe (see below). The flow from this pipe (0 - 58 cfs) ultimately discharges through diffuser screens into the transportation channel on the upstream side of the side entrance Gate and amends the flow coming from pool 1 over the transportation channel gate.


AWS Pump
Lube Water
System Supply
Gravity AWS
Supply
Side Entrance
AWS Flow
Control Valve
Discharge to Lower
Dissipator (below)
Side Entrance AWS

2.2.2.8. AWS Diffuser Screens

The AWS diffuser screens are located flush along the floor of the main entrance pool above the diffusion chamber and in the floor and sidewall at the side entrance. The screens are intended to prevent fish from entering the AWS diffusion basins and to provide a uniform discharge of auxiliary water into the ladder system. The diffuser screens are constructed of stainless steel and have 0.75 inch clear openings.

2.2.2.9. Other AWS Features (Filling Valve, Heavy Duty Flap Gate, etc.)

The AWS system includes other features within the pumphouse such as a heavy duty flap gate located in the vertical wall between the pump intake channel and the lower supply channel (see drawing MB506). The flap gate serves to equalize the water pressure across this wall by allowing flow to pass into the lower supply channel when filling or dewatering the pumphouse. The flap gate is normally held closed due to head differential since the water level in the supply channel is intended to be maintained one foot higher than the pump intake side.

The pumphouse filling gate ("Valve J") is located in the west wall of the Lower (energy) Dissipator (see drawings MB102 and MB301) and is intended to be used to fill the pumphouse with the AWS gravity water after a shutdown. The motorized actuator is located in the southeast corner of the pump room with pushbutton controls on the actuator and is powered from MCC DQ2 in the room.

The side entrance bypass gate ("Valve K") is also located in the north end of the west wall of the Lower Dissipator and is intended to redirect the AWS gravity water from the side entrance to the main entrance via a passage into the lower supply channel. The manual crank operator is located in the northeast corner of the pump room.

The 20-inch, gravity AWS supply pipe in the pump room includes two taps for (1) supplying reservoir water to the pump bearing lubrication water system for the lineshaft bearings and (2) serving as a backup water supply to the Powerhouse water system.

DRAFT

2.2.2.10. Instrumentation

AWS Pump controls are based primarily on the water level in the tailrace. A new level element for the tailrace water level was installed in an existing stilling well located in a sump off of pool 1 and accessible from the pump room (see drawings EC403 and EC501). A new level element for the pumphouse water level was also installed in an existing stilling well pipe located in the pump room (see drawing EC403).

2.2.2.11. Follow on Contract Features

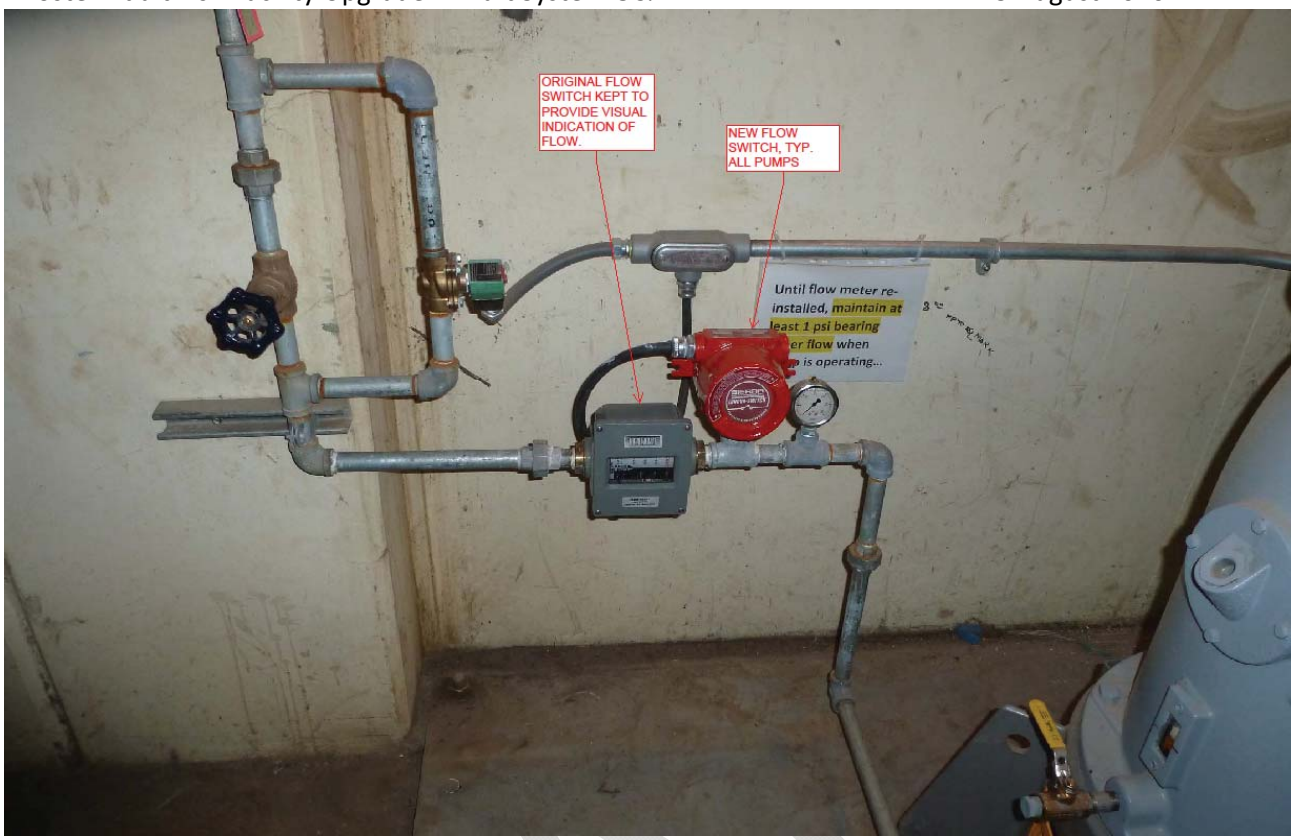
As part of the Follow on Contract, several features of the Auxiliary Water Supply System have been modified. Changes included adding sound absorbing materials in the pump room in order to reduce noise levels in the room, adding an orifice plate to the Gravity AWS Supply Pipe in order to suppress cavitation downstream of the Side Entrance AWS Flow Control Valve, adding a tee and valve in order to ease draining the Gravity AWS Supply Pipe, adding strainer baskets to the AWS Pump Lubrication Water Supply in order to reduce debris loading on the pump bearings, adding new flow switches to the AWS Pump Lubrication Water supplies because previous switches were not reliable.

SOUND ABSORBING MATERIAL ON WALLS
SOUND ABSORBING INSULATION ON GRAVITY AWS PIPE

EXISTING POWERHOUSE COOLING WATER BACKUP SUPPLY
NEW GLOBE VALVE AND GRAVITY AWS SUPPLY PIPE DRAIN. DRAINS TO AERATION CHAMBER

STRAINER BASKET ISOLATION VALVES
STRAINER BASKET BYPASS VALVE
AWS PUMP LUBRICATION WATER SUPPLY PIPE
STRAINER BASKET RETURN PIPE
STRAINER BASKET SUPPLY PIPE

STRAINER BASKET RETURN PIPE
STRAINER BASKET SUPPLY PIPE
DIFFERENTIAL PRESSURE TRANSMITTER
DUPLEX STRAINER BASKETS; ONE CAN BE IN SERVICE WHILE THE OTHER IS BEING CLEANED



2.2.3. Transport Channel

The new transport channel is the horizontal connection between the lower and upper fish ladder sections for fish travelling upstream to the Fish Facility. The total length is approximately 494 feet long. The channel is 3 feet wide with walls 8 feet high. From the lower ladder transition at pool 17, the transport channel extends 110.5 feet across the Powerhouse tailrace. The remainder of the transport channel runs overland to connect to the Upper Fishladder section. The invert of the transport channel is 539.7 feet NAVD 88. The channel conveys 30 cfs and the design velocity in the channel is about 2 ft/s with an approximate flow depth of 5 feet.

DRAFT

2.2.4. **Ladder Weirs and Orifices**

The fish ladder channel is 8 feet wide. There are 35 pools separated by 33 ladder weirs. Each ladder weir has a 4-foot, 5-inch long non-overflow weir and a 3-foot, 7-inch long overflow weir located between the fishway pools. A 12-inch wide by 15-inch tall orifice is located on the floor beneath the overflow section. The weir and orifice are constructed of reinforced concrete. The orifice opening is rounded to assist lamprey passage. The crest of the overflow weir is 6-feet above the invert and the non-overflow crest is 2-feet above the overflow crest. The weirs are spaced at 10 foot centers from pool to pool and the ladder invert is sloped at 1 vertical to 10 horizontal. The elevation difference between the crest of the weirs up

the ladder is 1.0-feet. The gravity system (via headbox and presort) must discharge about 30-cfs to maintain 1.0-foot ladder head (design criteria).

2.2.4.1. Lower Ladder

For fish travelling up the ladder, the lower ladder starts from pool 1 (main entrance pool) and Weir 528.6 NAVD 88 (525 NGVD 29 as shown on original as-builts) and terminates at Weir 543.6 NAVD 88 (540 NGVD 29 as shown on original as-builts) and pool 17. The lower ladder has 16 weirs. At pool 17 at the top, the ladder transitions to the tailrace transport channel. Between Weirs 528.6-543.6, the original weirs were replaced with new weirs with the dimensions described above. The positions of the overflow sections in the weirs were switched from the inside to the outside of the channel (or north adjacent to the spillway

stilling basin) to improve the flow characteristics in the transition and bend into the transport channel and in the two existing 90 degree bends. The design flow is 30 cfs with 1 foot head drop between pools.

2.2.4.2. Upper Ladder

For fish travelling up the ladder, the upper ladder guides the fish from the transport channel to the pre-sort pool. The upper ladder starts from pool 19 (transition from transport channel) and Weir 544.7 (NAVD 88) and terminates at Weir 560.7 (NAVD 88) and Pool 35. The upper ladder has 17 weirs. At Pool 35 at the top, the ladder transitions to the pre-sort pool. The design flow is 30 cfs with 1 foot head drop between pools.

2.2.5. Pool 35 – Ladder Head Control with Level Sensor

A level Sensor LT-008 is located in pool 35 between the Finger weir for the pre-sort pool and Weir 560.7 (uppermost weir in fishladder system). The sensor records the water surface elevation in pool 35 to monitor the fishladder head (difference in water surface and overflow weir crest elevations). The PLC will monitor the ladder head from LT-008 to assure that the 1.0 foot ladder head criteria is being maintained within ±0.1 feet tolerence.

2.3. GRAVITY FOREBAY WATER SUPPLY SYSTEM

The Forebay Water Supply (FWS) System provides reservoir water to various demands associated with the Adult Fish Facility, including the fish ladder, and Auxiliary Water System (AWS) through a pair of gravity supply pipes. There are two existing FWS intakes in the dam structure, an upper and lower intake, in the north wall of Penstock No. 2 that route water through two existing supply pipes through the valve room located at EL 591.65 feet (see drawings MA102 and MA301). A vertical trashrack is mounted in guides in front of the intakes for screening the reservoir water (see drawing MA510). The valve room provides for manual isolation and monitoring (temperature and pressure) of the two supply pipes. The upper supply is routed through a 24-inch pipe to serve as attraction water for the side entrance. The lower supply, which conveys the colder temperature water, is routed through a 36-inch pipe to meet demands at the fish facility.

Both pipes are routed through the valve room and down the hopper well to the former holding pool room at EL 573.58 feet where flowmeters are installed with proper straight runs of pipe upstream and downstream (see drawing MA302). The two pipes are buried below the driveway adjacent to the fish ladder structure from the base of the dam down to the vicinity of the Power House where the 24-inch FWS pipe reduces in size and extends into the pump room (see drawing MA502). The flow in this pipe is automatically regulated by a 20-inch rubber-seated ball valve to maintain the flow as monitored by the flowmeter (FIT-002) just outside the holding pool room and in accordance with the control system setpoint.

The 36-inch FWS pipe continues past the east and south sides of the Power House and eventually parallels the upper fish ladder to the Adult Fish Facility. Just upstream of the Headbox (see drawings MA508 and MA509), the pipe is routed through a buried vault where a 24-inch rubber-seated ball valve automatically regulates water flow to maintain the water level in the Headbox in accordance with the control system setpoint (see drawing MA505). Flow into the Headbox is split into ten vertical branches, five on either side, that include manual butterfly valves for adjusting individual pipe flow rates (see drawings MA508 and MP401). At the top of the Headbox, each pipe elbows down to discharge into the top of a packed column to degas and aerate the water supply.

2.2.6. Forebay Intake Screen

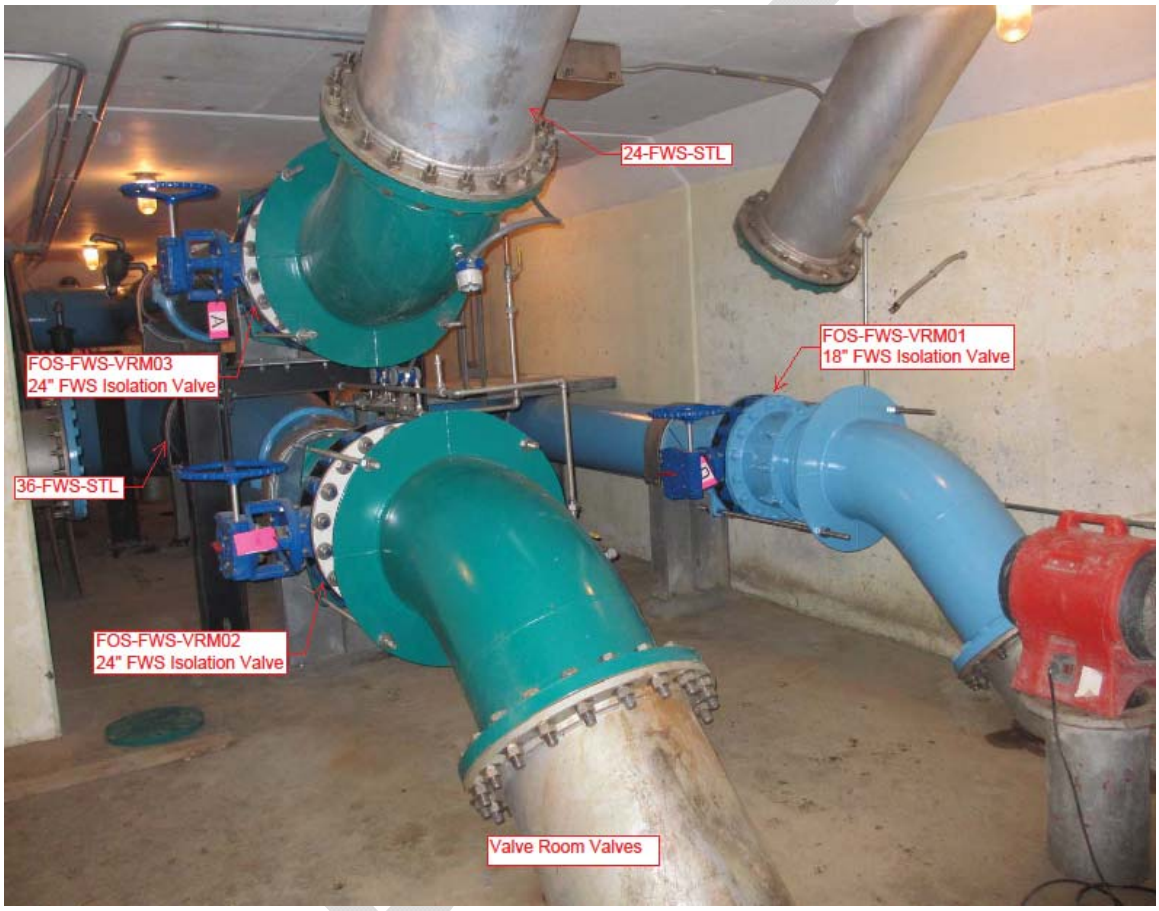
The forebay intake screen for the FWS system is roughly 6 feet wide by 20 feet tall and consists of multiple grating panels with 1½ ”x 3/16” bars set at 15/16” spacing. The trashrack is carbon steel construction that has been hot-dip galvanized and then coated with fusion-bonded epoxy powder coat. The structural frame allows for crane removal of the intake screen using the lifting lug that is extended to dam deck level with a steel alloy chain. The control system estimates the head loss across the trashrack by comparing the pressure values in the FWS pipes to the reservoir water surface elevation value, established by level transmitters (pressure transducers) mounted in the pipes and forebay.

2.2.7. Forebay Intake Bulkhead

A forebay intake bulkhead was fabricated by the Contractor for the project and is available for sealing off the two water intakes from the reservoir. To install the bulkhead (actually two pieces), the trashrack has to be removed first since they share the same guides and dive work is required.

2.2.8. Valve Room

The valve room provides for manual isolation and monitoring of the two FWS supplies (see drawings MA102 and MA301). The upper supply is routed through a 24-inch pipe to serve as attraction water for the side entrance. The lower supply, which conveys the colder temperature water, is routed through a 36-inch pipe to meet demands at the adult fish facility. The original upper and lower FWS supplies extend into the valve room from the ceiling and floor, respectively, as two pairs of 18-inch and 24-inch pipes.



2.2.8.1. Valves

The upper supply is extended off of the existing 24-inch pipe with a manual butterfly valve provided for isolation. The existing 18-inch upper supply is decommissioned at a blind flange. The lower supply is extended off of both the existing 18-inch and 24-inch pipes with individual manual butterfly valves provided for isolation and then manifolded together as the 36-inch FWS pipe. An automatic air/vacuum release valve is located at the high point of both FWS pipes.

2.2.8.2. Instrumentation

The upper 24-inch FWS pipe includes temperature and pressure sensors for monitoring the water supply. The existing lower 18-inch pipe includes a temperature sensor and the lower 24-inch FWS pipe includes a pressure sensor for monitoring the water supply.

2.2.8.3. Follow on Contract Features

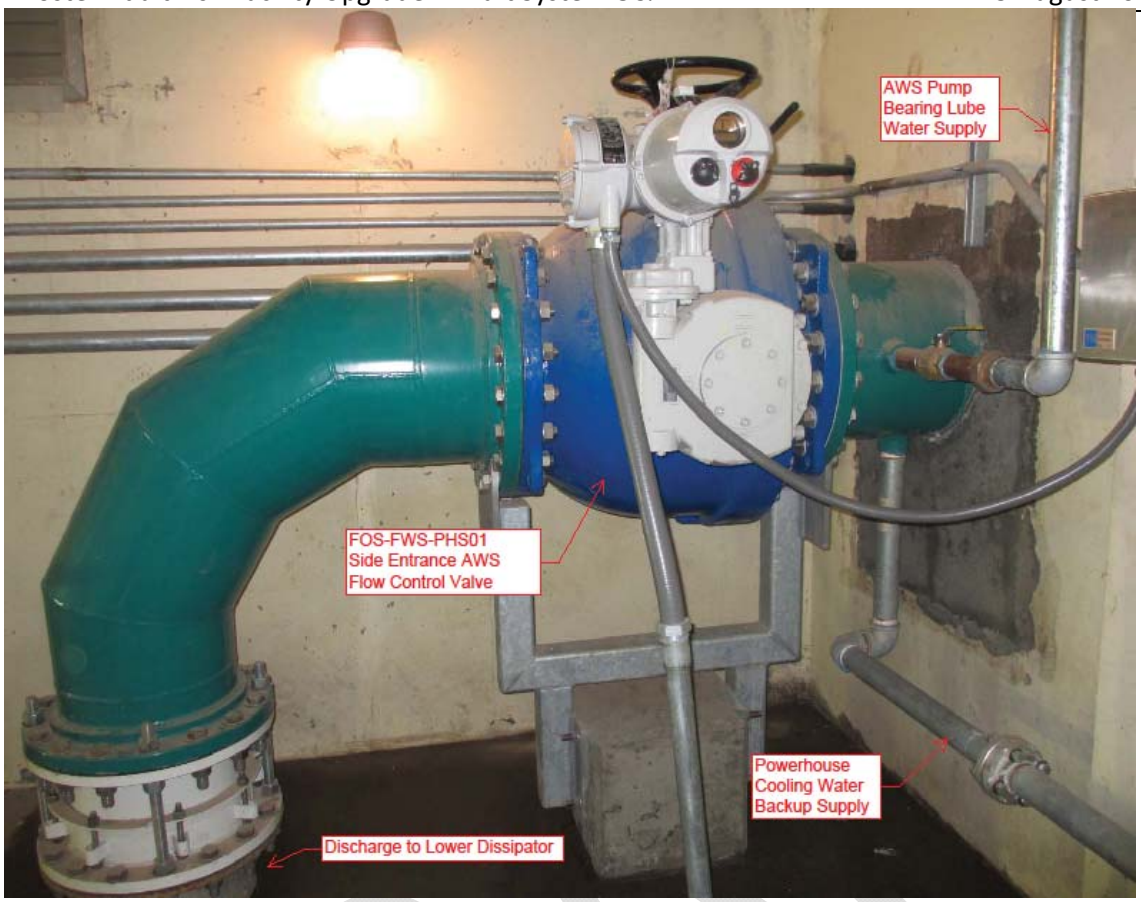
A safety cage was added around the instrumentation piping in order to prevent accidental contact with and subsequent damage to the piping.

2.2.9. Piping to Side Entrance (AWS)

The 24-inch FWS pipe is routed to the side entrance to serve as a gravity attraction water supply. The buried FWS pipe daylights into the pump room where it passes through a flow control valve before discharging through the floor into the Lower Dissipater (see drawings MB102 and MB301). The water flows through an aerator section before passing up through diffusion grating into the transportation channel just upstream of the side entrance gate. This flow can also be directed to either fill the pumphouse or bypass the side entrance and supply attraction water to the main entrance (see Other AWS Features above). After the system was initially put into operation, significant cavitation was observed downstream of the flow control valve in the vicinity of the mitered elbow. As part of the follow on contract, an orifice plate was designed and installed between the new dismantling joint and the existing embedded pipe in order to raise backpressure and suppress the cavitation.

2.2.9.1. Side Entrance AWS Control Valve (FOS-FWS- PHS01)

The flow control valve in the pump room is designed to regulate the flow to the side entrance up to 58 cfs. A 20-inch rubber-seated ball valve is used to automatically regulate the flow rate as monitored by the flowmeter (FIT-002) just outside the holding pool room and in accordance with the plant control system setpoint.



2.2.9.2. Instrumentation

A magnetic flowmeter (FIT-002) is provided in the 24-inch FWS pipe just outside the holding pool room for monitoring and control purposes. The flow signal will be used by the plant control system to regulate the flow control valve position to maintain the established flow rate setpoint.

2.2.9.3. Cathodic Protection

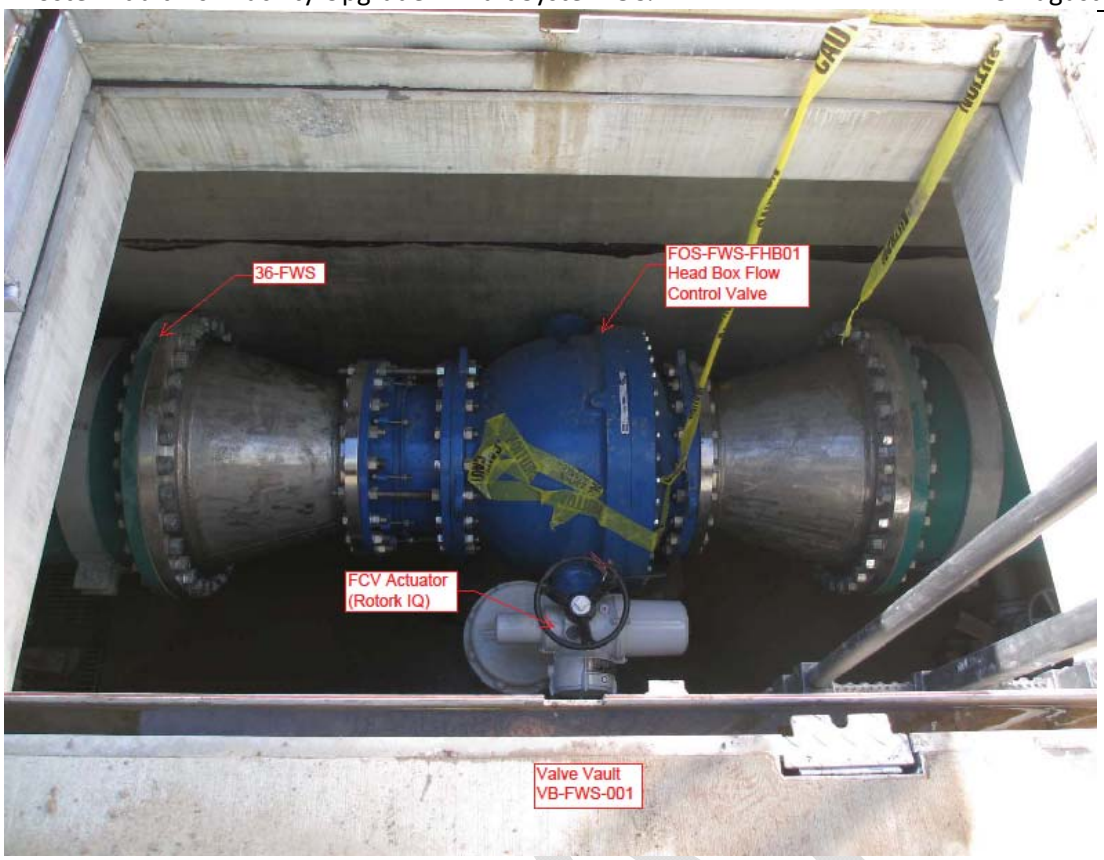
All FWS piping is provided with protective internal and external coatings with System 29, fusion-bonded epoxy. Buried FWS piping is constructed with bonded joints the length of the pipeline and isolation flange joints along with cathodic protection test stations at each end (see drawings MA504, MA508, and MA509). Sacrificial galvanic anodes are installed every 40 feet between the test stations.

2.2.10. Piping to Headbox (FWS)

The 36-inch FWS pipe is routed to the Headbox at the Adult Fish Facility. Upstream of the Headbox, the pipe enters a buried vault where flow passes through a flow control valve that automatically regulates the flow rate to maintain a defined water level in the Headbox (see drawing MA505). The 36-inch splits to supply both sides of the Headbox and branches into ten 14-inch supplies (see drawing MP401). The smaller supplies extend up to the top of the Headbox before elbowing down to discharge into the top of a ten packed columns that degas and aerate the water supply to the fish facility.

2.2.10.1. Headbox Control Valve (FOS-FWS- FHB01)

In the FWS valve vault, a 24-inch rubber-seated ball valve automatically regulates the flow to maintain the water level in the Head Box in accordance with the plant control system level setpoint. A constant water level in the Headbox is desirable for providing a consistent water pressure to demands at the fish facility.



2.2.10.2. Headbox Supply Isolation Valves

Where the 36-inch FWS reduces down to the ten vertical branches, a manual butterfly valve is provided at ground level for adjusting individual flow rates to the packed columns.

DRAFT

2.2.10.3. Instrumentation

A magnetic flowmeter (FIT-001) is provided in the 36-inch FWS pipe just outside the holding pool room for monitoring and control purposes. The flow signal will be monitored by the plant control system and will be used to initiate warning alarms and constrain valve travel if the maximum flow setpoints is reached.

2.2.10.4. Cathodic Protection

All FWS piping is provided with protective internal and external coatings with System 29, fusion-bonded epoxy. Buried FWS piping is constructed with bonded joints the length of the pipeline and isolation flange joints along with cathodic protection test stations at each end. Sacrificial galvanic anodes are installed every 40 feet between the test stations.

2.3. HEADBOX

2.3.1. General Description

The Headbox is a small reinforced concrete water reservoir maintained at a constant water surface elevation for providing a consistent water pressure to demands at the fish facility (see drawing MP401). The water flow to the Headbox is regulated by the upstream flow control valve to essentially match the rate that water is withdrawn from the Headbox (see drawing MA505). To promote fish viability, the quality of the fish facility water supply is improved by passing the reservoir water through packed columns to degas and aerate the water. There are ten columns located on top of the Headbox with individual water supply pipes (see drawing MP402). Each water supply pipe includes a manual butterfly valve for adjusting the water flow to each column given slight variability in piping friction losses.

2.3.2. Packed Columns

The columns (3’ diameter by 5’ tall) are filled with plastic packing media that provides relatively large surface area for promoting gas transfer in the falling water to reduce nitrogen and increase oxygen concentrations. The columns are fabricated of corrugated aluminum pipe with 1-inch aluminum grate lids for retaining the media and helping to distribute the water across the surface.

2.3.3. Instrumentation

A level sensor (LT-007) is provided for control of the headbox flow control valve and is located inside the Headbox (see drawing EF401).

2.3.4. Slide Gates

Stainless steel slide gates have been installed on the interior of the headbox over both of the FWDS supply outlet pipes. These slide gates allow each branch of the FWDS to be isolated independently so that the entire facility and headbox does not need to be dewatered in order to perform certain maintenance tasks at specific parts of the facility. The slide gates are electrically actuated.

2.4. PRE-SORT POOL

Fish jump from the fish ladder, over a finger weir, into the pre-sort pool. The 83-foot long, 13-foot wide,

15-foot tall pre-sort pool is constructed of reinforced concrete. (Normal Operating water volume dimensions are 80-feet by 10-feet wide by 6 feet deep, or 4800 cubic feet.) There is one contraction joint located at the center of the pre-sort pool. The pre-sort pool is sized to hold a maximum of 750 adult fish. Water is supplied to the pre-sort pool through two floor diffusers. During normal operation, the water is 6-feet deep. If water supply is disrupted, the pre-sort pool will maintain 5-feet of depth (as long as the pre-sort valves are closed). The freeboard is to be about 4.3 feet during normal operations.

The design water surface elevation in the pre-sort pool is 562.7 feet NAVD 88.

(However initial operations revealed that the False Weir invert is about 6 - 7 inches too high for the design water level for safe fish passage. This elevation discrepancy is being corrected in upcoming follow-on work. The water level will be about 6 inches higher after the follow-on work.)

2.4.1. Finger Weir

A finger weir is provided at the fish ladder to the pre-sort pool transition. The finger weir is made of aluminum "fingers" and prevents fish from dropping out of the pre-sort pool back into the fish ladder. The finger weir can be adjusted by a hand winch to match any changes to the pre-sort pool level; typically the pre-sort pool water elevation does not change and the finger weir will not need adjustment once the pre-sort pool water level has been set. Fill and vent holes were added to the body of the finger weir during the follow on contract. This allows trapped air to escape and helps the finger weir sink under its own weight when lowering.

1 - Finger Weir

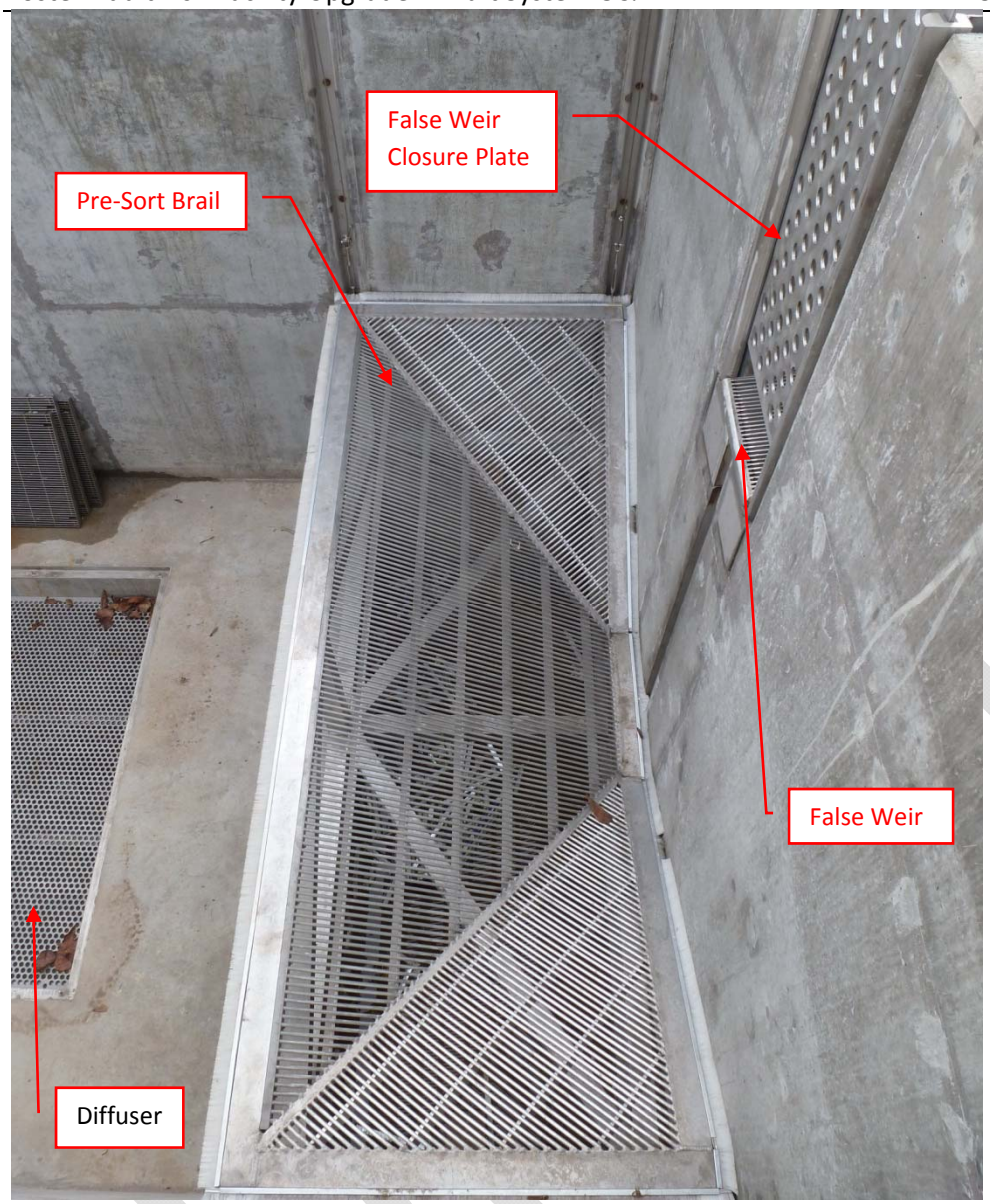
2.4.2. Crowder

The crowder is located in the pre-sort pool. If the fish do not respond to the false weir and jump into the flume on their own, the crowder is used to move the fish toward the false weir. The crowder is powered by electric motors and can be operated from either the pre-sort crowder control cabinet (located on the northeast wall of the pre-sort pool) or the pre-sort control console (located on the work platform at the east end of the pre-sort pool). The crowder has only a vertical barrier screen that lowers into the pool. This reduces the risk of pinching or crushing fish as the screen is lowered into position. During operation, the crowder moves horizontally along the length of the pre-sort pool and forces fish to be concentrated above the pre-sort pool brail.

2 - Pre-Sort Pool Crowder

2.4.3. Pre-Sort Pool Brail

The pre-sort pool brail is recessed into the floor of the pre-sort pool adjacent to the false weir. The brail surface is angled in such a way as to direct fish into the false weir as the brail is lifted vertically through the water column. The brail is operated by an electric motor and can be controlled from either the pre-sort crowder control cabinet or the pre-sort control console.



3 - Pre-Sort Pool Brail

2.4.4. **False Weir**

The false weir provides a falling water stream that enters the pre-sort pool. The water plunges into the pre-sort pool stimulating the fish to jump. Under normal conditions the fish will jump over the false

weir volitionally, eliminating the need for crowding the fish. Water to the false weir is supplied by a centrifugal pump with a rated capacity of 1795 gallons per minute. The amount of water discharging from the false weir can therefore be controlled by a potentiometer located on the pre-sort control console. The false weir also contains a drain section that prevents overspray from the false weir from travelling down the flume and diluting the anesthetic tank, and a flume supply section that provides water to the flume.

2.4.4.1. **False Weir Drain**

The center chamber of the false weir is a drain chamber. Overspray from the pumped false weir water supply should enter the drain chamber instead of going down the flume. The drain chamber is piped to

the storm sewer system and is controlled by a manually actuated butterfly valve. The drain valve should be left in the fully open position during normal operations.

2.4.4.2. False Weir Closure Plate

The false weir closure plate is an aluminum perforated plate that excludes fish from entering the flume while still allowing water to pass from the false weir into the pre-sort pool. In addition to shutting off the false weir pump (to discourage volitional jumping), the closure plate can be lowered into position in order to physically prevent fish from entering the flume. It is anticipated that facility operators will lower the closure plate in the event that the anesthetic tank is full of fish and they do not want more coming down the flume until processing the fish in the tank and/or at the end of the work day.

2.4.5. Pre-Sort Pool Piping (Headbox to Pre-Sort Pool)

The pre-sort pool supply valves will be controlled by the PLC based on the water level in the fish ladder

(pool 35). The water supply piping to the pre-sort pool is made of carbon steel pipe that has been coated on the interior and exterior with Paint System no. 29, fusion bonded epoxy. A 30” diameter pipe branched off of the 36” pipe leaving the West side of the Headbox. The 30” pipe is routed north under the pre-sort pool, where it tees into two 20” pipes that supply the east and west pre-sort pool floor diffusers.

2.4.5.1. Supply Valves

The pre-sort pool water supply piping has two 20" butterfly valves that are electrically actuated, one on each floor diffuser supply pipe. These valves can be modulated to vary the amount of water entering the pre-sort pool through each floor diffuser. The valves can be adjusted remotely by the PLC. Past experience has shown that fish are more likely to volitionally use the false weir if the majority of the flow is entering the pool through the floor diffuser closest to the false weir. Therefore, the PLC has been preset to have the West valve 80% open and the East valve 45% open during normal operations. (An interim operation has been set up to assist with false weir and crowding operations to reduce the elevation difference between False Weir invert and pre-sort pool level. Both Pre-sort valves are temporarily opened to 100% to raise the Pres-sort level about 0.4 ft.)

2.4.5.2. Diffusers

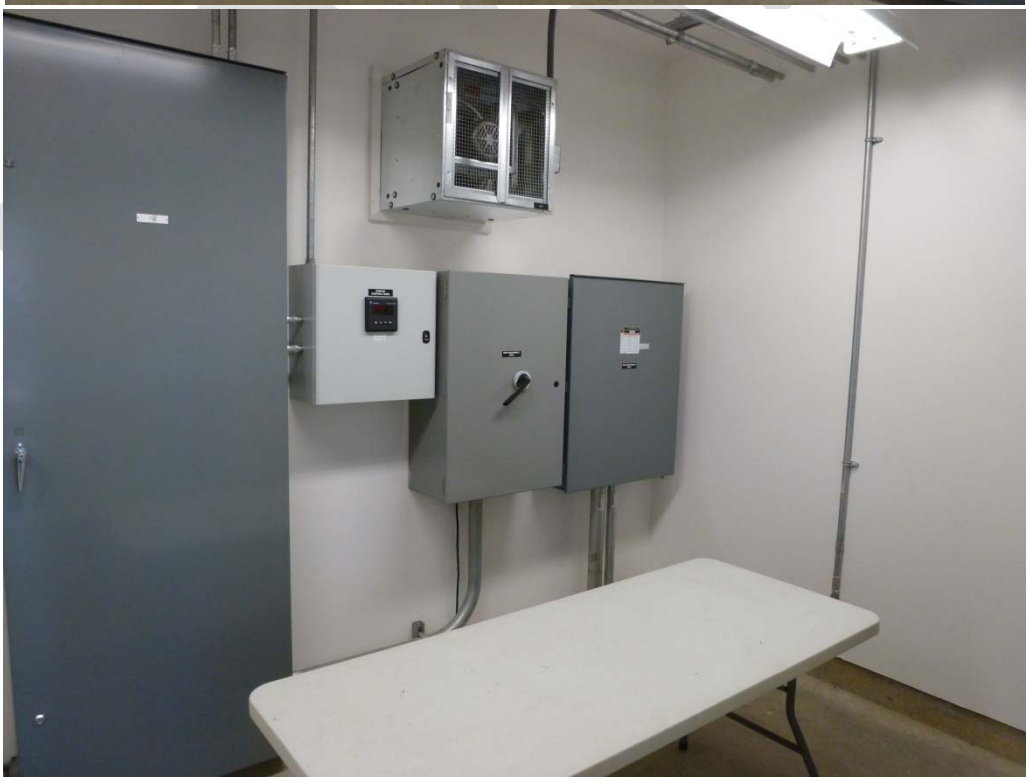
The pre-sort pool diffusers are approximately 2 ft deep and are located at the ends of the pre-sort pool floor. A perforated plate and diffuser grating is located in each diffuser. The perforation plates and diffuser screens are constructed of stainless steel. The perforated plate and diffusers screens are 6 ft by 5 ft. Porosity of the perforated plates is about 51 percent. The diffusers provide hydraulic resistance to flow to reduce any jetting flow that may occur near the outlet of a water pipe.

2.5. SORT FACILITY

After jumping out of the pre-sort pool, over the false weir, fish enter a flume to the sort facility. The sort facility is constructed of reinforced concrete and a fabricated metal building. The ground level of the structure consists of three rooms, including a mechanical/electrical room. The fish sorting equipment is also located on the ground floor of the sort structure.

2.5.1. Mechanical/Electrical Room

This room houses the lighting transformer and panel board for the sort structure electrical loads. Also located here are the PLC cabinet, potable water well pump controller and the intrusion detection panel.



2.5.1.1. Compressed Air

The compressed air system is comprised of a Compressed air pipe, copper type K. The compressed air system operates the anesthetic tank and recovery tank brails, flume switchgates, and long term post sort pool drain valves. There are also connections for pneumatic tools in the service building and one at the North end of the long term post sort pool trolley rails.

2.5.1.2. Washdown Water system

The washdown water system is composed of a 200 gallon (approximate) hydropneumatic tank, an 80 gallons per minute centrifugal pump, and associated piping, pressure switches, and appurtenances. The system supplies pressurized water to 3 frost proof hose bibs in the sorting area. The hydropneumatic tank operates within a pressure range of 30-50 psi.

DRAFT

2.5.2. Pre-Sort Flume to Anesthetic Tank

The transport flume provides fish passage from the pre-sort false weir to the first downstream switch gate. It is fabricated using aluminum and has a U profile. Square bottom to U bottom transitions are provided for the false weir and downstream switch gate.

2.5.3. Switch Gates

The switch gates are downstream from the fish transport flume. They are fabricated using aluminum and have Composite bushings at hinge points and a single pneumatic cylinder for actuation. There are three switch gates that allow the operator to choose where a fish is deposited; anesthetic tank, return to river pipe, short term post-sort pool 1 and short term post-sort pool 2. Switch gates are operated from the observer platform panel located near the pre-sort false weir. The switch gates are pneumatically actuated.

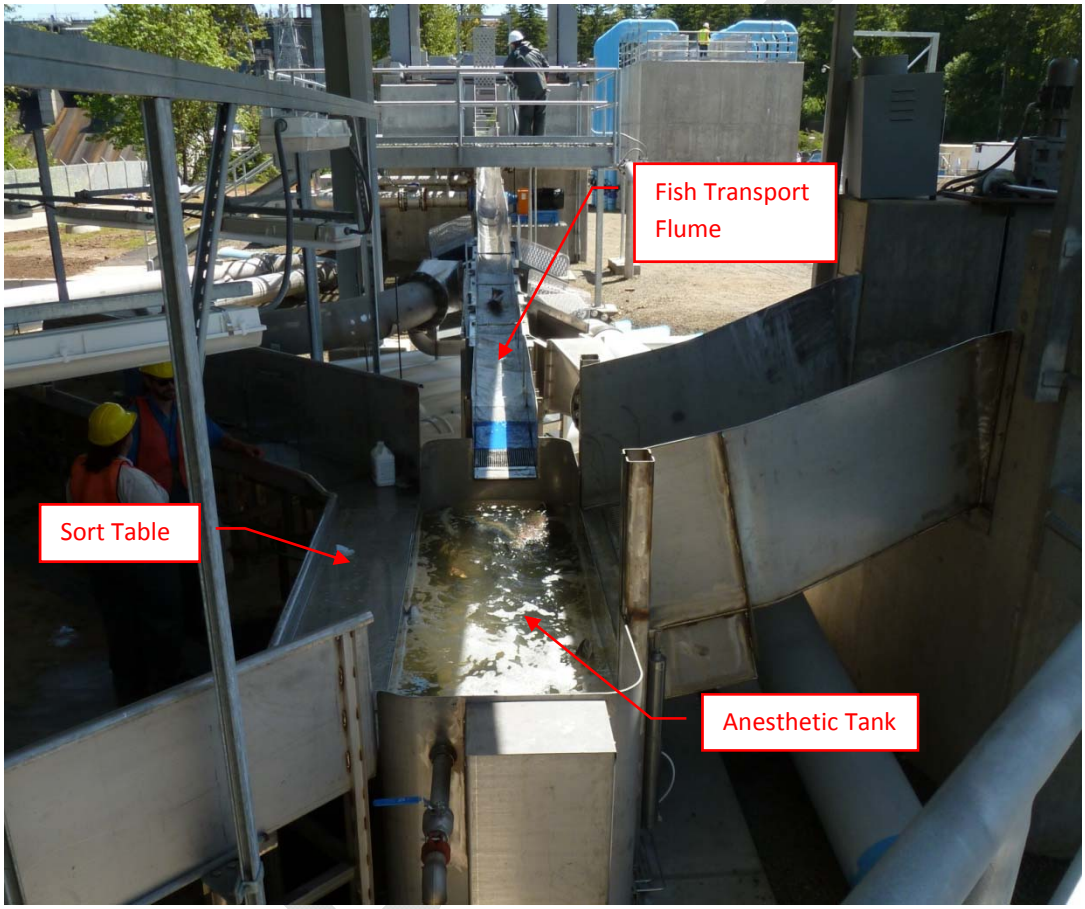
2.5.4. Anesthetic Tank

The anesthetic tank is a 3'x10' stainless steel tank used to anesthetize fish prior to sorting/spawning. A fish brail forms a false bottom in the anesthetic tank, and can be actuated up by pneumatic cylinders to lift anesthetized fish out of the water for processing. The fish transport flume and the fish lock return flume both run through a dewatering screen before connecting to the anesthetic tank. The anesthetic tank has a fill pipe that is controlled by a manually actuated ball valve, and overflow drain, and a low point tank drain. The low point tank drain is controlled by a manually actuated ball valve and is routed to a bioswale. The anesthetic tank is designed for use with clove oil or Eugenol anesthetic. However, if CO2 is used to anesthetize fish, a tank cover has been provided. Additionally, during the follow on contract, two air stones were added to the bottom of the tank along with tubing, hose, and fittings so that facility operators can supply compressed oxygen and/or compressed CO2 to the tank. Typically, there is one dedicated bottle of each gas piped to its own air stone.

DRAFT

2.5.5. **Sort Table**

The sort table is a large, V-shaped table used for sorting anesthetized fish. The sort table is connected to all 12 of the post-sort pools through watered fish pipes coming through the back wall of the table. The East end of the sort table also connects to the recovery tank. The 12 fish pipes each have a dedicated 4" water supply line, controlled by a 4" ball valve, beneath each fish pipe opening. Note that 3 of these fish pipes are for the future pools. There may be 2 additional short term post-sort pools and 1 more long term post-sort pool added to the facility in the future. The water supply valves on these future pool fish pipes should not be operated. The fish pipes have a blind flange with small drain hole installed at the end of each pipe.



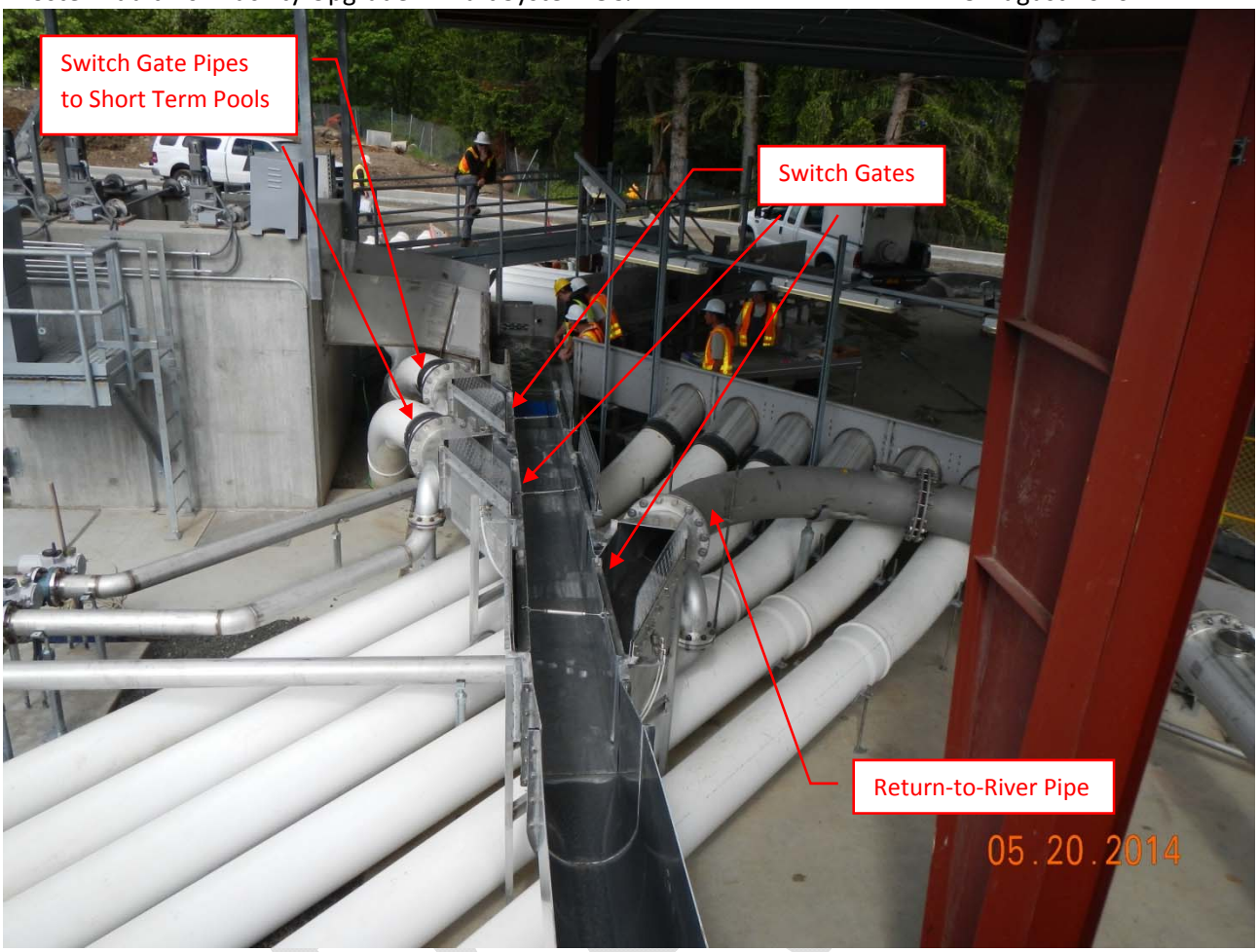
2.5.6. **Fish Transport Pipes**

The fish transport pipes are schedule 40 PVC pipe assembled using bell and spigot connections. They transport the fish from the sorting facility to the post-sort pools; long term or short term based operator preference.

2.5.6.1. Fish Pipes from Switch Gates to Short Term Pools

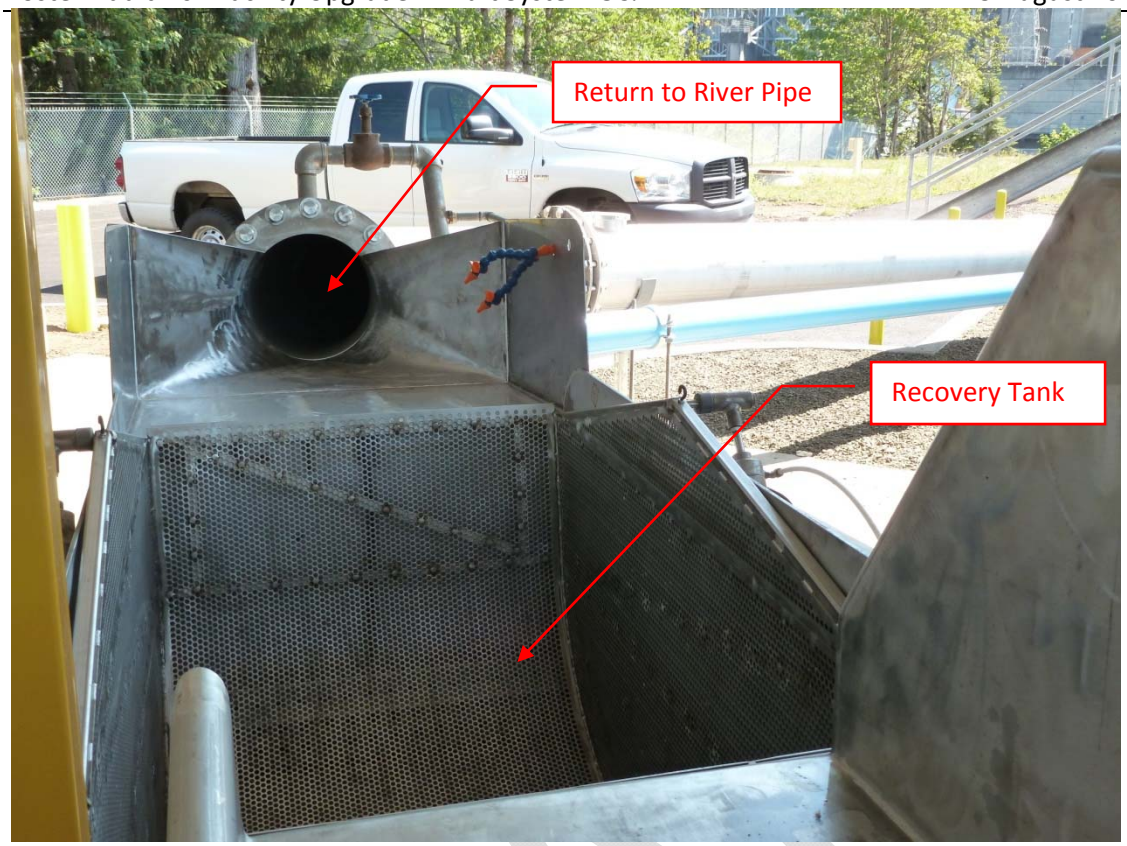
These fish pipes work with the switch gates to direct the fish from the flume to the short term post–sort pools without being handled by an operator.

DRAFT



2.5.7. **Recovery Tank**

The recovery tank's purpose is to provide a place for fish to recuperate from their anesthetized state before being returned to the river. The tank is stainless steel with a stainless steel fish brail inside of the tank. The brail is actuated by pneumatic cylinders.



2.5.8. Return to River Pipe

The return to river pipe is most composed of schedule 40 PVC pipe assembled using bell and spigot connections. Portions of this pipe are stainless steel to accommodate a 6 foot radius. This pipe moves non-target fish from the sorting facility to an out fall location in the river. ESA fish are not allowed in the pipe.

2.5.9. Sort Area Water Supply Piping, Valves, and Appurtenances

2.6. POST-SORT POOLS, SORTING CHANNEL, FISH LOCK AND HOPPER PIT

The post-sort pools, sort channel, and hopper pit are constructed of reinforced concrete. There are 5 long term post-sort holding pools and 4 short term post-sort holding pools. The long term pools are 10-foot wide by 80-foot long and the short term pools are 10-foot wide by 20 foot long. Water enters and exits the post-sort pools through floor diffusers. The long term post-sort pools are sized to hold a maximum 350 adult fish per pool. There is a 6-foot wide by 115-foot long crowding channel located between the long term and short term pools. A hopper pit is located on the south end of the crowding channel and the fish lock is located on the north end of the channel. Fish are crowded from the post-sort pools to the crowding channel and then to the hopper for truck loading or to the fish lock for processing.

2.6.1. Post-Sort Pool Crowders

There are 2 post-sort pool crowders; 1 for the short term pools and 1 for the long term pools. Each crowder has an associated trolley that is used to transport the crowder from one pool to another. The post-sort pool crowders are ride-on type crowders where the operator rides on the crowder while operating it. The trolleys are operated while standing on the crowder when it is parked on the trolley. The trolley is used to move the crowder from one post-sort pool to another. Both the trolleys and crowders are powered by electric motors.

2.6.2. Crowding Channel Crowder

There is one crowding channel crowder. This crowder has two vertical barrier screens; one on the north end for crowding fish into the fish lock, and one of the south end for crowding fish into the hopper. The crowder is a ride on type crowder and is operated by a pushbutton pendant.

2.6.3. FWS Piping (Headbox to Post-Sort Pools)

The piping that conveys water from the headbox to the post-sort pools comes from the 30 inch opening on the south side of the southwestern corner of the headbox. A 24 inch pipe tees off the 30 inch main immediately after exiting the headbox and is routed to the northwest in order to supply the switch gates, fish lock, the pipe then reduces to 20 inch and turns south to supply the short term post-sort pools. The 30 inch pipe continues south, reduces to 24 inch, and supplies the long term post-sort pools, hopper pit, and truck fill pump. The 30 and 24 inch pipes are carbon steel that have been coated on the interior and exterior with a fusion bonded epoxy paint system. 8 inch pipes branch off the 24 inch main to supply each individual short term post-sort pool while 10 inch pipes branch off and supply each long term post-sort pool and the hopper pit. These branch pipes are made of stainless steel as they pass through the short term and long term supply vaults, and then transition to PVC under the post-sort pool structure.

2.6.4. Recirculation Water System

The recirculation system consists of two 250 gpm centrifugal pumps, piping, isolation valves, appurtenances, and an electrical control panel. The recirculation system serves two functions. The first is to drain water from various locations to back to the river via the storm sewer system. The short term pools and diffuser pits, long term pools and diffuser pits, and hopper pit can all be drained back to the river by the recirculation pumps. The second function is to introduce a treatment chemical and recirculate it within any one of the long term post-sort pools. The treatment chemical is introduced, along with water from the selected pool on the suction side of the pump, the mixture is then discharged to the pool through a series of wall mounted sprayers. The recirculation system is located in the recirculation vault at the southeast corner of the post-sort pool area. All post-sort pools, the hopper pit, and the chemical intake are plumbed to a manifold on the suction side of the pumps. The discharge side of the pumps is a manifold consisting of lines to each long term post-sort pool sprayer system, and the drain to river line. An isolation valve is present on each line such that water can be drawn from one source and discharged to one location. Indeed, the system is designed draw water from only one source and discharge it to one location. The two pumps are redundant and the system is designed to function using only one pump at a time.

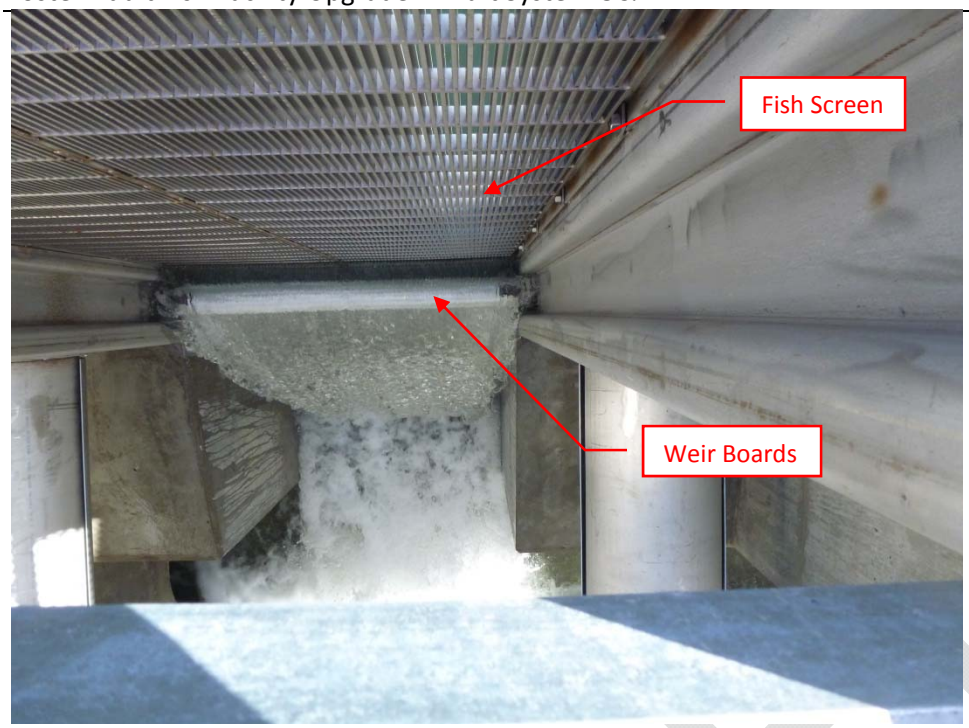
2.6.5. Diffusers

There is one post-sort pool floor diffuser per pool. The diffuser openings in the long term post-sort pools are are 3-foot wide by 3-foot long. The diffuser openings in the short term post-sort pools are 18” wide by 18” long. The diffuser opening is covered by a grating and a perforation plate is located under the grating. The grating and perforation plate are constructed of stainless steel.

2.6.6. Removable Fish Screens and Weir Boards

There are 9 removable screens, one at the end of each post-sort pool. The removable screens are constructed of a stainless steel frame and stainless steel bar grating. The porosity of the removable screens is 75%. There are 9 overflow weir boards at the end of each post-sort pool. The overflow weir boards are constructed of aluminum. There is one aluminum weir board lifting beam that can be used to latch onto a weir board and remove it from the slot.

DRAFT



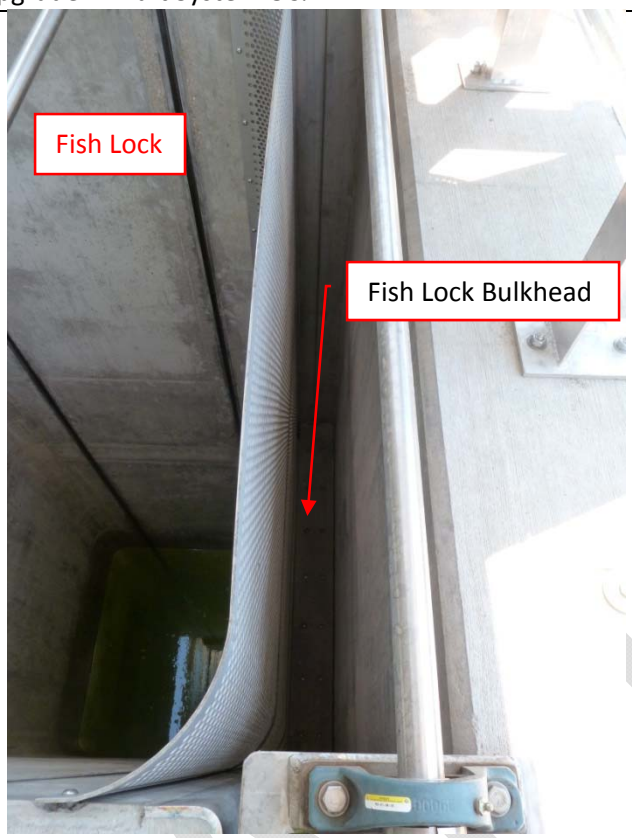
2.6.7. Post-Sort Pool Bulkheads and Hoists

These bulkheads provide separation between holding pools and the crowding channel. They can provide a hydrostatic seal in both directions. The bulkheads are moved using a pendant controlled hoist and are not designed to be moved under differential pressure.

DRAFT

2.6.8. Fish Lock Bulkhead and Hoist

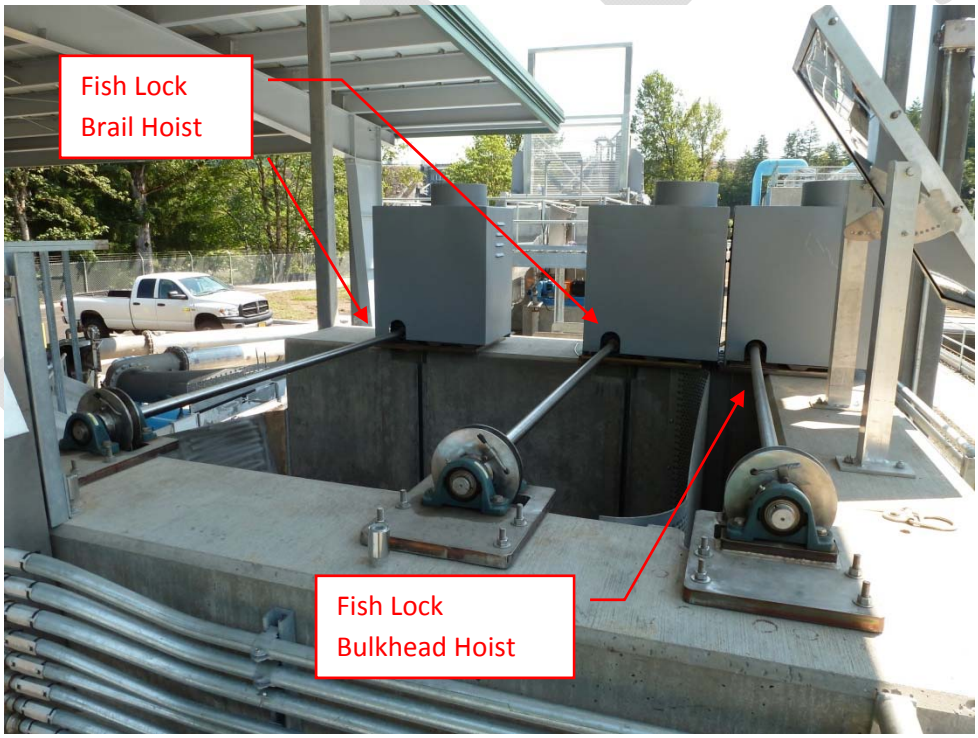
The fish lock bulkhead is used to seal a 6 foot by 6 foot column space at the end of the crowding channel. It is mostly aluminum in composition with composite rub blocks and J-bulb seals that work to seal the bulk head against stainless steel guides.



2.6.9. Fish Lock Brail and Hoist

The fish lock brail is fabricated from stainless steel components. There is a perimeter brush that keeps fish from the ancillary space between the brail and the lock wall.

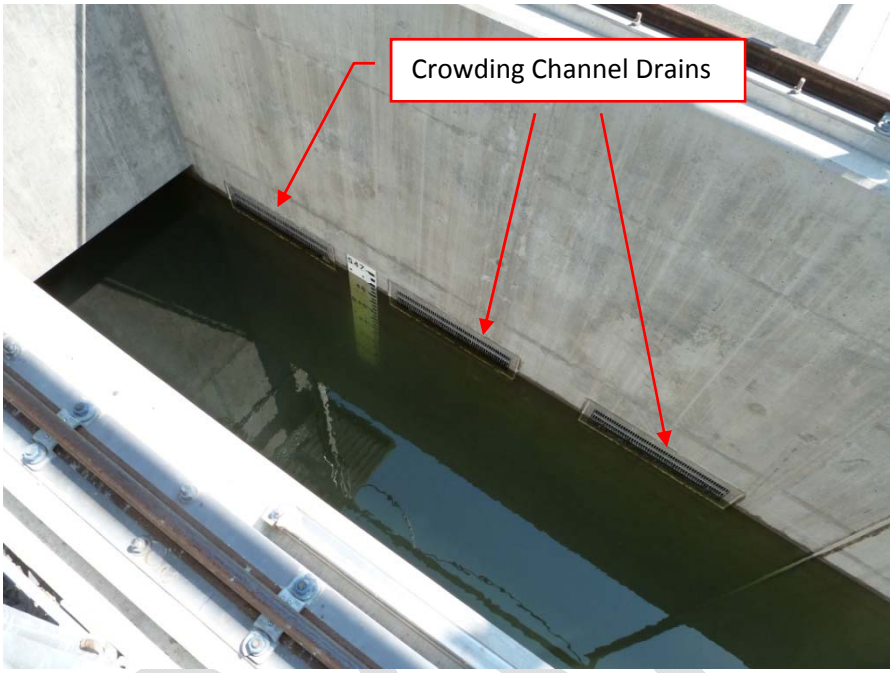
DRAFT



2.6.10. Crowding Channel Drain System

The water level in the crowding channel is maintained by overflow drains in the walls at the North end of the channel near the fish lock. The elevation of the overflow drains is such that the maximum was depth is nominally 6 feet deep. The Crowding channel can be drained one of three ways. First, if the fish lock bulkhead is open, the channel can be drained by opening the fish lock drain valve (FOS-FWDS-FLK02). Second, one or more post-sort pool bulkheads can be opened so that the channel drains through the post-

sort pool(s) as the pool(s) drains after weir boards are removed. Lastly, the channel could be drained by the recirculation pumps by opening the hopper pit drain valve is discharging the pumps to the river drain. This third method is not preferred nor recommended as it would add undue wear and tear on the recirculation pumps.



2.7. FISH TRANSFER SYSTEM AND LOADING EQUIPMENT

2.7.1. Hopper Crane

The hopper crane is provided for raising the fish hopper from the hopper pit at the south end of the crowding channel and moving it to the driveway to mate up with the fish transport truck. The hopper crane is a pendant-controlled (H4 Duty Class) monorail trolley and hoist rated for 7.5 tons and mounted in an underhung configuration. The crane has two-speed controls for both raising and lowering the load and moving the trolley along the monorail beam. The pendant provides pushbuttons for on/off, hoist up/down, trolley north/south, and crowder bypass, along with a 3-position bypass selector switch for testing the upper limit switch. The hoist has been set up with multiple safety devices including upper and lower geared travel limits and upper (gravity contact) limit switch. The hoist trolley will travel the length of the beam with bumper stops at either end as safety stops. The trolley will traverse at 65 or 22 fpm and the hoist will raise/lower at 15 or 5 fpm depending on how far the respective two-position pushbuttons are depressed.

2.7.2. **Hopper Loading Structure**

The hopper loading steel-frame structure extends from the hopper pit to the fish truck loading station in the driveway. It is fabricated using A992 structure steel shapes and A572 Grade 50 for fabricated brackets and bracing. Stainless steel wire ropes with adjustable turnbuckles are used to shore up the structural bracing. A325 structural bolts used in combination with load sensing washers are used for structural component assembly. A monorail beam extends overhead from the hopper pit to the driveway area.

2.7.3. **Fish Hopper**

The Fish Hopper is used to transport ESA fish from the Crowding Channel to the fish truck by "water to water" transfer. The Hopper is primarily fabricated from 6061-T6 aluminum. The hopper footprint is 5'-10" square and its height is 15'-7½". When stowed in the Hopper Pit, the portion of the Hopper extending above the channel floor elevation has one side open towards the Crowding Channel that interfaces with the Crowding Channel Crowder. The Crowder screen forms the fourth wall of the Hopper to retain fish inside

while the Hopper is stowed. As the Hopper is raised, the water drains out through the perforated sides and the fish are retained in the solid-wall-sided bottom. A concrete storage "box" is located at the hopper pit end of the crane for storing the Hopper above ground. General steps for using the hopper is as follows:

- The hopper is lowered into the crowding channel hopper pit.
- Fish are crowded down the crowding channel into the hopper with the screen panel sealing off the Hopper Pit area. The crowder makes contact with the limit switch at the end of the channel, which activates the hopper crane controls.
- The hopper is lifted out of the pit, moved along the monorail, and lowered onto the truck that has previously been filled with water.
- The hopper valve is opened to allow water to pass into the empty space in between and equalize pressure across the hopper door.
- The hopper door actuation lever is pulled down, opening the hopper door located at the bottom of the hopper and creating the water-to-water passage with the truck.
- The drain valve on the truck tank is opened to lower the water level into the truck and effectively transfer all fish into the truck.
- The drain valve is closed, the hopper door closed, the hopper disconnected from the truck, and the hopper replaced back in the Hopper Pit.

DRAFT

2.7.4. **Fish Truck**

The fish truck consists of a Freightliner truck chassis and a custom 1500 gallon stainless steel tank for holding fish. The tank was manufactured and assembled onto the chassis by West-Mark, Inc. in California. The tank includes features such as baffles, vents that can seal in order to minimize leakage when the water to water connection with the hopper is made, aerators, and a pneumatically actuated knife gate outlet. The trucks for Foster Fish Facility and Minto Fish Facility were procured under the same contract and are identical.

DRAFT

2.7.5. Truck Fill Station

The truck water fill station provides a pressurized water supply for quickly filling the fish truck prior to loading fish. Trucks are positioned at the fill station in the driveway adjacent to the Hopper Crane with the tank hatch beneath the overhead fill pipe outlet before starting the booster pump to deliver the water. The truck fill pump is operated by manual start/stop pushbuttons at the local control station and the water level monitored by visual observation of the truck tank sightglass. There is a butterfly valve on the discharge side of the pump that should be throttled in order to maintain a desired pressure of 8 psi on the pump which maintains a desirable operating condition for the pump. The truck fill station has provisions for freeze-protecting the water piping by closing a supply isolation valve and opening a drain valve plus draining the pump volute.

DRAFT

2.8. Drainage System

The site drainage system uses a system of catch basins, ditch inlets, manholes, and piping to convey stormwater and facility process water generated by the site to either the river or to one of three rain gardens.

2.8.1. Outfall Structure

The outfall structure is a 50 foot wide concrete bubbler type structure. The invert elevation of the pipe into the bubbler structure is 7.0 feet below the exit weir of the structure. When the bubbler structure is operating, head generated by the upstream system raises the water surface elevation within the bubblier structure until it crests over the weir. The bubbler structure conveys storm and discharge water to the river after it reduces the velocity of the water and broadens its flow width to reduce scour of the downstream riprap pad. Water tributary to the outfall structure includes: treated stormwater generated by the northwestern portion of the site near the sorting/spawning facility; the sorting/spawning facility foundation drains; the post sort pools; the head box; and the numerous vault floor drains.

Outfall Structure

2.8.2. Facility Drains

2.8.2.1. Post-Sort Pools and Vaults

The post-sort pools and vaults drain to the storm system in the northwestern section of the facility which, in turn, flows to the outfall structure and into the river.

2.8.2.2. Fish Truck Discharge

The fish truck discharge is located to the east of the truck fill station. It consists of a curb opening, riprap pad, and 2 inch underdrain. The underdrain discharges into sanitary sewer manhole #2. If the underdrain gets overwhelmed, excessive water drains to the adjacent low field and into a ditch inlet which conveys that water to the south rain garden

2.8.3. Rain Gardens

There are three rain gardens onsite: an east rain garden, a south rain garden, and a west rain garden. The east rain garden is located near the parking lot for the administration building. The south rain garden is located to the south of the long term post-sort pools. The west rain garden is located to the west of the sorting/spawning facility. Polluted rainwater flows into the rain gardens and is treated by the amended soils and root systems before infiltrating into the substrate.

DRAFT

South Rain Garden looking south

South Rain Garden looking north

West Rain Garden

East Rain Garden

2.8.4. Anesthetic Pond

The anesthetic pond is located between the sorting/spawning facility and the sort-term post-sorting pool. The anesthetic tank in the sorting/spawning facility drains to the anesthetic pond were the clove oil is allowed to evaporate and the remaining water is treated by the amended soils and root systems before infiltrating into the substrate.

Anesthetic Pond

2.8.5. Water Quality Catch Basins

There are two water quality catch basins onsite. One water quality catch basin is located north of the sorting/spawning facility. The other water quality catch basin is located north of the administrative building. The water quality catch basins are single filter StormFilter catch basins manufactured by Contech Engineered Solutions. Treated stormwater is discharged either directly into the river or into a storm drainage system which outfalls into the river.

DRAFT

Water Quality Catch Basin north of the Sorting/Spawning Facility

2.9. Sanitary Sewer

The site is served by a municipal sanitary sewer system operated and maintained by the City of Sweet Home, OR.

2.9.1. Oil/Water Separator

An oil/water separator removes petroleum based pollutants from the effluent from the maintenance building floor prior to discharging into the onsite sanitary sewer system. It is located to the south of the maintenance building.

2.10. Potable Water System

Potable water is provided to the site by the City of Sweet Home, OR.

2.11. Fire Protection Water System

A 6 inch fire service addition to the site was constructed on the western side of the site. Included in the fire service are two fire hydrants, one to the west of the sorting/spawning facility and the other to the west of the maintenance building.

2.12. Ancillary Structures

2.12.1. Maintenance Building

The Maintenance Building provides an office, break room, toilet room, and janitor's closet as well as a maintenance/storage area within the building. The building has three exterior doors and two roll-up doors into the maintenance/storage area. All spaces have HVAC for conditioned air delivery for ventilation and heating.

DRAFT

2.12.2. Site Host Pad

The site host structure includes a prefabricated metal structure and a reinforced concrete slab on grade.

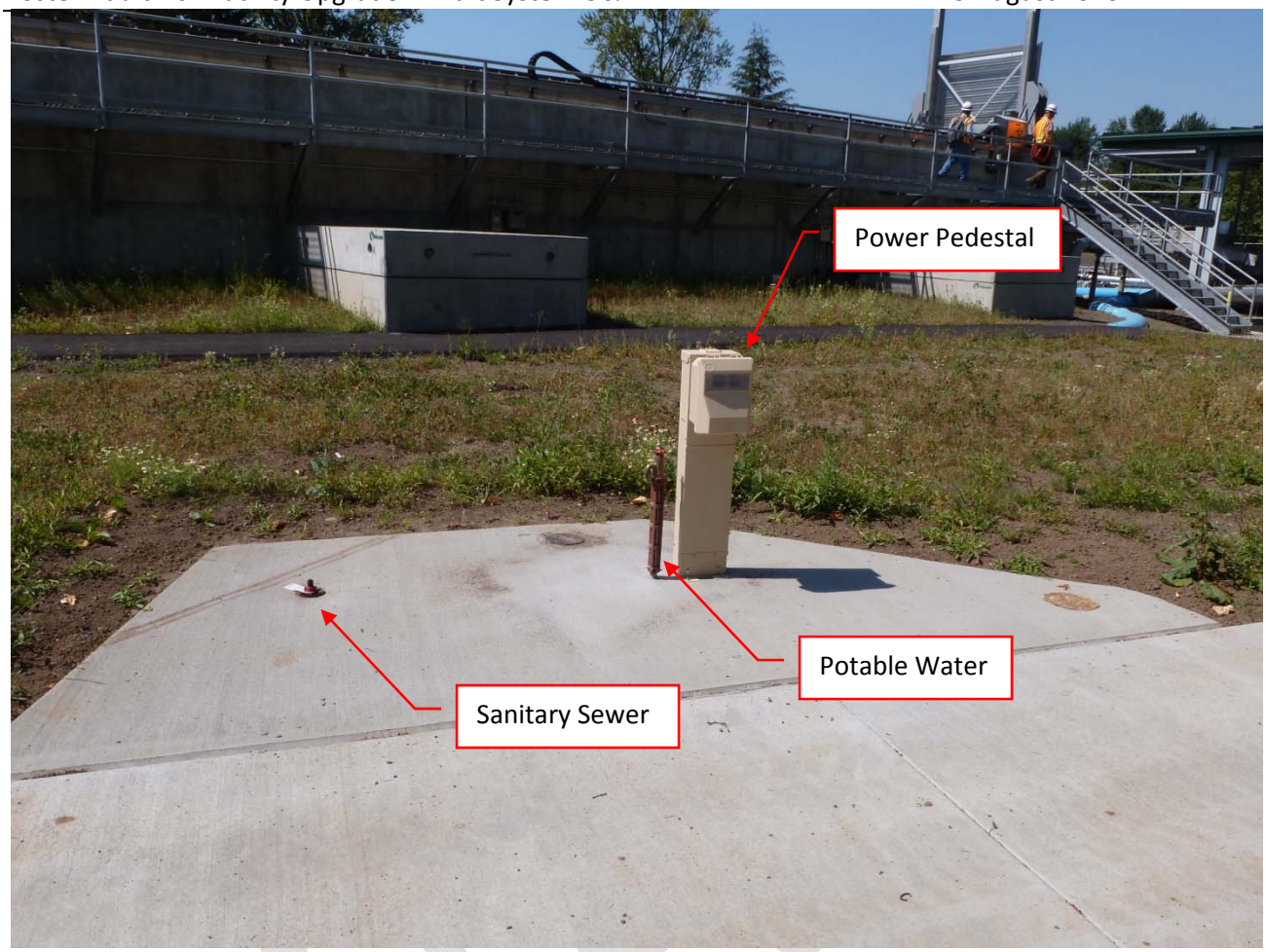
DRAFT

2.12.2.1. Power Pedestal

Power to the site host is provided from mini-power center MPC-2 (located in the IPS). The power pedestal provides receptacles for 50A (240V) and 30A (120V) service as well as a duplex 20A, 120V convenience receptacle. Circuit breakers are provided for each circuit.

2.12.2.2. Potable Water

Potable water is provided at the site host structure. A hose bib is provided as part of the power pedestal.



2.12.2.3. Sanitary Sewer

A sanitary sewer dump connection is provided at the site host structure.

2.12.3. Chemical Storage Building

The Chemical Storage Building provides a protected environment for safely storing Formalin fish treatment chemical while providing for worker safety. The pre-fabricated metal building is continuously ventilated to eliminate any potential for formaldehyde gas buildup and heated to maintain proper chemical temperature. The building includes built in secondary containment below a grated floor and a dry-chemical fire suppression system. An emergency eyewash/safety shower is included within the building with a hot water tank provided for supplying tepid water.

2.13. FACILITY ENTRANCE GATES

Vehicle access to the facility is restricted by two gates (bar gate and security gate). Each gate is operated by a motor operator. Motor operators are controlled either through a wireless remote control or keypads for both entry and exit. Facility personnel are able to open the gates with remote controllers without leaving their vehicles. Others are required to leave their vehicle and enter a code on the keypads to gain entry and to exit. The outer most gate (bar gate) has the capability to remain open during operation hours and then shut for after-hours security.

DRAFT

2.14. POWER

2.14.1. Station Service Supply

2.14.1.1. Backup Power System

The Emergency Generator brand name MTU Onsite Energy Rated at 600 KW.

The engine portion, manufactured by MTD Detroit Diesel, is a Model DS600D6SRA

Engine features include:

- V12 1600 series 4 Cycle Diesel engine with 21.0 Liter displacement.
- Common Rail fuel injection
- 24 Volt Charging alternator and battery system
- 24 Volt starting motor
- Rated RPM 1800
- Max power 896 bhp
- Electronic Isochronous Governor
- Thermostat controlled water Jacket heater with pump assist
- Recommended fuel #2 diesel
- Battery Cold cranking amps 1000
- Fuel Consumption 40 gal/hr at 100% load

The Generator Portion, manufactured by Marathon, is a model 572RSL4031

Generator features include:

- 480V/277V
- PMG (Permanent Magnet Generator)
- 3 Phase 4 Lead WYE
- PF 0.8
- 60 HZ
- 600 KW
- 750 KVA
- 902 AMPS
- 4 Pole, rotating field
- Sustained short circuit current of up to 300% of rated current for up to 10 Seconds
- Digital, Solid State, Volts per-Hertz Regulator/ ± 25% Voltage Regulation
- Brushless Alternator with Brushless Pilot Exciter

Liquid Capacities and specifications

- Total oil System 19.3 Gal / Delo SAE 15W/40W
- Engine water jacket capacity 17.2 Gal
- System Coolant capacity 28.1 Gal / Castrol Antifreeze NF Premix (45%)
- Primary fuel filter – RACOR 2020 PMOR 30 Micron Available thru NAPA (1 ea)
- Secondary fuel filter – MTU Fuel filter Part No. x57508300028 (1 ea)
- Oil filter – MTU oil filter Part No. x57518300024 (4 ea)

The MTU GENSET is equipped with a Digital Control Panel, its functions is to provide start and stop capability of the generator and monitor Engine and Generator parameters and provide protection functions it also includes the following features:

- Digital metering

- CAN Bus ECU Communications
- Windows-Based software
- Remote Communications to RDP-110 remote annunciator
- 16 Programmable Contact inputs
- Up to 11 Contact Outputs
- Event Recording
- Backup battery for Date and time monitoring
- Internal Dial-Out Modem with remote Dial-Out and Dial in Capability
- Generator protection includes:
    - Under voltage (27)
    - Over voltage (59)
    - Reverse Power (32)
    - Over frequency (81U)
    - Phase Imbalance (47)
    - Generator Overcurrent (51)

- Engine Protection includes:

  Alarms (Shutdowns)
    - Low Oil Pressure
    - High Coolant Temperature
    - Low Coolant level
    - Low Fuel Level
    - Overspeed
    - Overcrank
    - Engine Sender unit Failure
    - Emergency Stop
    - Battery Charger Failure
    - Critical Low Fuel Shutdown

- Pre-Alarm (Warnings)
    - Low Oil Pressure
    - High Coolant Temperature
    - Low Coolant Temperature
    - Battery Overvoltage
    - Weak Battery
    - Battery Charger Failure
    - Engine Sender unit Failure
    - Engine KW Overload (3 levels)
    - Maintenance Interval timer
    - Low Coolant Level
    - Low Fuel Level
    - Fuel Leak Detect
    - High Fuel Level

DRAFT

2.15. Industrial Control System (ICS)

2.15.1. Programmable Logic Controller (PLC)

There is a single controller (CPU) with distributed I/O located throughout the system. All graphic terminals, digital power meters, valve/gate actuators, and related analog and discrete I/O devices are connected to the PLC system.

2.15.2. Graphic Terminals

Graphic terminals are used to adjust and monitor various devices and systems of the fish collection system. Reference chapter 8 for additional information.

2.15.3. Water Level Sensors

All water level transmitters are submersible and not field adjustable.

2.16. Pavement

2.16.1. Asphalt Concrete

Hot mix asphalt was installed at all locations and drive aisles that expect regular vehicular traffic. The typical asphalt section for the site is 3 inches of asphaltic concrete over 8 inches of rock.

2.16.2. Portland Cement Concrete

The site host structure consists of 8 inches of portland concrete cement over 6 inches of gravel base rock.

2.16.3. Gravel

Where traffic, both vehicular and pedestrian is anticipated to be minimal, the surface was covered with 3 to 6 inches of gravel.

2.16.4. Grass Pavers

The maintenance way to the south of the fish ladder was covered with a cellular grass retention product to increase the bearing strength of the surface to allow for occasional maintenance vehicle traffic.

2.17. Landscaping

The site is conservatively landscaped with lawn, shrubs, and trees, most of which should be of fairly low maintenance.

DRAFT

3. Chapter 3: Theory of Operation

An executive summary of the facility operation will be added here for the final SOMM.

3.1. Theory of Operation

The Foster Adult Fish Facility Upgrade provides an improved fish ladder including a new ladder section routed to the new adult fish facility where fish holding pools were added, all for improved fish collection, monitoring, and transport. Associated upgrades include (1) two new gravity water supply pipelines for supplying side entrance attraction water and for meeting adult fish facility water demands including the fish ladder supply, (2) a modernized auxiliary water supply pumping system for providing attraction water at the fish ladder main entrance and side entrance including new control gates and electric hoist actuators, and (3) an updated control system with new instrumentation and touch screen controls.

3.1.1. Forebay Water Supply System

The Forebay Water Supply (FWS) System is designed to provide a gravity supply of reservoir water for meeting facility water demands including fish ladder flow, attraction water for the side entrance, and the adult fish facility. The supply for the FWS system relies on the existing intakes in the sidewall of Penstock No. 2. Reservoir water passes through a trashrack at the two intakes that are located approximately 10 feet and 24 feet below minimum reservoir WSEL. The intakes at these elevations avoid the majority of floating debris and tap the cooler water layers with the deeper intake dedicated to the fish facility. A new trashrack with 3/4-inch gaps between bars excludes debris and larger fish from the water supply. The upper intake is dedicated to supplying attraction water to the side entrance through a 24-inch diameter steel pipe. The lower intake is dedicated to supplying water to the fish facility including the fish ladder through a 36-inch steel pipe. The water supplies to the two pipelines can be isolated with manual butterfly valves in the valve room at EL 591.65 in the dam structure. Air/vacuum release valves are provided at the pipe high points in the valve room to automatically purge air for watering up and during operations and to allow air entry to prevent vacuum formation during pipeline draining.

The FWS system includes new pressure and temperature sensors installed in the piping in the valve room. The control system will compare the pressure values for the two FWS pipes (PIT-001 and PIT-002) to the forebay water surface elevation (LT-005) as a measure of head differential across the trashrack and will alarm to alert operators to potentially excessive debris buildup. Water temperatures will also be monitored in each FWS pipe (TIT-001 and TIT-002) and recorded by the control system.

The 24-inch FWS pipe to the side entrance is routed down through the old hopper well and across the former holding pool and former upper fish ladder before going below grade to the pump room. A magnetic flowmeter is located just outside the holding pool room for establishing the flow rate used in the flow control loop. A flow control valve (rubber-seated ball valve) is located in the pump room and automatically regulates the side entrance attraction water flow to the flow setpoint, typically between 19.4 -58.3 cfs. The control system constrains the side entrance attraction water flow to no greater 63 cfs to avoid excessive velocities in the pipeline. Out of the flow control valve, flow discharges into the existing Lower Dissipator before passing through an aeration passage and discharging up through diffusion grating in the transportation Channel just upstream of the side entrance.

The 36-inch FWS pipe to the side entrance is also routed down through the old hopper well and across the former holding pool and former upper fish ladder before going below grade to the Headbox. A magnetic flowmeter is located just outside the holding pool room for establishing the flow rate for control system alarming. A flow control valve (rubber-seated ball valve) is located in a buried vault upstream of the Headbox and automatically regulates the supply to maintain a constant level (elevation 569.5 feet NAVD88) in the Headbox. This setpoint will be set to average 6 inches below the overflow weir wall with a level tolerance of ±0.2 feet. When the headbox level moves outside tolerance (569.5 ±0.2 feet), the control ball valve will adjust to either raise or lower the inflow rate to bring the Headbox level back within tolerance. This level control loop will match supply to demand and maintain a relatively constant supply pressure for demands at the fish facility. The control system will also monitor the flow rate and automatically constrain valve position and alarm for high flow to avoid excessively high pipe velocities. An emergency overflow is provided in the Headbox for a control valve failure situation to safely bypass water flow over a weir wall and out a 36-inch gravity drain pipe that discharges to the drain system and eventually the river. Out of the flow control valve, the FWS supply pipe branches to either side of the Headbox and then tees off as 14-inch supplies to each of ten packed columns located on top of the Headbox. Manual butterfly valves are provided for fine tuning relative flows to the columns or for isolation purposes. Manual drain valves are provided on each supply pipe for draining the pipe for maintenance purposes while isolated and the remainder of the system is active.

The flow control valves have local pushbutton control on the electric actuator mounted on the valve. For manual control, the actuator Local-Stop-Remote knob would be placed in LOCAL and the Open/Stop/Close knob manipulated as desired to position the valve in accordance with flow or level readings. For automatic control, the actuator Local-Stop-Remote knob would be placed in REMOTE and the control system will automatically position the valves in accordance with the control system set point.

3.1.2. Facility Water Distribution System (FWDS)

Two supply pipes (30-inch and 36-inch) exit the Headbox. The 30-inch FWDS pipe provides a fresh water supply to all of the short-term and long-term holding pools as well as the fish lock, crowding channel, and truck fill station. The 36-inch FWDS pipe supplies water to the pre-sort pool, upper fish ladder, pre-sort pool false weir and distribution flume, fourteen fish transfer pipes, recovery tank and two fish return pipes, and spawning and sorting tables.

The Presort valves (FOS-FWS-PSS01 and FOS-FWS-PSS02) will be set in fixed position determined in initial startup so that at design operating Headbox level (569.5 feet), the ladder head recorded at LT-008will be 1 foot. The Presort valves will be left in manual remote operating mode, so that either valve may be corrected in the future. With a headbox level within tolerance (569.5 ±0.2 feet)If the Presort valves are properly set in fixed position, then the ladder head should easily stay within criteria (0.9 -1.1 feet). If the ladder head is goes out of criteria, the PLC will send an alarm and one or more of the Presort Valves can be adjusted.

Ladder head = Pool 36 Water surface elevation (LT-008) – Weir 35 crest elevation

Ladder head = LT-008 reading - 5 60.7 feet NAVD88

The FWDS has numerous valves, some electrically actuated, some manually operated, that allow facility operators to supply water to specific areas as needed and to conserve water when it isn't needed. Each

post sort pool has its own manually operated supply valve. The post sort pool supply pipes are outfitted with flow meters in order to allow the operator to provide the desired flow rate to each pool. The water supply to each fish pipe running from the sort table to the post sort pools are controlled by manual ball valves. The fish lock supply and drain pipes utilize electrically actuated valves that can be remotely operated in order to avoid repeated entry to the fish lock valve vault. Slide gates were added to both FWDS supply outlets from the headbox. This allows a portion of the FWDS to be dewatered for maintenance while the other portion continues operation. For example, if a post sort pool supply valve had to be replaced during the fish collection season, the post sort pool leg of the FWDS could be isolated using the slide gate while the pre sort pool leg of the FWDS could continue to provide flow for the fish ladder and presort pool. Alternately, the fish ladder could be dewatered for maintenance while fish could continue to be held in the post sort pools.

3.1.3. Auxiliary Water Supply (AWS) System

The auxiliary water supply (AWS) pumping system has been redesigned to retain essentially the same capacity and functionality as the original design. Four new AWS vertical axial flow pumps have been installed to provide a minimum of 41.7 cfs each for the future condition if pump intake screens were installed. This flow rate is the same capacity as the original AWS pumps. In the near-term, the AWS pumps will be capable of delivering a minimum of approximately 45 cfs each as attraction water to the fish ladder entrances.

The AWS Pumps convey water from the tailrace and ultimately discharge it into the main entrance pool (pool 1) to amend the fish ladder flow with attraction water exiting both entrances. The pumps draw tailrace water through a pump intake trashrack, below the main entrance, that was replaced with a new fabrication having 5/8-inch gaps between vertical grating bars. The tailrace water passes through the pump intake channel to the pumphouse and then flows vertically up into the pump bays. New flow modifiers were added in these passages with vertical and horizontal flow vanes to straighten the flow and promote improved approach velocities towards the pump intakes. The pump bays themselves were also upgraded with metal corner fillets and central flow splitter with perforated splitter plate. These improvements were all provided to greatly reduce the potential for swirling, vortex formation, and other unstable flow conditions that could lead to cavitation and reduced pump performance.

The AWS Pumps are controlled to automatically operate in sequence depending on Table 1 in Section **Error! Reference source not found.**. One pump will generally run at all times even for very low river flows (below 240 cfs; WSEL 528.0). An additional pump will always be run whenever the side entrance is in operation (Tailwater levels > 528.6 feet). So, a minimum of two pumps will be running at most times. A third pump will start when the tailrace reaches WSEL 529.3 and a fourth at WSEL 530.0. There will be a deadband of 0.1 feet in the operational setpoints depending on whether the tailwater is rising or falling. This is done to avoid unnecessary pump starts and stops in the case of a tailwater oscillating back and forth around a particular setpoint level.

The pumps discharge through flap gates, which prevent backflow when a pump is not in operation, into the upper supply channel (Pump No. 1 only) and lower supply channel (Pumps Nos. 2-4). The attraction water flows up into pool 1 through floor diffuser grating. The control gates work to regulate the water levels in pool 1 and at the entrances relative to the river level.

The AWS Pumps have local control panels mounted on the wall adjacent to each pump and powered from MCC DQ2 in the pump room. The pumps are provided with both soft starters and emergency contactors, for starting pumps by bypassing the soft starters using the hand-switch on the pump control panel. The pumps typically run in Automatic Normal mode with the Hand-Off-Auto (HOA) switch in AUTO. In Manual Normal mode, place the HOA in HAND the pump will run. The pump water lubrication system is interlocked to function whenever a pump starts. The solenoid valve on the individual water (FWS) supply line to that pump will open and the flow switch gauge should indicate flow passing down through the pump enclosure tube to lubricate the composite line-shaft bearings. If the flow switch is not activated an alarm will be initiated and the pump will be stopped. The pumps are also outfitted with vibration sensors mounted to the motor housing that will alarm for high vibration and alarm and turn off the pump for high-high vibration. The control system also monitors the head (pressure) differential between the tailrace (LT-003) and the pumphouse (LT-006) to alert operators to the trashrack possibly being clogged with debris. If the head differential exceeds 6.0 feet, an alarm will be initiated and all pumps will be stopped.

3.1.4. Fish Ladder Gates

Three automated vertical lift, or roller, gates, the main entrance gate, side entrance gate, and transportation channel gate, are provided to control water levels in pool 1 and the transportation channel relative to the river (tailrace) level. The main and side entrances were provided with new orifice gates that will typically serve as submerged weir gates. The transportation channel gate was refurbished and serves as a submerged weir gate. All gate operators were replaced with new wire rope drum hoists with electric actuators and refurbished sheaves.

All three gates can be positioned manually through either remote or local controls but will typically be controlled automatically to maintain a set head differential between water surface elevations as follows:

- The main entrance gate (RG-001) is used to regulate the WSEL differential between pool 1 (LT-002) and the tailrace (LT-003). The differential can be set between the range of .5 to 2 feet but will normally be set for 1.0 -1.5 foot, or 1.25 feet ±0.15 feet.
- When the side entrance is in operation, the transportation channel gate (TG-001) is used to provide about 0.25 feet differential between the main entrance pool (pool 1) and the transportation channel (LT-004). The gate invert will be positioned approximately 2.0 feet below the main entrance tailwater elevation (LT-003). The differential can be set between the range of 0 to 5 feet but will normally be set for 2.0 feet.
- The side entrance gate (RG-002) is used to regulate the WSEL differential between the pool 1 (LT-002) and the side entrance pool (LT-004). The differential can be set between the range of 0 to 2 feet but will normally be set for 0.25 feet ± 0.05 feet.. When the side entrance is not in operation, the transportation channel gate will be raised to stop all flow through the transportation channel to the side entrance. Also if the difference in tailwater elevations between side and main entrances exceed 0.75 feet (LT-005 – LT 003 > 0.75 feet), then the side entrance gate will also be closed (i.e. raised out of water).
- All gate operators have local pushbutton control on the electric actuator driving the drum hoist. For manual control, the actuator Local-Off-Remote knob would be placed in LOCAL and the Open/Stop/Close pushbuttons manipulated as desired to position the gate in accordance with WSELs and/or the gate position indicator. For automatic control, the actuator Local-Off-Remote

knob would be placed in REMOTE and the control system will automatically position the gates in accordance with the system setpoint.

3.1.5. Pumphouse Dewatering and Filling

The fish ladder and pumphouse were not designed to be dewatered individually. The drainage sump, located in the same well as the floatwells, drains the fish ladder supply channels and pumphouse simultaneously through the Powerhouse. Therefore, dewatering requires complete shutdown of fish passage and placement of bulkheads at the fish entrances and pump intake. Should it ever be considered necessary to dewater the pumphouse with a portable pump and with the fishladder left in operation it is recommended that the differential head between the supply channel and pumphouse be limited to a maximum of 20 feet. To safeguard the pumphouse and limit the horsepower requirement for the AWS Pumps, the control system monitors the head differential between the pumphouse (LT-006) and the main entrance pool (LT-003) and initiates an alarm and stops all pumps when the differential reaches 3.0 feet. An appreciable differential between the pumphouse and the supply channel cannot develop because of the 36-inch heavy duty flap gate located in the common wall near the floor of the two chambers. When the fish ladder and pumphouse are empty, they should be filled by opening in sequence the pumphouse filling gate ("Valve J") and the side entrance FCV (FOS-FWS-PHS01). This introduces forebay water into the pumphouse and the supply channel fills simultaneously through the 36-inch flap gate.

DRAFT

4. Chapter 4: Operations

4.1. System Operations

4.1.1. Facility Startup

To start up the Foster Adult Fish Facility, first complete all items in the Pre-Activation Checklist (Section

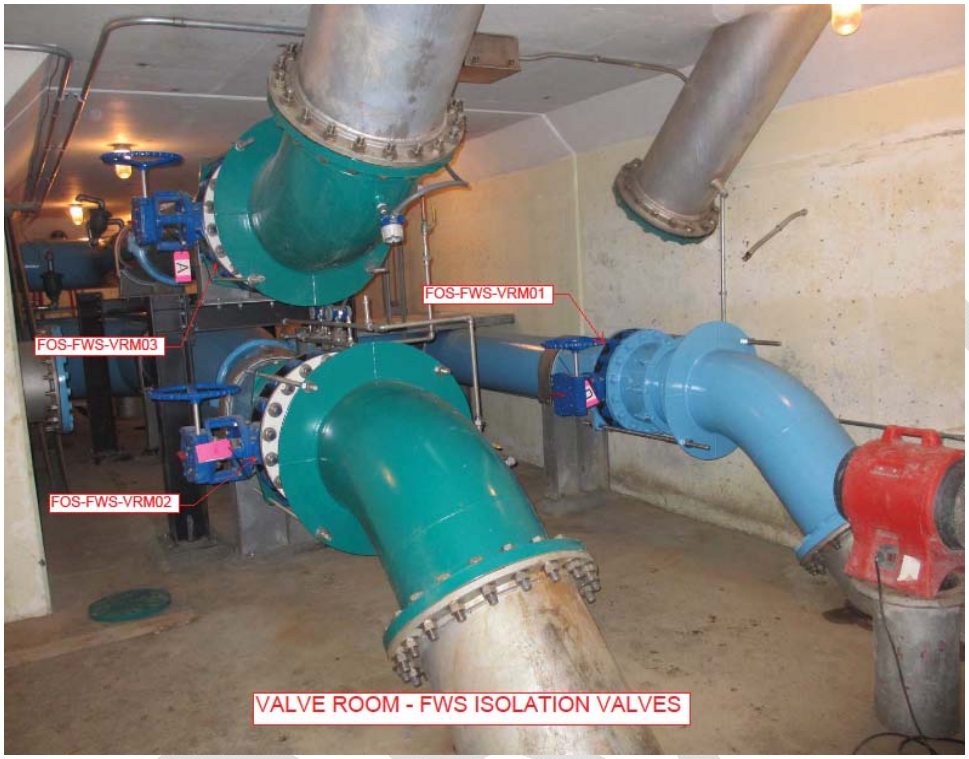
4.1.1.1) below. Note that these procedures include watering up the entire facility after a complete dewatering for thorough equipment/facility inspection and/or repairs. For typical operations during shutdown periods, the facility will likely be only partial dewatered (e.g., pumphouse watered and the 36-FWS to Fish Facility in service but fish ladder dewatered and the 24-FWS to the side entrance not in service). Typically, Automatic Startup (section 4.1.1.3) will be implemented following shutdown periods. When automatic startup it is not possible or desirable, Foster Adult Fish Facility startup can be done manually. To start up Foster Adult Fish Facility manually, complete all items in the Pre-Activation Checklist (section 4.1.1.1) and then follow the procedures in the Manual Startup section (section 4.1.1.2).

4.1.1.1. Pre-activation Checklist includes Watering-Up

Before facility startup perform the following:

1. Confirm that all applicable equipment is properly lubricated.
    a. AWS Pump gear drives
    b. FWS flow control valve actuators
    c. Roller gate drum hoist actuators and wire rope sheaves
2. Confirm that instrumentation is ready for operation.
3. Confirm that all electrical equipment and devices are powered.
4. Water up FWS pipelines to FCVs:
    a. Close FWS isolation valves FOS-FWS-VRM01, -VRM02, and –VRM03 in the valve room.
    b. Open each bulkhead purge valve to allow FWS intake piping upstream of the valve room to fill with water and for pressure to equalize across the bulkhead.
    c. Remove the bulkhead for each intake and install the FWS intake trashrack.
    d. Close the FCVs FOS-FWS-PHS01 in the pump room and FOS-FWS-FHB01 in the Headbox Valve Vault (VB-FWS-001).
    e. Close the manual drain valves FOS-FWS-FHB02 and -FHB03 on the 36-FWS in the Valve Vault.
    f. Close the manual gate valve on the 20” FWS pipe in the AWS pump room that drains the pipeline to the aeration chamber.
    g. Close the manual ball valve on the 20” FWS pipe in the AWS pump room that supplies lubrication water to the AWS pump bearings.
    h. Close the manual gate valve on the 20” FWS pipe in the AWS pump room that supplies backup cooling water to the Powerhouse.
    i. Confirm that the isolation valves for the two air vacuum release valves FOS-FWS-VRM04 and –VRM05 are fully open. Air will vent from the air vacuum release valves during filling and will automatically seal closed when the pipelines are full.

j. Slowly open the isolation butterfly valves in the valve room to partially open positions to slowly fill the 36-FWS and 24-FWS pipes. *[CAUTION: Do not allow these valves to open or close in less than 60 seconds.]*
    i. Open the 18-inch isolation valve FOS-FWS-VRM01 for the 36-FWS to a maximum 12% open position.
    ii. Open the 24-inch isolation valve FOS-FWS-VRM03 for the 24-FWS to a maximum 3% open position.



k. After pipelines are completely filled, fully open all three FWS isolation valves.

5. Water up pumphouse:
    a. Raise the main entrance, side entrance, and transportation channel gates to establish weir elevations slightly below the tailrace WSEL.
    b. Open the pumphouse filling gate (Valve J) in the pump room.
    c. Fill the pumphouse with water from the 24-FWS pipe:
        i. Slowly open FOS-FWS-PHS01 to no greater than 65% Open and allow the pumphouse to fill with water to equalize pressure across the pump intake channel and main entrance bulkheads. *[CAUTION: Do not allow these valves to open or close in less than 60 seconds.]*
        ii. The heavy duty flap gate will open to also allow the lower and upper supply channels and main entrance pool to fill along with the pump intake channel.
        iii. Monitor pumphouse WSEL (LT-006 in pump room) using the HMI.
    d. After the pumphouse has filled with water to approximately the tailrace WSEL:

i. Close FOS-FWS-PHS01. *[CAUTION: Do not allow FCV to open or close in less than 60 seconds.]*
ii. Close the pumphouse filling gate.
iii. Remove the pump intake channel bulkhead.
iv. Install the pump intake channel trashrack.
v. Remove the main entrance bulkhead

DRAFT

e. The pumphouse including supply channels and main entrance pool should now be fully watered and ready for operation.

6. Water Up 36-FWS Supply to Headbox:
   a. Ensure the air release valves in the short term post-sort pool supply vault, FOS-FWDS-AIR02, and in the west pre-sort pool valve vault, FOS-FWDS-AIR01, are functional and that their isolation valves are open.
   b. Close all other FWDS valves downstream of the headbox with the exception of the switch gate supply valves, FOS-FWDS-PSF01, FOS-FWDS, PSF-02, and FOS-FWDS-PSF03. These valves shall be opened in order to let air vent from the FWDS pipe while it is filling with water.
   c. Open the ten supply valves to the packed columns (FOS-FWS-FHB04 through –FHB13) and close the ten drain valves (FOS-FWS-FHB14 through –FHB23).
   d. Slowly open FOS-FWS-FHB01 to 50% open position to allow the remainder of 36-FWS to fill. *[CAUTION: Do not allow valve to open or close in less than 60 seconds.]*
   e. Allow all ten supply lines to discharge freely into the packed columns and allow the Headbox to fill up to 6 inches below the overflow weir.
   f. Close the switch gate supply valves, FOS-FWDS-PSF01, FOS-FWDS, PSF-02, and FOS-FWDS-PSF03 when water begins flowing out into the switch gates.
   g. Monitor Headbox WSEL (LT-007) using the HMI.
   h. Slowly close FOS-FWS-FHB01. *[CAUTION: Do not allow valve to open or close in less than 60 seconds.]*
   i. The 36-FWS supply to the Fish Facility is now ready for operation.

7. FWDS
    a. Air may have been trapped in the FWDS piping while it was filled with water. Open the fish pipe supply valves at the sort table in order to bleed off trapped air, FOS-FWDS-STB01 through –STB13. Close the valves once water starts flowing out.
    b. Set FOS-FWS-FHB01, the FWS 24-inch Ball Valve, to discharge approximately 30 cfs (or known desired ladder flow) recorded at Flow Meter FIT-001.
    c. Close pre-sort pool drain valve (FOS-FWDS-PRE01 located in Vault VB-FWDS-001 – see MP 424-425)
    d. Set Presort Valves FOS-FWDS-PSS01 and FOS-FWDS-PSS02 to normal fixed positions: 45% east and 80% west valve (calibrated during initial startup)
    e. Allow upper ladder system to fill (about 30 minutes).
    f. Record Headbox Level (LT-007) and set in auto mode.
    g. The FWDS is now watered up and the fish ladder operational.

4.1.1.2. Manual Startup

Once all items in the Pre-Activation Checklist (section 4.1.1.1) have been completed, follow the procedures below to implement Manual Startup of the Foster Adult Fish Facility. (Note: Automatic Startup should be used when possible.)

1. Verify all automated control processes are in Manual Mode by using any graphic terminal.

2. Prepare AWS pumps (pump room):
    a. Confirm water lubrication system isolation valve is OPEN on bottom of 24-FWS in southeast corner of pump room.
    b. Confirm all four AWS Pump control panels are powered up; white POWER lights should be lit.
    c. For all control panels place the HOA switch in AUTO.
    d. Confirm that LT-002, LT-003, and LT-004 are functional by viewing the HMI "ANALOG SENSORS" status screen. (A value of -99.9 indicates sensor trouble.)

3. For the side entrance water supply:
    a. In the pump room, confirm that actuator PHS-001 is powered - or switch respective circuit breaker at DQ2 to ON.
    b. Place LOCAL/STOP/REMOTE knob on actuator PHS-001 (FCV FOS-FWS-PHS01) in STOP.

4. For the Headbox water supply:
    a. Confirm that actuator HBO-003 is powered - or switch respective circuit breaker at FQ3 (Service Building) to ON.
    b. Confirm that LT-007 works by checking the HMI "ANALOG SENSORS" status screen.
    c. In the Valve Vault, place LSR knob on actuator HBO-003 (FCV FOS-FWS-FHB01) in STOP.

5. For the Fish Ladder Gates:
    a. Confirm that the gate actuators are powered at DQ2 (circuit breakers are ON) and digital displays on actuators are ON.
    b. Confirm that the transportation channel gate is positioned below the water surface.
    c. Confirm that the main entrance and side entrance gates are positioned with the invert of the gate orifice below the water surface.
    d. Place the LOR knob on the gate actuators to the OFF position.

6. Next, manually start and position the following devices in the order listed. If the control system is functional, it will be possible to switch to Automatic control afterwards if desired. In Automatic mode the pumps will automatically start/stop and valves will be modulated in accordance with control set points. In Manual mode operators need to monitor water parameters (e.g., water elevations and flow rates) to regulate the pumps and valves for maintaining proper operating conditions.
    a. AWS Pumps (FOS-AWS-PMP01 thru –PMP04).
        i. Determine tailrace level (LT-003) at a graphic terminal or river staff gauge.
        ii. Establish the number of pumps required to run in accordance with Table 1.
        iii. At the AWS Pump Control Panels, place the HOA switch in HAND for the number of pumps needing to run.
        iv. Confirm that the lubrication water is flowing and functioning properly (i.e. solenoid valve opens and water flow indicated) when the respective pump starts.

Table 1 – Operating Setpoints for Tailwater Elevation (LT-003) for AWS Pumps and FB Water Supply Discharge to Side Entrance

OPERATING SETPOINTS FOR CHANGES IN NUMBER OF AWS PUMPS AND FOREBAY SUPPLY DISCHARGE TO SIDE ENTRANCE					
Falling Tailwater			Rising Tailwater		
	PLC Reduction to:			PLC Increase to:	
LT-003 Elevation (ft)	AWS Pumps	FB supply discharge (cfs)	LT-003 Elevation (ft)	AWS Pumps	FB supply discharge (cfs)
536.0	4	58.3	536.1	4	58.3
530.0	3	38.9	530.1	4	58.3
529.3	2	19.4	529.4	3	38.9
528.0	1	0	528.1	2	19.4
526.1	0	0	526.2	1	0

    b. FWDS (details steps needed in order to move fish from pre-sort pool to a post-sort pool)
        i. Open the anesthetic tank supply valve (FOS-FWDS-ANS01) in order to fill the anesthetic tank. Close the valve once the tank is full.
        ii. Partially open the flume supply valve (FOS-FWDS-PRE03) using actuator PSF-01 to supply required flow to wet the distribution flume.
        iii. Select post-sort pools for usage and open supply valves (FOS-FWDS-LTM01 thru LTM05 and FOS-FWDS-STM01 thru STM04) to fill the pool(s). Ensure post sort pool bulkheads are closed and weirboards are in place. Observe the reading from the applicable flow meter and adjust the pool supply valve in order to reach the pool design flow or desired operational flow. The design flow for the long term post-sort pools and the hopper pit is 1500 gallons per minute. The design flow for the short term post-sort pools is 250 gallons per minute.
        iv. Open the fish pipe ball valve(s) (FOS-FWDS-STB02 thru STB13) at the sorting table that corresponds to the post-sort pool(s) that are filling and that fish will be placed in. Design flow for the fish pipes is approximately 550 gpm. Use discretion when setting the valve opening. Flow rate should be sufficient to meet the biological needs of fish, but avoid putting so much flow through the fish pipes that

it overwhelms the dewatering device at the end of the pipe and flows into the post sort pool as this could cause false attraction and cause fish to jump at the wall.

v. Open the false weir drain valve (FOS-FWDS-PRE04).
vi. Open the false weir supply valve (FOS-FWDS-PRE02) in the West Pre-sort pool vault.
vii. Start the false weir pump and increase flow until desired flow over the false weir is achieved.

c. Headbox water supply (FOS-FWS-FHB01).
   i. In the Valve Vault, place LSR knob on actuator HBO-003 (FOS-FWS-FHB01) in LOCAL. Initially open the valve to 25% open position by moving the Open/Close knob to the OPEN position; the actuator will continue to drive the valve open but the knob will return to the neutral position when let go. When the actuator display shows "25%", stop the valve by placing the LSR knob in STOP. [CAUTION: Do not fully open the valve in faster than 60 seconds.]
   ii. Monitor the flow rate in the 36-FWS pipe (FIT-001) either through the HMI "ANALOG SENSORS > FLOW SENSORS" control screen or visually on display at the FIT-001 transmitter outside the holding pool room. [CAUTION: Do not exceed 69 cfs flow rate to avoid high velocity conditions.]
   iii. Monitor the Headbox water level reading for LT-007 at the HMI "ANALOG SENSORS" screen, "HEADBOX VALVE" screen, or visually observe the staff gauge inside the Headbox.
   iv. Adjust the flow control valve position to match Headbox water supply to water demands at the Fish Facility (e.g., supply to pre-sort pool to establish flow down fish ladder). In Manual mode, the water can be allowed to overtop the overflow weir wall and discharge excess water through the drain to the river. In Auto mode, the water level will typically be regulated to ~6 inches below the top of the overflow weir wall.
   v. For recommended adjustments based on Headbox level (LT-007), refer to Table 2
   vi. Regularly check the Headbox water level especially after any change in water demands at the Fish Facility.

DRAFT

Table 2- Manual Adjustments to FWS Ball Valve

PLC for FWS 24-Inch Valve Operation								
HBL = Headbox Water Level = LT-007 (Target 569.5 feet ± 0.2 feet)								
Change Condition:						Action	Change in FWS Discharge	
IF HBL ≤	568.8	ft				Increase FW flow	9.6	cfs
IF HBL is between	568.8	ft and	568.9	ft		Increase FW flow	7.0	cfs
IF HBL is between	568.9	ft and	569.0	ft		Increase FW flow	5.5	cfs
IF HBL is between	569.0	ft and	569.1	ft		Increase FW flow	4.1	cfs
IF HBL is between	569.1	ft and	569.2	ft		Increase FW flow	2.8	cfs
IF HBL is between	569.2	ft and	569.3	ft		Increase FW flow	1.7	cfs
IF HBL is between	569.3	ft and	569.7	ft		no change	0.0	
IF HBL is between	569.7	ft and	569.8	ft		Decrease FWS Flow	-1.7	cfs
IF HBL is between	569.8	ft and	569.9	ft		Decrease FWS Flow	-2.8	cfs
IF HBL is between	569.9	ft and	570.0	ft		Decrease FWS Flow	-4.1	cfs
IF HBL is between	570.0	ft and	570.1	ft		Decrease FWS Flow	-5.5	cfs
IF HBL is between	570.1	ft and	570.2	ft		Decrease FWS Flow	-7.0	cfs
IF HBL ≥	570.2	ft				Decrease FWS Flow	-9.6	cfs

DRAFT

d. Side entrance attraction water supply (FOS-FWS-PHS01).
   i. In the pump room, place LSR knob on actuator PHS-001 (FOS-FWS-PHS01) in LOCAL. Initially open the valve to the 60% open position by moving the Open/Close knob to the OPEN position; the actuator will continue to drive the valve open but the knob will return to the neutral position when let go. When the actuator display shows "60%", stop the valve by placing the LSR knob in STOP. [CAUTION: Do not open the valve in faster than 60 seconds.]
   ii. Monitor the flow rate in the 24-FWS pipe (FIT-002) either through the HMI "ANALOG SENSORS" status screen or on the FIT-002 transmitter display, which is located outside the holding pool room. [CAUTION: Do not exceed 58 cfs flow rate to avoid high velocity conditions.]
   iii. Note tailwater elevation (LT-003) and refer to Table 1 to determine required discharge in 24-inch FWS supply to side entrance.
   iv. Adjust the position of FOS-FWS-PHS01 to establish appropriate discharge (± 5 cfs) in the 24-FWS supply to the side entrance.

e. Fish ladder gates (RG-001, RG-002, TG-001).
   i. Operators will likely want to wait until a stable water flow (30 cfs) is established down the fish ladder and emptying into pool 1.
   ii. Determine WSELs in pool 1 (LT-002), tailrace (LT-003), transportation channel (LT-004), and stilling basin (LT-005) through the HMI "ANALOG SENSORS" status screen or by observing the staff gauges in the river and water passages.
   iii. Raise the main entrance gate (RG-001) to establish the entrance head (water surface in pool 1 (LT-002) - tailrace (LT-003)) is 1.0 -1.5 feet (1.25 feet, optimum) above the
      1. At the gate actuator place the LOCAL/OFF/REMOTE switch in LOCAL.
      2. Push the CLOSE button to raise the gate. Push the STOP button when the water level approaches the correct WSEL in pool 1.
      3. Adjust the gate position as necessary using the OPEN/STOP/CLOSE buttons to fine tune the water surface differential.
      4. See Table 3 for recommended adjustment of RG-001 based on entrance head reading.

   iv. Position the transportation channel gate (TG-001) to set the weir invert 2.0 feet below the tailwater elevation (LT-003) at the main entrance.
      1. At the gate actuator place the LOR switch in LOCAL.
      2. Push the OPEN button to lower the gate. Push the STOP button when the gate invert approaches the correct elevation.
   v. Raise the side entrance Gate (RG-002) to establish a water surface in pool 1 (LT-002) that is 0.25 feet (or 3 inches) (±0.05 feet) above the water surface level in the side entrance pool (LT-004).
      1. At the gate actuator, place the LOR switch in LOCAL.
      2. Push the CLOSE button to raise the gate. Push the STOP button when the water level approaches the correct WSEL in the transportation channel.
      3. Adjust the side Entrance gate and transportation channel gate positions as necessary using the OPEN/STOP/CLOSE buttons to fine tune the water surface differentials.
      4. See Table 4 for recommended adjustment of RG-002 based on differential reading.

vi. Because each of these gates influences the water flow exiting the fish ladder and the relative position of each of the other gates, repeat these steps for each gate until stable water surface elevations are achieved.

Table 3 – Manual Operation of Entrance Weir Gate to Regulate Entrance Head (DH) and Minimum Pool 1 Depth

PLC for Main Entrance Gate Operation (RG-001)							
DH = Entrance head = LT-002 - LT-003							
Change Condition:					Action	Change in Invert	
IF DH ≤	0.5	ft			Raise Weir Gate	+3	Feet
IF DH is between	0.5	ft and	0.8	ft	Raise Weir Gate	+1.7	Feet
IF DH is between	0.8	ft and	1.0	ft	Raise Weir Gate	+1.1	Feet
IF DH is between	1	ft and	1.1	ft	Raise Weir Gate	+0.6	Feet
IF DH is between	1.1	ft and	1.4	ft	no change		
IF DH is between	1.4	ft and	1.5	ft	Lower Weir Gate	-0.5	Feet
IF DH is between	1.5	ft and	1.7	ft	Lower Weir Gate	-0.8	Feet
IF DH is between	1.7	ft and	2.0	ft	Lower Weir Gate	-1.3	Feet
IF DH ≥	2.0	ft			Lower Weir Gate	-1.6	Feet
Y = Pool 1 Depth = LT-002 - Invert Elevation 522.58 feet							
Change Condition:					Action	Change in Invert	
IF Y ≤	5.5	ft			Raise Weir Gate	0.8 feet	
IF Y is between	5.5	ft and	5.8	ft	Raise Weir Gate	0.4 feet	
IF Y is between	5.8	ft and	6	ft	Raise Weir Gate	0.2 feet	

DRAFT

Table 4 – Manual Operation of Side Entrance Weir Gate to Regulate Differential between Pool 1 & Side Entrance Pool

PLC for Side Entrance Gate Operation							
DH = Head Difference Between Pool 1 & Side Entrance Pool (Target = 0.25 feet)							
DH = Head over Telescoping Gate = LT-002 - LT-004							
Change Condition:					Action	Change in Weir Level	
IF DH ≤	0.1	ft			Lower Weir Gate	-0.35	Feet
IF DH is between	0.1	ft and	0.2	ft	Lower Weir Gate	-0.1	Feet
IF DH is between	0.2	ft and	0.3	ft	no change		
IF DH is between	0.3	ft and	0.4	ft	Raise Weir Gate	0.1	Feet
IF DH ≥	0.4	ft			Raise Weir Gate	0.4	Feet

4.1.1.3. Automatic Startup

Once all items in the Pre-Activation Checklist (section 4.1.1.1) have been completed, follow the procedures below to implement Automatic Startup of the Foster Dam Adult Fish Facility.

1. Automatic Startup assumes the control system is fully functional. At any graphic terminal verify applicable control loops are in Manual mode.
2. Prepare AWS pumps (pump room):
    a. Confirm water lubrication system isolation valve is OPEN on bottom of 24-FWS in southeast corner of pump room.
    b. Confirm all four AWS Pump control panels are powered up; white POWER lights should be lit.

c. For all control panels, place the HOA switch in AUTO.
d. Confirm transmitters LT-002, LT-003, and LT-004 are functional by viewing the HMI "ANALOG SENSORS" status screen. (A value of -99.9 indicates sensor trouble.)

3. For the side entrance water supply:
   a. In the pump room, confirm that actuator PHS-001 is powered - or switch respective circuit breaker at DQ2 to ON.
   b. Place LSR knob on actuator PHS-001 (FCV FOS-FWS-PHS01) in STOP.
4. For the Headbox water supply:
   a. Confirm that actuator HBO-003 is powered - or switch the respective circuit breaker at FQ3 (Service Building) to ON.
   b. Confirm LT-007 works by checking the HMI "ANALOG SENSORS" status screen. (A value of -99.9 indicates sensor trouble.)
   c. In the Valve Vault, place LSR knob on actuator HBO-003 (FCV FOS-FWS-FHB01) in STOP.
5. For the Fish Ladder Gates:
   a. Confirm that the gate actuators are powered at DQ2 (circuit breakers are ON) and digital displays on actuators are ON.
   b. Confirm that the transportation channel gate is positioned below the water surface.
   c. Confirm that the main entrance and side entrance gates are positioned with the invert of the gate orifice below the water surface.
   d. Place the LOR knob on the gate actuators to the REMOTE position.
6. At any HMI, place the following devices in AUTO in the order listed; devices will automatically start or modulate in accordance with control setpoints:
   a. AWS Pumps (FOS-AWS-PMP01 thru –PMP04). Place all four pumps in AUTO and press the "AUTO CONTROL" button if the status light indicates "READY". The number of pumps running will be automatically established based on tailrace WSEL. Reference chapter 8 for additional information.
   b. FWDS (details steps needed in order to move fish from pre-sort pool to a post-sort pool)
      i. Open the anesthetic tank supply valve (FOS-FWDS-ANS01) in order to fill the anesthetic tank. Close the valve once the tank is full.
      ii. Partially open the flume supply valve (FOS-FWDS-PRE03) using actuator PSF-01 to supply required flow to wet the distribution flume.
      iii. Select post-sort pools for usage and open supply valves (FOS-FWDS-LTM01 thru LTM05 and FOS-FWDS-STM01 thru STM04) to fill the pool(s). Ensure post sort pool bulkheads are closed and weirboards are in place. Observe the reading from the applicable flow meter and adjust the pool supply valve in order to reach the pool design flow. The design flow for the long term post-sort pools and the hopper pit is 1500 gallons per minute. The design flow for the short term post-sort pools is 250 gallons per minute.
      iv. Open the fish pipe ball valve(s) (FOS-FWDS-STB02 thru STB13) at the sorting table that corresponds to the post-sort pool(s) that are filling and that fish will be placed in. Design flow for the fish pipes is approximately 550 gpm. Use discretion when setting the valve opening. Flow rate should be sufficient to meet the biological needs of fish, but avoid putting so much flow through the fish pipes that it overwhelms the dewatering device at the end of the pipe and flows into the post sort pool as this could cause false attraction and cause fish to jump at the wall.
      v. Open the false weir drain valve (FOS-FWDS-PRE04).
      vi. Open the false weir supply valve (FOS-FWDS-PRE02) in the West Pre-sort pool vault.

vii. Start the false weir pump and increase flow until desired flow over the false weir is achieved.

c. Headbox water supply flow control valve (FOS-FWS-FHB01). The Headbox FCV will automatically modulate the FWS flow to maintain a WSEL in the Headbox that is at elevation 569.5 feet, approximately 6 inches below the top of the overflow weir wall. The discharge will be held below 69 cfs.

d. Side entrance attraction water supply flow control valve (FOS-FWS-PHS01). The side entrance FCV will automatically modulate the FWS flow delivered to the side entrance to maintain the flow setpoint, typically 19.4 - 58.3 cfs.

e. Fish ladder gates (RG-001, RG-002, TG-001). The vertical lift gates will be automatically positioned to maintain the head differential across the gates.

4.1.2. Normal Facility Operation

4.1.2.1. Normal Operating Criteria

The following information details operational criteria for operation of the facility. Any deviation observed should be reported to the engineering design branch at Block 300.

LADDER

- Ladder entrance head is 12 inches, operationally 1.0 feet ±0.1 feet
- Pool 1 WSEL = 1.0 – 1.5 feet above tailrace WSEL, operationally 1.25 feet ±0.15 feet.

HEADBOX

- Headbox operating water level = 569.5 feet ±0.25 feet. (22.5 Ft. deep +/- 0.25 Ft.)

4.1.2.2. Manual Normal Operation

When automatic operation is not possible or desirable, Foster Adult Fish Facility operation can be accomplished manually. To operate the Foster Adult Fish Facility manually, follow the procedures below. (Note: Automatic Normal Operation should be used when possible.) For the facility to operate satisfactorily, the normal operating criteria in section 4.2.1 must be met. These instructions assume that the Pre-Activation Checklist items have been completed and that water systems are watered up.

In the event the control system is out of service and cannot automatically control the gates, pumps, or valves; there are a number of staff gauges for manual verification of water levels. Operations personnel will need to verify the facility is running within ESA fish criteria during this time.

4.1.2.2.1. Gravity Forebay Water Supply (FWS) System

The FWS System can be operated in manual either locally at the actuator, or remotely via any graphic terminal as follows.

1. FWS attraction water supply to the side entrance – Local Manual:
    a. Confirm the current side entrance attraction water flow rate value and flow control valve (FOS-FWS-PHS01) position on the “SIDE ENTRANCE VALVE” control screen at HMI-3 in the pump room. If the control system is not functional, operators will have to rely

on the valve's characteristic curve that should be developed to document flow versus % valve opening at typical reservoir water surface elevations.

b. In the pump room, place the red Local/Stop/Remote (LSR) selector knob on the actuator housing (PHS-001) for the side entrance flow control valve in LOCAL.
c. Note the tailwater elevation (LT-003) and refer to Table 1 (in Section **Error! Reference source not found.**) to determine the desired discharge for the 24-inch FWS supply to the side entrance.
d. Move the black Open/Stop/Close selector knob on the valve actuator housing into the OPEN or CLOSE position as desired to open or close the FCV; the knob will return to the neutral position when released but the actuator will continue to drive the valve.
    i. If the control system is functional, monitor the side entrance attraction water flow value ("20" Pipe Discharge Rate (CFS)") on the "SIDE ENTRANCE VALVE" control screen or "ANALOG SENSOR" status screen. Adjust the FCV position using the actuator buttons to establish the desired flow rate to the side entrance, typically 19 - 58 cfs.
    ii. If the control system is not functional, adjust the FCV position in accordance with the valve's characteristic curve to establish the desired flow rate to the side entrance, typically 19 - 58 cfs.
e. CAUTION: If there is already water flowing in the pipe, do not close the valve in faster than 60 seconds.
f. NOTE: For complete power failure, it is possible to operate the FCV using the actuator handwheel. To engage the handwheel drive on the actuator housing, turn the Hand/Auto lever clockwise while turning the handwheel. The lever can be released and the handwheel will remain engaged until operated electrically when it will automatically disengage and return to motor drive. Turn the handwheel and monitor the local position indicator to achieve desired valve position.

2. FWS attraction water supply to the side entrance – Remote Manual:
    a. Confirm the current side entrance attraction water flow rate value and flow control valve (FOS-FWS-PHS01) position on the "SIDE ENTRANCE VALVE" screen at HMI-3.
    b. In the pump room, confirm that the red Local/Stop/Remote (LSR) selector knob on the actuator housing (PHS-001) is in REMOTE.
    c. On the "SIDE ENTRANCE VALVE" control screen, click on the MANUAL CONTROL button and then the KEY PAD button. Enter the desired percentage opening on the virtual keypad and press enter. The actuator will position the valve accordingly. [CAUTION: Do not allow the valve to open or close in faster than 60 seconds.]
3. FWS Supply to the Fish Facility – Local Manual:
    a. Confirm the current Headbox water surface level value and flow control valve (FOS-FWS-FHB01) position on the "HEADBOX LEVEL CONTROL" screen at any HMI. (HMI-1 at the Sorting Facility Service Building is the closest.). If the control system is not functional operators will have to rely on a characteristic curve that should be developed to document flow versus % valve opening at typical reservoir water surface elevations and/or operators will have to visually monitor the Headbox water surface level and adjust the valve position in order to maintain a relatively constant Headbox water level.

b. In the Headbox Valve Vault (VB-FWS-001), place the black Local/Stop/Remote selector switch on the actuator (HBO-003) for the Headbox flow control valve in LOCAL.
    i. Move the black Open/Stop/Close selector knob on the valve actuator housing into the OPEN or CLOSE position as desired to open or close the FCV; the knob will return to the neutral position when released but the actuator will continue to drive the valve.
    ii. Monitor the Headbox water level (LT-007) from the "HEADBOX LEVEL CONTROL" screen or "ANALOG STATUS" screen. Adjust the FCV position using the actuator buttons to maintain the desired water level in the Headbox, typically 569.5 feet EL±0.2 feet.
    iii. Refer to Table 2 in Section **Error! Reference source not found.** for suggested discharge adjustments as a function of Headbox level (LT-007).If the control system is not functional, visually monitor water level at the Headbox itself. Adjust the FCV position to maintain the water level in the Headbox at six inches below the top of the overflow weir.
    iv. CAUTION: Do not fully open or close the flow control valve in faster than 60 seconds.
    v. NOTE: For complete power failure, it is possible to operate the FCV using the actuator handwheel. To engage the handwheel drive on the actuator housing, turn the Hand/Auto lever clockwise while turning the handwheel. The lever can be released and the handwheel will remain engaged until operated electrically when it will automatically disengage and return to motor drive. Turn the handwheel and monitor the local position indicator to achieve desired valve position.

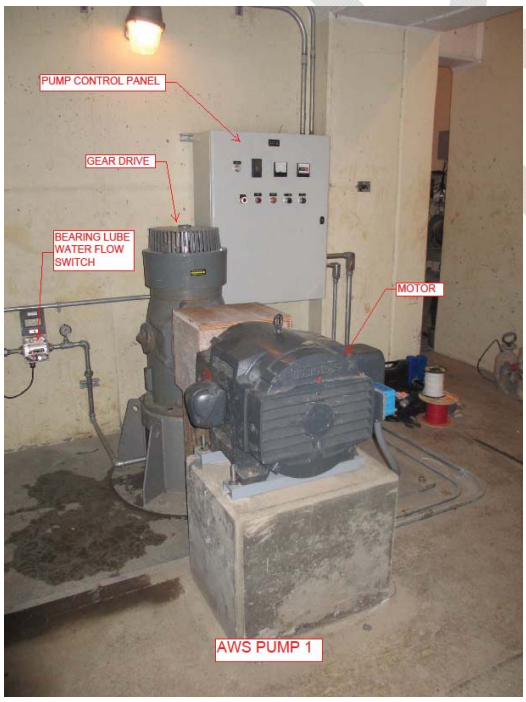
4. FWS Supply to the Fish Facility – Remote Manual:
    a. Confirm the Headbox water surface level value and flow control valve (FOS-FWS-FHB01) position on the "HEADBOX LEVEL CONTROL" screen at any graphic terminal. (HMI-1 at the Sorting Facility Structure is the closest.)
    b. In the Valve Vault confirm that the red Local/Stop/Remote (LSR) selector knob on the actuator housing (HBO-003) is in REMOTE.
    c. On the "HEADBOX LEVEL CONTROL" HMI screen, click on the MANUAL CONTROL button and then the KEY PAD button. Enter the desired percentage opening on the virtual keypad and press enter. The actuator will position the valve accordingly. [CAUTION: Do not allow the valve to open or close in faster than 60 seconds.]
    d. Refer to Table 2 in Section **Error! Reference source not found.** for suggested discharge adjustments as a function of Headbox level (LT-007).

4.1.2.2.2. AWS Pumps

The AWS Pumps can be operated in manual either locally from the pump room or remotely via any graphic terminal. Each AWS pump includes a local control panel, "AWS PUMP NO. # CONTROL PANEL", with reduced-voltage soft-start (RVSS) pump controller, mounted on the wall adjacent to the pump in the pump room. Power is routed through respective circuit breakers mounted in MCC DQ2 in the pump room.

Local Manual:

1. Determine tailrace WSEL (LT-003) either through a graphic terminal "ANALOG SENSORS" status screen or by using the river staff gauge. [NOTE: All new instrumentation and new staff gauges are referenced to the NAVD88 vertical datum.]
2. Start the number of pumps in accordance with the tailrace WSEL (LT-003) and Table 1 in Section **Error! Reference source not found.**. Alternatively, the "AUXILLARY WATER SYSTEM" control screen displays both the number of PUMPS REQUIRED and PUMPS RUNNING in the upper right Status area. [Note that AWS Pump No. 1 should always run as originally designed to be dedicated to the upper supply channel.]
    a. At the respective pump control panel, confirm that the panel is powered as indicated by the white POWER lamp.
    b. Confirm that the Emergency Stop (E-Stop) button is pulled out.
    c. Place the NORM/EMERG BYPASS switch in the NORM (normal) position, which will start the pump with the soft starter.
    d. Place the Hand/Off/Auto (HOA) switch in HAND and the pump will start running as indicated by the red RUN lamp.
    e. Repeat as necessary for the required number of pumps to run.
3. After starting each pump, confirm that the respective pump lubrication water system solenoid valve automatically opens with pump start and that water is flowing to the lineshaft bearings as observable at the flow switch.
4. NOTE: In the event that a soft start controller is not functional or is faulted, each pump can also be started by using the emergency bypass starter; see Emergency Operation section for operational steps.



Remote Manual:

1. Determine tailrace WSEL (LT-003) from a graphic terminal "ANALOG SENSORS" status screen or by using the river staff gauge. [NOTE: All new instrumentation and staff gauges are referenced to the NAVD88 vertical datum.
2. Start the number of pumps in accordance with the tailrace WSEL (LT-003) and Table 1 in Section **Error! Reference source not found.**. Alternatively, the "AUXILARY WATER SYSTEM" control screen displays both the number of PUMPS REQUIRED and PUMPS RUNNING in the upper right Status area. [Note that AWS Pump 1 should always run as originally designed to be dedicated to the upper supply channel.]
    a. At the respective pump control panel, confirm that the panel is powered as indicated by the white POWER lamp.
    b. Confirm that the Emergency Stop (E-Stop) button is pulled out.
    c. Place the NORM/EMERG BYPASS switch in the NORM (normal) position, which will include the soft starter in the motor circuit.
    d. Place the Hand/Off/Auto (HOA) switch in AUTO.
    e. At HMI-3 (or any HMI if all steps above have been completed), click the "AWS PUMPS" button to open the "AUXILARY WATER SYSTEM" control screen.
        i. Click the MANUAL CONTROL button to enable manual pump operation. The "SYSTEM IN MANUAL" indicator will be displayed as red below the button.
        ii. Place each MAN/OFF/AUTO sector switch in the "MAN" position.
        iii. Click the START PUMP button for the desired pump. After starting the "RUNNING" indicator will be displayed as green below the button in the pump's Status area.
    f. At the pump control panel, the running pump will be indicated by the red RUN lamp.
    g. Repeat as necessary for the required number of pumps to run.
5. After starting each pump, confirm that the respective pump lubrication water system solenoid valve automatically opens with pump start and that water is flowing to the line shaft bearings as observable at the flow switch.

4.1.2.2.3. Fish Ladder Gates

The Fish ladder gates (RG-001, RG-002, TG-001) can be operated in manual at the gate actuator (local) or remotely from a graphic terminal as follows.

Local Manual:

1. These procedures assume that a stable water flow (~30 cfs) has already been established down the fish ladder that empty into pool 1.
2. Determine WSELs in pool 1 (LT-002), tailrace (LT-003), transportation channel (LT-004), and stilling basin (LT-005) either through the HMI "ANALOG SENSORS" status screen or by observing the staff gauges in the river and water passages.
3. Raise the main entrance gate to establish a water surface in pool 1 that is 12 inches above the tailrace.
    a. At the gate actuator, place the LOR switch in LOCAL.

   b. Push the CLOSE button to raise the gate. Push the STOP button when the water level approaches the correct WSEL in pool 1.
   c. Adjust the gate position as necessary using the OPEN/STOP/CLOSE buttons to fine tune the water surface differential.
   d. Refer to Table 3 in Section **Error! Reference source not found.** for suggested RG-001 adjustment based on entrance head (LT-002 – LT-003).
4. Position the transportation channel Gate (TG-001) to set the weir invert 2.6 feet below the water surface in pool 1.
   a. At the gate actuator, place the LOR switch in LOCAL.
   b. Push the OPEN button to lower the gate. Push the STOP button when the gate invert approaches the correct elevation.
   c. TG-001 = Tailwater elevation (LT-003) – 2 feet.
5. Raise the side entrance gate (RG-002) to establish a water surface in the transportation channel that is 9 inches above the stilling basin WSEL.
   a. At the gate actuator, place the LOR switch in LOCAL.
   b. Push the CLOSE button to raise the gate. Push the STOP button when the water level approaches the correct WSEL in the transportation channel.
   c. Adjust the side entrance gate and transportation channel gate positions as necessary using the OPEN/STOP/CLOSE buttons to fine tune the water surface differential.
   d. Refer to Table 4 in Section **Error! Reference source not found.** for suggested RG-002 adjustments based on differential between pool 1 and side entrance pool (LT-002 – LT-004).
6. Because each of these gates influences the water flow exiting the fish ladder and the relative position of each of the other gates, repeat these steps for each gate until stable water surface elevations are achieved.

Remote Manual:

1. These procedures assume that a stable water flow (~30 cfs) has already been established down the fish ladder that empties into pool 1.
2. Determine WSELs in pool 1 (LT-002), tailrace (LT-003), transportation channel (LT-004), and stilling basin (LT-005) either through the HMI "ANALOG SENSORS" status screen or by observing the staff gauges in the river and water passages.
3. At any HMI press the "GATE SUMMARY" button to open the fish ladder gates control screen.
4. Adjust the position of the main entrance gate to establish an entrance head (water surface in pool 1 (LT-002 - the tailrace WSEL (LT-003)) that is 1.25 feet ± 0.15 feet above as follows:
   a. From the HMI verify the actuator LOR switch is in REMOTE and the alarm status shows "OKAY". A green "READY" indicator should be visible above the "MANUAL CONTROL" button.
   b. Press the "MANUAL CONTROL" button to place the gate in manual mode. A red "M" should be visible for manual mode.
   c. Press the KEY PAD button and enter the gate % closed value for achieving the desired head differential across the gate (typically 12 inches). Note that all gate actuator positions are in % Closed, not % Open.
   d. On the same control screen under *PROCESS STATUS*, monitor the "Pool 1 - Tailrace" calculated value to confirm proper gate position.
   e. Readjust gate position using the virtual keypad as necessary to fine tune the gate head differential.
   f. Refer to Table 3 in Section **Error! Reference source not found.** for suggested RG-001 adjustment based on entrance head (LT-002 – LT-003).
5. Adjust the position of the transportation channel gate so that the invert is 2.0 feet below the tailrace WSEL (LT-003) as follows:
   a. Repeat previous step 4a for the transportation gate.

b. Repeat previous step 4b for the transportation gate.
c. Press the KEY PAD button and enter the gate % closed value for achieving the desired top of gate elevation, which is typically 2ft below the main tailrace water surface. Note that all gate actuator positions are in % Closed. At 100% closed the gate is fully raised blocking all flow. At 15% closed the channel is 100% open, permitting full flow.
d. On the same control screen under *PROCESS STATUS*, monitor the "Main Tailrace – 2Ft." calculated value to confirm proper gate position.
e. TG-001 = Tailrace (LT-003) – 2 feet.
f. Readjust the gate as necessary to fine tune the top of gate position.

6. Adjust the position of the side entrance gate to establish a differential in water surface so that pool 1 is 0.25 feet ±0.05 feet above the side entrance pool (LT-004) as follows:
   a. Repeat previous step 4a for the side entrance gate.
   b. Repeat previous step 4b for the side entrance gate.
   c. Press the KEY PAD button to move the gate to a % closed position. Note the minimum setting is 10.4% closed (gate lowered allowing full flow). The maximum setting is 85.5% closed (gate raised blocking flow).
   d. On the same control screen under PROCESS STATUS, monitor the "Pool 1 – Side Pool" to confirm proper gate position.
   e. Readjust gate position using the virtual keypad as necessary to fine tune the pool differential.
   f. Refer to Table 4 in Section **Error! Reference source not found.** for suggested RG-002 adjustments based on differential between pool 1 and side entrance pool (LT-002 – LT-004).

4.1.2.2.4. Sorting Operations

Before fish jump over the false weir or are crowded out of the pre-sort pool, the facility operator should decide if any fish will be diverted by a switch gate. If switch gate diversion is a possible course of action, open the appropriate switch gate supply valve preemptively so that water flows down the associated fish pipe prior to diverting fish through a switch gate.

Fish not diverted through a switch gate will go to the anesthetic tank. After fish are anesthetized, the operator may take them out of the tank and either place them in the recovery tank for return to river (note: only resident fish, or juvenile salmon or steelhead are to be placed in the recovery tank and returned to the river, adult salmon or steelhead are not to be returned to the river by this method), or placed them in a fish transport pipe for deposition into a post-sort pool. The fish transport pipes on the west side of the sorting table go to the short term post-sort pools while the fish transport pipes on the east side of the sorting table lead to the long term post-sort holding pools. The operator will ensure the corresponding fish pipe water supply valve (located under the sort table, directly below each fish pipe) is open and water is flowing into the fish transport pipe at the desired rate prior to placing fish in the pipe. Also ensure that the receiving post-sort pool is full of water (water is overflowing the weir boards) and that water is being supplied to the pool at the design flow rate.

4.1.2.2.5. Post-Sort Pool Operations

Once a post-sort pool is full of fish and/or the facility operator chooses to haul a pool of fish to another destination, the following procedures should be followed.

a. Fill the crowding channel with water. If fish are to be crowded to the hopper, open the hopper pit supply valve (FOS-FWDS-STC01) in the long term supply vault. If fish are to be crowded to the fish lock, open the fish lock supply valve (FOS-FWDS-FLK01) using actuator FLS-01. Both valves may be opened to fill the crowding channel quickly. Close the appropriate valve when the water level in the channel reaches full height.

b. Ensure the fish lock drain valve (FOS-FWDS-FLK02) is closed.

c. With the post-sort pool crowder (long term or short term) parked on its trolley, move the trolley to the post-sort pool to be crowded.

d. Drive the crowder off the trolley and over the post-sort pool so that the vertical barrier screen can be raised. It is advised to lower the vertical barrier screen as close to the pool drain screen as possible so that fish do not end up behind the vertical barrier screen once it is lowered.

e. Position crowding channel crowder in appropriate location (see paragraph 4.1.2.2.6 below).

f. Fully raise post-sort pool bulkhead.

g. Fully lower post-sort pool crowder vertical barrier screen.

h. Move the crowder forward and crowd fish out of the post-sort pool.

i. Once fish have exited the post-sort pool and entered the crowding channel, fully close the post - sort pool bulkhead.

j. Fully raise the post-sort pool crowder vertical barrier screen and return crowder to its parked position on the trolley.

4.1.2.2.6. Crowding Channel Operations

The crowding channel is used to crowd fish to the hopper for truck transport, or to the fish lock for return to the anesthetic tank. The crowding channel crowder has two vertical barrier screens for this reason. When crowding fish to the hopper, follow these steps:

a. Fully lower the southern vertical barrier screen (Screen #1 on the pendant).

b. Move the crowder so that the face of the lowered vertical barrier screen is just to the north of the bulkhead opening of the post-sort pool from which fish are to be crowded.

c. Ensure the hopper is positioned in the hopper pit before opening the post-sort pool bulkhead.

d. Once fish have been crowded out of the post-sort pool and into the crowding channel, and the post-sort pool bulkhead lowered, move the crowding channel crowder south towards the hopper.

e. After the crowding channel crowder stops at its southern travel limit by the hopper, raise the hopper and load fish into the fish transport truck.

f. Reverse the crowding channel crowder until clear of the hopper hoist structure, then fully raise the southern vertical barrier screen.

If fish are to be crowded into the fish lock, follow the procedures below.

a. Ensure the fish lock brail is fully lowered and the fish lock bulkhead is fully raised.

b. Fully lower the northern vertical barrier screen (Screen #2 on the pendant) on the crowding channel crowder.

c. Move the crowding channel crowder so that the face of the protruding screen section is just to the south of the bulkhead opening of the post-sort pool from which fish are to be crowded. If needed, steps g. and h. can be interchanged.

d. Once fish have been crowded out of the post-sort pool into the crowding channel, and the post-sort pool bulkhead closed, move the crowding channel crowder towards the fish lock.

e. After the crowding channel crowder stops at its northern travel limit by the fish lock, lower the fish lock bulkhead.

f. Reverse the crowding channel crowder until the vertical barrier screen is clear of the fish lock opening, then fully raise the northern vertical barrier screen.

4.1.2.2.7. Fish Lock Operations

After fish have been crowded into the fish lock and the bulkhead fully lowered, keep the fish lock supply valve open until water fills the fish lock chamber and begins to overflow down the return flume to the anesthetic tank. The fish lock supply valve can be adjusted manually from the fish lock control panel so that the fish lock chamber fills and then overflows at the Operator's desired rates. Once the fish lock is full of water, raise the fish lock brail in order to raise the fish and meter them out into the return flume. Once all the fish have been brailed out of the fish lock, fully lower the fish lock brail. Open the fish lock drain valve in order to drain water from the fish lock. IMPORTANT: do not attempt to raise the fish lock bulkhead when there is a head differential across it. The water level in the crowding channel and the water level in the fish lock must be approximately equal before opening the fish lock bulkhead. Failure to comply will break the bulkhead hoisting cables.

4.1.2.3. Automatic Operation

To operate the Foster Adult Fish Facility in Automatic mode, follow the procedures below. For the facility to operate satisfactorily, the normal operating criteria in section 4.2.1 must be met. These instructions assume that the Pre-Activation Checklist items have been completed, water systems are watered up, and properly started up. START-UP ORDER NEEDS TO BE INCLUDED, OTHERWISE LADDER FLOW MAY OVERTOP ENTRANCE GATES?.

4.1.2.3.1. Gravity Forebay Water Supply System

The FWS System is designed to function automatically by implementing the following steps:

1. FWS attraction water supply to side entrance:
    a. Place the side entrance FCV actuator (PHS-001) red LSR selector switch in REMOTE.

b. At any graphic terminal navigate to the "*SIDE ENTRANCE VALVE*" screen. Verify the green "*READY*" symbol is visible above the "*AUTO CONTROL*" button.
c. After pressing the "*AUTO CONTROL*" button a green circle with "A" should appear.
d. The Side entrance FCV (FOS-FWS-PHS01) should modulate automatically to maintain the flow rate setpoint for supplying attraction water to the side entrance.

2. FWS supply to Fish Facility:
   a. Place the Headbox FCV actuator (HBO-003) red LSR selector switch in REMOTE.
   b. At any graphic terminal navigate to the "HEADBOX V*ALVE*" screen. Verify the green "*READY*" symbol is visible above the "*AUTO CONTROL*" button.
   c. After pressing the "*AUTO CONTROL*" button a green circle with "A" should appear.
   d. The Headbox FCV (FOS-FWS-FHB01) should modulate automatically to maintain the Headbox level setpoint for supplying FWS water to meet Fish Facility demands.
   e. Manually adjust the ten manual 14-inch butterfly valves at the Headbox as necessary to equalize FWS flow to the ten packed columns.

4.1.2.3.2. AWS Pumps

In normal operation the AWS Pumps are designed to function automatically in response to river level by performing the following:

1. Place the Pump HOA selector switch in AUTO at each pump control panel.
2. At any graphic terminal navigate to the "AWS PUMP" screen and verify that all pump selector switches are in the AUTO position.
3. Verify the "*READY for AUTO*" light is visible below the "*AUTO CONTROL*" button.
4. After pressing the "*AUTO CONTROL*" button the "*SYSTEM in AUTO*" light should illuminate.
5. Check that the pump control setpoints established through the control screen are in accordance with the recommended operating procedures in Table 1 in Section **Error! Reference source not found.**.

4.1.2.3.3. Fish Ladder Gates

In normal operation the Fish Ladder Gates are designed to function automatically in response to river level and attraction water flows by performing the following steps:

1. Place the three roller gate actuators in REMOTE using the LOR selector switch on each unit.
2. At any graphic terminal navigate to the "GATE SUMMARY" screen. Alternatively each individual gate control screen may be used.
3. At the HMI verify each actuator LOR switch shows "REMOTE" and the alarm status shows "OKAY". A green "READY" indicator should be visible above each "AUTO CONTROL" button.
4. Place the two Fish Ladder Entrance Gates (RG-001 and RG-002) and the transportation channel gate (TG-001) in AUTO.
5. After pressing the "AUTO CONTROL" button a letter "A" within a green circle should appear, indicating automatic mode.

4.1.2.3.4. Pre-Sort Pool Operations

4.1.3. Normal Facility Shutdown

To shut down the Foster Adult Fish Facility AWS system, follow the procedures in section 4.1.3.1 AWS System Shutdown. To shut down the entire Foster Adult Fish Facility, follow the procedures in sections 4.1.3.2 (Facility Shutdown) and 4.1.3.3 (Dewatering Procedure).

4.1.3.1. Attraction Water Systems Shutdown

When fish trapping is to be curtailed, the attraction water systems, side entrance FWS water and AWS Pumps, are no longer needed. To shut down the Foster Adult Fish Facility attraction water systems, follow the procedures below.

Prior to beginning these shutdown procedures, lower the picket gates at both the main entrance and side entrance to exclude fish from entering the ladder system. Facility shutdown cannot be implemented until all fish have traveled up the ladder and/or been processed or removed from all fish facilities.

4.1.3.1.1. Side Entrance Attraction Water Shutdown

1. Place the side entrance FCV actuator (PHS-001) LOR switch in LOCAL.
2. Slowly close the FCV by pushing the CLOSE pushbutton. CAUTION: Do not close the valve in faster than 60 seconds. Cycle the actuator between STOP and CLOSE as necessary to regulate closing time.

Alternatively (Remote Manual):

1. At any HMI navigate to the “SIDE ENTRANCE VALVE” control screen, and verify the side entrance FCV actuator (PHS-001) LOR switch is in REMOTE and the status is “OKAY”.
2. From the same HMI screen, verify the green “READY” indicator is visible above the “MANUAL CONTROL” button.
3. After placing the side entrance FCV (FOS-FWS-PHS01) in manual, a letter “M” within a red circle should be visible.
4. Close the FCV by entering 0.0% open using the virtual keypad.

4.1.3.1.2. AWS Pumps Shutdown

1. At each AWS Pump control panel, place the HOA switch for each Pump (FOS-AWS-PMP01 thru – PMP04) in OFF.
2. Confirm that the bearing lube water supply solenoid valve closes.

Alternatively (Remote Manual):

1. At any HMI navigate to the “AWS PUMP” screen. Verify the HOA switch for each Pump (FOS-AWS-PMP01 through PMP04) is in AUTO.
2. Press the red “STOP” button for each pump to be stopped.

4.1.3.2. Facility Shutdown

To shut down the Foster Adult Fish Facility, follow the procedures below, and in section 4.1.3.3 (Dewatering Procedure). To shut down only the attraction water systems, follow the procedures in section 4.1.3.1. AWS System Shutdown.

4.1.3.2.1. Side Entrance Attraction Water Shutdown

1. Place the side entrance FCV actuator (PHS-001) LOR switch in LOCAL.
2. Slowly close the FCV by pushing the CLOSE pushbutton. CAUTION: Do not close the valve in faster than 60 seconds. Cycle the actuator between STOP and CLOSE as necessary to regulate closing time.
3. In the pump room, place the LSR knob in the STOP position at actuator PHS-001.

Alternatively (Remote Manual):

1. At any HMI navigate to the "SIDE ENTRANCE VALVE" control screen, and verify the side entrance FCV actuator (PHS-001) LOR switch is in REMOTE and the status is "OKAY".
2. From the same HMI screen, verify the green "READY" indicator is visible above the "MANUAL CONTROL" button.
3. After placing the side entrance FCV (FOS-FWS-PHS01) in manual, a letter "M" within a red circle should be visible.
4. Close the FCV by entering 0.0% open using the virtual keypad.
5. In the pump room, place the red LSR knob in the STOP position at actuator PHS-001.

4.1.3.2.2. AWS Pumps Shutdown

1. At each AWS Pump control panel, place the HOA switch for each Pump (FOS-AWS-PMP01 thru – PMP04) in OFF.
2. Confirm that the bearing lube water supply solenoid valve closes.

Alternatively (Remote Manual):

1. At any HMI navigate to the "AWS PUMP" screen. Verify the HOA switch for each Pump (FOS-AWS-PMP01 through PMP04) is in AUTO.
2. Press the red "STOP" button for each pump to be stopped.
3. For extended shutdowns, turn off the bearing lubrication water system by shutting the supply valve on the 24-FWS pipe and opening the solenoid valve bypass valve for each pump to allow the piping to drain.

4.1.3.2.3. Fish Facility

1. Dewater the pre-sort pool:
    a. Shut the two pre-sort pool supply valves (FOS-FWDS-PSS01 and FOS-FWDS-PSS02). These are 20" butterfly valves with electric actuators. They can be actuated remotely via the HMI or locally at each actuator. This will stop water from flowing into the pre-sort pool. The water in the pool will drain down the fish ladder until the water reaches the crest of the finger weir (approximate 5 foot water depth in pool).
    b. Open the pre-sort pool drain valve (FOS-FWDS-PRE01) located in the East pre-sort pool supply vault. This is an 8" butterfly valve that is manually actuated. This will drain the remaining water from the pre-sort pool and floor diffuser pits to the river via the storm sewer system.
    c. Open the pre-sort pool Brail pit drain valve (FOS-FWDS-PRE05). This is a 2", manually actuated ball valve.

2. FWS supply to Headbox:
    a. At any HMI, navigate to the "HEADBOX VALVE" control screen and verify the Headbox FCV (FOS-FWS-FHB01) LOR switch is in REMOTE and the status is "OKAY".

b. From the same HMI screen, verify the green "READY" indicator is visible above the "MANUAL CONTROL" button.
c. After placing the valve in manual control mode, the letter "M" within a red circle should be visible.
d. Close the FCV by entering 0.0% open using the virtual keypad.

3. Dewater the Headbox and FWDS.

The Facility Water Distribution System is interconnected. Individual points of use have isolation valves and can be shut down separately from the system. As part of the follow on contract, two stainless steel slide gates were installed inside the headbox that allow facility operators to shut off flow to each branch of the FWDS independently. Therefore, the post sort pool area can be dewatered while maintaining operations at the presort pool, sorting area, and fish ladder. Alternately, the presort pool, fish ladder, and sorting area could be dewatered while continuing to hold fish in the post sort pools. The steps below outline procedures to dewater each branch of the FWDS as well as the entire facility.

a. To dewater the post sort pools while maintaining fish ladder flow, perform the following:
    1) Close all post sort pool supply valves, hopper pit supply valve, and fish lock supply valve so that the slide gate can be closed under a no flow condition.
    2) Close the slide gate valve on the post sort pool branch of the FWDS. This slide gate is on the South side of the headbox.
    3) Assuming multiple post sort pools and the crowding channel are watered up, open the post sort pool bulkheads so that the post sort pools and crowding channel are hydraulically connected.
    4) Under a balanced head, open the fish lock bulkhead.
    5) Open all three switchgate supply valves, FOS-FWDS-PSF01, FOS-FWDS-PSF02, and FOS-FWDS-PSFPSF03. These are the high points in this branch and will allow air to enter the pipes while draining.
    6) Open the fish lock supply valve, FOS-FWDS-FLK01. This is the low point in the system and will drain the majority of the water in the piping.
    7) Open the fish lock drain valve, FOS-FWDS-FLK02. This will drain all water in the piping and post sort pools to the outfall structure at the river.
    8) If the post sort pool supply pipes under each post sort pool need to be drained, use the recirculation pumps in drainage mode.

b. To dewater the presort pool and fish ladder while maintaining operations in the post sort pools, perform the following:
    1) Notify ODFW and prepare to perform fish salvage operations in the presort pool and fish ladder.
    2) Close the presort pool supply valves, FOS-FWDS-PSS01 and FOS-FWDS-PSS02, in accordance with fish ladder dewatering and fish salvage procedures.
    3) Close all other supply valves in the sorting area. This will allow the slide gate to close under a no flow condition.
    4) Close the slide gate on the presort pool/sorting area branch of the FWDS. This in on the West side of the headbox.
    5) Open the flume supply valve, FOS-FWDS-PRE03. This is the high spot on this branch and will allow air to enter the system while draining.
    6) Open the presort pool drain valve, FOS-FWDS-PRE01, and the brail pit drain valve, FOS-FWDS-PRE05. This will drain the piping to the pre-sort pool floor and brail pit elevation.
c. To dewater the entire FWDS to include the headbox, perform the following:

1) Ensure all post-sort pools and the Central Crowding Channel are at the same water depth (full) by opening the associated water supply valve. Then open all post-sort pool bulkheads. This hydraulically connects the entire post-sort area. Alternately, each post-sort pool could be drained separately by lifting out the weirboards at the end of each pool.
2) Open the flume supply valve, fish pipe supply valves at the sorting table, and switch gate valves. In addition to drawing water from the Headbox and draining it more quickly, these valves are the high points in the system. In addition the combination air/vacuum release valves located in the short term post-sort pool supply vault and the West pre-sort pool supply vault these high point valves will allow air to enter the system while draining the pipelines.
3) Open the fish lock drain valve and the fish lock supply valve. The fish lock is the low point in the system. All water in the FDWS pipes will ultimately drain through the fish lock supply line and out the fish lock drain to the river via the storm sewer system.

4.1.3.3. Dewatering Procedure

After completing the Facility Shutdown procedures (section 4.1.3.2) follow the procedures below to dewater the Foster Adult Fish Facility.

1. Dewater FWS Pipelines:
    a. Close FWS isolation valves FOS-FWS-VRM01, -VRM02, and –VRM03 in the valve room.
    b. At any HMI open FOS-FWS-PHS01 to the 25% open position to drain the 24-FWS through the lower dissipator and side entrance. The air vacuum release valve in the valve room will allow air to enter to prevent vacuum conditions in the pipe.
    c. In the Valve Vault, open the two globe drain valves to slowly drain the 36-FWS through the storm drain system to the river. The air vacuum release valve in the valve room will allow air to enter to prevent vacuum conditions in the pipe.
    d. At the Headbox, confirm that all ten butterfly valves are fully open on the 14-FWS supply pipes.
2. Dewater pumphouse:
    a. At main entrance, remove the pump intake trash rack.
    b. Install the pump intake bulkhead.
    c. Prepare the drainage system in the Powerhouse.
    d. Open the drain valve in the main entrance sump, which will allow the remaining water in the pumphouse to drain to the Powerhouse.

4.1.4. Emergency Operations

4.1.4.1. Power Outage

Given that fish collection is a non-critical operation at Foster Dam and the capacity limitations of the existing emergency generator, there is limited fish facility equipment provided with emergency backup power at the site. Since the FWS system conveys water by gravity, the water supply to the fish facility, including the fish holding pools, and attraction water to the side entrance can be maintained during a power outage. The FWS flow control valves will fail in the last position so flow will automatically continue with no action taken. The following procedures address the operational steps for addressing power outage operations.

1. 24-FWS to side entrance:

a. The flow control valve will fail in last position and it may not be necessary to take any action. To provide some safeguard that excessive velocities are not generated in the pipe, the FCV could be closed slightly using the manual handwheel (See Manual Normal procedures for more details).

2. 36-FWS Supply to Fish Facility:
   a. The Headbox flow control valve will fail in last position and it may not be necessary to take any action. To assure that all water demands are met at the Fish Facility, the valve could be adjusted manually to produce enough flow to slightly overtop the Headbox overflow weir (See Manual Normal procedures for more details). Otherwise, the level in the Headbox can be visually monitored and the valve manually adjusted to maintain adequate water level. This will assure that water continues to flow down the fish ladder and not strand any fish in transit up the ladder.
   b. [other procedures at Fish Facility; need input from USACE]
3. AWS Pumps: The AWS Pumps are strictly for attraction water and will not operate during a power outage.

4.2. Equipment Operations

4.2.1. Fish Ladder

[All equipment procedures are covered in the facility operations (see Section 4.1 for details).

4.2.2. Headbox

[All equipment procedures are covered in the facility operations (see Section 4.1 for details).

4.2.3. Pre-Sort Pool

4.2.3.1. Finger Weir

The finger weir can be raised and lowered manually by a hand winch on the NE end of the pre-sort pool. The level should be set in accordance with the fish biologist's recommendations. The crest of the finger weir shouldn't be so far out of the water as to impede fish from entering the pool. Nor should it be so low that fish are able to easily fall back out of the pre-sort pool into the fish ladder.

4.2.3.2. Crowder

The pre-sort crowder can be operated at the either the Presort Control Console or the Pre-sort Crowder Control Cabinet, shown in Figure 12. A description of each button function is provided below:

SPEED: Select between two crowder speeds, 'Lo' and 'Hi'.

RAISE: Raises crowder screen.

LOWER: Lowers crowder screen.

CROWD (FWD): Moves crowder forward toward false weir (east).

PARK (REV): Reverses crowder away from false weir (west).

STOP: Stops all crowder operation.

ENABLE: This button must be pressed in the event and E-STOP button is actuated.

Crowder Control Cabinet

Operator Station at False Weir Platform

4.2.3.3. False Weir

The false weir attraction flow is supplied by pump. Operate the false weir at the Pre-sort Control Console. The false weir controls are shown in more detail in Figure 13. To turn the false weir on, push the 'START VFD' button. Flow can be regulated using the turn dial, set dial to 0% for minimum flow and 100% for maximum flow. To turn the false weir off and stop flow, push the 'STOP VFD' button.

4.2.3.4. Closure Gate

The Closure Gate prevents the fish from entering the false weir and flume when processing is temporarily suspended. The closure gate is operated by a winch with an automatic brake. The winch is located adjacent to the gate and is operated manually to open and close the gate.

4.2.3.5. Pre-Sort Brail

The pre-sort brail is intended to be used in the last step of crowding if the adult fish do not move volitionally by way of the false weir. The brail only activates when the crowder has reached its full crowder position. By depressing the 'raise' button the brail will move up in the water column until the operator presses the stop button. The brail may be moved down or up from an intermediate position if the brail is stopped prior to reaching its lower or upper limit.

For maintenance purposes limits can be overridden and the brail can be operated with the crowder in the parked position.

4.2.3.6. Pre-Sort Pool Piping

The primary portions of this pipe are buried or embedded. The pipe material is schedule 40/80 PVC and the pipe embedded in concrete is stainless steel. System pressure varies based on head box water surface elevation and can never exceed 20 PSI.

4.2.3.7. False Weir Water Supply and Drain

These are 6"actuated valves that regulates the water traveling down the Transport flume. Up to 1.25 CFS can be supplied for passage operations sourced from the FWS.

4.2.3.8. Valves

Process valves in the Pre-sort area are butterfly valves operated by lever or electric actuator.

4.2.3.9. Diffusers

There are two Pre-sort diffusers each one is supplied by 16" diameter pipe as part of the FWS piping system. Diffusers should be inspected annually for sediment and debris accumulation. The screen for each pool should be removed and pressure washed to remove debris. Remove the porosity plates located below the diffuser grating and pressure wash them to remove debris. Sediment and debris should also be removed from the pit area below the porosity plate. It is recommended that the majority of the debris is removed and disposed of in accordance with local laws and regulations.

4.2.4. Sort Facility

4.2.4.1. Switch Gates

Switch gates are used to direct incoming fish to desired locations. The label above each button indicates the location where each fish will be deposited. Momentarily press the desired pushbutton to open the switch gate. Switch gate will close upon release of the pushbutton. The "Return-to-River" switch gate can be held open indefinitely by switching the "SWITCHGATE CONTROLS" selector switch (on the Pre-sort Control Console) to "WINTER RETURN". This selector switch should normally be in the "NORMAL" position. The switch gate speed can be adjusted by needle valve. Switch gate operation should only be set to a minimum actuation speed as faster speeds increase wear and tear on the switch gates.

CAUTION: Ensure water supply valves at operator control station have been opened prior to operating switch gates. (See operator station at false weir)

DRAFT

Switch gate Control at Operator Station at False Weir Platform

4.2.4.2. Anesthetic Tank

The anesthetic tank has a pneumatically operated brail. Press the 'RAISE' button to raise the brail and 'LOWER' button to lower it.

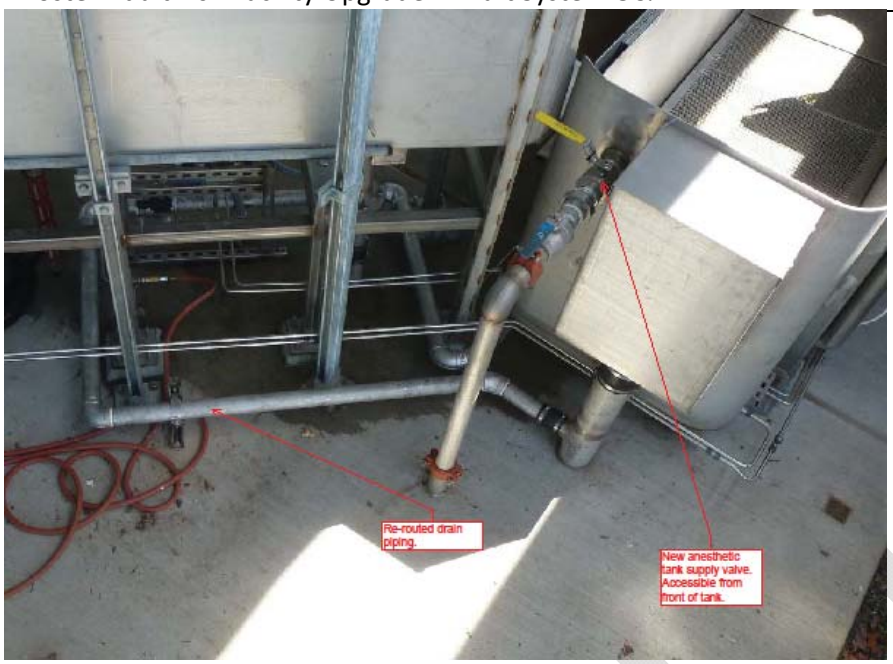
CAUTION: Personnel should not enter the anesthetic tank. The brail is not designed for floor loads and will not support the weight of an operator safely.

The anesthetic tank is filled by opening a manually actuated ball valve. Water is sourced from the FWS.

The anesthetic tank is drained by opening a ball valve. It drains to the raingarden near the fish lock.

Some fish lock control is allowed at the anesthetic tank. The brail hoist may be operated from the anesthetic tank. The left side controls move the tank brail up and down; the right side controls move the fish lock brail up and down.

DRAFT



Behind Sorting Table

Operator Station at Anesthetic tank

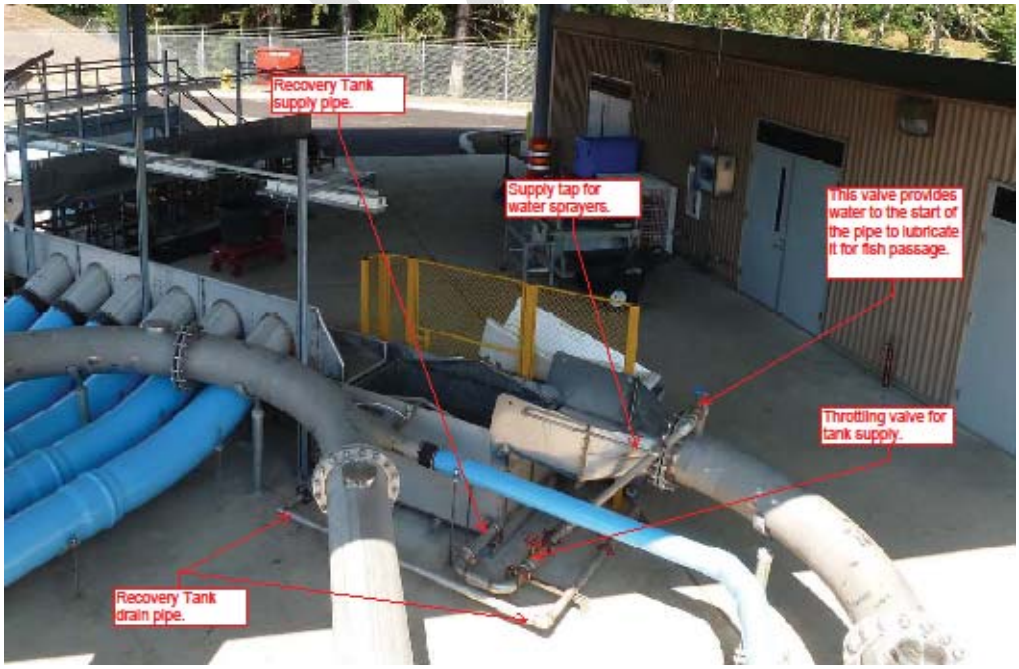
4.2.4.3. Sort Table

The sort table is connected to a network of fish pipes. Control of the fish pipe water supply is performed here at manually controlled valves beneath the table at each fish pipe entry. The quantity of water should be adjusted to ensure excess water is not added to the sorting ponds. Flushing water is provided and should also be adjusted as required to allow non-injurious movement of adult fish.

4.2.4.4. Recovery Tank

The recovery tank allows anesthetized fish to regain consciousness. A pneumatically operated brail can be used to move fish into the return to river pipe. For safety an interlock is used to control the brail; to operate the interlock button must be depressed while simultaneously depressing the 'up' or 'down' button.

Prior to operating recovery tank ensure flushing water valve is on (located on top of return to river pipe) and attraction water, by way of flexible nozzle is operating.



Recovery Tank

4.2.4.5. Return to River Pipe

The return to river pipe takes fish from the transport flume and the recovery tank and deposits them downstream from the dam tailwater. Flushing water is provided by the transport flume and the recovery tank.

4.2.4.1. Mechanical Room

4.2.4.1.1. Compressed Air

The compressed air system is self-activating in that a relay will control air pressure for each air access point. Pressure should be maintained at approximately 110 PSI.

4.2.4.1.1. Wash down water pump and tank

The washdown pump is self-activating in that a pressure switch will control water pressure in the tank. Pressure will vary from 30 to 50 PSI.

4.2.4.2. HVAC

4.2.4.2.1. Exhaust fans

When the room temperature reaches 80 degrees Fahrenheit, the fans will start.

4.2.4.2.2. Unit Heaters

Unit heaters will cycle to maintain the space at 55 ° F (Adjustable).

4.2.5. Post-Sort Pools, Crowding Channel, and Hopper Pit

4.2.5.1. Post-Sort Pool Trolley

There are two crowder trolleys; one for the short term side and one for the long term side. The crowder trolley is used to move the crowder to the pool that requires crowding. Each crowder trolley has identical controls.

LEVER: Moves trolley north or south along rails. The lever functions as a two speed switch and while in low speed the low speed light is lit.

E-STOP: For safety button is pressed at any point to stop the trolley.

ALIGNMENT BYPASS: Used to adjust the trolley to ensure the crowder rails are aligned in the event that the limit switches fail to automatically align the crowder to the crowder rails.

CROWDER DOCKED: Indicates, when lit, that the crowder is correctly on the trolley and ready for travel to the next pond.

RAILS ALIGNED: Indicates, when lit, that the trolley is correctly aligned with the crowder rails. At this point the crowder can be moved off the trolley.

CAUTION: Operator should verify that the trolley crowder rails are aligned with the pool crowder rails prior to moving the crowder off the trolley.

4.2.5.2. Post-Sort Pool Crowder

There are two crowders; one for the short term side and one for the long term side. The crowder is used to move fish from a pond to the sorting channel. Each crowder has identical controls.

LEVER: Moves crowder forward or backward along rails. Lights indicate the direction of travel. The lever functions as a two speed switch and while in low speed the low speed light is lit.

E-STOP: For safety button is pressed at any point to stop the crowder.

REVERSE LIMIT BYPASS: Follow on work complete

ENABLE: Follow on work complete

RAISE: Press to raise crowding screen.

LOWER: Press to lower crowding screen.

STOP: Stops crowder screen at any point of travel.

4.2.5.3. Crowding Channel Crowder

The sorting channel crowder functions to move fish to the hopper or the fish lock. There is a separate operating crowding screen for each direction of travel. See picture below.

4.2.5.4. FWS Piping (Headbox to Post-Sort Pools)

4.2.5.5. Recirculation Water System

The recirculation water system controls pond drains, surface sprayers, and chemical delivery. Each action is outlined by placard at the operator station.

DRAFT

4.2.5.6. Fish Screens and Weir boards

The fish screens have a hinged panel located at the bottom of the screen for maintenance. This panel can be opened so debris can be moved to pond drains. It may be necessary to periodically clean debris using a rake or squeegee.

Behind the screens are weir boards. The weir boards control the water surface elevation of each pond. A lifting beam is supplied so an operator can remove weir boards while standing on the deck grating.

LIFTING BEAM OPERATION:

- Water level should be reduced to the desired water elevation. The weir boards that need to be removed should be completely out of the water.
- Lower lifting beam down to cap weir board allowing it to engage both hooks; remove weir board
- Repeat with the desired number of weir boards that need to be removed. *Note: each board is 8" in height*
- Attach cap weir board to the lifting beam and lower down slot
- Allow main line to go slack (this should allow hooks to disengage) pull secondary line to keep hooks from reengaging weir board and then pull lifting beam up and out of slot with main line.

4.2.5.7. Post-Sort Pool Bulkheads and Hoists

The post-sort pool bulkheads should normally be kept in the closed (down) position. The bulkheads are designed to seal in both directions so that the Crowding Channel may be watered up and the post-sort pool dry, or vice versa. The post-sort pool bulkheads are not designed to be opened under differential. Water levels in the Crowding Channel and post-sort pools must be equal before raising the bulkheads.

The bulkheads are operated by an electric wire rope hoist. Each hoist is controlled by a handheld pendant.

4.2.5.8. Fish lock Bulkhead and Hoist

In order to use the fish lock a column of water must be supported to an elevation sufficient to allow fish to move into the anesthetic tank. Using the sorting crowder fish are moved into the base of the fish ladder. The fish lock bulk head is lowered and the column is then filled with water.

HOIST

RAISE: When pressed raises the brail.

LOWER: When pressed lowers brail.

VFD-BYPASS: Follow on work complete

STOP: Stops brail at any point of travel.

HOIST RUNNING: When lit, Brail is moving

SPEED: Low/high speed selection

BULKHEAD

EXTREME CAUTION: Bulkhead operator must verify that the water level in the column is level with the sorting channel prior to raising the bulkhead.

RAISE: When pressed raises the bulkhead.

LOWER: When pressed lowers bulkhead.

VFD-BYPASS: Follow on work complete

STOP: Stops bulkhead at any point of travel.

HOIST RUNNING: When lit, Bulkhead is moving

SPEED: Low/high speed selection

Once the bulkhead is lowered the supply valve is opened filling the column. Valve position can be changed to allow a small amount of overflow water to enter the fish lock flume. After the fish have been processed the brail should be lowered and the fish lock should be emptied using the drain valve.

4.2.5.9. Sort Channel Drain System

Need a picture?

4.2.6. Fish Transfer and Loading Equipment

4.2.6.1. Hopper Crane

The hopper crane will typically remain hooked to the fish hopper, which will be positioned either in the hopper pit or the above-ground hopper storage box under the crane structure. During fish transfer periods, fish will be crowded directly into the fish hopper in the pit. When ready to transfer fish to the fish truck perform the following steps:

1. Push the START button to activate the hoist and trolley controls.
2. Confirm that the Crowding Channel Crowder is parked against the hopper and has fully engaged the limit switch; otherwise, the hopper cannot be moved with the usual pendant pushbuttons. [If desired, the CROWDER BYPASS button can be used to defeat the limit switch permissive.]
3. Slowly raise the hopper by depressing the HOIST UP button (two step button for two-speed control) to allow water to slowly drain out the perforations while retaining all fish.
4. Raise the hopper to clear all obstacles and high enough to clear the fish truck mating flange.
5. Push the TROLLEY RIGHT button to move the hopper over the fish truck (previously filled with water). Fully depress the RIGHT button for faster travel.
6. Manipulate the TROLLEY and HOIST buttons to align the hopper flange with the mating flange on the truck. Fully lower the hopper onto the truck flange.
7. Open the butterfly valve to allow hopper water to fill the void between the hopper and truck.
8. Pull the hopper door handle down to raise the door inside the hopper and complete the water-to-water connection.
9. Open the drain valve at the back of the fish truck to release water to the area drain and lower the water level from the hopper into the truck tank effectively transferring all fish into the truck.
10. Confirm water level in the truck tank and close the truck drain valve when at the proper level.
11. Close the water transfer valve, close the door, and raise the hopper off the truck. Reposition the hopper into the hopper pit or storage box.

DRAFT

4.2.6.2. Fish Hopper

The fish hopper is generally a welded-aluminum construction "box" used for transferring fish from the post-sort pools to fish trucks for out-planting fish upstream of Foster Dam. The hopper has a limited number of moving components and is generally maneuvered using the hopper crane (see above). The hopper will typically be positioned in the hopper pit at the end of the Crowding Channel. The three-sided box allows fish to be crowded into the hopper through the open side with the crowder screen serving as the fourth side of the enclosure to retain fish inside. Brush strips are included where needed on edges to preclude fish from areas where they could be harmed or elude transfer. When the crowding channel crowder has mated up with the fish hopper, a limit switch completes a contact, which is a permissive for using the hopper crane to raise the hopper. The limit switch assures that the crowder screen is fully against the hopper so fish cannot escape.

The hopper includes a manually operated water transfer ("drain") valve that is used to complete the water-to-water connection between the hopper and the fish truck. After the hopper has been positioned on the fish truck's tank flange, the butterfly valve is opened to transfer hopper water into the void below the hopper door and equalize pressure. Otherwise, the weight of water in the hopper is too great to open the door. The circular plunger-style hopper door is opened by pulling down on the door handle on the exterior of the hopper once the water-to-water connection is complete. The door rises to effectively interconnect the hopper water with the truck tank water and allow fish to pass. When the tank is drained down enough, all the water and the fish end up in the truck's tank. When fish transfer is complete, the hopper door and water transfer valve are both closed and the hopper repositioned with the hopper crane back into the hopper pit for the next batch of fish.

4.2.6.3. Fish Truck

4.2.6.4. Truck Fill Station

The truck fill station is used to fill fish trucks with water prior to transferring fish from the hopper. The truck fill pump provides a pressurized water supply (FWS water) to lift the water up into the truck and accelerate the filling process. The fill pump is activated through the local control panel mounted next to the pump.

1. Confirm that pump and control panel are powered up; green STANDBY lamp should be lit.
2. Confirm that discharge isolation valve is open (should always remain open).
3. Confirm that FWS supply valve (post-mounted handwheel operator) is fully open and that buried drain valve (tee-handle operator) is closed (should only be closed/opened, respectively, during freezing periods).
4. Move the RUN/STOP switch to the RUN position to start the pump.
5. Visually monitor the fish truck tank level.
6. Stop the pump when tank is full to the brim by moving the switch to the STOP position.

4.2.7. Fire Protection Water System

4.2.7.1. Piping

4.2.7.2. Fire Hydrant

4.2.7.3. Hose Box

4.2.8. Maintenance Building Office/Maintenance Building

4.2.8.1. Reduced Pressure Backflow Preventer

Refer to the Contractor's approved Operation and Maintenance manual, Volume 8 Part 1, for operation procedures for Reduced Pressure Backflow Preventer.

4.2.8.2. Electric Water Heater

Refer to the Contractor's approved Operation and Maintenance manual, Volume 8 Part 1, for operation procedures for operation procedures for Electric Water Heater.

4.2.8.3. Electric Trap Primer

Refer to the Contractor's approved Operation and Maintenance manual, Volume 8 Part 1, for operation procedures for Electric Trap Primers.

4.2.8.4. Plumbing Fixtures

Refer to the Contractor's approved Operation and Maintenance manual, Volume 8 Part 1, for operation procedures for plumbing fixtures.

4.2.8.5. Sanitary Sewer

Deploy trap and drain auger at blockage location. If efforts fail a third party vendor may be required that specializes in blockage removal. In all cases, ensure protective gear is worn per EM-385 guidelines.

4.2.8.6. Unit Heaters

Unit heaters will cycle to maintain the space at 55 °F (Adjustable). Refer to the Contractor's approved Operation and Maintenance manual, Volume 8 Part 1, for more on unit heater operation.

4.2.8.7. Make-up Air Handling Unit

The space will be ventilated continuously while the following conditions are met: The space is occupied, carbon monoxide levels are at or above 9PPM, and when space temperature is below 45 ° F. Occupancy will be determined with an occupancy sensor, temperature will be determined by a temperature sensor and CO will be measured with a VOC sensor. All sensors are located in the Maintenance Room. Refer to the Contractor's approved Operation and Maintenance manual, Volume 8 Part 1, for more on the Make-up Air Handling Unit operation.

4.2.8.8. Split System Heat Pumps

Units will cycle as required to hold a temperature of 72 °F (adjustable) in the spaces being served. Refer to the Contractor's approved Operation and Maintenance manual, Volume 8 Part 1, for more on Split System Heat Pump operations.

4.2.8.9. Chemical Storage Building

Refer to the Contractor's approved Operation and Maintenance manual.

4.2.9. Power

DRAFT

5. Chapter 5: Preventative Maintenance

5.1. System Maintenance

5.1.1. General Maintenance Policies

This section describes the equipment and routine operation and maintenance procedures for the Foster Adult Fish Facility. Additional reference data and revised procedures and parameters should be inserted into the manual as dictated by changing conditions and operator experience with this particular facility.

5.1.1.1. Contractor Supplied O&M Manual

All employees should become familiar with the equipment and the respective manufacturer's operation and maintenance (O&M) literature before performing the procedures described in this section. All equipment should be maintained in accordance with the manufacturer's recommendations. Detailed information is provided in the manufacturer-supplied O&M manual, such as operation, maintenance, adjustment, troubleshooting, lubrication, startup, shutdown, assembly, spare parts, and storage. The manufacturer-supplied O&M manual should be kept current by inserting or replacing information as equipment items are added or replaced.

5.1.1.2. Routine Maintenance Policies

All equipment should be operated and maintained in accordance with the manufacturer's instructions. This section describes general policies applicable to all areas. Efficient operation and maintenance of the facility requires that all areas be kept neat, clean, and organized. Operators should perform the required housekeeping in their assigned areas. Typical housekeeping tasks are listed below:

- Clean debris from fish screens and porosity plates.
- Keep the cooling surfaces of electric motors clean.
- Replace burned-out light bulbs.
- Keep general area clean and free of obstacles.
- Clean and touch up paint.
- Keep all grating, access covers, and safety shields in place.
- Keep all water hoses and power cords rolled up and properly stored.

5.1.1.3. Pre-startup Procedure

The following basic procedures are recommended before starting and operating all processes and equipment:

- Be sure that the appropriate HAND/OFF/AUTO switches, ON/OFF switches, etc. are turned OFF prior to energizing equipment electrical supply.

- Be sure all grating, equipment safety shields, and floor hatches are in place. Always keep grating, equipment shields, and floor hatches in place, except during maintenance procedures; then replace immediately upon completion of task.
- Check that all clothing, tools, etc. are removed from control panels and equipment.
- Check that all electrical junction boxes and control panels are properly closed.
- Valves and gates should work smoothly and seat properly.
- Valves and gates should be set in the correct position prior to start-up. Verify that all lock-out/tag-out procedures are completed.
- Make any needed repairs or adjustments prior to startup.
- Check that all equipment is properly lubricated and ready to operate. (Follow manufacturer's instructions.)
- Check that all foreign objects have been removed from equipment and piping.
- Check all equipment frequently during the first day of operation, after repair, replacement, or seasonal startup. If a malfunction occurs, do not continue to operate. Minor problems can often cause serious damage if not corrected.

5.1.2. Basic Maintenance Procedures

The operation and maintenance of equipment and structures is important for effective performance. The result of good maintenance is lower operating costs, better morale for staff, and better visitor image. To assist in achieving these objectives, the recommendations in this chapter should be followed. This chapter contains maintenance procedures common to many of the Foster Adult Fish Facility elements. For specific procedures for the various elements, see equipment Maintenance and Contractor supplied O&M manuals. An overall inspection should be made twice a year for determination of maintenance work required for each element. Inspections and maintenance of specific elements should be made on the schedule noted herein, or as noted in the manufacturer's instructions. The best policy is to complete maintenance work as it is required. Delaying maintenance work will only increase the cost and amount of work required, and decrease the life of the equipment. This policy should not preclude more frequent inspections and resulting maintenance. The material used for maintenance repairs shall conform or be equal to the original construction contract specification requirements.

5.1.3. Preventative Maintenance Management

5.1.3.1. General

Periodic maintenance and inspection is required for all mechanical equipment. Proper and efficient maintenance of equipment and structures will extend the useful life. The use of a maintenance management program will help to ensure that all equipment is maintained at the required intervals.

5.1.3.2. Equipment Inspection and Maintenance

Visual and physical observations of the machinery and equipment should be performed by the operators on a regular basis. All unusual conditions are to be reported immediately to the facility manager. If the operator feels that damage to the piece of equipment and/or a safety hazard is created by this condition, the piece of equipment should be taken out of service immediately and the facility manager notified.

5.2. Equipment and Structure Maintenance

5.2.1. Fish Ladder

The fish ladder should be visually inspected annually to see that no objects and debris are present anywhere within the fish ladder. Visual inspection should also include the condition of concrete surfaces and the various steel items such as fish screens, diffusers, lifting frame, personnel guardrails and walkways located near the entrance. Connector machine bolts and concrete anchors should be visually inspected for corrosion and replaced in kind as needed.

5.2.1.1. Fish Ladder Entrance

5.2.1.1.1. Fish Entrance Gates

Each gate and actuator should be visually inspected for damage and corrosion. Ensure hoisting mechanism is lubricated per manufacturer's recommendations. Exercise each hoist (open completely and close completely) every month.

5.2.1.1.2. Fish Barrier Screen and Support Structure

A visual inspection should include the condition of various steel items such as fasteners, wire rope, and connection points on the screen. The lifting frame should not show significant corrosion clean the screen as needed to remove corrosion. Bolted connections and concrete anchors should be visually inspected for corrosion and replaced in kind as needed. Exercise the gate hoist from the full up position to 6 inches above the water surface, three times every month.

5.2.1.2. AWS Pump Structure

A visual inspection of the structure should be performed during the annual ladder outage if full dewatering will be performed. Report any large concrete cracks or unusual surface erosion.

5.2.2. Pre-Sort Pool

Visually inspect the concrete surface for surface damage annually. All steel features such as work platforms, walkways, personnel guard rails, Crowder rails, metal doors and the steel stairs should be inspected for corrosion. All connection fasteners for the work platforms and walkway system should be inspected and any corroded bolts replaced in kind as needed. Repaint or repair galvanizing as needed.

The cover structure should be visually inspected for corrosion spots or peeling paint in the metal roof and support columns and beams. Corrosion on metal items should be cleaned and metal surfaces recoated with materials as needed to match the initial coating. All fasteners shall be checked for corrosion and replaced in kind as needed.

5.2.2.1. Finger Weir

Visually inspect the aluminum frame work for cracks and damage. All bolted connections, wire ropes, and sheaves should be inspected monthly and any deficiencies should be reported immediately. Operate the finger weir monthly through its full range of motion and ensure winch brake holds the weir at various elevations. The winch is sealed and does not require periodic lubrication however, it should be inspected for corrosion and damage; replace if inoperable or if operating is unsafe.

See Contractor provided Operation and maintenance manual Volume 03.

5.2.2.2. Crowder

Visually inspect the chassis for corrosion, cracks, and damage every two weeks. Items that are heavily corroded or damaged should be reported and replaced as needed. After the visual inspection, if the crowder has not been operated in the previous two weeks, the crowder should be exercised. Three cycles of screen Travel should be performed, observe the operation and report any problems. Three traversing cycles should be performed with the screen in the up position.

See Contractor provided Operation and maintenance manual Volume 06, Part 04.

5.2.2.3. False Weir

Visually inspect for corrosion, cracks, leaks, and damage on a monthly basis. Items that are damaged should be reported and replaced as needed. Monitor leaks and report if deemed excessive or a threat to equipment or operator safety. The false weir pump should be exercised every two weeks if left idle for an extended period. This operation should be performed with the closure gate in the down position to avoid attracting fish into the flume. Unusual performance or noise should be reported immediately.

See Contractor provided Operation and maintenance manual Volume 03.

5.2.2.4. Closure Gate

Visually inspect the frame for cracks and damage. All bolted connections, wire ropes, and sheaves should be inspected monthly and any deficiencies should be reported immediately. Operate the closure gate monthly through its full range of motion and ensure winch brake holds the gate at various elevations. The winch is sealed and does not require periodic lubrication however, it should be inspected for corrosion and damage; replace if inoperable or if operating is unsafe.

See Contractor provided Operation and maintenance manual Volume 03.

5.2.2.5. Pre-sort Pool Piping

Exposed pre-sort piping should be visually inspected for leaks on a month to month basis. Leaks should be reported and monitored. Areas that experience erosion should be reported as this could indicate a buried pipe is leaking.

5.2.2.6. False Weir Drain

Visually inspect the false weir drain annually for leaks and damage. The valve should be exercised on a month to month basis.

See Contractor provided Operation and maintenance manual Volume 07, section 01.

5.2.2.7. Valves

The valves in pre-sort piping area should be visually inspected for leaks and corrosion on a month to month basis. Leaks and significant corrosion should be reported and monitored. Valves should be exercised, full open to full closed, on a month to month basis. Unusual difficultly opening or closing the valve should be reported.

See Contractor provided Operation and maintenance manual Volume 07, Part 01.

5.2.2.8. Diffusers

Diffuser maintenance is only performed during the annual facility shutdown period. The diffuser grating should be removed and cleaned annually. The diffuser pit should be inspected for debris accumulation and the low point drain should drain freely.

5.2.3. Sort Facility

The cover structure should be visually inspected for corrosion spots or peeling paint in the metal roof and support columns and beams. Corrosion on metal items should be cleaned and metal surfaces recoated with materials as needed to match the initial coating. All fasteners shall be checked for corrosion and replaced in kind as needed.

5.2.3.1. Mechanical/Electrical

5.2.3.1.1. Compressed Air

The air compressor and any exposed compressed air pipe should be visually inspected monthly. The Operator should note any unusually significant increase in compressor operation and report it to the appropriate personnel.

5.2.3.2. Plumbing

The mechanical room piping should be visually inspected for leaks and damage every six months. Report or perform authorized repairs for any significant leak.

5.2.3.3. HVAC

The heater units should be inspected and cleaned per manufacturer's recommended interval.

The office heat pump should be inspected for debris infiltration and insect infestation every three months. Perform maintenance per manufacturer's recommendations.

See Contractor provided Operation and maintenance manual Volume 08, part 1.

5.2.4. Post-Sort Pools, Sorting Channel, and Hopper Pit

Visually inspect the concrete surface for surface damage annually. All steel features such as work platforms, walkways, personnel guard rails, Crowder rails, metal doors and the steel stairs should be inspected for corrosion. All connection fasteners for the work platforms and walkway system should be inspected and any corroded bolts replaced in kind as needed. Repaint or repair galvanizing as needed.

5.2.4.1. Post-sort Pool Crowders

Visually inspect the chassis for corrosion, cracks, and damage every two weeks. Items that are heavily corroded or damaged should be reported and replaced as needed. After the visual inspection the crowder should be exercised. Three cycles of screen Travel should be performed, observe the operation and report any problems. Three traversing cycles should be performed with the screen in the up position. If long term inactivity is expected park the crowder under the post sort pool shade structure.

See Contractor provided Operation and maintenance manual Volume 06, Part 01.

5.2.4.2. Sorting Channel Crowder

Visually inspect the chassis for corrosion, cracks, and damage every two weeks. Items that are heavily corroded or damaged should be reported and replaced as needed. After the visual inspection the crowder

should be exercised. Three cycles of screen Travel should be performed, observe the operation and report any problems. Three traversing cycles should be performed with the screen in the up position.

See Contractor provided Operation and maintenance manual Volume 06, Part 03.

5.2.4.3. FWS Piping

Visually inspect exposed piping for leaks and damage once every 6 months. Report leaks and damage to the appropriate authorities.

5.2.4.4. Diffusers

Diffuser maintenance is only performed during the annual facility shutdown period. The diffuser grating should be removed and cleaned annually. The diffuser pit should be inspected for debris accumulation; clean debris as necessary. Pit drains should drain freely.

5.2.4.5. Removable Fish Screens and Overflow Stoplogs

The removable fish screens should be cleaned weekly; the change in water height across the screen should not exceed 6 inches between cleanings.

5.2.4.6. Sort Channel Drain System

The pipe should be flushed prior to use. Annual inspections should be performed to ensure the interior of the pipe is not damaged.

5.2.4.7. FWS Piping

The FWS pipe in the IPS should be visually inspected for damage, leaks, and corrosion. It is normal for the pipe to have condensed water dripping from the bottom of the pipe; the leak should be actively dripping water. If a leak is found report it to the appropriate authorities.

5.2.4.8. FWS Flowmeter

The flow meter should not require regular maintenance. Function is purely electronic in nature.

See Contractor provided Operation and maintenance manual Volume 01.

5.2.4.9. AWS Valve and Sump Pump System

See Contractor provided Operation and maintenance manual Volume 02.

5.2.4.10. Washdown Pipe System

Visually inspect for corrosion, leaks, and damage on a bi-annual basis. Items that are damaged should be reported and replaced by authorized personnel. Monitor leaks and report if deemed excessive or a threat to equipment or operator safety. Each hose bib should be used at least once every three months. washdown pump function should be verified while running the hose bibs.

See Contractor provided Operation and maintenance manual Volume 07, part 1 and 2.

5.2.4.11. Intake Screen

Clean using the trash rake?

5.2.5. Fish Sorting Equipment

5.2.5.1. Fish Transport Flume

Visually inspect for corrosion, cracks, leaks, and damage on a monthly basis. Items that are damaged should be reported and replaced as needed. Monitor leaks and report if deemed excessive or a threat to equipment or operator safety.

5.2.5.2. Switch Gates

Visually inspect for corrosion, cracks, leaks, and damage on a monthly basis. Items that are damaged should be reported and replaced as needed. Monitor water leaks and report if deemed excessive or a threat to equipment or operator safety. Report compressed air leaks for immediate repair. Cycle each switch gate three times every month.

See Contractor provided Operation and maintenance manual Volume 04.

5.2.5.3. Anesthetic Tank

Visually inspect for corrosion, cracks, leaks, and damage on a monthly basis. Items that are damaged should be reported and replaced as needed. Water leaks should be repaired immediately as it could lead to accelerated anesthetic dilution or fish un-watering and low dissolved oxygen levels. Report compressed air leaks for immediate repair. If freezing temperatures are expected crack the tank fill valve to keep pipe from freezing. Cycle the anesthetic tank brail three times every two weeks with water in the tank. Empty the tank using the drain pump this will serve to exercise the pump.

See Contractor provided Operation and maintenance manual Volume 04.

5.2.5.4. Sort Table

Visually inspect for corrosion, cracks, leaks, and damage on a monthly basis. Items that are damaged should be reported and replaced as needed. If freezing temperatures are expected crack each flume supply valve to keep the pipes from freezing.

See Contractor provided Operation and maintenance manual Volume 04

5.2.5.5. Recovery Tank

Visually inspect for corrosion, cracks, leaks, and damage on a monthly basis. Items that are damaged should be reported and replaced as needed. If freezing temperatures are expected crack the tank fill valve to keep the pipes from freezing. Cycle the recovery tank brail three times every two weeks.

See Contractor provided Operation and maintenance manual Volume 04.

5.2.6. Fish Transfer and Loading Equipment

5.2.6.1. Hopper Hoist

Visually inspect for corrosion, cracks, and damage on a monthly basis. Items that are damaged should be reported and replaced by authorized personnel. The hopper hoist maintenance is performed per manufacturer's recommendations. Reference EM 385-1-1 for additional requirements related to safe operation of a monorail crane.

See Contractor provided Operation and maintenance manual Volume 05, Part 02.

5.2.6.2. Hopper Loading Structure

Visually inspect for corrosion, cracks, and damage on a monthly basis. Items that are damaged should be reported; items are replaced by authorized personnel only.

5.2.6.3. Hopper

Visually inspect for corrosion, cracks, leaks, and damage on a monthly basis. Items that are damaged should be reported and replaced as needed. Monitor leaks and report if deemed excessive or a threat to equipment or operator safety.

See Contractor provided Operation and maintenance manual Volume 05, Part 02.

5.2.6.4. Fish Truck

5.2.6.4.1. Diesel Generator

Visually inspect generator for leaks. Check fluid levels and run generator periodically per manufacturer's recommendations.

See Contractor provided Operation and maintenance manual Volume 08.

5.2.6.4.2. Automatic Transfer Switch

See Contractor provided Operation and maintenance manual Volume 08.

5.2.6.5. Maintenance Building

The structure should be visually inspected for corrosion spots or peeling paint in the metal roof and support columns and beams. Corrosion on metal items should be cleaned and metal surfaces recoated with materials as needed to match the initial coating. All fasteners shall be checked for corrosion and replaced in kind as needed.

See Contractor provided Operation and maintenance manual Volume 08.

5.2.6.6. Site Host Structure

The cover structure should be visually inspected for corrosion spots or peeling paint in the metal roof and support columns and beams. Corrosion on metal items should be cleaned and metal surfaces recoated with materials as needed to match the initial coating. All fasteners shall be checked for corrosion and replaced in kind as needed.

See Contractor provided Operation and maintenance manual Volume XX, section XX.

5.2.6.6.1. Power Pedestal

This pedestal should be visually inspected on an annual basis. Report any unusual damage or functionality.

See Contractor provided Operation and maintenance manual Volume XX, section XX.

5.2.6.6.2. Potable Water

The hose bib should be visually inspected on an annual basis. Report any damage or loss of functionality.

5.2.6.6.3. Sanitary Sewer

The sanitary sewer dump connection should be visually inspected on an annual basis. Report any damage or loss of functionality.

5.2.7. Storm Water Facilities

The storm drainage system should be inspected annually and after every significant storm event and cleared of trash and debris.

The O&M manuals for the rain gardens, swales, planters, catch basins, and water quality catch basins are located in Appendix J.

5.2.8. Sanitary Sewer System

The sanitary sewer system should be inspected annually and cleared of excessive trash and debris.

5.2.9. Facility Vehicle Entrance Gates

A visual inspection of the fencing and rollers should be performed monthly. Gates should be operated monthly to ensure moving components receive lubrication. Rollers may require lubrication based on use refer to the Manufacturer's O&M manual.

See Contractor provided Operation and maintenance manual Volume XX, section XX.

5.2.10. Power

5.2.10.1. Primary Metering Cabinet

5.2.10.2. Transformer FTQ1

5.2.10.3. Backup Power System

5.2.10.4. Metering, Protection, and Grounding

5.2.11. Industrial Control System (ICS)

Reference the operations and maintenance manual for specific preventative maintenance requirements.

5.2.12. Intrusion Detection

6. Chapter 6: Industrial Control System

6.1. General

The industrial control system (ICS) and graphic terminals (HMI) allow monitoring and control of various fish collection facility sensors, gates, power meters, valves, and automated processes. All graphic terminals are touch screens except for the desktop workstation in the control room.

LOCATION AND IDENTIFICATION

- Control Room – (PC)
- Fish Hatchery – (HMI 4)
- Maintenance Building – (HMI 2)
- Pump Room – (HMI 3)
- Sorting Area – (HMI 1)

REFERENCE

- Sheet EI601 – Control Network Diagram
- Sheet EI603 – Sort Facility HMI Cabinet
- Sheet EI606 – Hatchery Remote I/O Cabinet
- Sheet EI608 – Pump Room Remote I/O Cabinet
- Sheet EI611 – Maintenance Building Remote I/O Cabinet

6.2. MAIN OVERVIEW SCREEN

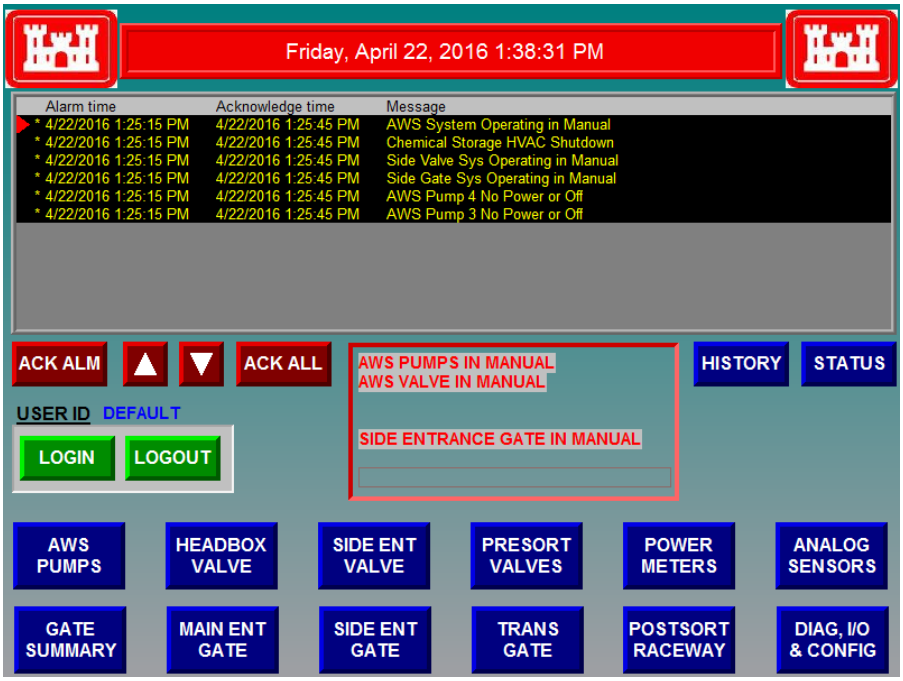


Figure 1

The main display is used for accessing all other screens and is shown in figure 1. Each blue pushbutton opens a Fish Collection Facility screen as labeled. Any control-type screen first requires the user to login

using the green pushbutton. Data monitoring type screens without control capability do not typically require the user to login.

The alarm object provides a brief listing of recent alarms. For additional alarm information go to the alarm "HISTORY" and/or alarm "STATUS" screens by pressing the correct blue pushbutton.

The "ACK ALM" pushbutton can be used to acknowledge individual alarms, as selected by the up/down arrows. The "ACK ALL" button acknowledges all current alarms. Acknowledging an alarm does not clear an alarm, even if it is no longer active. Alarm clearing is performed from the alarm "HISTORY" screen.

The date and time for each graphic terminal is synchronized with the Fish Collection Facility PLC every day around 3:01AM. Time shifts related to Daylight Saving Time (DST) should be updated automatically.

6.3. AUXILLARY WATER PUMPS

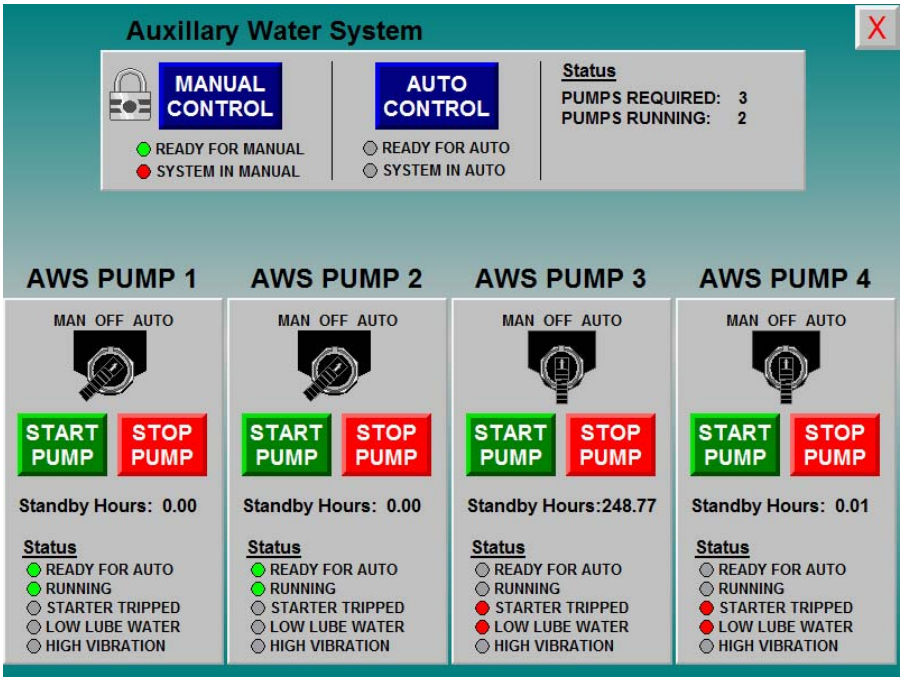


Figure 2

The AWS PUMP screen shown in figure 2 permits both control and monitoring of the auxiliary water system pumps. In automatic control mode the number of pumps required are automatically determined and operated based on the tailrace (LT.003) water elevation. In manual mode each pump is controlled by the START PUMP and STOP PUMP buttons.

The "MANUAL CONTROL" pushbutton sets the control mode for the AWS Pump process. When pressed a lock will appear, indicating the mode will not change from manual unless the "AUTO CONTROL" pushbutton is pressed. In manual mode each pump must be individually started and stopped as described below. The "READY FOR MANUAL" light is green if at least one pump is ready for manual control.

The “AUTO CONTROL” pushbutton will not function unless the “READY FOR AUTO” light is green. Automatic control requires the following prerequisites listed below. Without all prerequisites satisfied the system will remain in manual or revert to manual until the prerequisites have been established and/or reestablished.

- All four pumps indicate “READY FOR AUTO”.
- Tailrace Level Transmitter (LT.003) is functional.
- No pumps are running in manual/hand.
- The AWS pump process alarm is not disabled.

PUMP STATUS: An individual pump is “READY FOR AUTO” based on the following prerequisites:

- The cabinet selector switch is in auto position.
- The soft-starter is not tripped
- The high vibration alarm switch is not active. Note there is a second high vibration switch that is hardwired to stop the pump. The second switch is not connected to nor monitored by the controller and graphic terminals.
- The low lubrication water flow alarm is not active during pump operation. Note the “LOW LUBE WATER” status is normally red when the pump is off. The low lube alarm may only occur while the pump is running.
- The PLC input module for the pumps has not faulted.

The green “START PUMP” pushbutton runs the corresponding AWS pump. Since there is no confirmation after pressing the button, the pump should run immediately. If adequate flow is not achieved five seconds after the pump starts an alarm will be generated and the pump will stop. If the “START PUMP” button appears yellow there is a communications error between the graphic terminal and controller.

The red “STOP PUMP” button halts the corresponding AWS pump. There is no confirmation after pressing the button. After the pump stops the “LOW LUBE WATER” light should turn red. If the “STOP PUMP” button appears yellow there is a communications error between the graphic terminal and controller.

Pump standby hours are incremented only when the unit is not running but “READY FOR AUTO”. A pump is not in standby mode when off or otherwise unavailable to run. In automatic mode all pumps in standby mode will be automatically exercised every 30 days or sooner. Standby hours are immediately reset when the unit runs.

6.4. FACILITY WATER SYSTEM

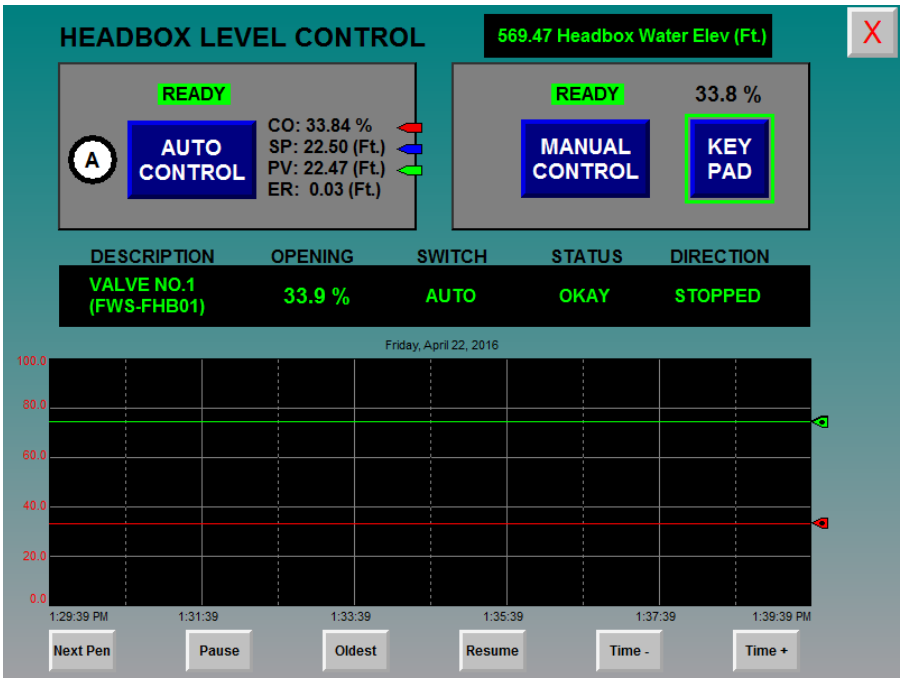


Figure 3

The hydraulic headbox level control screen for the facility water system (FWS) is shown in Figure 3. This screen permits automatic control of the headbox water level and manual positioning of the valve actuator. The valve's actual position, switch status, alarm status, and current movement is included on the display.

The "MANUAL CONTROL" pushbutton permits manual positioning of the headbox valve actuator through a virtual on-screen KEYPAD. The minimum setting is 0% open (fully closed). The maximum setting is 70% open. A lock symbol is visible after MANUAL CONTROL is selected, indicating the controller will not attempt to return the mode to automatic control. A green "Ready" symbol above the blue "MANUAL CONTROL" pushbutton indicates all required prerequisites listed below are present.

- The Actuator selector switch is in remote
- The actuator has not tripped on thermal overload.
- The actuator has not jammed
- No actuator internal alarms
- No actuator network alarm

The "AUTO CONTROL" pushbutton permits automatic headbox water level control. In automatic mode the controller should maintain the reservoir's water level at the setpoint +/- the deadband by modulating the valve actuator. If the green "Ready" symbol above the blue pushbutton is not visible then the system cannot be placed in "Auto". A red "NOT READY" symbol indicates one or more of the following prerequisites is missing.

- The actuator is ready for manual control. (See above.)
- Headbox Level Transmitter LT.007 is functional.
- The headbox process alarm is not disabled.

The graph displays the CO, PV, and SP over the last 10 minutes. Only the graphic terminals at the Control Room and Sorting Facility log historical data so that it's available anytime the screen is displayed. All other terminals populate graphs only when the screen is open for viewing.

- CO represents Controller Output, and should normally match the gate opening shown.
- SP is the desired water depth of the headbox & is fixed at 22.5 Ft deep with a 0.25 Ft deadband
- PV represents Process Variable and is the actual measured water level in the headbox.
- ER is the error or the difference between SP and PV and is normally within +/- 0.25 Ft.

6.5. SIDE ENTRANCE WATER SUPPLY

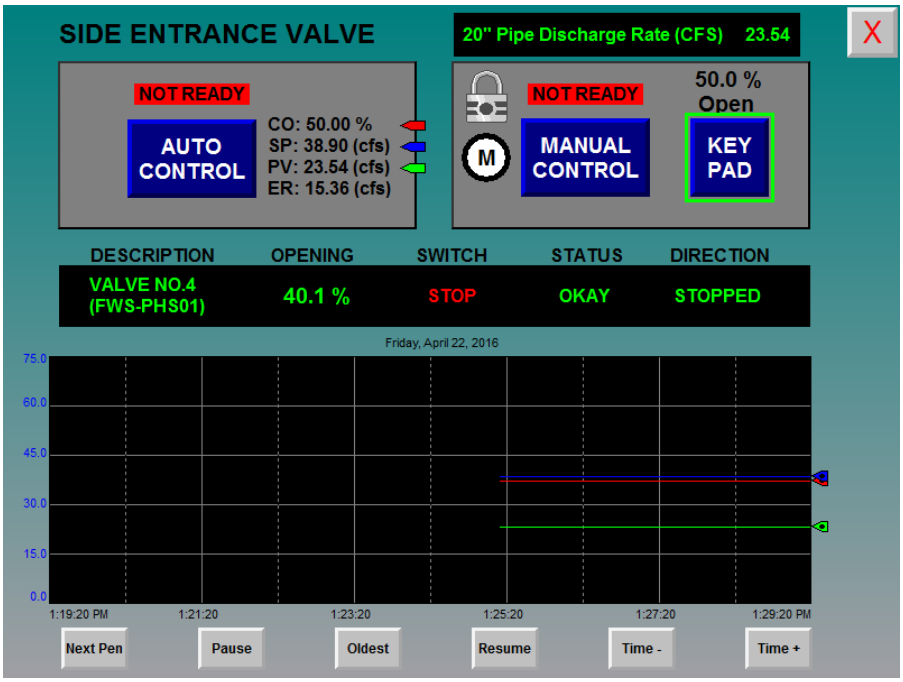


Figure 4

The side entrance water supply control screen is shown in figure 4. This screen permits manual and automatic control of the attraction water for the spillgate-side fish ladder entrance. The display includes the actuator description, valve position (% open), selector switch status, alarm status, current movement, and trending graph.

The "*MANUAL CONTROL*" pushbutton permits manual positioning of the valve actuator through a virtual on-screen KEYPAD. The minimum setting is 0% open (fully closed) and the maximum setting is 100% open. A lock symbol is visible after *MANUAL CONTROL* is selected, indicating the controller will not attempt to return the process to automatic mode. A green "*READY*" symbol above the blue pushbutton indicates all required prerequisites listed below are present. A red "*NOT READY*" symbol indicates at least one permissive is missing.

- The Actuator selector switch is in remote
- The actuator has not tripped on thermal overload
- The actuator has not jammed

- No actuator internal alarms
- No actuator network alarm

The "*AUTO CONTROL*" pushbutton permits automatic water flow control for the side entrance to the fish ladder. In automatic mode the controller should maintain the side entrance water flow at the setpoint +/- the deadband by modulating the valve actuator. If the green "Ready" symbol above the *AUTO CONTROL* button is not visible then the system cannot be placed in "Auto". A red "NOT READY" symbol indicates one or more of the following prerequisites is missing.

- The actuator is ready for manual control. (See above.)
- Pool 1 Water Level Transmitter LT.002 is functional.
- Transportation Water Level Transmitter Lt.004 is functional.
- The Side Valve Process alarm is not disabled.

The graph displays the SP, CO, and PV over the last 10 minutes. Only the Control Room and Sorting Facility graphic terminals log historical data, enabling graph data to be available anytime the display is selected. All other terminals populate graphs only when the screen is open for viewing.

- CO represents Controller Output, and should normally match the gate opening shown.
- SP is desired water flow in CFS and varies based on the number of AWS pumps running. There is a 5.0 CFS deadband.
- PV represents Process Variable and is the actual measured water flow at the side entrance.
- ER is the error or the difference between SP and PV in CFS.

6.6. PRESORT POOL WATER SUPLY

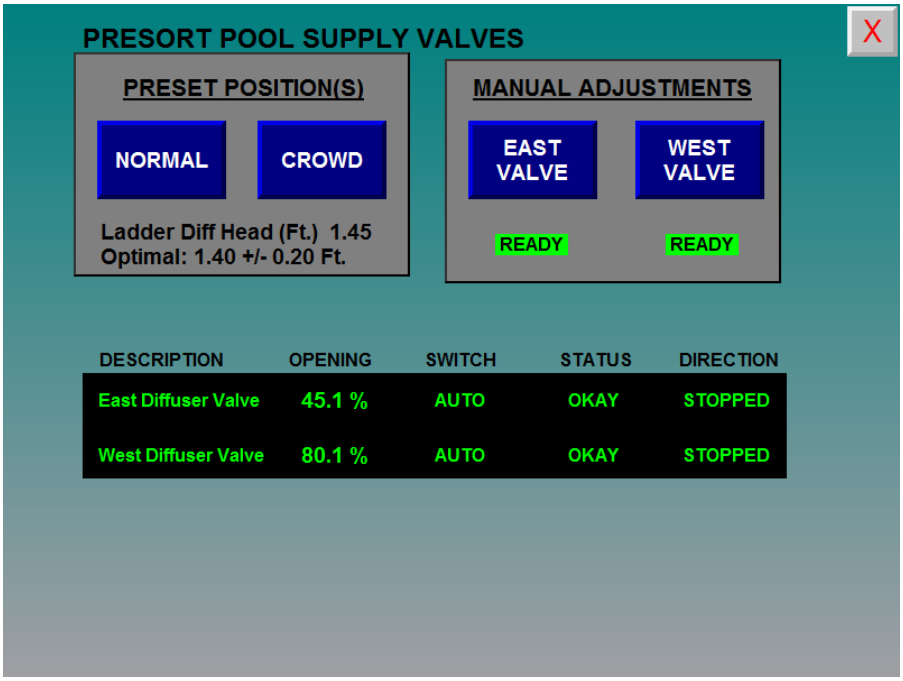


Figure 5

The presort pool water supply screen is shown in figure 5. The display permits manual positioning of the valves or the use of presets for normal operation and fish crowding. The display includes the actuator description, valve position (% open), selector switch status, alarm status, and current movement.

Manual adjustments for the "*EAST VALVE*" and "*WEST VALVE*" are achieved through a virtual touch screen keyboard that is activated by the corresponding blue pushbutton. A green "*READY*" symbol below the blue pushbutton indicates all required prerequisites are present. A red "*NOT READY*" symbol indicates at least one permissive listed below is missing.

- The Actuator selector switch is in remote
- The actuator has not tripped on thermal overload
- The actuator has not jammed
- No actuator internal alarms
- No actuator network alarm

Preset valve adjustments are executed by pressing the "*NORMAL*" or "*CROWD*" pushbuttons. The "*NORMAL*" preset moves the east valve to approximately 45% open and the west valve to approximately 80% open. The "*CROWD*" preset moves both valves to 100% open.

When the "*CROWD*" preset is selected the time delay for the Pre-Sort pool Water Level High or Low alarm is changed from 5 minutes to 6 hours to help reduce unwanted alarms while crowding fish.

6.7. DIGITAL POWER METERS

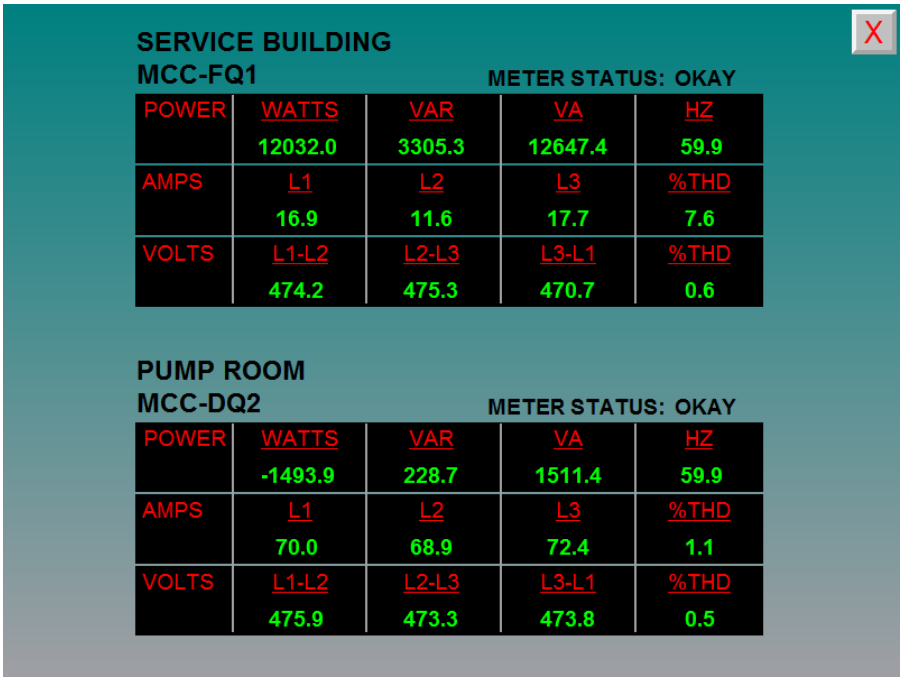


Figure 6

The power meters screen is shown in figure 6. Real time power consumption as measured from the Service Building Panelboard and Pump Room Motor Control Center is displayed. Any cell displaying -99.9 indicates meter trouble or loss of communications. Meter status is either "okay" or "alarm".

6.8. INSTRUMENTATION

WATER LEVEL SENSORS

SENSOR	LOCATION	ELEVATION	FEET
LT.001	Forebay	618.54	9.06
LT.002	Main Entrance (Pool 1)	531.02	7.44
LT.003	Tailrace	529.72	6.14
LT.004	Transportation Channel	531.28	7.69
LT.005	Ladder Side Entrance	529.75	2.67
LT.006	AWS Pump Intake	529.58	5.76
LT.007	Headbox	569.47	22.47
LT.008	Ladder Pool 35	562.15	6.45
LT.009	Short Term Pond 1	541.06	0.06
LT.010	Short Term Pond 2	541.10	0.10
LT.011	Short Term Pond 3	541.03	0.03
LT.012	Short Term Pond 4	541.11	0.11
LT.013	Long Term Pond 1	541.03	0.02
LT.014	Long Term Pond 2	541.04	0.04
LT.015	Long Term Pond 3	541.13	0.13
LT.016	Long Term Pond 4	541.09	0.09
LT.017	Long Term Pond 5	541.05	0.05
PIT.001	Lower Intake (FWS)	615.47	20.94
PIT.002	Upper Intake (AWS)	618.95	20.95

WATER TEMPERATURE AND FLOW SENSORS

SENSOR	LOCATION	MAGNITUDE	UNITS
TIT.001	Lower Intake	48.58	°F
TIT.012	Upper Intake	56.45	°F
FIT.001	FWS 36" Pipe	29.29	CFS
FIT.002	FWS 24" Pipe	23.54	CFS
PDIT.003	AWS Pump Lube Strainer	965.89	Ft. H2O

Figure 7

Analog instrumentation for water flow, level, and temperature sensing is summarized in figure 7. A value of -99.9 indicates sensor trouble and the actual value is unknown.

ABREVIATIONS

- FIT Flow Transmitter with integral display
- LT Level Transmitter – submersible type with no display.
- PIT Pressure Transmitter with integral display
- TIT Temperature Transmitter with integral display

SENSOR DETAILS and LOCATIONS

- Sheet EI-617 Sensor schedules and details.
- Sheet EB403 Location of LT.001.
- Sheet EC501 Location of LT.002 through LT.004.
- Sheet EC404 Location of LT.005.
- Sheet EC403 Location of LT.006.
- Sheet EF401 Location of LT.007.
- Sheet EJ401 Location of LT.008.
- Sheet EM401 Location of LT.009 through LT.017.
- Sheet EB402 Location of PIT.001 and PIT.002.
- Sheet EB402 Location of TIT.001 and TIT.002
- Sheet EB401 Location of FIT.001 and FIT.002
- Sheet EC403 Location of PIT.003.

6.9. MAIN FISH ENTRANCE GATE

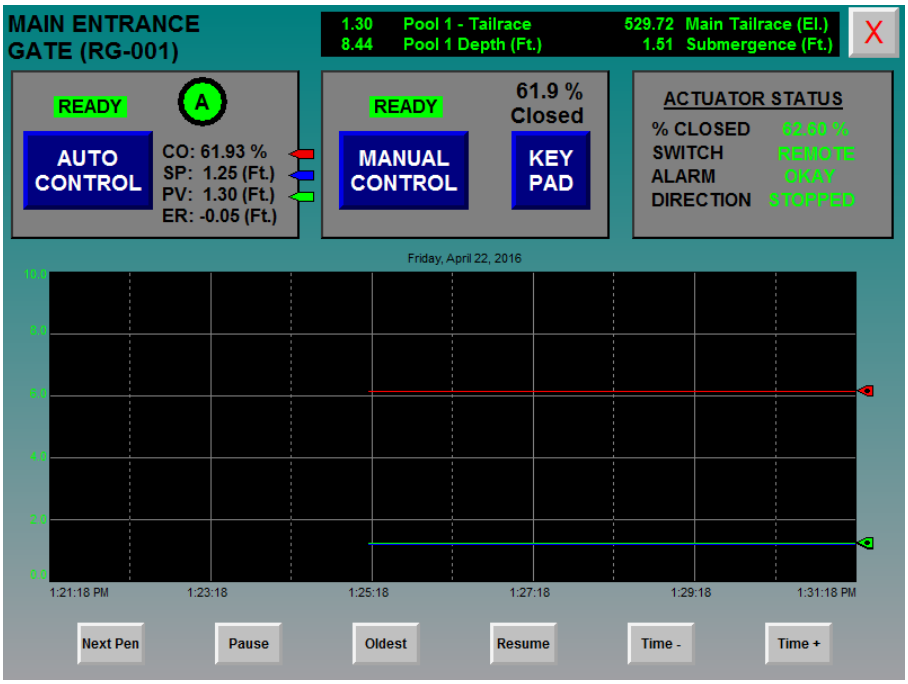


Figure 8

The main entrance gate control screen is shown in figure 8. This screen is for manual and automatic control of the main entrance gate to the fish ladder. The display includes the actuator description, gate position (% closed), selector switch status, alarm status, current movement, and historical graph.

The "*MANUAL CONTROL*" pushbutton enables manual positioning of the gate actuator through a virtual on-screen KEYPAD. The minimum setting is 10.4% closed (gate lowered allowing full flow). The maximum setting is 85.5% closed (gate raised blocking flow). A visible lock symbol will appear after selecting *MANUAL CONTROL*, indicating the controller will not attempt to return the process to automatic control mode. A green "*READY*" symbol above the blue pushbutton indicates all required prerequisites listed below are present. A red "*NOT READY*" symbol indicates at least one permissive is missing.

- The actuator's selector switch is in remote
- No actuator internal warnings
- No actuator internal faults
- No actuator internal not-ready indication. (Various collective internal signals from actuator.)
- No actuator loss of phase
- No actuator network alarm

The "*AUTO CONTROL*" pushbutton permits automatic positioning of the main entrance gate by the controller to maintain the pool 1 water level at the desired set-point +/- the deadband. If the green "*READY*" symbol above the blue button is not visible then the system cannot be placed in "Auto". A red "*NOT READY*" symbol indicates one or more of the following prerequisites is missing.

- The actuator is ready for manual control. (See above.)

- Pool 1 water Level Transmitter LT.002 is functional.
- Tailrace water Level Transmitter LT.003 is functional.
- The Main Entrance Gate Process alarm is not disabled.

The graph displays the SP, CO, and PV over the last 10 minutes. Only the graphic terminals at the Control Room and Sorting Facility log historical data, enabling graph data to be available anytime the display is selected. All other terminals populate graphs only when the screen is open for viewing.

- CO represents Controller Output, which is the desired gate position sent to the actuator.
- The SP is normally 1.25 Ft, which is the pool 1 water height above the river (tailrace). The setpoint may automatically increase if the pool 1 water depth is not at least 6.0 ft. The SP has a 0.15 Ft dead-band.
- PV represents Process Variable and is the measured water level difference between Pool 1 and the Tailrace.
- ER (error) is the difference between the actual SP and the measured PV.

6.10. SIDE FISH ENTRANCE GATE

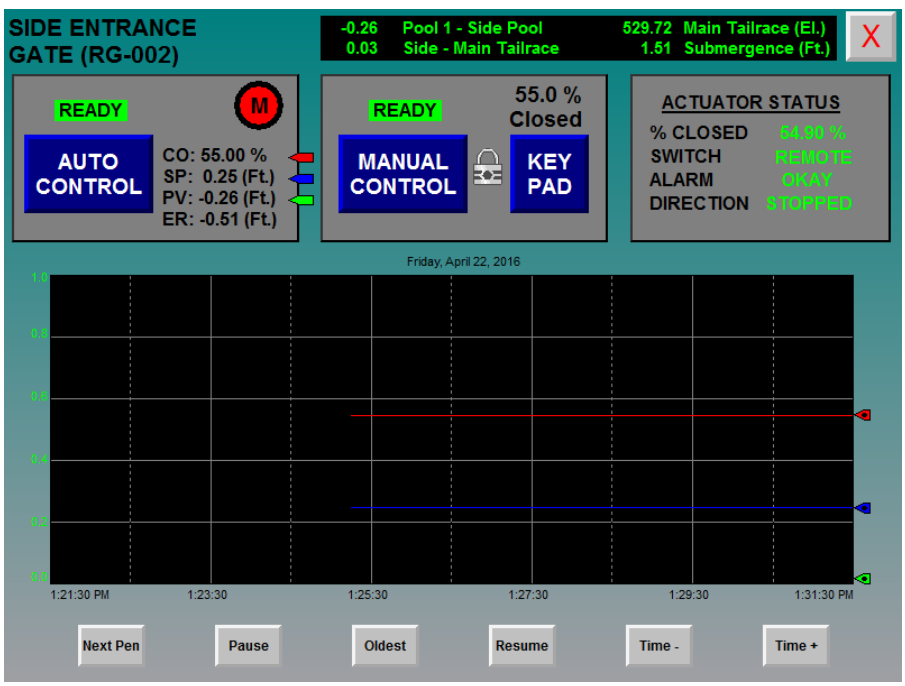


Figure 9

The side entrance gate control display is shown in Figure 9. The screen enables manual and automatic control of the side entrance gate to the fish ladder. The display includes the actuator description, gate position (% closed), selector switch status, alarm status, current movement, and historical graph.

The "*MANUAL CONTROL*" pushbutton permits manual positioning of the gate actuator through a virtual on-screen KEYPAD. The minimum setting is 10.4% closed (gate lowered allowing full flow). The maximum setting is 85.5% closed (gate raised blocking flow). A visible lock symbol will appear after selecting *MANUAL CONTROL*, indicating the controller will not attempt to return the process to automatic mode. A green

"*READY*" symbol above the "*MANUAL CONTROL"* pushbutton indicates all required prerequisites listed below are present. A red "*NOT READY*" symbol indicates at least one permissive is missing.

- The actuator's selector switch is in remote
- No actuator internal warnings
- No actuator internal faults
- No actuator internal not-ready indication. (Various collective internal signals from actuator.)
- No actuator loss of phase
- No actuator network alarm

The "*AUTO CONTROL*" pushbutton permits automatic positioning of the side entrance gate by the controller to maintain the water differential across pool 1 and the transportation channel at the desired set-point +/- the deadband. If the green "*READY*" symbol above the "*AUTO CONTROL*" pushbutton is not visible then the process cannot be placed in automatic mode. A red "NOT READY" symbol indicates one or more of the following prerequisites is missing.

- The actuator is ready for manual control. (See above.)
- Pool 1 water Level Transmitter LT.002 is functional.
- Transportation channel water Level Transmitter Lt.004 is functional. (Note the transportation channel water level is equivalent to the side entrance pool level.)
- The Side Entrance Gate process alarm is not disabled.

The graph displays the SP, CO, and PV over the last 10 minutes. Only the Control Room and Sorting Facility graphic terminals log historical data, enabling graph data to be available anytime the display is selected. All other terminals capture graph data only while the display is open for viewing.

- CO represents Controller Output, which is the desired gate position sent to the actuator.
- The SP (setpoint) is 0.25 Ft, which is the desired pool 1 water height above the transportation channel (side entrance pool). The controller deadband is 0.10 Ft.
- PV represents Process Variable and is the measured water level difference between pool 1 and the transportation channel (side entrance pool).
- ER (error) is the difference between the actual SP and the measured PV.

6.11. TRANSPORTATION CHANNEL GATE

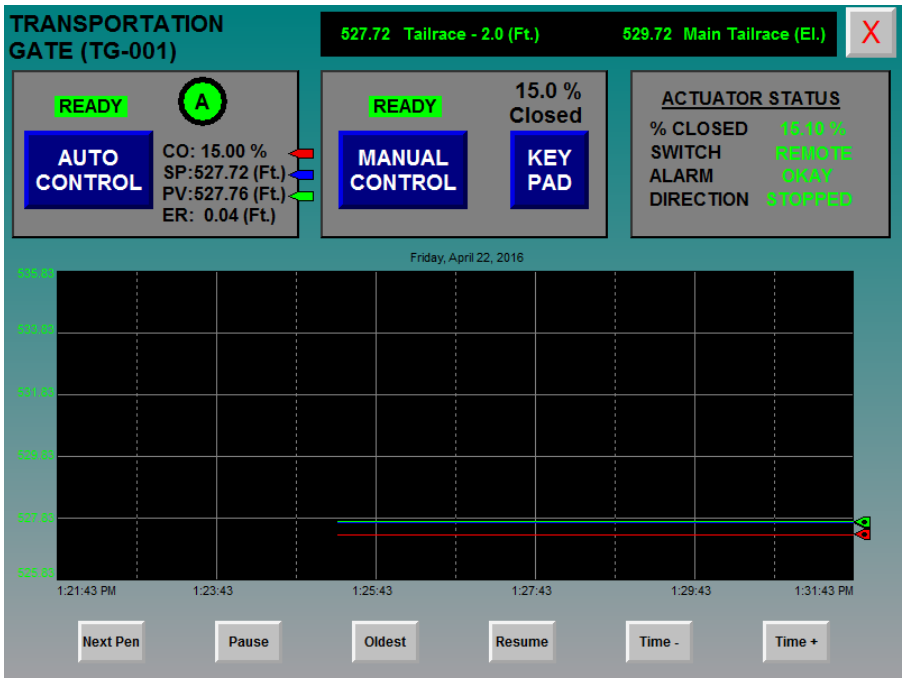


Figure 10

The transportation channel gate control display is shown in figure 10. The screen permits manual and automatic control of the transportation channel gate, which connects the side fish entrance to the main fish ladder entrance. The display includes the actuator description, gate position (% closed), selector switch status, alarm status, current movement, and historical graph.

The "*MANUAL CONTROL*" pushbutton permits manual positioning of the gate actuator through a virtual on-screen KEYPAD. The minimum setting is 15% closed (gate lowered allowing full flow). The maximum setting is 100% closed (gate raised blocking flow). A visible lock symbol will appear after selecting *MANUAL CONTROL*, indicating the controller will not attempt to return the process to automatic mode. A green "*READY*" symbol above the "*MANUAL CONTROL*" pushbutton indicates all required prerequisites listed below are present. A red "*NOT READY*" symbol indicates at least one permissive is missing.

- Actuator's selector switch is in remote
- No actuator internal warnings
- No actuator internal faults
- No actuator internal not-ready indication. (Various collective internal signals from actuator.)
- No actuator loss of phase
- No actuator network alarm

The "AUTO CONTROL" pushbutton permits automatic positioning of the transportation channel gate by the controller to maintain the transportation gate position at the desired set-point +/- the deadband. If the green "READY" symbol above the "AUTO CONTROL" button is not visible then the system cannot be placed in "Auto". A red "NOT READY" symbol indicates one or more of the following prerequisites is missing.

- The actuator is ready for manual control. (See above.)
- Tailrace water Level Transmitter LT.003 is functional.
- The Transportation Channel Gate process alarm is not disabled.

The graph displays the SP, CO, and PV over the last 10 minutes. Only the Control Room and Sorting Facility graphic terminals log historical data, enabling graph data to be available anytime the display is selected. All other terminals capture graph data only while the display is open for viewing.

- CO represents Controller Output, which is the desired gate position sent to the actuator.
- The SP (setpoint) is the tailrace water elevation – 2.0 Ft. The top of the transportation gate should equal the set point elevation. The actuator has an internal 0.10 Ft positioning deadband.
- PV represents Process Variable and is the actuator position feedback signal converted to top of gate elevation. Maximum top of gate elevation is 535.55 ft and the minimum top of gate elevation is 526.37 ft.
- ER (error) is the difference between the actual SP and the measured PV.

6.12. CONSOLIDATED GATE SCREEN

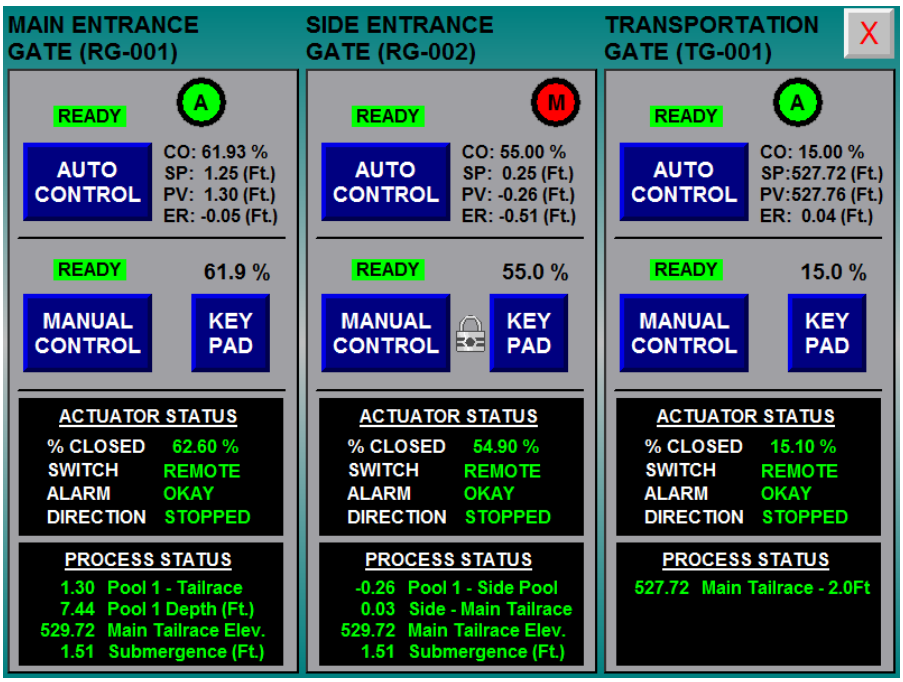


Figure 11

The consolidated gate control screen is shown in figure 11 and provides similar control and information as the individual Gate Control Screens. The letter "A" within a green circle indicates automatic mode. A letter "M" within a red circle indicates manual mode. Reference the respective gate control screen for operating instructions.

6.13. PORT SORT RACEWAYS

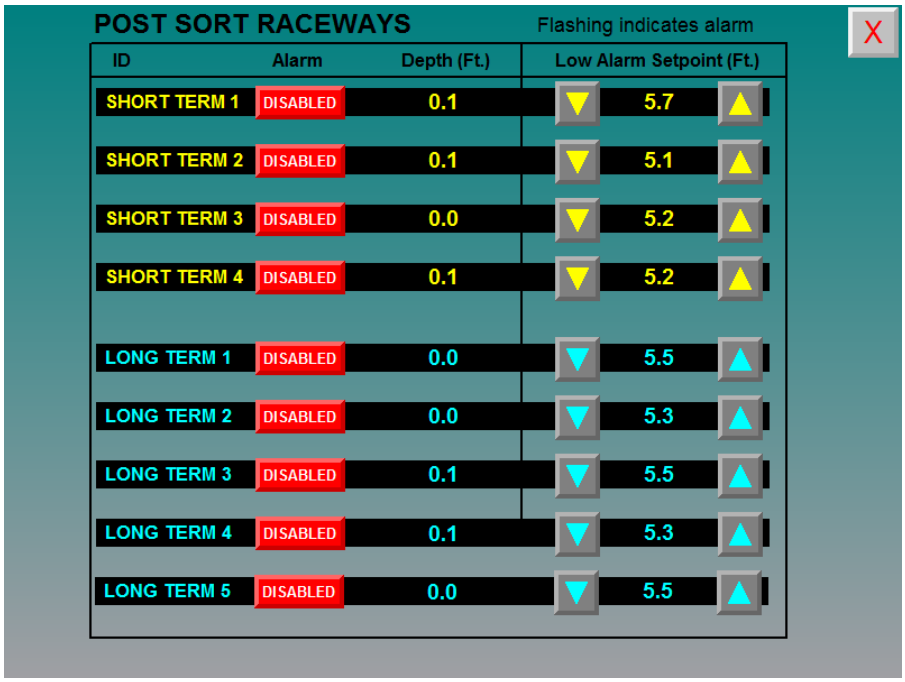


Figure 13

The post soft raceway alarm configuration screen is shown in figure 13. The screen permits adjusting, enabling, and disabling the water level alarm for each raceway. The low water level alarm setpoint is adjustable for each raceway using the up/down arrow, while the upper water level alarms are fixed at 7.0 Ft. The actual water depth of each raceway is also indicated.

6.14. DIAGNOSTICS, I/O, & CONFIGURATION

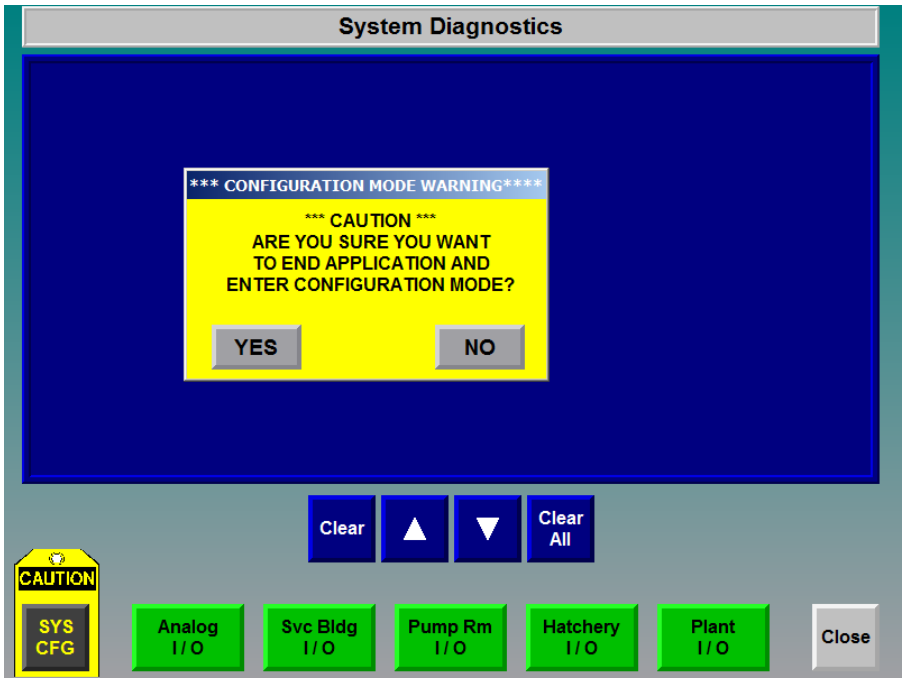


Figure 14

The diagnostics, I/O, and graphic terminal configuration screen is shown in figure 14. The screen displays information and messages generated by the graphic terminal, and provides links to input/output (I/O) screens to facilitate checkout and testing. The yellow pushbutton provides a method for configuring that graphic terminal, but requires an administrator account at login. A confirmation warning is provided (shown above) to prevent accidental shutdown of the terminal and access to the unit's configuration menu.

6.15. SORT FACILITY - DISCRETE I/O

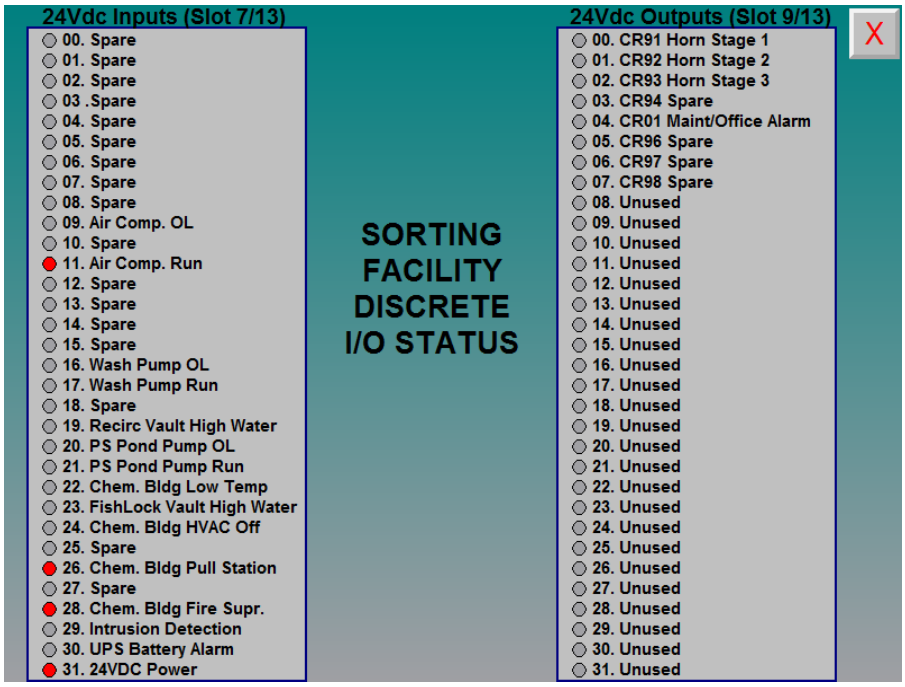


Figure 15

The sort facility discrete I/O screen is shown in figure 15, and displays channel status for the 24VDC input module. A red light indicates a voltage present at the input module. Channel status for the 24VDC output module is also shown, and a red light indicates the output is energized by the controller. The input and output modules depicted are located within the electric room PLC cabinet.

6.16. PUMP ROOM - DISCRETE I/O

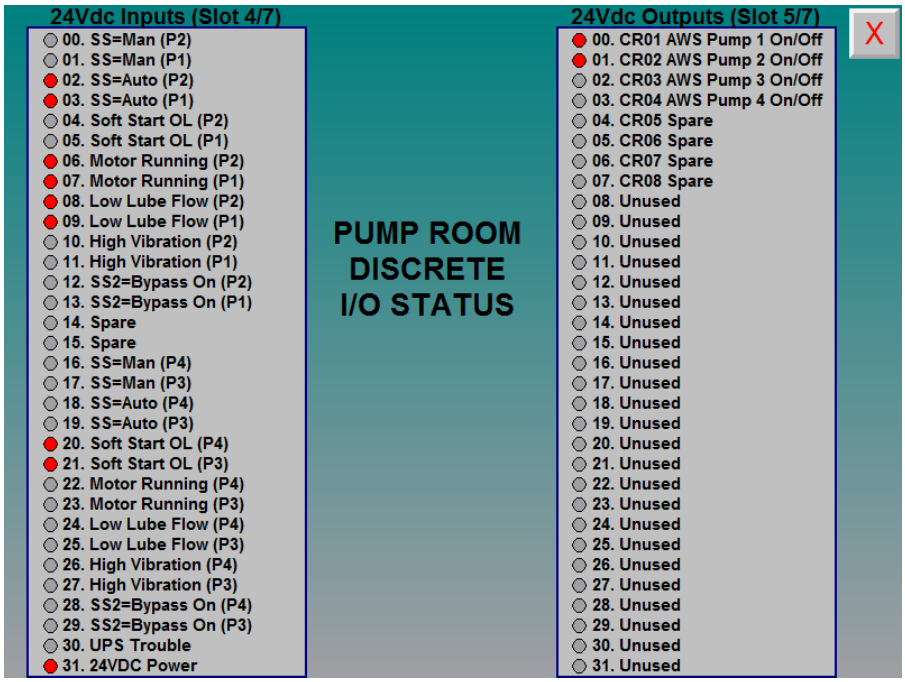


Figure 16

The pump room discrete I/O screen is shown in figure 16 and displays channel status for the 24VDC input module. A red light indicates a voltage present at the input module. Channel status for the 24VDC output module is also shown, and a red light indicates the output is energized by the controller. The input and output modules depicted are located within the pump room remote I/O cabinet.

6.17. HATCHERY - DISCRETE I/O

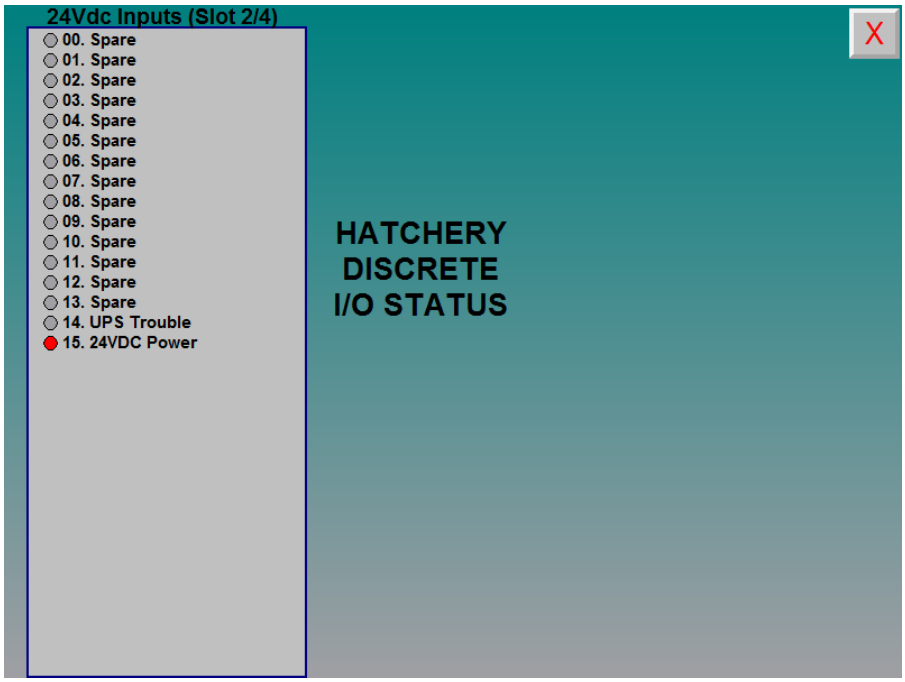


Figure 17

The fish hatchery discrete I/O screen is shown in figure 17 and displays channel status for the 24VDC input module. A red light indicates a voltage present at the input channel. The input and output modules depicted are located within the fish hatchery HMI cabinet.

6.18. PLANT OVERVIEW

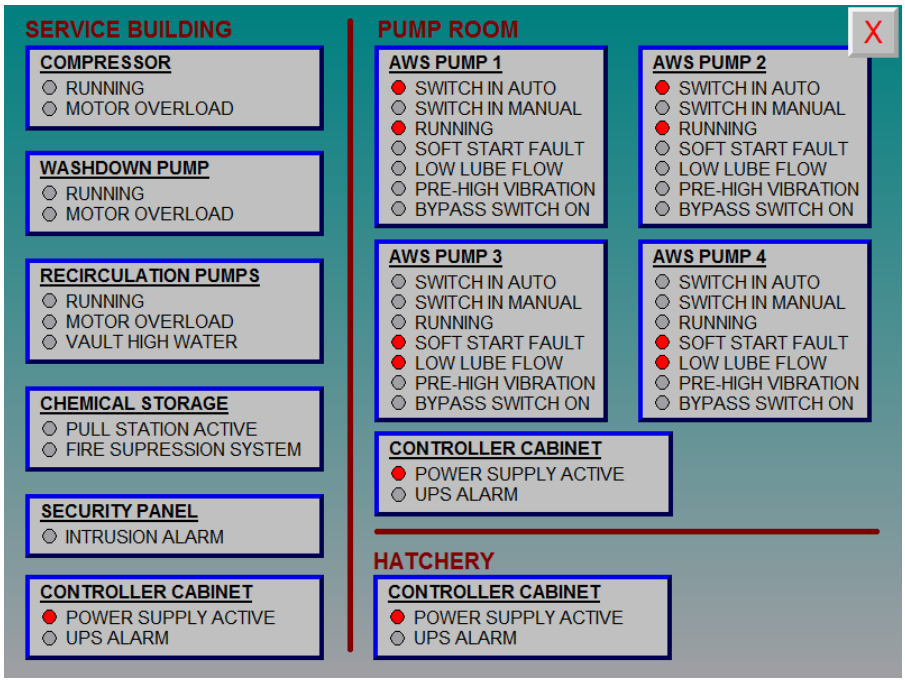


Figure 18

The fish collection facility plant I/O screen shown in figure 18 displays all 24VDC discrete inputs utilized throughout the facility. A red light indicates a voltage present for the respective input listed.

6.19. KEY PAD

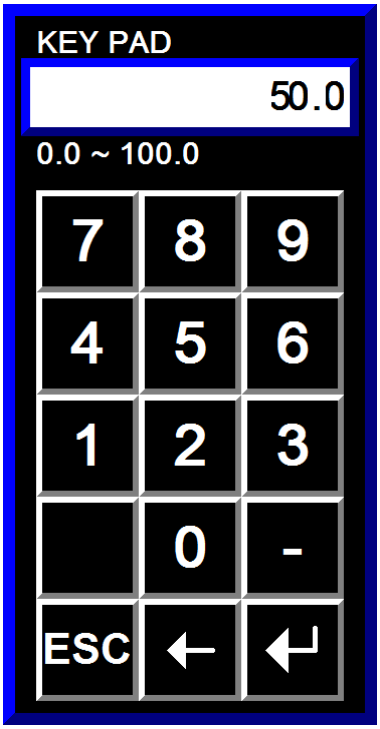


Figure 19

The touchscreen keypad shown in figure 19 permits data entry as required for manual operation. The allowed data range is displayed above the numbers, and is 0.0 to 100.0 for figure 19. Attempts to enter data outside the listed range will be rejected by the graphic terminal. The *ENTER* button is in the lower right corner.

6.20. LOGIN

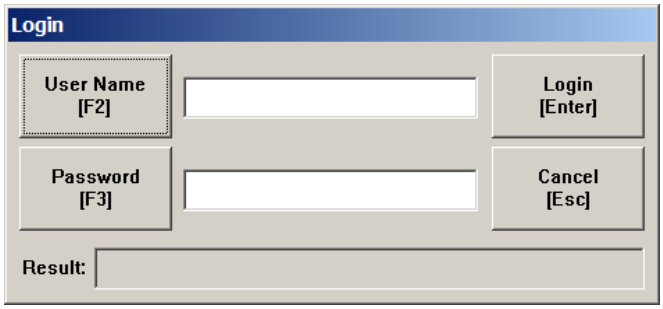


Figure 20

The login prompt is shown in figure 20. The login/enter pushbutton must be pressed after entering both the user name and password. All graphic terminals will automatically logoff the user after 30 minutes of inactivity.

6.21. ALARM HISTORY

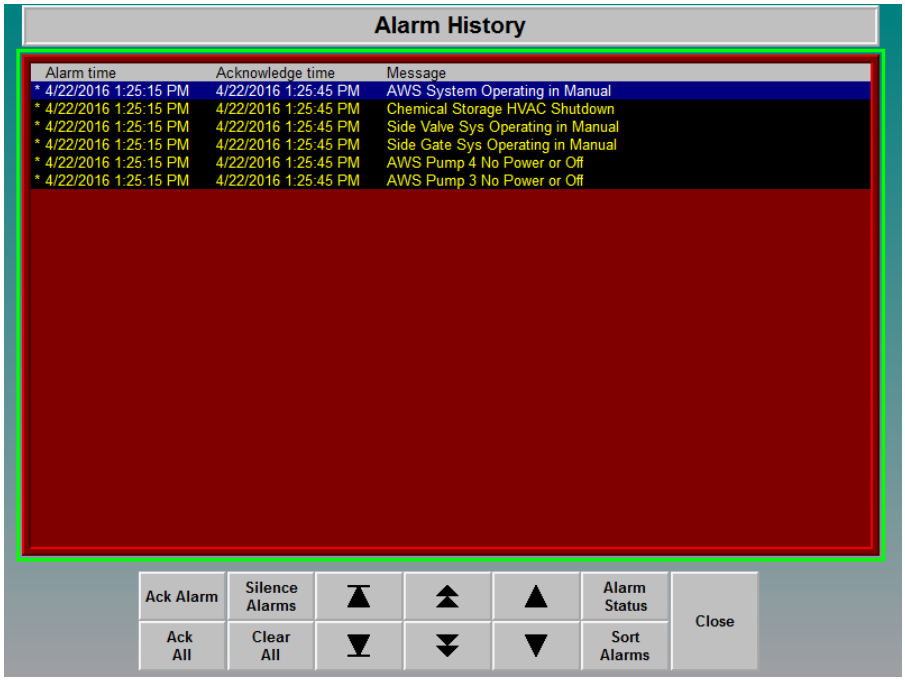


Figure 21

The alarm history screen is shown in figure 21 and is used to acknowledge, clear, and sort past alarms that have not yet been cleared. The “clear all” button will remove all historical alarms from view, even if the alarm is still active.

6.22. ACTIVE ALARM STATUS

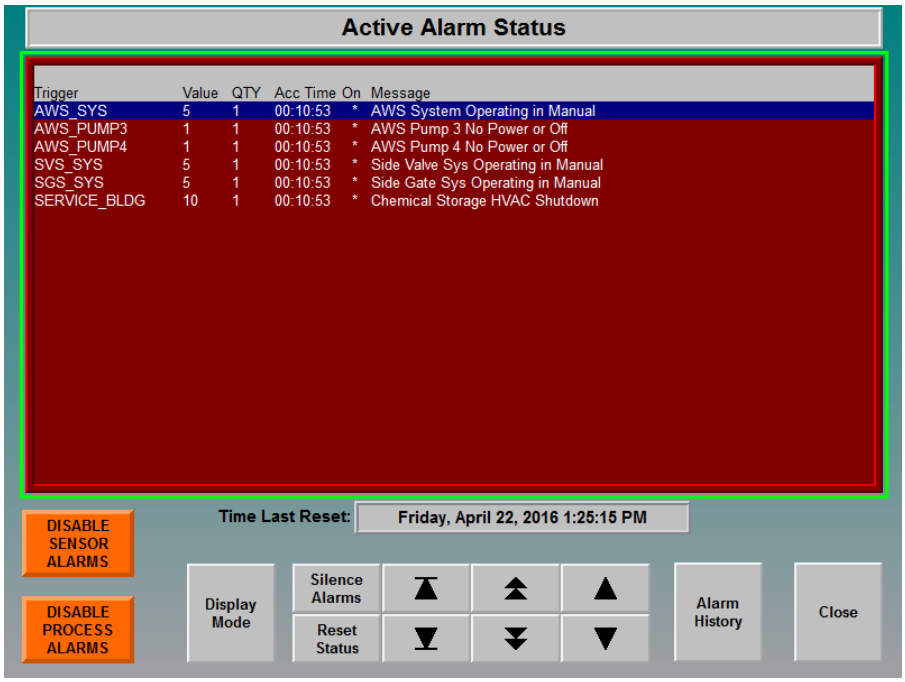


Figure 22

The active alarm status screen displays all active alarms and is shown in figure 22. The *"RESET STATUS"* button restarts the accumulated time shown. The *"SILENCE ALARMS"* pushbutton is not functional since the graphic terminals do not have an integral speaker. The orange "DISABLE SENSOR ALARMS" and "DISABLE PROCESS ALARMS" buttons open screens for alarm management.

6.23. ALARM MANAGEMENT - ANALOG SENSORS

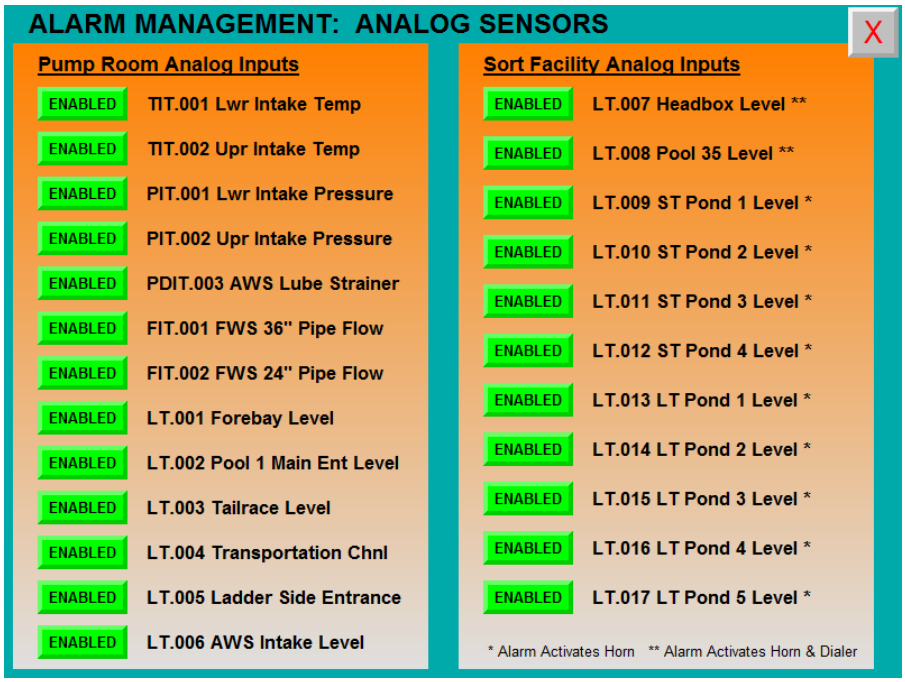


Figure 23

The analog sensor alarm management screen shown in figure 23 permits specific analog sensor alarms to be disabled or enabled. Sensor alarms should only be disabled if the device is out-of-service for repair or the fish collection facility has been shut down. An “ENABLED” alarm is indicated by a green pushbutton while a red pushbutton indicates a “DISABLED” alarm. Pressing a button will switch the alarm mode to the opposite state currently shown.

6.24. ALARM MANAGEMENT - ACTUATORS AND PROCESS CONTROL

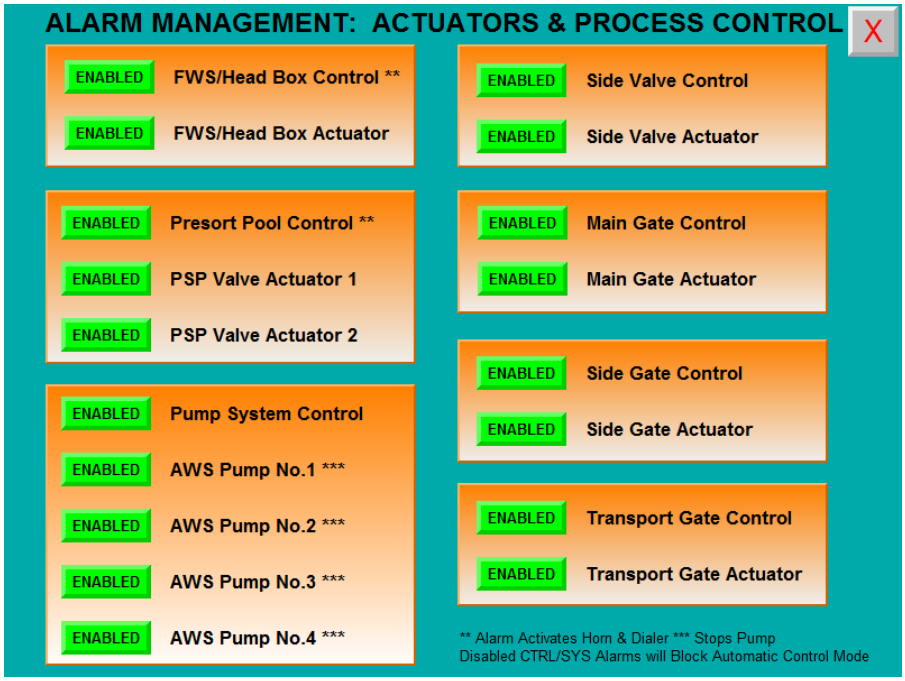


Figure 24

The actuator and process control alarm management screen shown in figure 24 permits alarms related to specific actuators and processes to be disabled or enabled. Actuator and process alarms should only be disabled if the device is out-of-service for repair or the Fish Collection Facility has been shut down. Note that disabling certain alarms will force a process running in automatic mode to switch to manual mode. See the alarm summary matrix for further information. An “ENABLED” alarm is indicated by a green pushbutton while a red pushbutton indicates a “DISABLED” alarm. Pressing a button will switch the alarm mode to the opposite state currently shown.

APPENDICES

Appendix A: As-Built Drawings

Appendix B: Contractor's O&M Manuals

Appendix C: FOSTER FISH COLLECTION FACILITY GRAPHIC TERMINAL ALARM SUMMARY

Draft Version. Last Updated April 21 2016

GRAPHIC TERMINAL (HMI) ALARM TEXT	ALARM DESCRIPTION	POSSIBLE CAUSE OR ADDITIONAL INFORMATION	ALARM DISABLED ?	ALARM DELAY	* ALARM ACTIVE IN MANUAL MODE?	DISABLE ALARM AT HMI?	** AUDIBLE & ODFW REMOTE NOTIFICATION
ANALOG SENSORS (Sort Area)							
LT.007 Error (Headbox Level)	Submersible Water Level Transmitter Trouble	No Power, Broken wire, Signal Out-of-Range, Out-of-Calibration, Device Failure, etc…		10 Sec	n/a	yes	Horn & Dialer
LT.008 Error (Pool 35 Level)	Submersible Water Level Transmitter Trouble	No Power, Broken wire, Signal Out-of-Range, Out-of-Calibration, Device Failure, etc…		10 Sec	n/a	yes	Horn & Dialer
LT.009 Error (ST Pond 1 Lvl)	Submersible Water Level Transmitter Trouble	No Power, Broken wire, Signal Out-of-Range, Out-of-Calibration, Device Failure, etc…		10 Sec	n/a	yes	Horn & Dialer
LT.010 Error (ST Pond 2 Lvl)	Submersible Water Level Transmitter Trouble	No Power, Broken wire, Signal Out-of-Range, Out-of-Calibration, Device Failure, etc…		10 Sec	n/a	yes	Horn & Dialer
LT.011 Error (ST Pond 3 Lvl)	Submersible Water Level Transmitter Trouble	No Power, Broken wire, Signal Out-of-Range, Out-of-Calibration, Device Failure, etc…		10 Sec	n/a	yes	Horn & Dialer
LT.012 Error (ST Pond 4 Lvl)	Submersible Water Level Transmitter Trouble	No Power, Broken wire, Signal Out-of-Range, Out-of-Calibration, Device Failure, etc…		10 Sec	n/a	yes	Horn & Dialer
LT.013 Error (LT Pond 1 Lvl)	Submersible Water Level Transmitter Trouble	No Power, Broken wire, Signal Out-of-Range, Out-of-Calibration, Device Failure, etc…		10 Sec	n/a	yes	Horn & Dialer
LT.014 Error (LT Pond 2 Lvl)	Submersible Water Level Transmitter Trouble	No Power, Broken wire, Signal Out-of-Range, Out-of-Calibration, Device Failure, etc…		10 Sec	n/a	yes	Horn & Dialer
LT.015 Error (LT Pond 3 Lvl)	Submersible Water Level Transmitter Trouble	No Power, Broken wire, Signal Out-of-Range, Out-of-Calibration, Device Failure, etc…		10 Sec	n/a	yes	Horn & Dialer
LT.016 Error (LT Pond 4 Lvl)	Submersible Water Level Transmitter Trouble	No Power, Broken wire, Signal Out-of-Range, Out-of-Calibration, Device Failure, etc…		10 Sec	n/a	yes	Horn & Dialer
LT.017 Error (LT Pond 5 Lvl)	Submersible Water Level Transmitter Trouble	No Power, Broken wire, Signal Out-of-Range, Out-of-Calibration, Device Failure, etc…		10 Sec	n/a	yes	Horn & Dialer
Spare Analog Input Ch.11	n/a	n/a		n/a	n/a	n/a	
Spare Analog Input Ch.12	n/a	n/a		n/a	n/a	n/a	
Spare Analog Input Ch.13	n/a	n/a		n/a	n/a	n/a	
Spare Analog Input Ch.14	n/a	n/a		n/a	n/a	n/a	
Spare Analog Input Ch.15	n/a	n/a		n/a	n/a	n/a	
ANALOG SENSORS (Pump Room Area)							
TIT.001 Error (Lower Intake)	Water Temperature Transmitter (w/Display) Trouble	No Power, Broken wire, Signal Out-of-Range, Out-of-Calibration, Device Failure, etc…		10 Sec	n/a	yes	
TIT.002 Error (Upper Intake)	Water Temperature Transmitter (w/Display) Trouble	No Power, Broken wire, Signal Out-of-Range, Out-of-Calibration, Device Failure, etc…		10 Sec	n/a	yes	
PIT.001 Error (Lower Intake)	Water Pressure Transmitter (w/Display) Trouble	No Power, Broken wire, Signal Out-of-Range, Out-of-Calibration, Device Failure, etc…		10 Sec	n/a	yes	
PIT.002 Error (Upper Intake)	Water Pressure Transmitter (w/Display) Trouble	No Power, Broken wire, Signal Out-of-Range, Out-of-Calibration, Device Failure, etc…		10 Sec	n/a	yes	
FIT.001 Error (36 Pipe FWS)	Water Flow Transmitter (w/Display) Trouble	No Power, Broken wire, Signal Out-of-Range, Out-of-Calibration, Device Failure, etc…		10 Sec	n/a	yes	
FIT.002 Error (24 Pipe FWS)	Water Flow Transmitter (w/Display) Trouble	No Power, Broken wire, Signal Out-of-Range, Out-of-Calibration, Device Failure, etc…		10 Sec	n/a	yes	
LT.001 Error (Forebay)	Submersible Water Level Transmitter Trouble	No Power, Broken wire, Signal Out-of-Range, Out-of-Calibration, Device Failure, etc…		10 Sec	n/a	yes	
LT.002 Error (Pool 1 Main Ent)	Submersible Water Level Transmitter Trouble	No Power, Broken wire, Signal Out-of-Range, Out-of-Calibration, Device Failure, etc…		10 Sec	n/a	yes	
LT.003 Error (Tailrace)	Submersible Water Level Transmitter Trouble	No Power, Broken wire, Signal Out-of-Range, Out-of-Calibration, Device Failure, etc…		10 Sec	n/a	yes	
LT.004 Error (Trans Chnl)	Submersible Water Level Transmitter Trouble	No Power, Broken wire, Signal Out-of-Range, Out-of-Calibration, Device Failure, etc…		10 Sec	n/a	yes	
LT.005 Error (Ladder Side Ent)	Submersible Water Level Transmitter Trouble	No Power, Broken wire, Signal Out-of-Range, Out-of-Calibration, Device Failure, etc…		10 Sec	n/a	yes	
LT.006 Error (AWS Pump Intake)	Submersible Water Level Transmitter Trouble	No Power, Broken wire, Signal Out-of-Range, Out-of-Calibration, Device Failure, etc…		10 Sec	n/a	yes	
PDIT.003 Error (AWS Pump Strainer)	Differential Water Pressure Transmitter (w/Display) Trouble	No Power, Broken wire, Signal Out-of-Range, Out-of-Calibration, Device Failure, etc…		10 Sec	n/a	n/a	
Spare Analog Input Ch.13	n/a	n/a		n/a	n/a	n/a	
Spare Analog Input Ch.14	n/a	n/a		n/a	n/a	n/a	
Spare Analog Input Ch.15	n/a	n/a		n/a	n/a	n/a	
AUXILLARY WATER SYSTEM CONTROL							
AWS Pump / Table Mismatch	Quantity of Pumps running does not match design table.	Total pumps running do not equal the req' quantity based on Tailrace water level (Lt.003)		360 sec	no		
AWS System Forced to Manual	AWS Pump system jumped from Auto to Manual Mode	Pump not in auto, Soft-start fault, High vibration, Low lube flow, LT.003 trouble, PLC module fault,		Instant	no		
AWS System Not Used	n/a	n/a		n/a	n/a	yes	
AWS Upr Intake Trashrack Hi Differential	AWS Intake Pipe High Differential Pressure	(Lt.001 - PT.002) is greater than 10 Ft.		60 Sec	yes		
AWS System Operating in Manual	AWS Pump control system in manual mode	System placed in Manual at HMI or an unscheduled event caused jump from Auto to Manual		60 Sec	yes		
AWS System Return to Auto Attempted	Return to Auto Mode attempted after System Forced to Man	Pump & Process Alms Enabled, Pumps in Auto, LT.003, Vibration, & Low Flow Alarms Cleared.	Disabled	240 Sec	n/a		
AWS Pumps Lube Water Strainer Dirty	AWS Pump Lubrication Water Filter	Differential Pressure across strainer is greater than 50 ft of water.		60 Sec	n/a		
AUXILLARY WATER SYSTEM PUMPS							
AWS Pump 1 No Power or Off	Selector Switch Position = OFF or no control power	120VAC voltage signal not reeceived through control panel selector switch		5 Sec	yes		
AWS Pump 1 Not in Auto	Selector Switch Position Not in Auto	Control Panel Selector Switch not in Auto Position		30 Sec	yes		
AWS Pump 1 Soft Starter Fault	Soft Starter Overload or Fault	Soft Starter Overload or Trouble		30 Sec	yes		
AWS Pump 1 Low Lube Flow	Lubrication Water Flow is Low	Low Water Flow when Pump Running		5 Sec	yes	yes	
AWS Pump 1 High Vibration Warning	High Pump Vibration Detected	Pump Vibration Sensor Active		30 Sec	yes		
AWS Pump 1 Run Failure (Vibration, Flow,or Fault)	Failure due to Low Flow, High Vibration, or Soft-Starter Fault	Feedback from motor contactor does not match PLC output to run		30 Sec	no		

AWS Pump 1 Auto Stop Failure	Pump Failed to Stop	Feedback from motor contactor does not match PLC output to stop		30 Sec	no		
AWS Pump 2 No Power or Off	Selector Switch Position = OFF or no control power	120VAC voltage signal not reeceived through control panel selector switch		5 Sec	yes		
AWS Pump 2 Not in Auto	Selector Switch Position Not in Auto	Control Panel Selector Switch not in Auto Position		30 Sec	yes		
AWS Pump 2 Soft Starter Fault	Soft Starter Overload or Fault	Soft Starter Overload or Trouble		30 Sec	yes		
AWS Pump 2 Low Lube Flow	Lubrication Water Flow is Low	Low Water Flow when Pump Running		5 Sec	yes	yes	
AWS Pump 2 High Vibration Warning	High Pump Vibration Detected	Pump Vibration Sensor Active		30 Sec	yes		
AWS Pump 2 Run Failure (Vibration, Flow,or Fault)	Failure due to Low Flow, High Vibration, or Soft-Starter Fault	Feedback from motor contactor does not match PLC output to run		30 Sec	no		
AWS Pump 2 Auto Stop Failure	Pump Failed to Stop	Feedback from motor contactor does not match PLC output to stop		30 Sec	no		
AWS Pump 3 No Power or Off	Selector Switch Position = OFF or no control power	120VAC voltage signal not reeceived through control panel selector switch		5 Sec	yes		
AWS Pump 3 Not in Auto	Selector Switch Position Not in Auto	Control Panel Selector Switch not in Auto Position		30 Sec	yes		
AWS Pump 3 Soft Starter Fault	Soft Starter Overload or Fault	Soft Starter Overload or Trouble		30 Sec	yes		
AWS Pump 3 Low Lube Flow	Lubrication Water Flow is Low	Low Water Flow when Pump Running		5 Sec	yes	yes	
AWS Pump 3 High Vibration Warning	High Pump Vibration Detected	Pump Vibration Sensor Active		30 Sec	yes		
AWS Pump 3 Run Failure (Vibration, Flow,or Fault)	Failure due to Low Flow, High Vibration, or Soft-Starter Fault	Feedback from motor contactor does not match PLC output to run		30 Sec	no		
AWS Pump 3 Auto Stop Failure	Pump Failed to Stop	Feedback from motor contactor does not match PLC output to stop		30 Sec	no		
AWS Pump 4 No Power or Off	Selector Switch Position = OFF or no control power	120VAC voltage signal not reeceived through control panel selector switch		5 Sec	yes		
AWS Pump 4 Not in Auto	Selector Switch Position Not in Auto	Control Panel Selector Switch not in Auto Position		30 Sec	yes		
AWS Pump 4 Soft Starter Fault	Soft Starter Overload or Fault	Soft Starter Overload or Trouble		30 Sec	yes		
AWS Pump 4 Low Lube Flow	Lubrication Water Flow is Low	Low Water Flow when Pump Running		5 Sec	yes	yes	
AWS Pump 4 High Vibration Warning	High Pump Vibration Detected	Pump Vibration Sensor Active		30 Sec	yes		
AWS Pump 4 Run Failure (Vibration, Flow,or Fault)	Failure due to Low Flow, High Vibration, or Soft-Starter Fault	Feedback from motor contactor does not match PLC output to run		30 Sec	no		
AWS Pump 4 Auto Stop Failure	Pump Failed to Stop	Feedback from motor contactor does not match PLC output to stop		30 Sec	no		
PRESORT POOL SYSTEM							
Pre-Sort-Pool Water Level High or Low	Presort Pool Water Level at Upper or Lower Limit	Pool 35 Water Elev (LT.008) - Top of Weir (560.7) is GEQ than 1.6 Ft or LEQ 1.2 Ft		300 Sec	yes	yes	Horn & Dialer
PRESORT POOL SYSTEM ACTUATORS							
Valve PSP 1 Communication Error	Actuator Communication Error	Rotork Acuator not found on network due to loss of power at actuator or Devicenet problem		30 Sec	yes		
Valve PSP 1 Not in Remote	Actuator Selector Switch Not In Remote	Rotork Actuator Selector Switch in stop or Local position		2 Sec	yes		
Valve PSP 1 Close Failure within Allotted Time	Actuator did not fully close within expetcted time	Verify Rotork Actuator limit switch settings and general operation		60 Sec	no	yes	
Valve PSP 1 Open Failure within Allotted Time	Actuator did not fully open within expected time	Verify Rotork Actuator limit switch settings and general operation		60 Sec	no		
Valve PSP 1 Setpoint Rejected by Actuator	Command for Setpoint Positioning Mode Rejected.	Alarm ignored due to signal loss at 0 and 100% setpoints or when fully open/closed. ONLY ISSUE w/ROTORK.	Disabled	n/a	n/a		
Valve PSP 1 Internal Alarm	Actuator Internal Alarm Active	Rotork Actuator Obstructed, Jammed, Thermal Overload, Low Battery, or Monitor Error.		5 Sec	no		
Valve PSP 2 Communication Error	Actuator Communication Error	Rotork Acuator not found on network due to loss of power at actuator or Devicenet problem		30 Sec	yes		
Valve PSP 2 Not in Remote	Actuator Selector Switch Not In Remote	Rotork Actuator Selector Switch in stop or Local position		2 Sec	yes		
Valve PSP 2 Close Failure within Allotted Time	Actuator did not fully close within expetcted time	Verify Rotork Actuator limit switch settings and general operation		60 Sec	no	yes	
Valve PSP 2 Open Failure within Allotted Time	Actuator did not fully open within expected time	Verify Rotork Actuator limit switch settings and general operation		60 Sec	no		
Valve PSP 2 Setpoint Rejected by Actuator	Command for Setpoint Positioning Mode Rejected.	Alarm ignored due to signal loss at 0 and 100% setpoints or when fully open/closed. ONLY ISSUE w/ROTORK.	Disabled	n/a	n/a		
Valve PSP 2 Internal Alarm	Actuator Internal Alarm Active	Rotork Actuator Obstructed, Jammed, Thermal Overload, Low Battery, or Monitor Error.		5 Sec	no		
FACILITY WATER SYSTEM CONTROL (Headbox)							
FWS Valve Sys Forced to Manual	Unscheduled event caused jump from Auto to Man	System Alm Disabled, LT.007 Error, Network Error, Actuator Alms or Switch Not in Remote		Instant	no		
FWS Valve Sys Controller Output at Limit	Process PLC output at Upper or Lower Limit	PLC output to valve at 70% open (max limit) or 0% open (min limit). Unable to regulate process.		300 Sec	no		
FWS Headbox Water Level High or Low	Process Variable (LT.007) at Upper or Lower Limit	PLC input (LT.007) is greater than 23.5ft or less than 21.5ft.		300 Sec	no	yes	Horn & Dialer
FWS Lwr Intake Trashrack Hi Differential	FWS Intake Pipe High Differential Pressure	(Lt.001 - PT.001) is greater than 10 Ft		60 Sec	yes		
FWS Valve Sys Operating in Manual	FWS Valve (Headbox) control system in manual mode	System placed in manual or event caused jump from Auto. Lock visible if placed in Man by Operator.		60 Sec	yes		
FWS Valve Sys Return to Auto Attempted	Return to Auto Mode attempted after System Forced to Man	FQ1 Power Restored, Process Alm Enabled, SS=Rem, or LT.007, Network & Actuator Errors Cleared.		240 Sec	no		
FACILITY WATER SYSTEM ACTUATOR							
FWS Valve Communication Error	Actuator Communication Error	Rotork Acuator not found on network due to loss of power or Devicenet problem		30 Sec	yes		
FWS Valve Not in Remote	Actuator Selector Switch Not In Remote	Rotork actuator selector switch in Stop or Local position		2 Sec	yes		
FWS Valve Close Failure within Allotted Time	Actuator did not fully close within expetcted time	Verify Rotork Actuator limit switch settings and general operation		60 Sec	no	yes	
FWS Valve Open Failure within Allotted Time	Actuator did not fully open within expected time	Verify Rotork Actuator limit switch settings and general operation		60 Sec	no		
FWS Valve Setpoint Rejected by Actuator	Command for Setpoint Positioning Mode Rejected.	Alarm ignored due to signal loss at 0 and 100% setpoints or when fully open/closed. ONLY ISSUE w/ROTORK.	Disabled	n/a	n/a		
FWS Valve Internal Alarm	Actuator Internal Alarm Active	Rotork Actuator Obstructed, Jammed, Thermal Overload, Low Battery, or Monitor Error.		2 Sec	no		
SIDE VALVE CONTROL							
Side Valve Sys Forced to Manual	Unscheduled event caused jump from Auto to Man	System Alm Disabled, LT.002 or LT.004 Error, Network Error, Actuator Alms or Switch Not in Remote		Instant	no		
Side Valve Sys Controller Output at Limit	PLC output remaining at Upper or Lower Limit too Long	PLC output to valve at 100% open (max limit) or 0% open (min limit). Unable to regulate process.	Disabled	300 Sec	no		
Side Valve Process out of Tolerance	Process Variable (FIT.002) at Upper or Lower Limit	Process Variable (FIT.002) is greater than 65 CFS or less than -5.0 CFS for 5 minutes.		300 Sec	no	yes	
Side Valve Sys Operating in Manual	Side valve control system in manual mode	System placed in Manual at HMI or an unscheduled event caused jump from Auto to Manual		60 Sec	yes		

Side Valve Sys Return to Auto Attempted	Return to Auto Mode attempted after System Forced to Man	FQ1 Power Restored, Process Alm Enabled, SS=Rem, or LT.002, LT.004, Network & Actuator Errors Cleared.	Disabled	240 Sec	n/a		
SIDE VALVE ACTUATOR							
Side Valve Communication Error	Actuator Communication Error	Rotork Acuator not found on network due to loss of power or Devicenet problem		30 Sec	yes		
Side Valve Not in Remote	Actuator Selector Switch Not In Remote	Rotork Actuator Selector Switch in stop or Local position		2 Sec	yes		
Side Valve Close Failure within Allotted Time	Actuator did not fully close within expetcted time	Verify Rotork Actuator limit switch settings and general operation		60 Sec	no	yes	
Side Valve Open Failure within Allotted Time	Actuator did not fully open within expected time	Verify Rotork Actuator limit switch settings and general operation		60 Sec	no		
Side Valve Setpoint Rejected by Actuator	Command for Setpoint Positioning Mode Rejected.	Alarm ignored due to signal loss at 0 and 100% setpoints or when fully open/closed. ONLY ISSUE w/ROTORK.	Disabled	n/a	n/a		
Side Valve Internal Alarm	Actuator Internal Alarm Active	Rotork Actuator Obstructed, Jammed, Thermal Overload, Low Battery, or Monitor Error.		5 Sec	no		
MAIN ENTRANCE GATE CONTROL							
Main Gate Sys Forced to Manual	Unscheduled event caused jump from Auto to Man	System Alm Disabled, LT.002 or LT.003 Error, Network Error, Actuator Alms or Switch Not in Remote		Instant	no		
Main Gate Sys Controller Output at Limit	PLC output remaining at Upper or Lower Limit too Long	PLC output to gate at 85.5% open (max limit) or 10.4% open (min limit). Unable to regulate process.	Disabled	300 Sec	no		
Main Gate Process out of Tolerance	Pool 1 (LT.002) - Tailrace (Lt.003) out of range.	PLC input (LT.002 - LT.003) GEQ than 10.0 ft or LEQ 0.0 ft.		300 Sec	no	yes	
Main Gate Sys Operating in Manual	Main Ladder Entrance Gate system in manual mode	System placed in manual or event caused jump from Auto to Man. Lock visible if placed in manual.		60 Sec	yes		
Main Gate Sys Return to Auto Attempted	Return to Auto Mode attempted after System Forced to Man	FQ1 Power Restored, Process Alm Enabled, SS=Rem, or LT.002, LT.003, Network & Actuator Errors Cleared.	Disabled	240 Sec	n/a		
MAIN ENTRANCE GATE ACTUATOR							
Main Gate Communication Error	Actuator Communication Error	Auma Acuator not found on network due to loss of power or Devicenet problem		30 Sec	yes		
Main Gate Not in Remote	Actuator Selector Switch Not In Remote	Auma Actuator Selector Switch in stop or Local position		2 Sec	yes		
Main Gate Close Failure within Allotted Time	Actuator did not fully close within expetcted time	Verify Auma Actuator limit switch settings and general operation		10 Min	no	yes	
Main Gate Open Failure within Allotted Time	Actuator did not fully open within expected time	Verify Auma Actuator limit switch settings and general operation		10 Min	no		
Main Gate Positioning Failure within Alloted Time	Actuator did not reach setpoint position within expected time	Verify Auma Actuator limit switch settings and general operation		10 Min	n/a		
Main Gate Internal Alarm	Actuator Internal Alarm Active	Auma Actuator internal fault, warning, or not ready signal(s) active.		2 Sec	no		
SIDE ENTRANCE GATE CONTROL							
Side Gate Sys Forced to Manual	Unscheduled event caused jump from Auto to Man	System Alm Disabled, LT.002 or LT.004 Error, Network Error, Actuator Alms or Switch Not in Remote		Instant	no		
Side Gate Sys Controller Output at Limit	PLC output remaining at Upper or Lower Limit too Long	PLC output to gate at 85.5% open (max limit) or 10.4% open (min limit). Unable to regulate process.	Disabled	300 Sec	no		
Side Gate Process out of Tolerance	Pool 1 (LT.002) - Transportation Chnl (LT.004) out of range.	PLC input (LT.002 - LT.004) GEQ than 2.0 ft or LEQ 0.0 ft.		300 Sec	no	yes	
Side Gate Sys Operating in Manual	Side Entrance Gate control system in manual mode	System placed in manual or event caused jump from Auto to Man. Lock visible if placed in manual.		60 Sec	yes		
Side Gate Sys Return to Auto Attempted	Return to Auto Mode attempted after System Forced to Man	FQ1 Power Restored, Process Alm Enabled, SS=Rem, or LT.002, LT.004, Network & Actuator Errors Cleared.	Disabled	240 Sec	n/a		
SIDE ENTRANCE GATE ACTUATOR							
Side Gate Communication Error	Actuator Communication Error	Auma Acuator not found on network due to loss of power or Devicenet problem		30 Sec	yes		
Side Gate Not in Remote	Actuator Selector Switch Not In Remote	Auma Actuator Selector Switch in stop or Local position		2 Sec	yes		
Side Gate Close Failure within Allotted Time	Actuator did not fully close within expetcted time	Verify Auma Actuator limit switch settings and general operation		10 Min	no	yes	
Side Gate Open Failure within Allotted Time	Actuator did not fully open within expected time	Verify Auma Actuator limit switch settings and general operation		10 Min	no		
Side Gate Positioning Failure within Alloted Time	Actuator did not reach setpoint position within expected time	Verify Auma Actuator limit switch settings and general operation		10 Min	n/a		
Side Gate Internal Alarm	Actuator Internal Alarm Active	Auma Actuator internal fault, warning, or not ready signal(s) active.		2 Sec	no		
TRANSPORTATION GATE CONTROL							
Trans Gate Sys Forced to Manual	Control Loop Forced from Auto into Manual Mode	System Alm Disabled, LT.003 Error, Network Error, Actuator Alms or Switch Not in Remote		Instant	no		
Trans Gate Sys Controller Output at Limit	PLC output remaining at Upper or Lower Limit too Long	PLC output to gate at 100.0% open (max limit) or 15.0% open (min limit). Unable to regulate process.	Disabled	300 Sec	no		
Trans Gate Process out of Tolerance	Top of gate out-of-range. Open= 526.37 ft., closed=535.55ft	PLC input (Gate Position) GEQ than 536.0 ft or LEQ 526.0 ft.		300 Sec	no	yes	
Trans Gate Sys Operating in Manual	Transportation Gate control system in manual mode	System placed in manual or event caused jump from Auto to Man. Lock visible if placed in manual.		60 Sec	yes		
Trans Gate Sys Return to Auto Attempted	Return to Auto Mode attempted after System Forced to Man	FQ1 Power Restored, Process Alm Enabled, SS=Rem, or LT.003, Network & Actuator Errors Cleared.	Disabled	240 Sec	n/a		
TRANSPORTATION GATE ACTUATOR							
Trans Gate Communication Error	Actuator Communication Error	Auma Acuator not found on network due to loss of power or Devicenet problem		30 Sec	yes		
Trans Gate Not in Remote	Actuator Selector Switch Not In Remote	Auma Actuator Selector Switch in stop or Local position		2 Sec	yes		
Trans Gate Close Failure within Allotted Time	Actuator did not fully close within expetcted time	Verify Auma Actuator limit switch settings and general operation		11 Min	no	yes	
Trans Gate Open Failure within Allotted Time	Actuator did not fully open within expected time	Verify Auma Actuator limit switch settings and general operation		11 Min	no		
Trans Gate Positioning Failure within Alloted Time	Actuator did not reach setpoint position within expected time	Verify Auma Actuator limit switch settings and general operation		11 Min	n/a		
Trans Gate Internal Alarm	Actuator Internal Alarm Active	Auma Actuator internal fault, warning, or not ready signal(s) active.		2 Sec	no		
HOLDING PONDS (RACEWAYS)							
Short Term Pond 1 Low Water	Water Depth Below Setpoint	Check Pond Water Level, adjust setpoint, or disable alarm		30 Sec	n/a	yes	Horn & Dialer
Short Term Pond 1 High Water	Water Depth Above Setpoint	Check Pond Water Level, adjust setpoint, or disable alarm		60 Sec			Horn & Dialer
Short Term Pond 2 Low Water	Water Depth Below Setpoint	Check Pond Water Level, adjust setpoint, or disable alarm		30 Sec	n/a	yes	Horn & Dialer
Short Term Pond 2 High Water	Water Depth Above Setpoint	Check Pond Water Level, adjust setpoint, or disable alarm		60 Sec			Horn & Dialer
Short Term Pond 3 Low Water	Water Depth Below Setpoint	Check Pond Water Level, adjust setpoint, or disable alarm		30 Sec	n/a	yes	Horn & Dialer
Short Term Pond 3 High Water	Water Depth Above Setpoint	Check Pond Water Level, adjust setpoint, or disable alarm		60 Sec			Horn & Dialer
Short Term Pond 4 Low Water	Water Depth Below Setpoint	Check Pond Water Level, adjust setpoint, or disable alarm		30 Sec	n/a	yes	Horn & Dialer
Short Term Pond 4 High Water	Water Depth Above Setpoint	Check Pond Water Level, adjust setpoint, or disable alarm		60 Sec			Horn & Dialer

Long Term Pond 1 Low Water	Water Depth Below Setpoint	Check Pond Water Level, adjust setpoint, or disable alarm		30 Sec	n/a	yes	Horn & Dialer
Long Term Pond 1 High Water	Water Depth Above Setpoint	Check Pond Water Level, adjust setpoint, or disable alarm		60 Sec			Horn & Dialer
Long Term Pond 2 Low Water	Water Depth Below Setpoint	Check Pond Water Level, adjust setpoint, or disable alarm		30 Sec	n/a	yes	Horn & Dialer
Long Term Pond 2 High Water	Water Depth Above Setpoint	Check Pond Water Level, adjust setpoint, or disable alarm		60 Sec			Horn & Dialer
Long Term Pond 3 Low Water	Water Depth Below Setpoint	Check Pond Water Level, adjust setpoint, or disable alarm		30 Sec	n/a	yes	Horn & Dialer
Long Term Pond 3 High Water	Water Depth Above Setpoint	Check Pond Water Level, adjust setpoint, or disable alarm		60 Sec			Horn & Dialer
Long Term Pond 4 Low Water	Water Depth Below Setpoint	Check Pond Water Level, adjust setpoint, or disable alarm		30 Sec	n/a	yes	Horn & Dialer
Long Term Pond 4 High Water	Water Depth Above Setpoint	Check Pond Water Level, adjust setpoint, or disable alarm		60 Sec			Horn & Dialer
Long Term Pond 5 Low Water	Water Depth Below Setpoint	Check Pond Water Level, adjust setpoint, or disable alarm		30 Sec	n/a	yes	Horn & Dialer
Long Term Pond 5 High Water	Water Depth Above Setpoint	Check Pond Water Level, adjust setpoint, or disable alarm		60 Sec			Horn & Dialer
MISCELLANEOUS HARDWARE ALARMS							
Compressor Overload	Air Compessor Motor Overload Relay.	Check unloaded amps & OL relay. Verify windings not shorted/grounded. Check load & motor rating.		120 sec	n/a	no	
FishLock Vault High Water	High Water Level in Vault	Check for flooding		15 sec	n/a	no	
Washdown Pump Overload	Washdown Pump Motor Overload Relay.	Check unloaded amps & OL relay. Verify windings not shorted/grounded. Check load & motor rating.		15 sec	n/a	no	
Recirculation Vault High Level	Recirculation Vault High Water Level.	Verify fault not flooded.		15 sec	n/a	no	
Recirculation Pump VFD Fault	Variable Speed Drive Fault.	Check VFD alarm log & motor.		15 sec	n/a	no	
Chemical Storage Pull Station Active	Manual Pull Station Alarm.	Check manual pull stations (x2).		15 sec	n/a	no	Horn
Chemical Storage Fire Suppression Active	Fire Suppression System Activated	Check Alarm Initiating Switch SW2.		15 sec	n/a	no	Horn
Chemical Storage HVAC Shutdown	HVAC system not running.	Check power, thermostat, and HVAC equipment.		15 sec	n/a	no	
Chemical Storage Low Temperature	Building Low Air Temperature	Check building for adequate heat.		15 sec	n/a	no	
SvcBldg UPS Battery Trouble	PLC Cabinet UPS Battery Low	Check UPS Battery		15 sec	n/a	no	
SvcBldg 24VDC Power Lost	PLC cabinet 24Vdc power supply missing.	Check power supply.		15 sec	n/a	no	
SvcBldg Security Panel	Not functional. Needs to be completed by construction	n/a		15 sec	n/a	no	Horn
SvcBldg Power Meter COMM Fault	Ethernet Link to Power Meter Lost.	Check Ethernet Switches, Power Supply, Fiber Optic Cables, Patch Cables, etc.		5 Sec	n/a	no	
SvcBldg Output Module Fault	24Vdc output module has detected a fault.	Check for PLC hardware failure.		Instant	n/a	no	
SvcBldg Input Module Fault	24Vdc input module has detected a fault.	Check for PLC hardware failure.		Instant	n/a	no	
Pump Rm UPS Battery Trouble	Cabinet UPS Battery Low	Check UPS Battery		15 sec	n/a	no	
Pump Rm 24VDC Power Lost	24Vdc power supply missing.	Check power supply.		15 sec	n/a	no	
Pump Rm Not Used	n/a	n/a		n/a	n/a	n/a	
Pump Intake Trashrack Hi Differential	Pump Intake Differential Head > 1.0 Feet	Check Trashrack and Pressure Sensors LT.003 & Lt.006		60 sec	n/a	no	
Pump Rm PLC Chassis COMM Fault	Ethernet Link to PLC Chassis Lost.	Check Ethernet Switches, Power Supply, Fiber Optic Cables, Patch Cables, etc.		5 sec	n/a	no	
Pump Rm Power Meter COMM Fault	Ethernet Link to Power Meter Lost.	Check Ethernet Switches, Power Supply, Fiber Optic Cables, Patch Cables, etc.		5 Sec	n/a	no	
Pump Rm Output Module Fault	24Vdc PLC output module has detected a fault.	Possible PLC hardware failure.		Instant	n/a	no	
Pump Rm Input Module Fault	24Vdc PLC input module has detected a fault.	Possible PLC hardware failure.		Instant	n/a	no	
Hatchery UPS Battery Trouble	PLC Cabinet UPS Battery Low	Check UPS Battery		15 sec	n/a	no	
Hatchery 24VDC Power Lost	PLC cabinet 24Vdc power supply missing.	Check power supply.		15 sec	n/a	no	
Hatchery PLC Chassis COMM Fault	Ethernet Link to PLC Chassis Lost.	Check Ethernet Switches, Power Supply, Fiber Optic Cables, Patch Cables, etc.		5 Sec	n/a	no	
Hatchery Output Module Fault	24Vdc output module has detected a fault.	Check for PLC hardware failure.		Instant	n/a	no	
Hatchery Input Module Fault	24Vdc input module has detected a fault.	Check for PLC hardware failure.		Instant	n/a	no	
MISCELLANEOUS CONTROLLER ALARMS							
CPU Not Running	PLC has stopped executing logic.	PLC is being tested, programmed, or has faulted.		Instant	n/a	no	
CPU in Program Mode	PLC has been placed in program mode.	Verify PLC not left unit in program mode.		Instant	n/a	no	
CPU in Debug Mode	PLC has been placed in debug mode.	Verify PLC not left unit in test mode.		Instant	n/a	no	
Not Used - RSVD for Future	n/a	n/a		n/a	n/a	n/a	
CPU Forces Present	PLC has forced I/O (overrides) present.	Verify programmer has not left I/O forces in memory.		Instant	n/a	no	
CPU Forces Enabled	PLC has forced I/O (overrides) enabled.	Verify programmer has not left I/O forces enabled.		Instant	n/a	no	
CPU Bad Flash	PLC memory is bad.	Verify memory is not corrupted.		Instant	n/a	no	
CPU Major Fault	PLC has faulted.	Go on-line with PLC to determine cause. Reset Fault on-line or by switching key to PGRM then RUN		Instant	n/a	no	
Not Used - RSVD for Future	n/a	n/a		n/a	n/a	n/a	
CPU Low Battery	PLC engergy storage device is low or missing	Check energy storage device such as battery.		Instant	n/a	no	
CPU Minor Fault	PLC has detected a minor fault.	Go on-line with PLC to determine cause and correct software.		Instant	n/a	no	
Disabled Sensor Alarm(s) Present	One or more Analog Sensor Alarms are disabled.	From Graphic Terminal go to alarm "STATUS" and "DISABLE SENSOR ALARMS" to change.		Instant	n/a	no	
Disabled Process Alarm(s) Present	One or more Process or Actuator Alarms are disabled.	From Graphic Terminal goto alarm "STATUS" and "DISABLE PROCESS ALARMS" to change.		Instant	n/a	no	

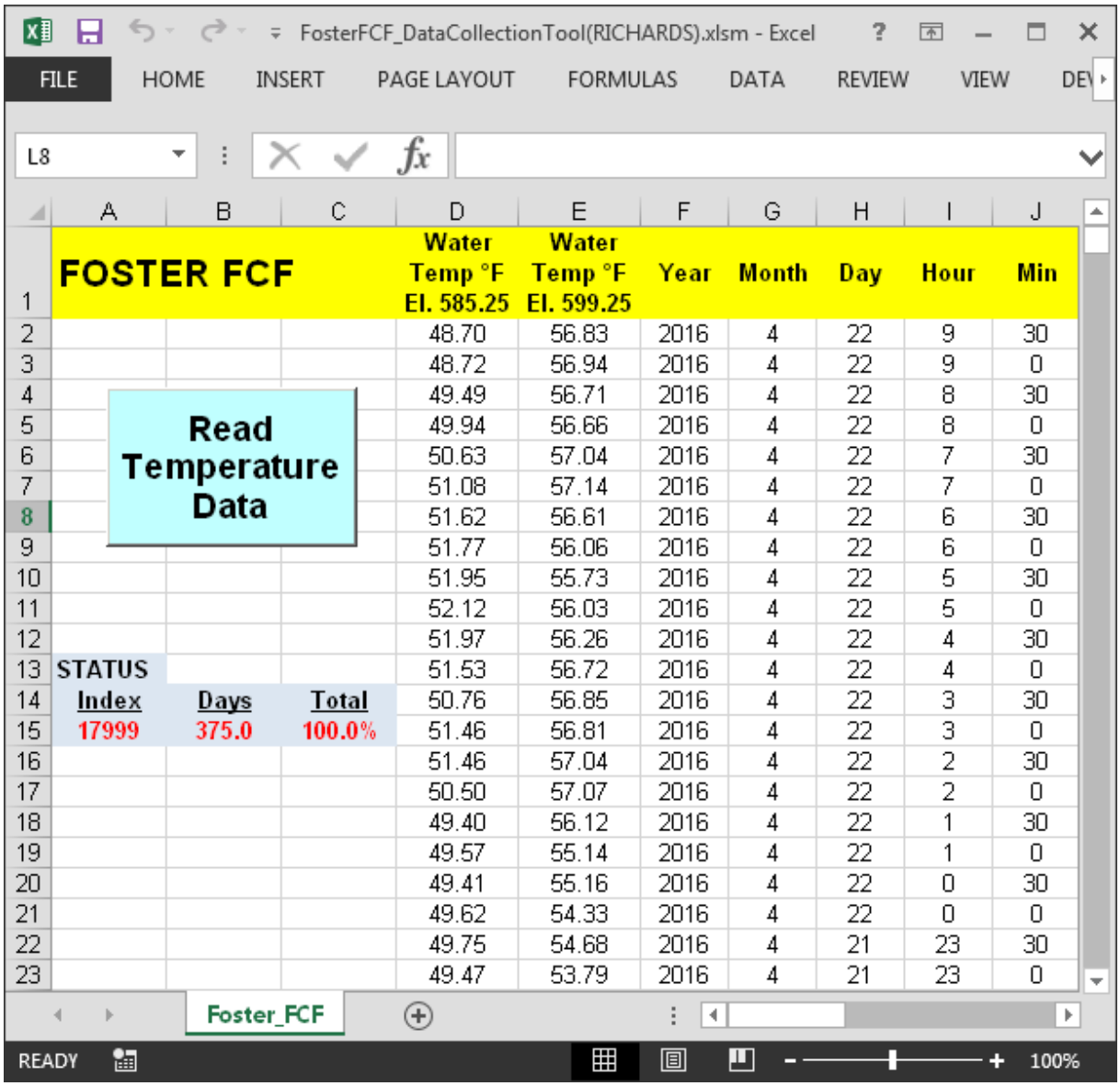
* Manual mode for individual pumps & actuators is set by selector switch at unit. Manual mode for PLC control is set via HMI. Analog sensors and other discrete divices do not have an automatic or manual mode.

** Additional delays exist for autodialer notification to ODFW.

Appendix D: Historical Temperature Data Collection

Description: The fish collection facility (FCF) controller located in the sorting facility electric room logs the forebay water temperature at El. 585.25 (lower intake) and El. 599.25 (upper intake) every thirty minutes. The historical data is stored for 375 days until overwritten by new data. Retrieval of the historical data is performed by the K-grade electrician utilizing RSLinx communications software and a customized Excel spreadsheet as shown in Figure 1. Temperature data should always be retrieved prior to controller software changes. Software should never be downloaded to the controller without first preserving the existing temperature data. Placing the controller in program mode on the hour or half hour should also be avoided. Additional data collection instructions are included on the customized Excel spreadsheet and will not be duplicated here.

Reference Drawings: Sheets EB402 & EI617 for temperature sensors TIT.001 and TIT.002



	A	B	C	D	E	F	G	H	I	J
1	FOSTER FCF			Water Temp °F El. 585.25	Water Temp °F El. 599.25	Year	Month	Day	Hour	Min
2				48.70	56.83	2016	4	22	9	30
3				48.72	56.94	2016	4	22	9	0
4				49.49	56.71	2016	4	22	8	30
5				49.94	56.66	2016	4	22	8	0
6				50.63	57.04	2016	4	22	7	30
7				51.08	57.14	2016	4	22	7	0
8				51.62	56.61	2016	4	22	6	30
9				51.77	56.06	2016	4	22	6	0
10				51.95	55.73	2016	4	22	5	30
11				52.12	56.03	2016	4	22	5	0
12				51.97	56.26	2016	4	22	4	30
13	STATUS			51.53	56.72	2016	4	22	4	0
14	Index	Days	Total	50.76	56.85	2016	4	22	3	30
15	17999	375.0	100.0%	51.46	56.81	2016	4	22	3	0
16				51.46	57.04	2016	4	22	2	30
17				50.50	57.07	2016	4	22	2	0
18				49.40	56.12	2016	4	22	1	30
19				49.57	55.14	2016	4	22	1	0
20				49.41	55.16	2016	4	22	0	30
21				49.62	54.33	2016	4	22	0	0
22				49.75	54.68	2016	4	21	23	30
23				49.47	53.79	2016	4	21	23	0

Appendix E

Appendix E: Stormwater Facilities O&M Manuals

Appendix F: Maintenance Check List and Job Plans

COUGAR DAM

ADULT FISH COLLECTION FACILITY

OPERATION AND MAINTENANCE MANUAL

U.S. Army Corps of Engineers, Portland District

100% Back-Checked Draft – September 28, 2011

ARMY CORPS OF ENGINEERS

Facility Operations and Maintenance Manual

Cougar Adult Fish Collection Facility

100 % Back-Checked Draft

9/28/2011

Operations Document

Facility Operations and Maintenance Manual

Cougar Adult Fish Collection Facility

TABLE OF CONTENTS

1. INTRODUCTION 1
1.1. Original Authorization 3
1.2. Post Authorization Changes 3
1.3. Purpose & Scope 3
1.4. Parts of Manual 3
1.5. Project Description 4
2. PROJECT FEATURES 5
2.1. Pump Stations 5
2.1.1. FWS Pump Station 5
2.1.1.1. FWS Pumps 5
2.1.1.2. FWS Piping 6
2.1.1.3. FWS Check Valves 6
2.1.2. AWS Pump Station 6
2.1.2.1. AWS Pumps 7
2.1.2.2. AWS Piping 7
2.1.2.3. AWS Flow Meter 8
2.1.2.4. AWS Check Valves 8
2.1.3. Pump Intake Structure 9
2.1.4. Pump Intake Screens 9
2.1.5. Air Burst Manifolds 10
2.1.6. Porosity Plates 10
2.1.7. Air Compressor 11
2.1.8. Dewatering Bulkheads 11
2.2. Fish Ladder Features 11
2.2.1. Ladder Entrance 12
2.2.1.1. Entrance Gate 13
2.2.1.2. Fish Screen Gate 14
2.2.2. Ladder Weirs and Orifices 15
2.2.3. Diffusers 15
2.2.3.1. Diffuser Valves 16
2.2.3.2. Diffusion Basins with Diffuser Screens and Porosity Plates 16
2.3. Pre-Sort Pool Features 18
2.3.1. Finger Weir 18
2.3.2. Crowder 19
2.3.3. False Weir 20
2.3.4. Closure Gate 21
2.3.5. False Weir Drains 21

2.3.6. Pre-Sort Pool Valves 22
2.3.6.1. FWS Diversion Valve Assembly 22
2.3.6.2. Pre-Sort Pool Drain Valve 22
2.3.7. Diffusers 23
2.3.8. Pre-Sort Pool Fence 23
2.4. Sorting and Holding Facility 24
2.4.1. Fish Transfer Flumes 24
2.4.2. Switch Gate 25
2.4.3. Post-Sort Pools 26
2.4.4. Truck Loading Area 27
2.4.5. Sorting Platform and Stairs 27
2.4.6. Anesthetic Tank 28
2.5. Mechanical Room 29
2.5.1. Air Receiver 29
2.5.2. Heater 29
2.6. Electrical Room 29
2.7. Storage Room 29
2.8. Fish Return to the River System 30
2.8.1. Recovery Tank 30
2.8.2. Recovery Tank Knife Gate Valve 30
2.8.3. Flume to River 30
2.9. Power 33
2.9.1. Primary Feeder Breakers 33
2.9.2. Pad Mounted Transformer 34
2.9.3. Emergency Generator and Automatic Transfer Switch (ATS) 35
2.10. Controls 36
2.10.1. Touch Screens 36
2.10.2. SCADA 36
2.10.3. Water Level Sensors 37
3. OPERATIONS AND MAINTENANCE 39
3.1. General Maintenance Policies 39
3.1.1. Contractor Supplied O&M Manual 39
3.1.2. Routine Maintenance Procedures 39
3.1.3. Pre-Start-up Procedures 39
3.2. Alarms and Alarm Response Procedure 40
3.2.1. General 40
3.2.2. Alarm Response Tables 40
3.3. Basic Maintenance Procedures 40
3.3.1. General 40
3.3.2. Protective Coatings 41
3.4. Preventative Maintenance Management 41
3.4.1. General 41
3.4.2. List of Contractor's O&M Manuals 41
3.4.3. Equipment Inspection and Maintenance 41

3.4.3.1. General Pump Maintenance 41
3.4.4. Valve and Gate List 42
3.4.5. Maintenance of Structural Features 42
3.4.5.1. General 42
3.4.5.2. Fish Ladder 42
3.4.5.3. Cover Structures 43
3.4.5.4. Pre-Sort and Post-Sort Structures 43
3.4.5.5. AWS and FWS Pump Stations 43
3.5. Operation Procedures 43
3.5.1. Facility Startup 43
3.5.1.1. Pre-Activation Checklist 43
3.5.1.2. Automatic Startup 48
3.5.1.3. Manual Startup 50
3.5.2. Normal Facility Operation 57
3.5.2.1. Normal Operating Criteria 58
3.5.2.2. Automatic Normal Operation 58
3.5.2.3. Manual Normal Operation 59
3.5.3. Fish Processing Operation Procedures 64
3.5.3.1. Finger weir 64
3.5.3.2. Crowder 64
3.5.3.3. False Weir 65
3.5.3.4. Switch Gate 68
3.5.3.5. Post-Sort Pool Fill Controls 69
3.5.3.6. Post-Sort Pool Drain Controls 70
3.5.3.7. Truck Fill Pipe Controls 71
3.5.3.8. Bellow Hoists 72
3.5.3.9. Post-Sort Knife Gate Controls 73
3.5.3.10. Fish Transfer Operation 74
3.5.3.11. Anesthetic Tank 75
3.5.3.12. Recovery Tank 75
3.5.4. Normal Facility Shutdown 75
3.5.4.1. AWS System Shutdown 76
3.5.4.2. Facility Shutdown 76
3.5.4.3. Dewatering Procedure 76
3.5.4.4. Winterization 77
3.5.5. Emergency Operations 78
3.5.5.1. Planned Power Outage 78
3.5.5.2. Un-planned Power Outage (Type II) 78
3.5.6. Power 79
3.5.6.1. Primary Feeder Breakers 79
3.5.6.2. Pad Mounted Transformer 81
3.5.6.3. Emergency Generator and Automatic Transfer Switch (ATS) 82
3.5.7. Controls 84
3.5.7.1. Variable Frequency Drive-AWS Pumps 84

3.5.7.2. Variable Frequency Drive-FWS Pumps 86
3.5.7.3. PLC Controlled Actuators for Entrance Gate and Valves 88
3.5.7.4. Stand Alone Electric Actuators for Valves 90
3.5.7.5. AWS Air Burst Cabinet 92
3.5.7.6. FWS Air Burst Cabinet 94
3.5.7.7. Touch Screens 96
3.5.7.8. SCADA 105
3.5.8. Aeration System 108
3.6. Troubleshooting 109
3.6.1. AWS Pumps 109
3.6.2. Emergency Generator Charts and Alarms 111
3.6.3. Facility SCADA Alarms 113
3.7. Intrusion Detection 113
3.7.1. Security Switches 113
4. APPENDICIES 115
4.1. APPENDIX A-PLATES 117
4.2. APPENDIX B-LOCATION INFORMATION FOR LEVEL TRANSMITTERS 203
4.3. APPENDIX C- HYDRAULIC DATA 207
4.4. APPENDIX D-SCADA ALARMS 211
4.5. APPENDIX E-OPERATOR WALKTHROUGH POWERPOINT 217
4.6. APPENDIX F-DEVICENET CONFIGURATION AND EQUIPEMENT PARAMETERS 241

LIST OF FIGURES

Figure 1 – Isometric Rendering of the Cougar AFCF (Excerpt from Cougar AFCF Plans Sheet G-004) ... 2
Figure 2 – AWS Discharge Rate as Function of Tailwater Elevation 51
Figure 3 – Diffuser Valve Settings as Function of Tailwater Elevation 52
Figure 4 – AWS Discharge Rate as Function of Tailwater Elevation 60
Figure 5 – Diffuser Valve Settings as Function of Tailwater Elevation 61
Figure 6 - Finger Weir Handle 64
Figure 7 – False Weir Cabinet 67
Figure 8 - Inside of Cabinet 68
Figure 9 – 8 inch Drain Location 68
Figure 10 – Recovery Tank 75
Figure 11 – Primary Feeder Breakers 80
Figure 12 – Pad Mounted Transformer 81
Figure 13 – Emergency Generator 82
Figure 14 –Controls for Drain Valves for Sorting Pools 92
Figure 15 – Main Touch Screen 97
Figure 16 – FWS Pumps Touch Screen 98
Figure 17 – AWS Pumps Touch Screen 99
Figure 18 –Water Lever Sensors Touch Screen 100
Figure 19 – Diffuser Valve Touch Screen (Automatic Mode) 101
Figure 20 – Diffuser Valve Touch Screen (Manual Mode) 101

Figure 21 – Diffuser Valve Touch Screen (Manual Mode Operation) 102
Figure 22 – Entrance Gate Touch Screen 103
Figure 23 – Alarm History Touch Screen 103
Figure 24 – Alarm Status Touch Screen 104
Figure 25 – Airburst Screen Cleaners Touch Screen 104
Figure 26- Power Meter Touch Screen for AWS and FWS Pumps 105
Figure 27 – FCS Alarm Status Screen 106
Figure 28 – FCF Overview Screen 107
Figure 29 - Power Meter Screen for XJ1F and XJF2 Feeders 108
Figure 30– Cougar Tailwater Elevation at AFCF Fish ladder Entrance Verses Powerhouse Discharge Rate (Minimum Discharge to 100 year Flood) 207
Figure 31 – Cougar Tailwater Elevation at AFCF Fish Ladder Entrance Verses Powerhouse Discharge Rate (Normal Operation Range) 208

LIST OF TABLES

Table 1 – List of Level Transmitters with Locations, Purposes and Elevations 37
Table 2 – Valve and Gate List with Locations 42
Table 3 - Combined Table for AWS Discharge, Number of Pumps Operating and Maximum Diffuser Valve Open Versus Tailwater Elevation 53
Table 4 – Expected Entrance Gate Opening (% of Maximum Open) for Start-up Tailwater Elevation 55
Table 5 – Manual Operation of Entrance Gate to Regulate Entrance Head (DH) 57
Table 6 – Combined Table for AWS Discharge, Number of Pump Operating and Maximum Diffuser Valve Open Versus Tailwater Elevation 62
Table 7 – Manual Operation of Entrance Gate to Regulate Entrance Head (DH) 63
Table 8 – Percent of Maximum RPM for AWS Pumps versus Tailwater Elevation 209
Table 9 - Percent of Maximum RPM for FWS Pumps versus Tailwater Elevation required to meet 1-foot Ladder Head at Pool 31 209

ABBREVIATIONS AND ACRONYMS

AFCF	Adult Fish Collection Facility
ATS	Automatic Transfer Switch
AWS	Auxiliary Water Supply (Pumped water for entrance attraction flow)
CFM	Cubic Feet per Minute
CFS	Cubic Feet per Second
DDR	Design Document Report
FCF	Fish Collection Facility
FWS	Facility Water Supply (Pumped water for fish ladder, pre-sort pool, post-sort pools, false weir and other sorting uses)
IOP	Interim Operation Plan (Operation plan to facilitate the operation of AFCF during the 2010 season)
O&M	Operation and Maintenance
PAC	Post Authorization Change
PLC	Programmable Logic Control
PSI	Pounds per Square Inch
SCADA	Supervisory Control and Data Acquisition
VFD	Variable Frequency Drive
WTC	Water Temperature Control (Tower)

1. INTRODUCTION

In 2005, a new Water Temperature Control Tower (WTC) was commissioned at the Cougar Dam Project. The new temperature control system has delivered significant improvements to the downstream salmon habitat by removing a former thermal obstruction (caused by previous dam releases without temperature control) and by providing outflow water temperatures that more closely resemble the natural cycle before the dam was built. After the WTC project began operating, Spring Willamette Chinook began to return to the base of the powerhouse. A permanent adult salmon fish collection facility (AFCF) was authorized as the next step in a comprehensive program to improve the native salmon condition in the McKenzie River Basin.

The AFCF was designed to collect upstream migrating fish (salmon, bull trout and other resident fish) from the Cougar Dam tailrace and sort the fish (e.g. separate native and hatchery fish) so that selected fish may be transported above the Cougar Project. This project effectively expands spawning and rearing habitat, and will help restore biological connectivity between upstream and downstream habitats. The new AFCF was built during 2008-2010, and commissioned in July 2010. After a seven-day Endurance test and installation of a new programmable logic control (PLC), the AFCF was operated for fish collection and sorting purposes until Oct 15, 2010.

The Willamette Project is responsible for the operation and maintenance of this new system. Given the electrical, mechanical and structural complexity of the AFCF, the preparation of an Operation and Maintenance Manual (O&M) was mandated by the Portland District. This O&M manual will work in conjunction with the Contractor's Operation and Maintenance Manual—twelve volumes that will contain detailed product and maintenance information on the separate components of the system. The following O&M manual is intended to provide the overall framework and guidance on how to operate, maintain and trouble shoot the AFCF as a system.

Figure 1 – Isometric Rendering of the Cougar AFCF (Excerpt from Cougar AFCF Plans Sheet G-004)

1.1. ORIGINAL AUTHORIZATION

The initiation of activity that led to the ultimate construction of the Cougar Adult Fish Collection Facility (AFCF) was launched from two Congressional resolutions which provide authority to the Corps of Engineers to conduct temperature control studies at the Blue River and Cougar lakes projects. In 1995, the Corps produced the Willamette River Temperature Control Final Feasibility Report and Environmental Impact Statement. This study evaluated the potential for modifying the Cougar and Blue River projects for water temperature control, investigating alternatives that would modify the temperature of downstream releases to replicate pre-project water temperatures to benefit anadromous and native fish species. These alternatives included operational changes, a curtain barrier, mixing devices, and a selective withdrawal system.

1.2. POST AUTHORIZATION CHANGES

As part of these two Congressional resolutions, a Post Authorization Change (PAC) Report was generated, which recommended the construction of a permanent Adult Fish Collection Facility (AFCF), to be located at Cougar Dam. The report recommends a specific plan for construction of the facility and provides justification for implementing this plan as part of the Willamette River Temperature Control Project. The specific recommendations were to (1) construct a permanent fish collection and transportation facility composed of electric pumps and a pool-and-weir fishway, (2) extend monitoring of Chinook salmon and bull trout, and (3) defer construction of Blue River.

1.3. PURPOSE & SCOPE

The Willamette Project will be responsible for the operation and maintenance of the new Cougar AFCF system. The new facility is a complex system with many interacting mechanical, electrical, and structural components. In addition, the hydraulic performance must be carefully controlled so that the system operation routinely meets NOAA Fisheries criteria and provides effective fish passage.
The Operation and Maintenance (O&M) Manual will be developed to provide the necessary guidance in the general system operation and to describe the specific operation and maintenance of each pertinent component in the system. Inspection cycles and maintenance procedures need to be identified, described and scheduled for all of the pertinent features and components of the new system. This O&M manual needs to provide easy reference to specific and relevant locations in the Contractors O&M manual, which contain detailed product O&M information for each item that was furnished. The O&M Manual should be detailed, comprehensive in scope and prepared in a manner that is accessible to the personnel that will be operating and maintaining this system in current and future decades.

1.4. PARTS OF MANUAL

There are three general parts:

1. Introduction, purpose and scope
2. Description of project features with photos
3. Operation and Maintenance of the system- This describes the general system operation (automatic or manual), general maintenance, and specific maintenance for the components.

Appendices include (A) Plates, (B) Location Information for Level Transmitters, (C) Hydraulic Data, (D) SCADA Alarms, (E) Operator Walkthrough PowerPoint, (F) DeviceNet Configuration and Equipment Parameters.

1.5. PROJECT DESCRIPTION

The Cougar Project is located 42 air miles east of Eugene, Oregon on the South Fork of the McKenzie River. The South Fork of the McKenzie River is 61 river miles upstream from the mouth of the McKenzie River, which is a tributary to the Willamette River.

On the downstream side of the Cougar dam, there are two separate primary outflow channels that merge together about 1000 feet downstream of the dam. The powerhouse (2 units, 1350 cfs combined maximum discharge, 25,000 Kilowatts Rated Power) releases into the north channel. The Reservoir Outlet (13-foot Tunnel, 12,050 cfs) discharges into a plunge pool in the south channel.
The Cougar AFCF is located on the north bank of the powerhouse (north) outlet channel. The less frequently used diversion tunnel (re-commissioned for the construction of the Water Temperature Tower) also discharges into the Powerhouse channel, south of the powerhouse.
The Cougar AFCF includes the following general features:

1. Two pump stations each equipped with VFDs and airburst screen cleaners:
    a. Facility Water Supply (FWS) supplies water to the Presort and upper fish ladder, holding, sorting, and transporting facility (3 pumps);
    b. Auxiliary Water Supply (AWS) delivers attraction water to the fish ladder entrance (3 pumps);
2. Sorting Facility including:
    a. Pre-sort pool with Crowder, finger weir and false weir;
    b. 3 post-sort pools, and a loading hopper to load trucks for fish transport;
    c. Anesthetizing tank; and
    d. Recovery tank and return to river flume.
3. Fish Ladder System with:
    a. Pools separated by weirs and orifices;
    b. Diffusers in lower pools supplied by the AWS pumps; and
    c. Fish Ladder Entrance with entrance gate and fish exclusion screen
4. Transport Truck Access Roadway and a new Access Road to the Powerhouse.
5. Station Service Upgrades at the Powerhouse to support increased power requirements of the fish collection facility.
6. Emergency backup power generator
7. Fish Transport Truck

2. PROJECT FEATURES

A specific description of each pertinent project feature is provided in this section.

2.1. PUMP STATIONS

There are two pump stations that supply the Cougar AFCF:

- Facility Water Supply (FWS)
- Auxiliary Water Supply (AWS)

These pump stations are described in detail in the following sections.

2.1.1. FWS Pump Station

Update picture after follow on to show hoods on the combination valves

The FWS pump station is located downstream of the fish ladder and is constructed of reinforced concrete. The FWS supplies water to the sorting facility and the upper end of the fish ladder. The FWS pumps are the most critical to the operation of the facility. Without the operation of two FWS pumps, fish will not be able to ascend the ladder, enter the pre-sort pool, pass over the false weir, and enter the rest of the sorting facility.

2.1.1.1. FWS Pumps

There are three, variable frequency drive (VFD) controlled, pumps at the FWS pump station, two of which are normally running. The three pumps are KSB's Amacan S 650-404/656UAG2. Each pump is rated for a maximum 72.6 Hp and a maximum output of 5162 GPM. The FWS pumps supply river water to the sorting facility post-sort and pre-sort pools. The pre-sort pool supply flows into the ladder and is

the only water supply to keep the ladder watered up. In the event of a power outage the generator only powers one FWS pump.

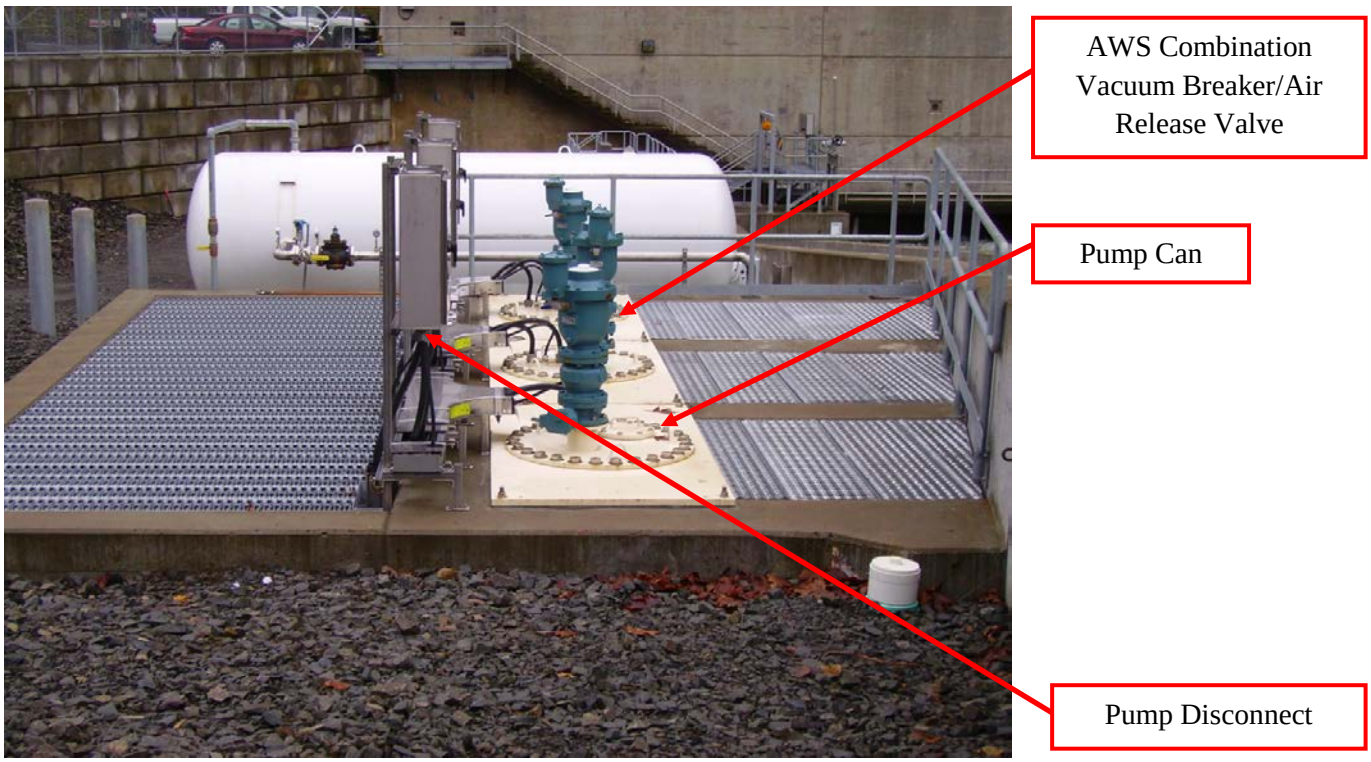
2.1.1.2. FWS Piping

The FWS pipe is painted carbon steel (inside and outside), with a diameter of 24" and a wall thickness of 0.375". Internal system pressure can be observed by gauge readings near the check valves at the pump cans. The piping must be drained during the winter because the water in the pipe will not flow back into the river. A ball valve is located at the bottom of the pipe manifold near the pump cans for draining. The piping routes water to the pre-sort pool, post-sort pools, and false weir. This water is the primary source of flow for ladder operation.

2.1.1.3. FWS Check Valves

The FWS pump check valves are located approximately four feet downstream of the pump cans. Each check valve is a 24" diameter APCO 9000 with a cast iron body, ductile iron doors with nickel facing, stainless steel spring, Buna-N seat material and stainless steel hinge pin. Each check valve weighs approximately 700 pounds. The check valves are needed to prevent backflow through any pump that is not operating or has failed.

2.1.2. AWS Pump Station



Update picture after hoods have been put on the valves

The AWS pump station is located near the midpoint of the fish ladder and is constructed of reinforced concrete. Water from the AWS pumps provides attraction flow at the ladder entrance under varying powerhouse operations. The AWS pump operation has been configured to discharge 39 – 80 cfs with two

operating pumps and 27 - 38 cfs with one pump. AWS pump operation is 50 – 80 cfs for normal tailwater levels (at least one powerhouse unit operating at minimum 300 cfs).

2.1.2.1. AWS Pumps

There are three submerged, variable frequency drive (VFD) controlled, pumps at the AWS pump station, two of which are normally running, except at very low tailwater levels. The three pumps are KSB's Amacan PA-540/1008UTG1. Each unit is rated for a maximum 127 Hp and a maximum output near 40 cfs. The AWS pumps supply river water to the first 4 ladder pools through a series of butterfly valves. The AWS water supply provides additional flow to attract fish; that flow is determined by tailrace conditions.

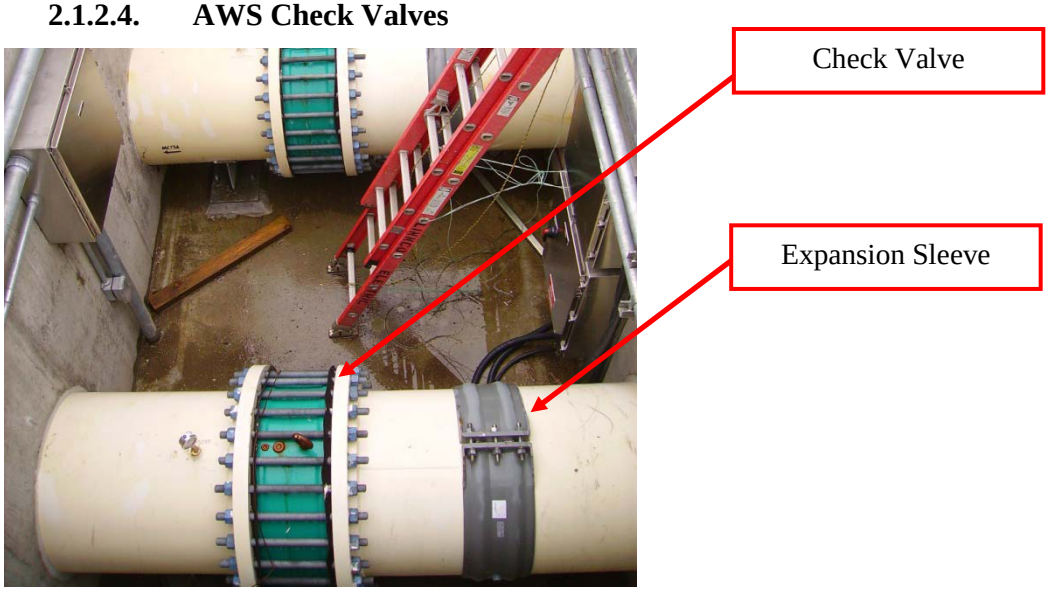
2.1.2.2. AWS Piping

The AWS piping consists of a variety of different diameter pipes. The main conveyance line is a 4-foot diameter pipeline. Refer to as-built drawings for specific sizes and lengths. The piping is unique as it operates with a vacuum when the combination air release/air vacuum breaker valves are open. During pumping operations the pipe must be filled with water to avoid excess cavitations at the pumps. The pumping system will self-sweep excess air from the system once the combination valves are closed and the pumps are running. If excess noise is heard at the pumps refer to air removal operation in Section 3.6. The piping provides flow from the AWS pumps to ladder pools 1-4; the flow can be regulated by pump speed and five diversion valves.

2.1.2.3. AWS Flow Meter

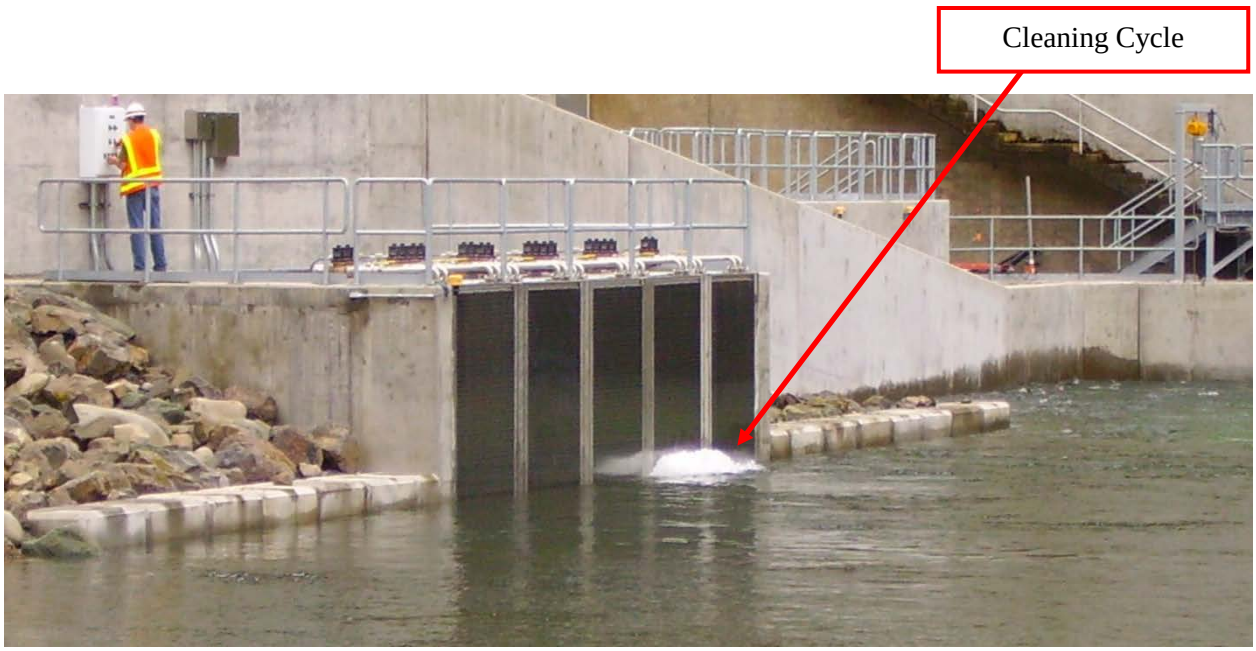
The Accusonic Model 798 is a clamp-on permanent ultrasonic flow meter that measures flow through the main AWS pipeline near the AWS compressed air receiver. This measured flow is sent as feedback to the PLC which then adjusted the flow based on ladder criteria. WARNING: This flow meter will only measure flow in a full pipe; air entrainment will provide false readings to the PLC and the system will not adjust AWS flow correctly.

2.1.2.4. AWS Check Valves



The AWS pump check valves are located in the pit behind the AWS pumps. Each check valve is a 30” diameter APCO 9000 with a cast iron body, ductile iron doors with nickel facing, stainless steel spring, Buna-N seat material and stainless steel hinge pin. Each check valve weighs approximately 1100 pounds. The check valves are needed to prevent backflow through any pump that is not operating or has failed.

2.1.3. Pump Intake Structure



AWS Pump Intake Structure

The purpose of the intake screens is to prevent the entrainment of juvenile salmonid fish and other small resident fish into the sump, pumps and discharge pipe system. The intake screens also prevent debris from entering the intake structure that may damage the pumps or other equipment in the system. Both the AWS and FWS pump intake structures are fabricated from 304L stainless steel vertical profile bars. The gaps between the bars are 1.75 mm, sized for juvenile fish per NOAA Fisheries Criteria. Each screen is 6 ft wide, framed with hollow structural sections, and with structural supports between sections. The FWS has two (2) 11-foot tall intake screens. The AWS has five (5) 16.5-foot tall intake screens. For the FWS, normal screen water velocity is limited to 0.4 fps. For the AWS, normal screen water velocity is limited to 0.2 fps.

2.1.4. Pump Intake Screens

The pump intake screens need to remain free from debris to minimize the pressure differential across the screens (and reduce likelihood of velocity hot spots); this maximizes the suction head for the pumps, keeping pump operation as efficient as possible. The cleaning is done by pressurized air released from a series of nozzles. The air jets release debris from the screens and the river flow provides a sweeping velocity to move the debris downstream. The FWS airburst system will clean the screens at least six times a day and anytime the water elevation differential exceeds 0.6 feet between the tailwater and the pump sump behind the screen. The AWS airburst system will clean its screens twice a day and anytime the water elevation differential across the screen reaches 0.6 feet.

2.1.5. Air Burst Manifolds

Airburst Solenoids Manifold and Nozzles

Label solenoids and sensor

Each airburst manifolds consist of a series of nozzles and compressed air pipe that sit behind the pump intake screens. Each manifold is pressurized by the actuation of an electric air solenoid valve. The AWS pumps have five pump intake screens and the FWS pumps have two screens. The screens have four separate zones that activate based on water elevation on the screen. A cleaning airburst will only happen for zones that have at least two-thirds water coverage. Each system has a receiver acting as a reservoir if the supply air is interrupted. The AWS receiver has a 3000 gal capacity and the FWS receiver has a 1000 gal capacity; each is sized to allow one cleaning cycle if there is a problem with the air supply from the powerhouse.

2.1.6. Porosity Plates

The porosity plates for both the AWS and FWS are fabricated from 304L stainless steel. The purpose of the porosity plates is to make the flow pass through the screens more uniformly and prevent the occurrence of velocity hot-spots on the fish screen that could endanger juvenile fish. This is accomplished by having the porosity plate create much more hydraulic resistance than the fish screens. The AWS and FWS perforated plates have 12.8% open area through the plate. Each frame is 6 ft wide, framed with hollow structural sections, and with structural supports between sections. The FWS porosity plates are 11 ft tall. The AWS porosity plates are 16.5 ft tall. The FWS has 2 porosity plates. The AWS has 5 porosity plates.

2.1.7. Air Compressor

Will Change for follow on contract

Compressed air for the screen cleaning system is supplied by an air compressor located in the powerhouse. The AFCF currently shares its air supply with the powerhouse. The air compressor can supply 137 CFM@125 PSI. Currently the powerhouse air supply cannot be separated from the facility air supply. This will create a problem if an air burst solenoid is stuck open. SCADA alarms are in place that will warn of low pressure at the powerhouse receivers.

2.1.8. Dewatering Bulkheads

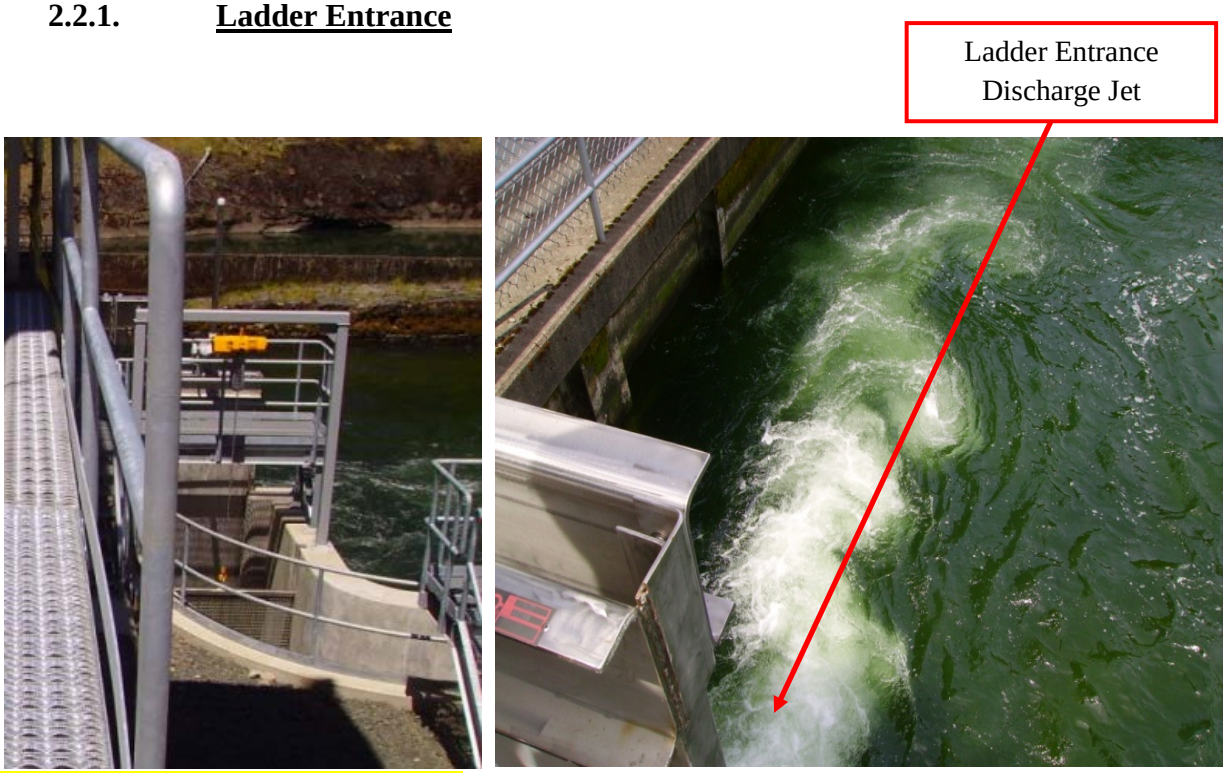
There are 5 bulkheads that can be used to dewater the FWS and the AWS. The bulkheads are 6.6 ft wide and 15.5 ft tall. The bulkheads are fabricated from 0.5 in plate and WT 4x14, painted carbon steel, sections. The bulkheads will be stored in the horizontal position on cribbing.

2.2. FISH LADDER FEATURES

The fish ladder guides fish from the powerhouse tailrace to the AFCF presort pool. This fish ladder consists of 31 pools separated by 31 ladder weirs. The ladder is approximately 311 feet long and the invert is sloped at 1 on 9 feet, rising 30 feet from Pool 1 to the Presort Pool. Discharge down the ladder starts at the top from the Presort Pool and steps down from Pool 31 to Pool 1 and releases out the entrance to the tailrace. The FWS pumps supply the Presort pool and upper ladder flow (about 18 cfs). There are

four diffusers in the lower four pools that provide AWS attraction flow for the entrance discharge. The AWS pumps provide 50-80 cfs to the diffuser system.

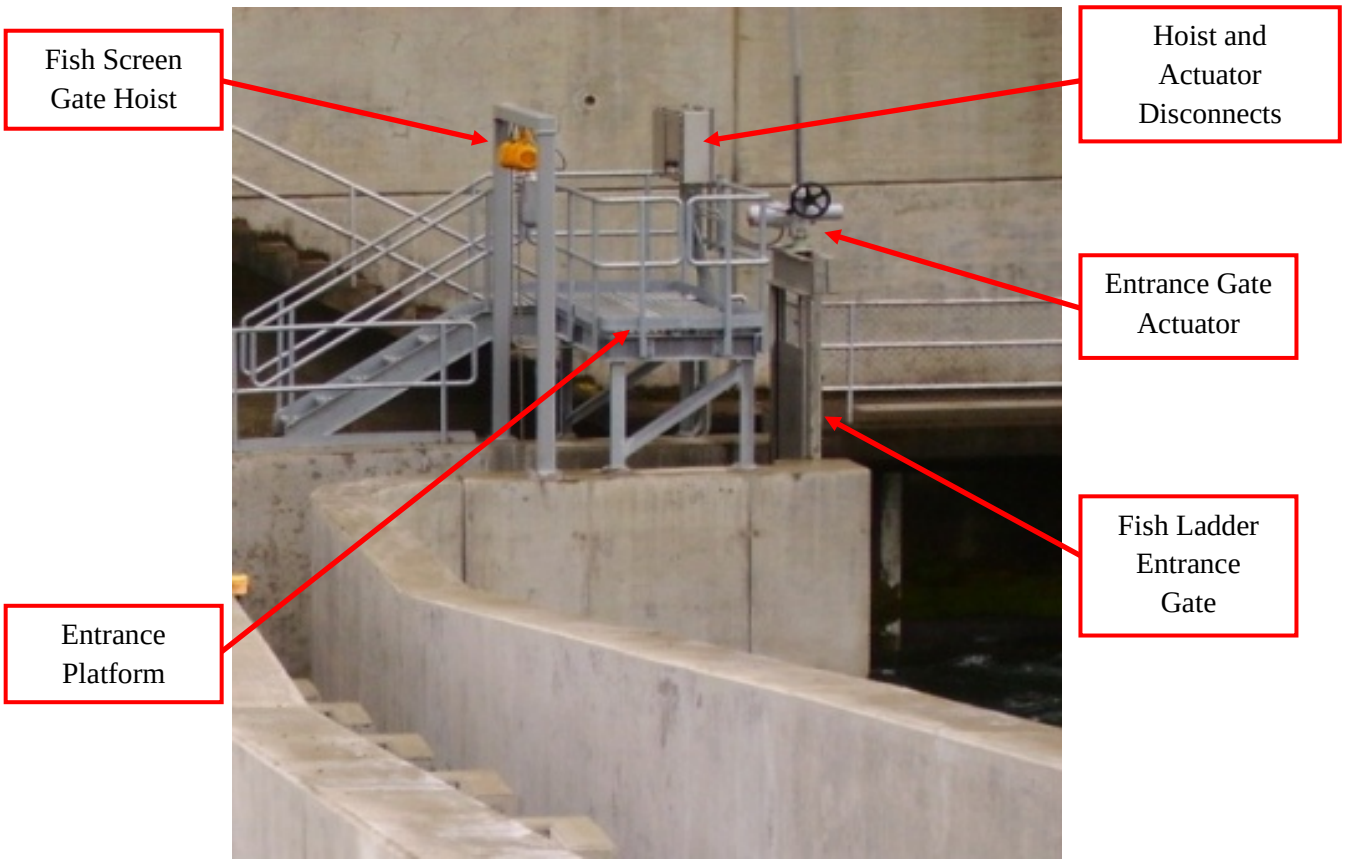
2.2.1. Ladder Entrance



Insert a new picture from a better angle

The fish ladder has one entrance located adjacent to the northeast corner of the Powerhouse. The ladder entrance has a concrete ramp leading up to the entrance to assist lamprey in entering the ladder. There is a four-foot wide entrance gate located at the entrance to the fish ladder. A fish screen gate is located behind (or upstream of) the entrance gate. Both gates close from the top downward. A work platform is located over the fish ladder entrance. The platform allows worker access to the fish ladder entrance gate and the fish screen gate.

2.2.1.1. Entrance Gate

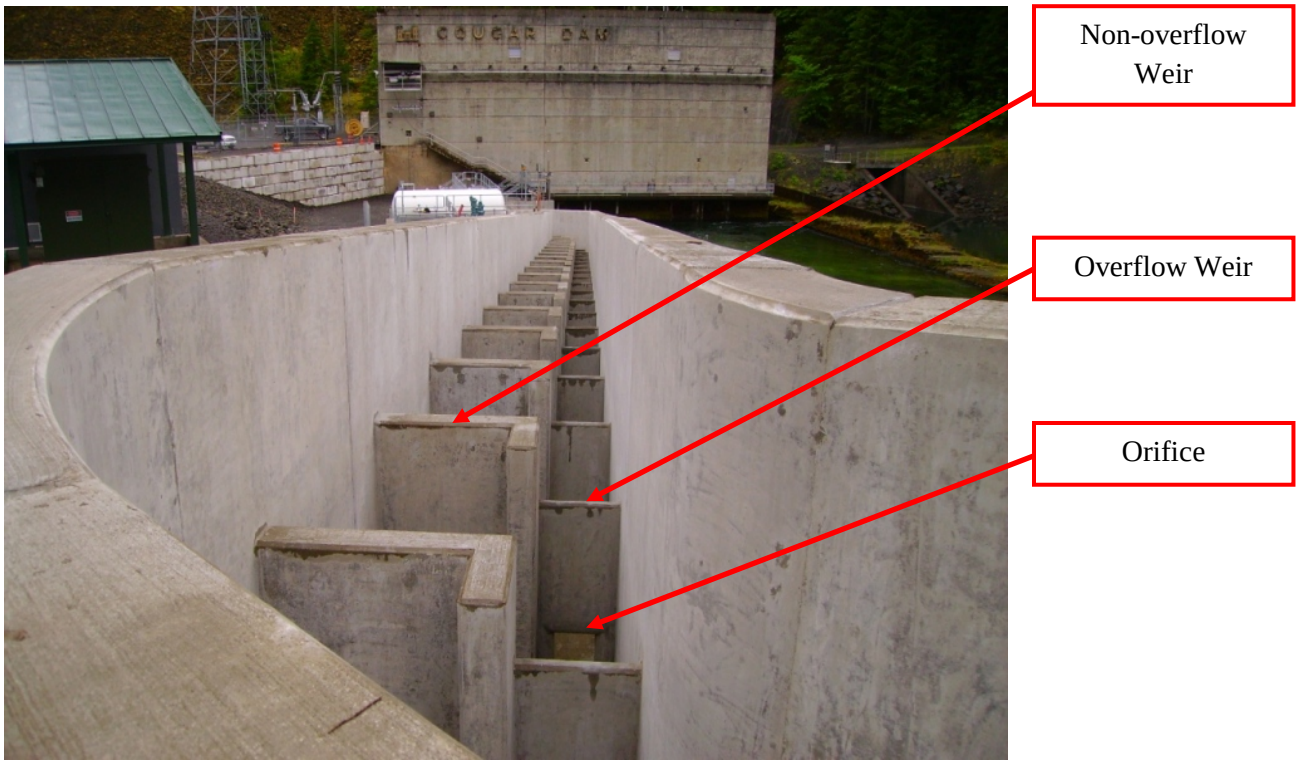


An entrance gate is located at the entrance to the fish ladder. The Entrance gate is a slide plate that is moved by jack screw and actuator. The gate's primary function is to keep the ladder water elevation approximately 1.5 feet higher than the tail water elevation while maintaining a pool 1 water level of approximately 5 feet. The opening varies from nine to sixty inches (5 feet) and its position is normally regulated by the PLC; the gate is programmed to respond to changing output flow and tailrace elevation to keep the ladder entrance water level within criteria.

2.2.1.2. Fish Screen Gate

The fish screen gate is used to keep fish from entering the fish ladder during start up and shut down operations. The 6.5 ft wide by 9.5 ft tall gate is fabricated from 304L stainless steel grating, framed by a hollow structural section. The gate is raised and lowered by a manual hoist mounted to a lifting frame.

2.2.2. Ladder Weirs and Orifices



The fish ladder channel is 6 feet wide. There are 31 pools separated by ladder weirs. Each ladder weir has a 4-foot long non-overflow weir and a 2-foot long overflow weir located between the fishway pools. A 12 inch wide by 15 inch tall orifice is located on the floor under the 2-foot overflow section. The weir and orifice are constructed of reinforced concrete. The orifice opening is rounded to assist lamprey passage. The crest of the overflow weir is 5 feet above the invert and the non-overflow crest is 2 feet above the overflow crest. The weirs are spaced at 9-foot centers from pool to pool and the ladder invert is sloped at 1 vertical to 9 horizontal. The elevation difference between the crest of the weirs up the ladder is 1 foot. The FWS pumps must discharge a combined discharge of 18 cfs to maintain one foot ladder head (design criteria).

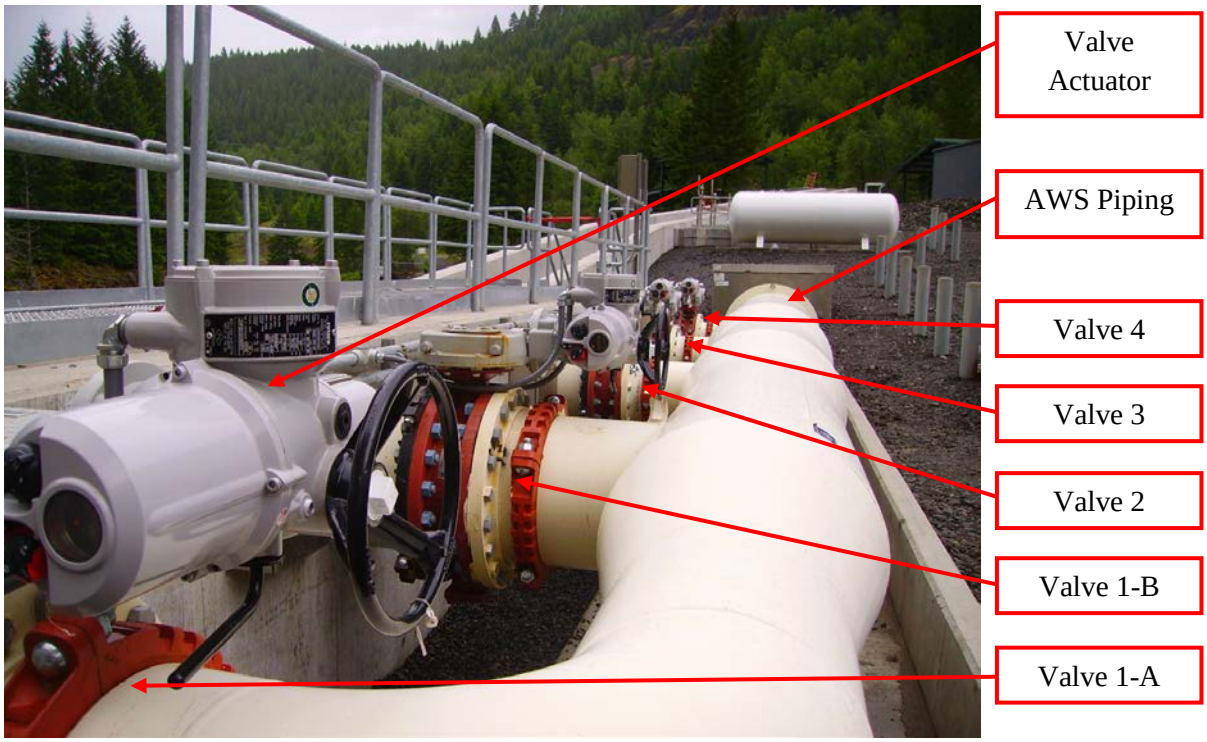
2.2.3. Diffusers

There are five diffusers through which the AWS flow is discharged in the lower four ladder pools. Each diffuser includes an on/off diffuser valve, diffusion basin, porosity plate and diffuser screen.

- Diffuser Valves 1-A and 1-B discharge to two diffuser screens in Pool 1, and share a common diffusion basin
- Diffuser valves 2, 3 and 4 each discharge to single diffuser screens in Pool 2, 3 and 4, respectively.

FIND PICTURES FOR THIS

2.2.3.1. Diffuser Valves



The diffuser valves are butterfly valves used to control water height in ladder pools one through four. Pool 1 is regulated by two 20-inch diameter valves (1-A and 1-B); each providing approximately 50 CFS of water to the pool. Pools 2, 3, and 4 each have a valve (2, 3, and 4, respectively) that is 16 inch diameter and provides approximately 10 CFS of flow to each pool. Tailrace water elevation determines which valves should be open. As the tailrace water elevation increases, the ladder flow must also increase to provide necessary head differential at the ladder entrance. This operation must concurrently adjust to keep Pool 1 water depth near 5 ft. Valves will open in succession based on the flow generated by the AWS pumps. The diffuser valves are not throttled; they are either fully open or fully closed.

2.2.3.2. Diffusion Basins with Diffuser Screens and Porosity Plates

The four AWS diffusion basins receive discharge from the AWS diffuser pipes and release the flow by means of wall diffuser screens to adjacent fish ladder Pools 1 – 4. These basins dissipate the concentrated flow energy that comes in from the downward directed AWS pipes so that the flow may enter the fish ladder channels laterally in more diffused and uniformly low velocities. There is a separate diffusion chambers for each pool (1-4). All basins are 6 feet wide. Basins 2 - 4 are 7.5 feet long and Basin 1 is 16 feet 4 inches. The inverts vary in elevation, with Basin 1 being the lowest. The floors are sloped 0.5% to drain southward towards the diffuser screens and ladder channel. The AWS pipes enter the basins through the north wall and the porosity plates are attached to the inside of the south walls of the basins. The diffuser screens are on the outside of the south walls of the basin, or inside of the walls in the adjacent fish ladder pools.

The auxiliary water diffuser screens are located flush along the ladder wall. The screens are intended to prevent fish from entering the auxiliary water supply diffusion basins and to provide a uniform discharge

of auxiliary water into the ladder system. The screens are fabricated from 304L stainless steel grating and consist of 3/16 inch thick bars with 15/16 inch gaps. There are 5 diffuser screens. The diffuser screens are 6 ft wide by 5 ft tall. Each diffuser screen has a porosity plate behind it.

The porosity plate provides a uniform discharge through the diffuser screens by creating most of the hydraulic resistance and head drop between diffusion basin and adjacent fish ladder pool. The porosity plates are constructed of 304L stainless steel plate. The porosity plates have equivalent height and width as the diffuser screens. The porosity plates are 5/8-inches thick with ¾ inch diameter holes at 1.5 inch staggered centers (22.7% porosity).

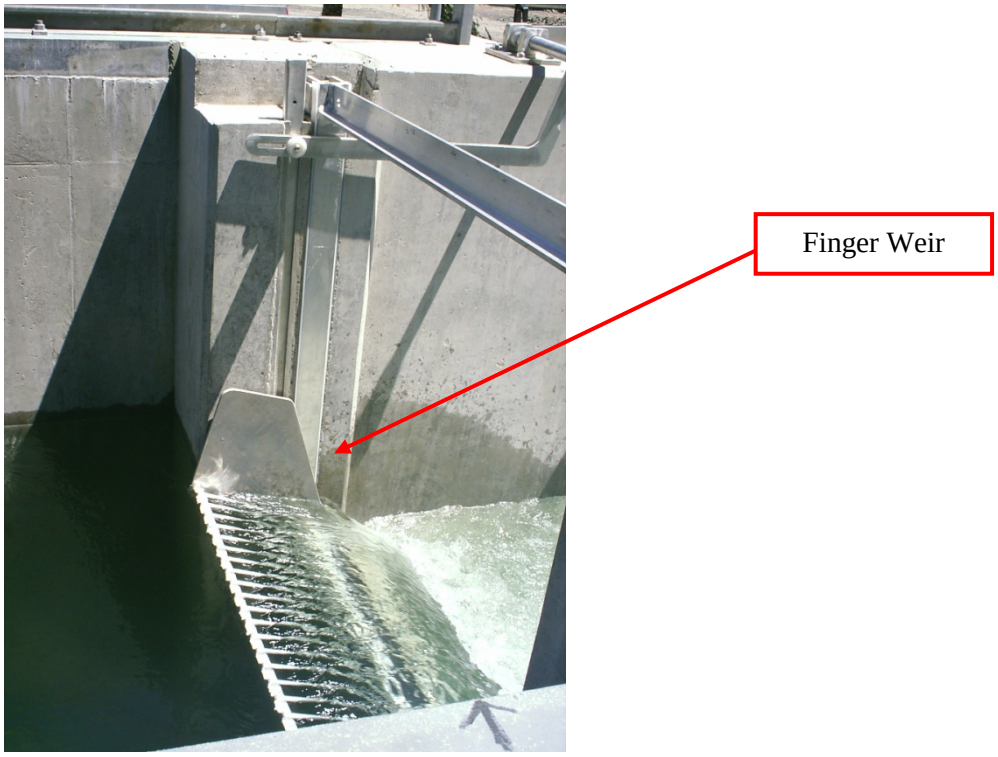
2.3. PRE-SORT POOL FEATURES

REPLACE PHOTO PER FOLLOW-ON to include end of fish ladder false weir and closure gate…

Fish jump from the fish ladder, over a finger weir, into the pre-sort pool. The 44 ft long, 11 ft wide, 13 ft tall pre-sort pool is constructed of reinforced concrete. There is one contraction joint located at the center of the pre-sort pool. Water is supplied to the pre-sort pool through two floor diffusers. During normal operation, the water is about 6 feet deep. If water supply is disrupted, the pre-sort pool will maintain 5 feet of depth.

2.3.1. Finger Weir

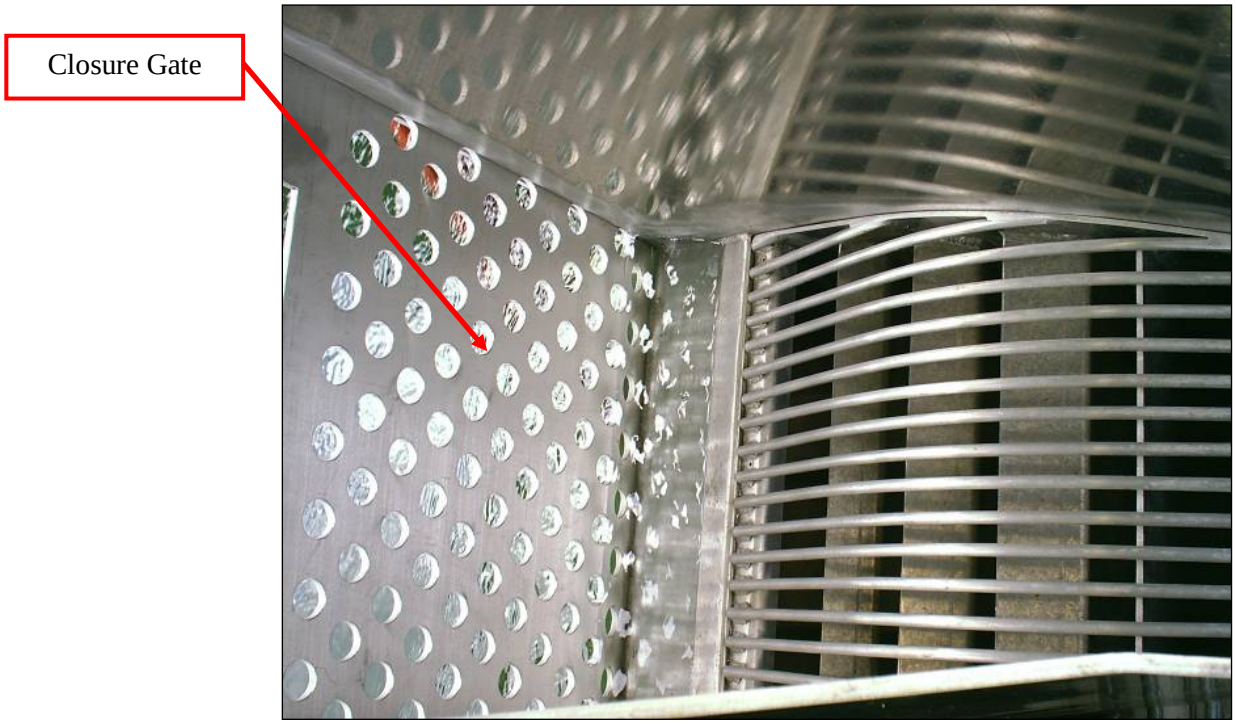
A finger weir is provided at the fish ladder to pre-sort pool transition. The finger weir prevents fish from dropping out of the pre-sort pool back into the ladder. The finger weir can be adjusted to match any changes to the pre-sort pool level; typically the pre-sort pool water elevation does not change and the finger weir will not need adjustment once the pre-sort pool water level has been set. Currently the finger weir is moved by a pole and locked in place by pinning the adjustment handle.



2.3.2. Crowder

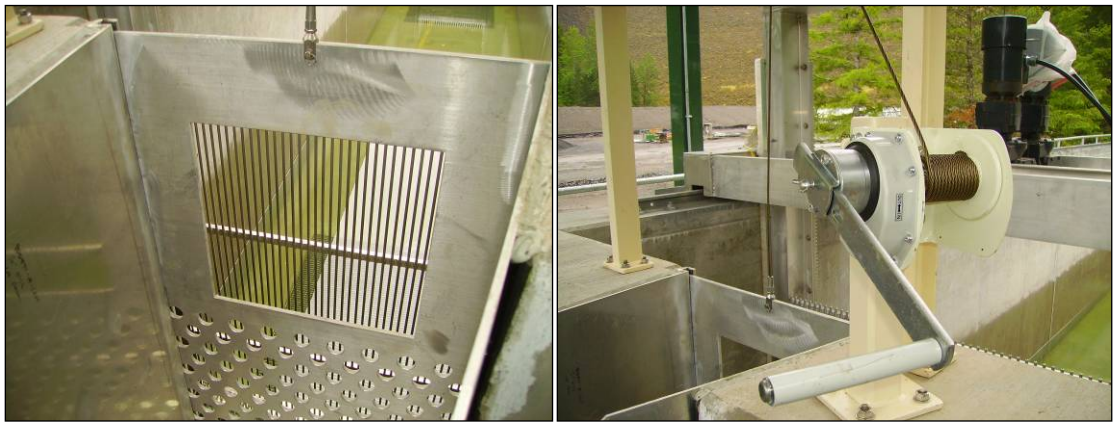
The Crowder is located in the presort pool. If the fish do not respond to the false weir and jump into the flume on their own, the Crowder is used to move them towards the false weir. The Crowder is operated from the control box located on the northwest side of the pre-sort pool. During operation the Crowder moves along the length of the presort pool forcing the fish to be concentrated next to the false weir. The Crowder lower edge can then be moved vertically to push fish into the entrance area of the false weir as necessary to get the fish moving thru the false weir.

2.3.3. False Weir



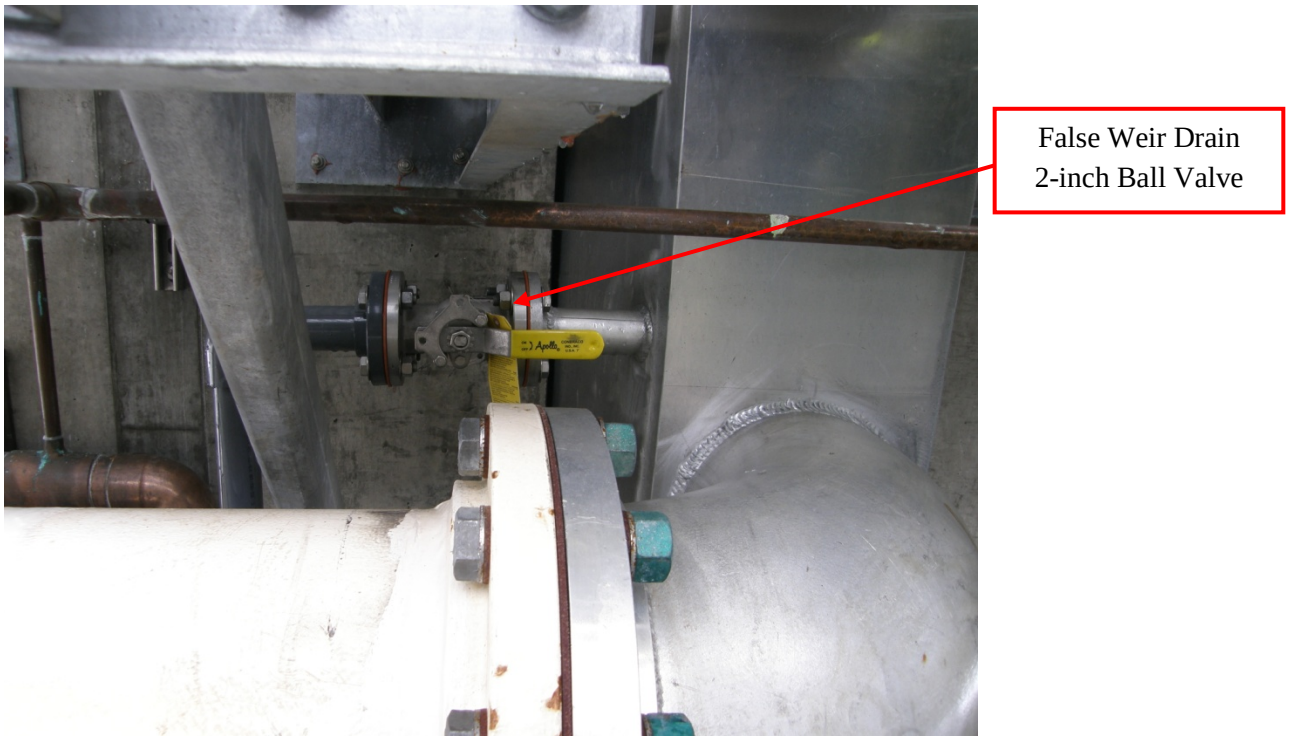
The false weir provides a falling water stream that enters the presort-pool. The water plunges into the presort pool stimulating the fish to jump. Under normal conditions the fish will jump over the false weir without the need to crowd the fish. The false weir's water stream can be changed in two ways; the water supply can be diverted from the floor diffusers in the pre-sort pool or the total volume of water in the pipe can be changed prior to the diversion valve. These modifications can be done independently or simultaneously, typically the operators will adjust these until the fish are jumping into the flume and no further changes are necessary.

2.3.4. Closure Gate



The closure gate is an aluminum slide gate that is perforated to allow water to partially pass through. In the event that fish cannot be processed down the flume the gate can be lowered to keep the fish from jumping into the false weir water stream. The diversion valve actuation is very slow; the closure gate provides a temporary flow disturbance that keeps the fish from entering the flume.
ADD OVERALL PICTURE

2.3.5. False Weir Drains



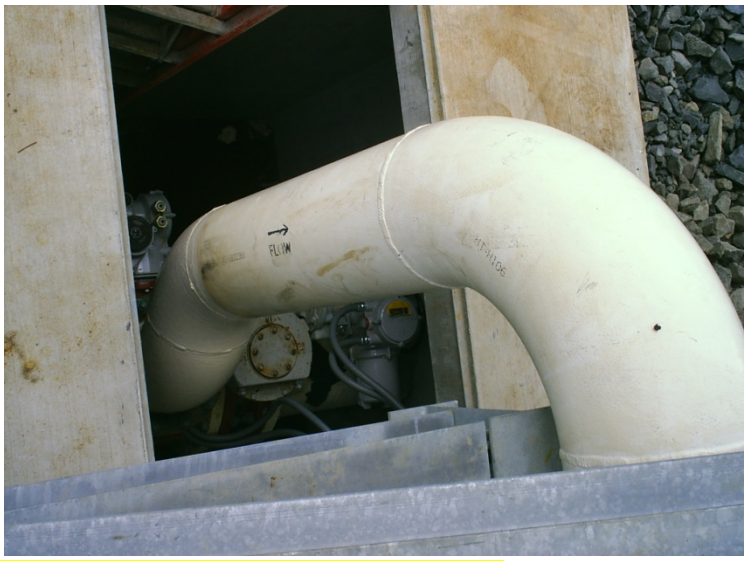
The False weir has two false weir drains. One drain is a 2-inch ball valve located on the side of the weir housing, and is used to fine tune the amount of water entering the flume at the backside of the false weir.

A larger drain is located at the back of the housing, beneath the flume. This drain is throttled with an 8 inch diameter butterfly valve that is located on the west side of the false weir below the work platform.

2.3.6. Pre-Sort Pool Valves

The pre-sort pool has two valves used during operations: the FWS diversion valve and the pre-sort pool drain valve.
CAUTION: The pre-sort pool fills as a result of activating the FWS pumps to fill the ladder; ensure the pre-sort drain is closed prior to filling the ladder.

2.3.6.1. FWS Diversion Valve Assembly

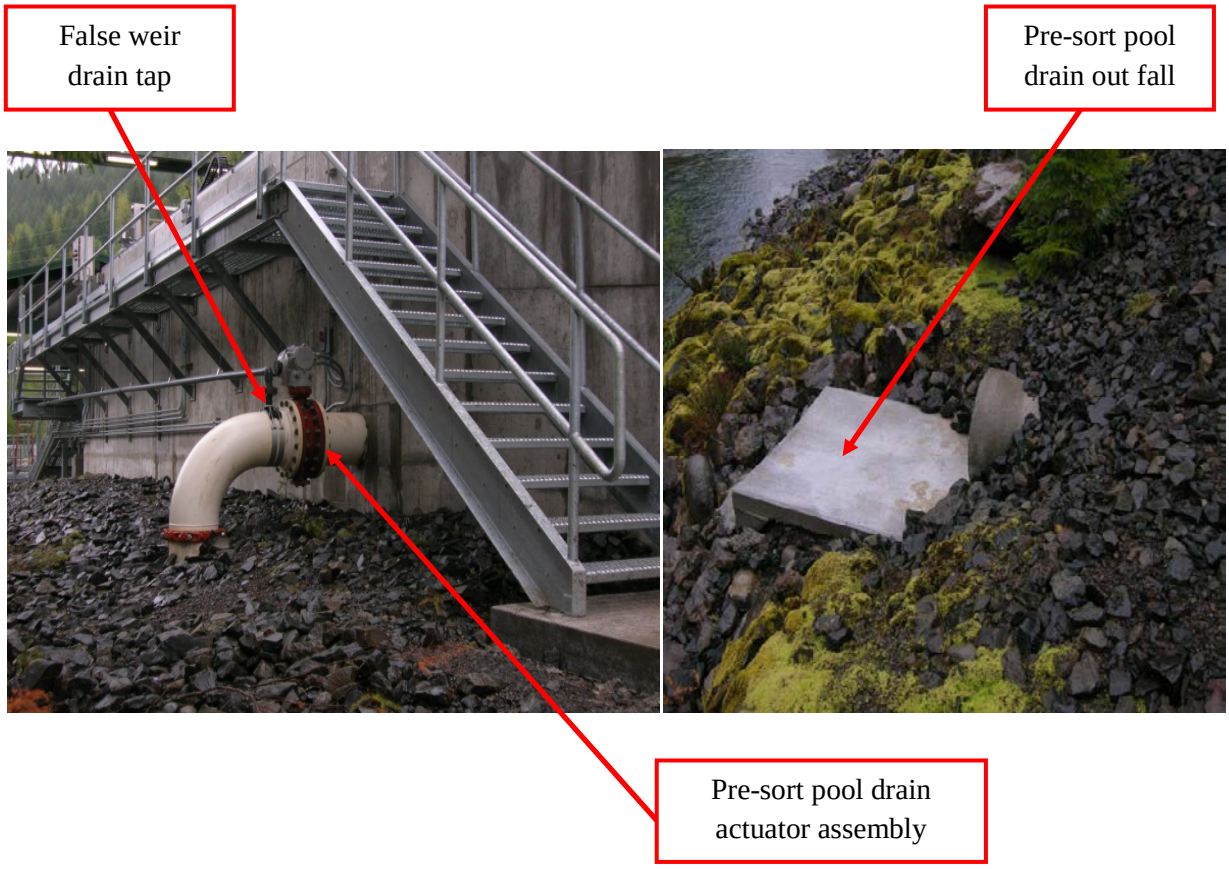


Needs a new picture showing the handrails

Water flow from the FWS pumps is directed by a 24” pipe to a diversion valve assembly. This valve assembly has two operating positions; in one position it directs 100 percent of the flow to the pre-sort pool diffusers and in the other position it diverts a portion of the supply flow to a 13” pipe that provides water to the false weir leaving the remainder continuing to feed the pre-sort pool diffusers. The valves are operated manually to provide the most optimal fish processing capability. These valves are located in the vault near the pre-sort pool.

2.3.6.2. Pre-Sort Pool Drain Valve

The pre-sort pool drain valve is only used when the facility is winterized. The drain allows the pre-sort pool to empty below the ladder weir and it should not used until all fish have been removed from the pre-sort pool. The drain empties into the river along the rocky embankment. The drain pipe and discharge slab are in the following 2 photos.



2.3.7. Diffusers

The pre-sort pool diffusers are approximately 2 ft deep and are located at the quarter points of the pre-sort pool floor. A perforated plate and diffuser grating is located in each diffuser. The perforation plates and diffuser screens are constructed of 304L stainless steel. The perforated plate and diffusers screens are 6 ft by 5 ft. Porosity of the perforated plates is about 51 percent. The diffusers are supplied by the FWS pumps. The diffusers provide hydraulic resistance to flow to reduce any jetting flow that may occur near the outlet of a water pipe.

2.3.8. Pre-Sort Pool Fence

To be added once the work is complete

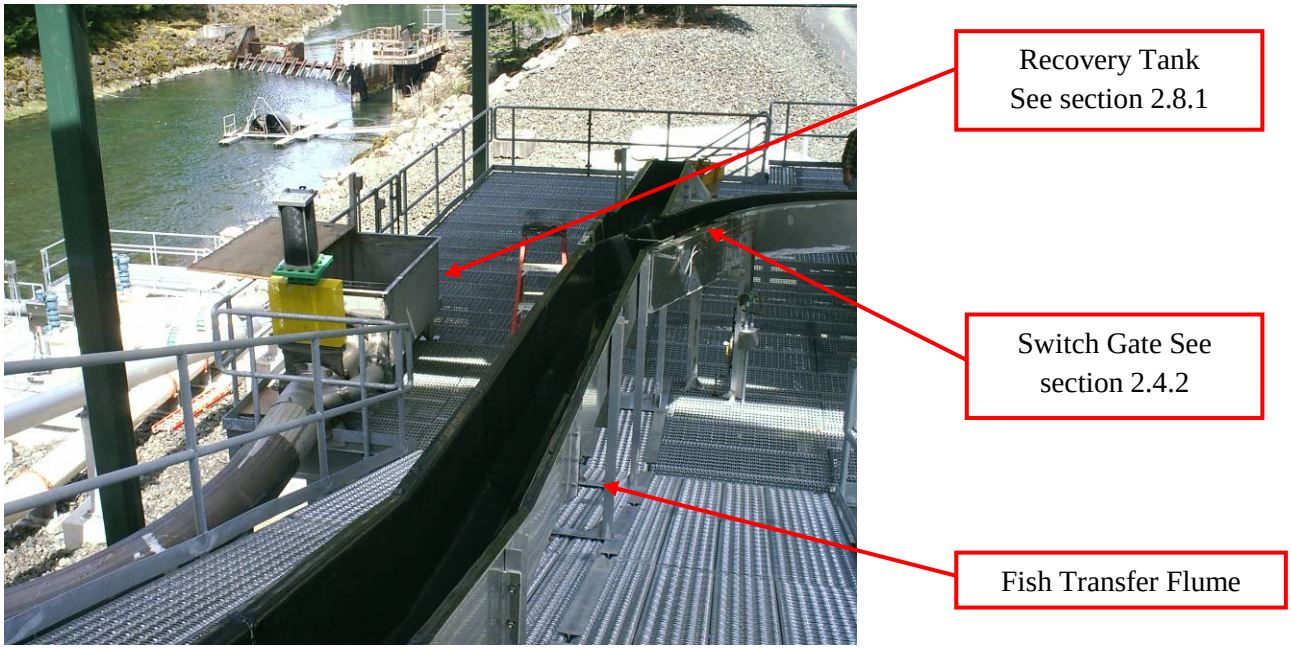
2.4. SORTING AND HOLDING FACILITY

After jumping out of the pre-sort pool, over the false weir, fish enter the flumes of the sorting and holding facility. The sorting and holding facility structure is constructed of reinforced concrete and galvanized steel work platforms, and consists of two levels. The ground level consists of a drive through truck loading area and a mechanical and electrical room. The upper level consists of flumes, the post-sort pools, the anesthetic tank, the recovery tank, and elevated work platforms. The sorting and holding facility is covered by two steel roof structures. The steel structures were manufactured by Litchfield Industries Landscape Elements.

2.4.1. Fish Transfer Flumes

The flumes are constructed from aluminum and lined with neoprene rubber. They provide a path for the fish to enter the anesthetic tank or post-sort pool 1 by way of a switch gate. A small amount of water is used to wet the surface of the flumes; this water originates at the false weir and is regulated by a 2”

diameter drain. The water that travels down the flume is captured by a drain located at the entrance of the anesthetic tank.



2.4.2. Switch Gate

The switch gate is located in the flumes and directs the fish into one of two places; the anesthetic tank or post-sort pool 1. The gate is pneumatically operated from two stations; one station is near the false weir and one is attached to the anesthetic tank. The gate actuation speed can be adjusted by a needle valve located near the actuator just upstream from the electronic valves. Excessive switch gate speed may fatigue components and reduce its operational life. The gate should be operated at the minimum speed necessary to keep up with fish processing.

2.4.3. Post-Sort Pools

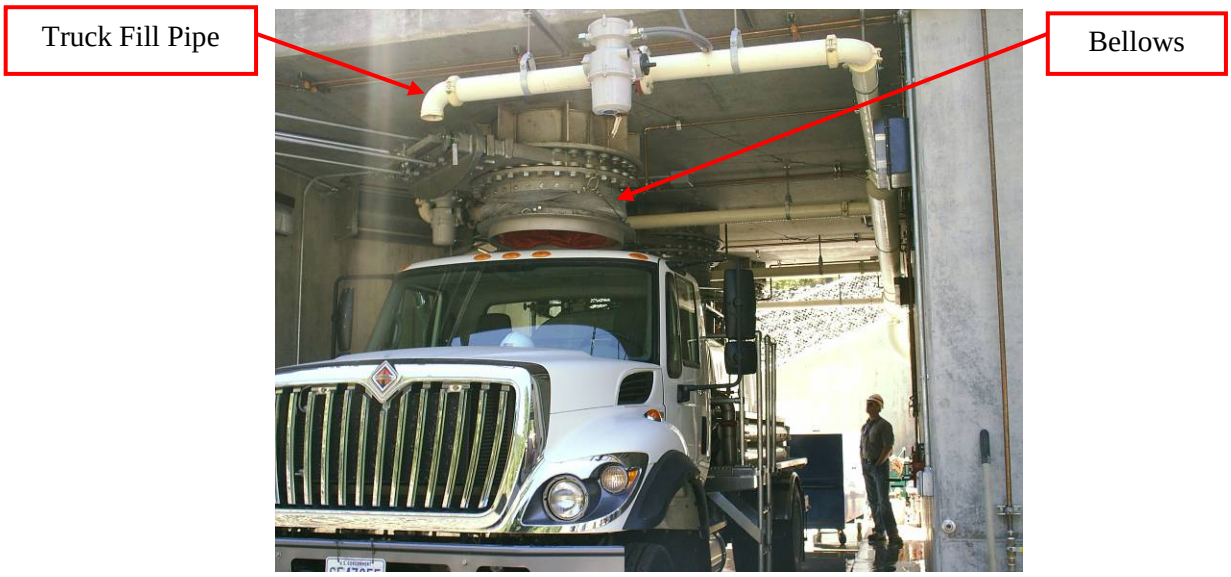
Post-Sort Pools looking northward across the three pools

The three post-sort pools are constructed of reinforced concrete. The post-sort pools are 8.5 ft wide and 25.5 ft long. Water enters and exits the post-sort ponds through floor diffusers. The floor diffusers are 18 in by 36 in. A perforated plate and diffuser grating is located in each diffuser. The perforated plates and diffuser screens are constructed of 304L stainless steel. Porosity of the perforated plates is about 51 percent. Each post-sort pool has a 36 in diameter hole for fish discharge. The fish are transferred to the trucks through the fish discharge.

Post-Sort Pool Fish Transfer opening

2.4.4. Truck Loading Area

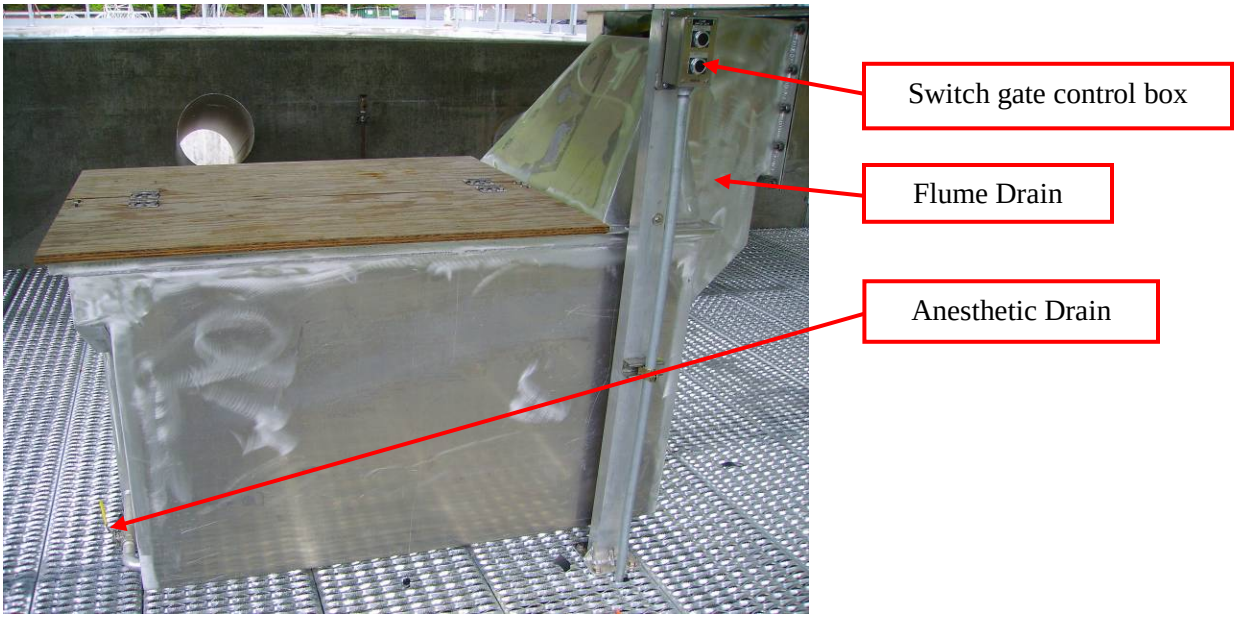
Truck loading occurs beneath the post-sort pools. The truck backs into the bay, first stopping below the truck fill pipe to fill the truck with water. Once this is completed the truck moves back aligning the 36" tank opening with the bellows assembly. A fish transfer operation can commence, see section 3.5.3.10.



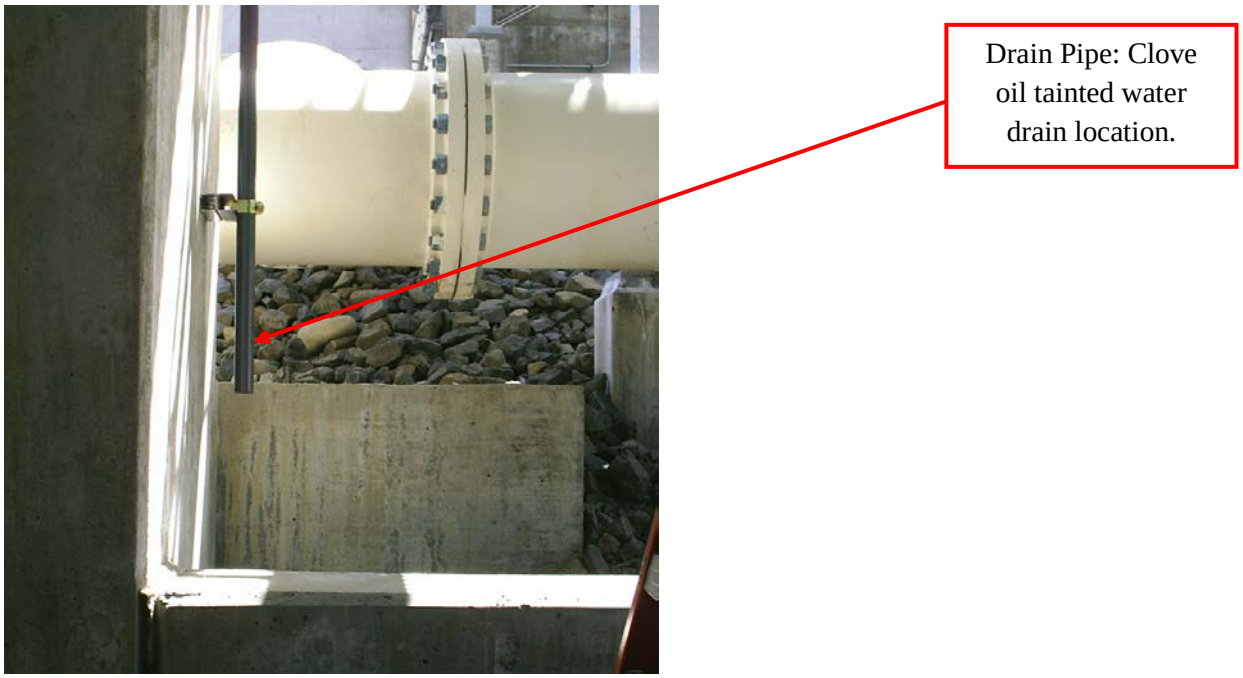
2.4.5. Sorting Platform and Stairs

The sorting platform and stairs are fabricated from galvanized steel and are designed to EM 385-1-1 requirements. The walking surface for all platforms and stair treads is galvanized Grip Strut. The work platforms are also designed to support the mechanical equipment shown in the as-built drawings.

2.4.6. Anesthetic Tank



The anesthetic tank is located at the end of the flume in the sorting facility. The tank is used to anesthetize fish so they can be handled to determine their size and origin. The tank has a 2” diameter fill valve and a 1” diameter drain valve. The anesthetic is clove oil and the tank drains into the rocky area across from the generator near the post-sort pool concrete support structure. The tank has a flume drain that catches water from the flume and diverts it to an open drain.
CAUTION: Clove oil tainted water cannot be drained directly into the river by an open drain or other means. The tank has a UHMW removable lid. Attached to the tank is a regulated and filtered air source used to infuse extra oxygen into the water aiding a fish in recovery from the clove oil anesthetic.



2.5. MECHANICAL ROOM

The mechanical and electrical storage rooms are located in the sorting facility. The rooms have heaters.

2.5.1. Air Receiver

This air receiver provides air for the sorting facility's pneumatically operated valves and anesthetic tank aeration assembly. It has an electronic automatic drain valve to periodically remove water from the tank.

2.5.2. Heater

The heater provided in the mechanical room is identical to the heater in the storage room. The heater is intended to function to keep the rooms above freezing during the winter months.

2.6. ELECTRICAL ROOM

A precast concrete structure was supplied to house the electrical equipment needed for the operation of the FWS pumps, sorting facility, and other related systems. The main control cabinet is also located within this room.

2.7. STORAGE ROOM

A small (8'-0" by 4'-6") storage room is located below the Post-Sort Pools along the north side of the structure to allow for equipment and supplies for operation of the facility to be stored near the work areas.

2.8. FISH RETURN TO THE RIVER SYSTEM

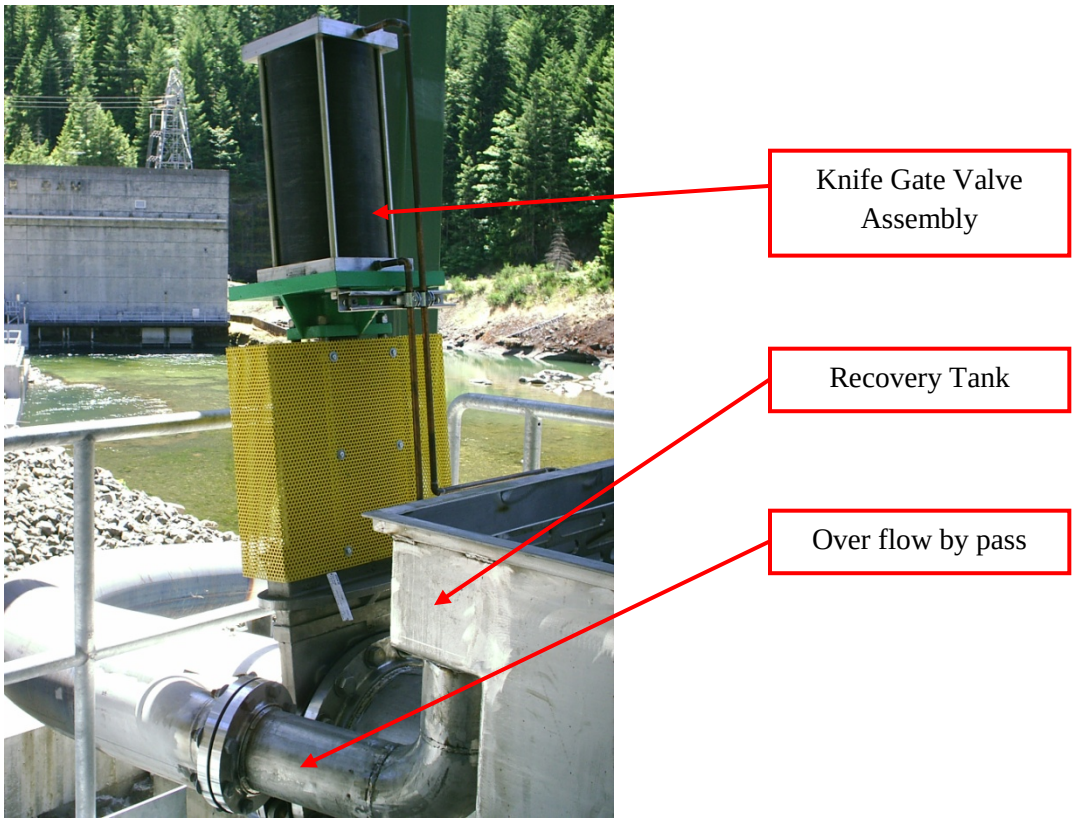
The fish return to the river system includes a recovery tank, an open/close gate valve and a steeply sloped pipe flume back to the tailrace. The purpose of the fish return is to safely and speedily return fish to the tailrace.

2.8.1. Recovery Tank

The recovery tank is located in the sorting facility on the river side near the handrail. It has a marine grade plywood lid with a chain prop. The tank has a 3" globe valve for filling the tank and circulating the water. The recovery tank is emptied by a pneumatic knife gate; the contents within the recovery tank travel by pipe and exit into the river near the FWS pump station.

2.8.2. Recovery Tank Knife Gate Valve

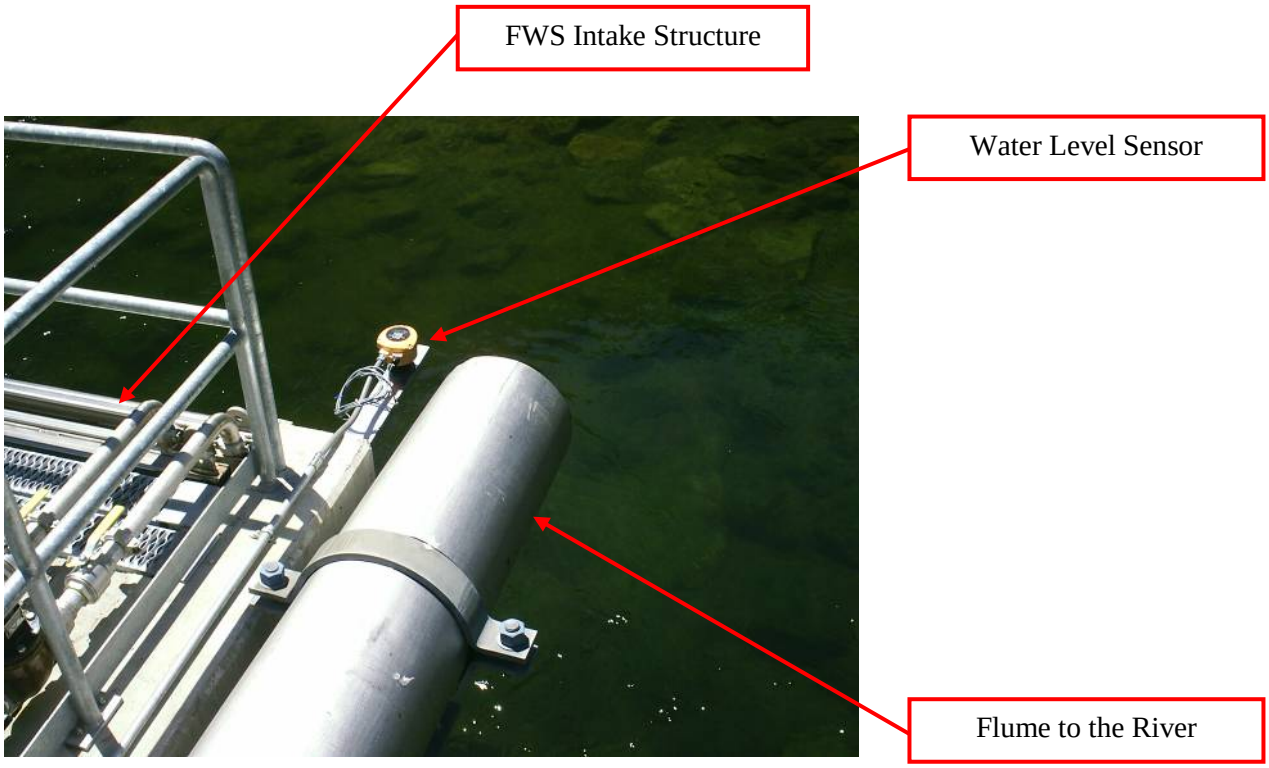
The knife gate is an 18", pneumatically operated valve. The controls are located just northwest of the recovery tank near the hand railing.

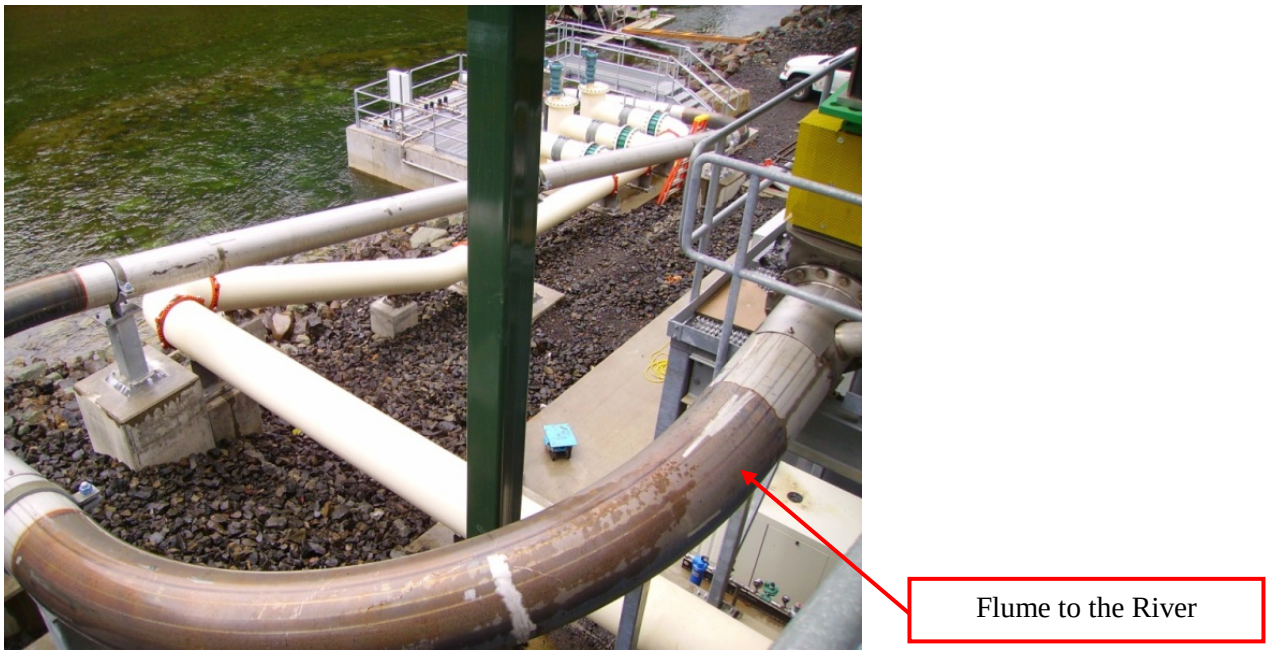


2.8.3. Flume to River

The fish return pipe begins after the recovery tank and knife gate valve and exits off the edge of the top of the FWS structure to discharge into the tailrace. The 102.6 ft long flume consists of 18-in OD T304 stainless steel pipe. The flume drops in elevation about 20 feet 9 inches and discharges to the tailrace

with an invert elevation of about 1256 feet. The pipe slope varies between 32% near the top to 10% at the bottom, with an average slope of 20%. Normal velocities will be between 10 -15 ft/s.
The fish return pipe has six access hatches located at all splice welds. The access hatches allow for inspection of the welds on the inside of the pipe. The access hatch covers are bolted on to the top of the fish return pipe. The fish return pipe is supported in seven locations. The pipe is held in place by pipe clamps that are welded on to a built up plate section. The pipe and pipe clamp assembly is bolted onto a support structure. Five of the structural supports consist of a hollow tube section and a concrete footing. One of the structural supports is bolted to the 10" concrete slab adjacent to the FWS. The structural support at the river end of the pipe is bolted on to the side of the FWS structure.




Flume to the River

2.9. POWER

2.9.1. Primary Feeder Breakers

Feeder circuit breakers XJ1F and XJ2F operate at 6.9KV and supply electrical power to the entire fish collection facility. XJ1F is energized through hydroelectric generator No.1 and/or the BPA transmission line. XJ2F is connected to the hydroelectric generator No.2 bus. Circuit breakers XJ1F and XJ2F are electrically interlocked such that both cannot be closed simultaneously. If one breaker is in the test or draw-out position, the other breaker is still operational.

2.9.2. Pad Mounted Transformer

The Fish Collection Facility transformer is rated 1000KVA, 6.9KV-480V, and is fed from circuit breakers XJ1F and XJ2F. This transformer supplies electrical power to the entire fish collection facility. The transformer has two internal load-break switches on the primary to permit paralleling of sources. The available switch positions are as shown below. Normally the load-break switches are in the “Source A & B” position and power is controlled through circuit breakers XJ1F or XJ2F.

- OFF
- SOURCE A (XJ1F)
- SOURCE B (XJ2F)
- SOURCES A & B

2.9.3. Emergency Generator and Automatic Transfer Switch (ATS)

The 150KW propane generator provides power to the FWS portion of the fish collection facility which includes all devices connected to MCC-FCQ2. The AWS portion of the facility (MCC-FCQ1) is not connected to an emergency generator. Upon loss of normal power from the powerhouse, the Automatic Transfer Switch (ATS) commands the genset to start, then connects MCC-FCQ2 to the emergency generator. Following restoration of normal power the genset will re-transfer MCC-FCQ2 back to the powerhouse feeder, following a preset time-delay.

Since the ATS is an open transfer type, all operating loads will momentarily lose power when switching between normal and emergency sources. All running VFD's and other loads not connected to an uninterruptable power supply will need to be restarted.

The generator supplies power to only the FWS portion of the fish facility. If the fish collection system is running and there is a loss of normal power, the emergency generator will start up. Within approximately one minute the PLC will automatically attempt to start one FWS pump. A single FWS pump will maintain adequate water in the presort tank and ladder to sustain life for any trapped fish until normal power is restored or a shutdown can be performed.

The generator is equipped with 12 volt battery charger that outputs 2 amp or 10 amps. If there is only light demand on the battery it will maintain a constant 2 amp float charge, but if the demand exceeds 2 amps the charger will automatically charge as high a 10 amps.

Note that if the 120VAC supply to the charger is off for a period of time and the battery drops below 12volts, the charger will not operate, as it is only designed as a float charger and not for recharging a dead battery. If the power is going to be off any length of time the battery should be disconnected to prevent unwanted discharge.

The Emergency Generator is equipped with a Hanson Tank Model P-1150 LP fuel tank, with 1150 gallon capacity. Propane vapor withdrawal fuel system and approximately 10 to 20% of the fuel tank capacity will be needed for fuel expansion. It is important to keep the tank filled above 20% for reliable operation. The fuel line is located underground after it leaves the tank and re-emerges from the concrete pad that the generator is setting on. There is a regulator and shut of valve on the concrete wall. The line then goes back under the pad and then re-emerges into the generator housing. There is an emergency fuel shut off push button located on the North side of the FWS building.

2.10. CONTROLS

2.10.1. Touch Screens

Located in the FWS Electric Building, the touch screen is used to control and monitor various devices and systems of the fish collection system. There are individual status and/or control screens for the following: Current status, Alarm history, AWS/FWS pump systems, Water level sensors, Diffuser valves, Screen cleaner systems, Fish ladder entrance gate, and AWS/FWS digital power meters. For some it may be easier to use a plastic stylus instead of a finger to press the virtual buttons.

2.10.2. SCADA

Located in the Cougar and Lookout point Control Rooms, SCADA screens are used to monitor various hardware and systems of the Fish Collection Facility. The screens include real-time data for the AWS/FWS pump systems, Water level sensors, Diffuser valves, Screen cleaner systems, Fish ladder

entrance gate, Primary feeder circuit breakers, Genset/ATS position, AWS/FWS digital power values, and Alarm status.

2.10.3. Water Level Sensors

The sensors used at the Cougar AFCF are Mobrey MSP400RH Series ultrasonic level transmitters. These sensors measure the water surface elevations at critical locations in the fish ladder system. The level transmitters compute the water surface elevations by reading the vertical distance from transmitter to the water surface. The sensor determines the vertical distance by recording the time it takes for a sonic signal to reflect off the water surface and return to the transmitter. Signal pulses are sent 1 (default; potential range is 0.5 – 2) times per second so that data from a turbulent water surface can be time averaged over a longer period. The elevations of the level transmitters are known and included the PLC logic. These sensors provide critical feedback data to the PLC, so that the PLC can determine if and what automatic changes are needed in the operation (e.g. AWS discharge, FWS discharge, diffuser valves, entrance gate opening) to keep the fish ladder system operating within fisheries criteria.

The following Table contains a list of Level Transmitters by numbering, locations, purposes and elevations. Included in the list are elevations of the Weir 31 crest, Pool 1 invert and top of wall at the Pre-sort pond. All of these elevations were surveyed with the installation of the level transmitters.

Table 1 – List of Level Transmitters with Locations, Purposes and Elevations

Level Transmitter	Location	Purpose	Sensor Elevation (feet)
LT-002	Ladder Pool 1	Provides Pool 1 depth	1263.62
		Monitors Entrance head (LT-02 - LT-10)	
		Monitor Diffuser 1 screen head differential (LT-003 – LT-002)	
LT-003	Pool 1 Diffuser Basin	Monitor Diffuser 1 screen head differential (LT-003 – LT-002)	1263.62

LT-004	Removed for spare		
LT-005	Removed for spare		
LT-006	Removed for spare		
LT-007	Removed for spare		
LT-008	Removed for spare		
LT-009	Removed for spare		
LT-010	AWS Pump Station: Tailrace	Provides Tailwater elevation	1261.58
		Controls AWS discharge rate	
		Monitors Entrance head (LT-002 – LT-010)	
		Monitor AWS screen head differential for Airburst Cleaner (LT-010 – LT-011)	
LT-011	AWS Pump Station: between Porosity Plates and Pumps	Monitor AWS screen head differential for Airburst Cleaner (LT-010 – LT-011)	1260.37
LT-012	Ladder Pool 31	Provides ladder head—the difference between in elevation between the water surface and the weir crest in Pool 31	1287.94
		Control FWS Pump discharge rates to maintain 1-foot Ladder Head	
LT-013	FWS Pump Station: Tailrace	Monitor FWS screen head differential for Airburst Cleaner (LT-013 – LT-014)	1256.52
LT-014	FWS Pump Station: between Porosity Plates and Pumps	Monitor FWS screen head differential for Airburst Cleaner (LT-013 – LT-014)	1255.95
Other Pertinent Elevations			
	Weir 31 Crest		1282.84
	Entrance Gate and Pool 1 invert		1248.59
	Presort Pool –Top of Wall		1288.59

The specific locations of the level transmitters are shown at Plate reference.

3. OPERATIONS AND MAINTENANCE

3.1. GENERAL MAINTENANCE POLICIES

This section describes the equipment and routine operation and maintenance procedures for the Cougar Adult Fish Collection Facility (AFCF). It also describes procedures for various emergency situations. The value of this manual depends on how it is used. For this reason, additional reference data and revised procedures and parameters should be inserted into the manual as dictated by changing conditions and operator experience with this particular facility.

3.1.1. Contractor Supplied O&M Manual

All employees should become familiar with the equipment and the respective manufacturer's operation and maintenance (O&M) literature before performing the procedures described in this section. All equipment should be maintained in accordance with the manufacturer's recommendations. Detailed information is provided in the manufacturer-supplied O&M manual, such as operation, maintenance, adjustment, troubleshooting, lubrication, startup, shutdown, assembly, spare parts, and storage. The manufacturer-supplied O&M manual should be kept current by inserting or replacing information as equipment items are added or replaced.

3.1.2. Routine Maintenance Procedures

All equipment should be operated and maintained in accordance with the manufacturer's instructions. This section describes general policies applicable to all areas. Efficient operation and maintenance of the facility requires that all areas be kept neat, clean, and organized. Operators should perform the required housekeeping in their assigned areas. Typical housekeeping tasks are listed below:

- Clean debris from fish screens and porosity plates.
- Keep the cooling surfaces of electric motors clean.
- Replace burned-out light bulbs.
- Keep general area clean and free of obstacles.
- Clean and touch up paint.
- Keep all grating, access covers, and safety shields in place.
- Keep all water hoses and power cords rolled up and properly stored.

3.1.3. Pre-Start-up Procedures

The following basic procedures are recommended before starting and operating all processes and equipment:

- Be sure that the appropriate HAND/OFF/AUTO switches, ON/OFF switches, etc. are turned OFF prior to energizing equipment electrical supply.
- Be sure all grating, equipment safety shields, and floor hatches are in place. Always keep grating, equipment shields, and floor hatches in place, except during maintenance procedures; then replace immediately upon completion of task.
- Check that all clothing, tools, etc. are removed from control panels and equipment.
- Check that all electrical junction boxes and control panels are properly closed.

- Valves and gates should work smoothly and seat properly.
- Valves and gates should be set in the correct position prior to start-up. Verify that all lock-out/tag-out procedures are completed.
- Make any needed repairs or adjustments prior to startup.
- Check that all equipment is properly lubricated and ready to operate. (Follow manufacturer's instructions.)
- Check that all foreign objects have been removed from equipment and piping.
- Check all equipment frequently during the first day of operation, after repair, replacement, or seasonal startup. If a malfunction occurs, do not continue to operate. Minor problems can often cause serious damage if not corrected.

3.2. ALARMS AND ALARM RESPONSE PROCEDURE

3.2.1. General

The facility operator should keep in regular contact with the control room operator at Lookout Point. If unsure of how to resolve any problem, the facility operator should consult with the Lookout Point control room operator. When the situation is resolved, the facility operator should notify control room operator. All true emergencies should immediately be reported to the Lookout Point control room.

3.2.2. Alarm Response Tables

Various system warnings generate alarms that are displayed at Lookout Point and the facility touch screens. Aside from water up procedures, and routine removal of waterborne trash and debris, proper alarm handling and response is the most crucial aspect of operator training. Refer to Appendix D for a table of alarms with cause, result and resolutions.

3.3. BASIC MAINTENANCE PROCEDURES

3.3.1. General

The operation and maintenance of buildings and their appurtenances is important for appearance and effective performance. The result of good maintenance is lower operating costs, better morale for staff, and better visitor image. To assist in achieving these objectives, the recommendations in this chapter should be followed. This chapter contains operation and maintenance procedures common to many of the Cougar Adult Fish Facility elements. For specific procedures for the various elements, see also the description of that element and the manufacturer's instructions for that element. An overall inspection should be made twice a year for determination of maintenance work required for each element. Inspections and maintenance of specific elements should be made on the schedule noted herein, or as noted in the manufacturer's instructions. The best policy is to complete maintenance work as it is required. Delaying maintenance work will only increase the cost and amount of work required, and decrease the life of the equipment. This policy should not preclude more frequent inspections and resulting maintenance. The material used for maintenance repairs shall conform or be equal to the original construction contract specification requirements.

3.3.2. Protective Coatings

Cougar AFCF buildings, facilities and other appurtenances were designed and constructed to minimize maintenance coating work. The buildings are pre-cast structures painted to resist weathering elements. Many features at this facility are fabricated using aluminum or stainless steel; they both weather well without the use of coatings. Minimizing the use of coatings reduces the amount of maintenance needed due to corrosion and wear and tear.

3.4. PREVENTATIVE MAINTENANCE MANAGEMENT

3.4.1. General

Periodic maintenance and inspection is required for all mechanical equipment. Proper and efficient maintenance of mechanical equipment will extend the useful life. The use of a maintenance management program will help to ensure that all equipment is maintained at the required intervals.

3.4.2. List of Contractor's O&M Manuals

OUTLINE FOR CONTRACTOR MANUAL ONCE FINALIZED

3.4.3. Equipment Inspection and Maintenance

Visual and physical observations of the machinery and equipment should be performed by the operators on a regular basis. All unusual conditions are to be reported immediately to the facility manager. If the operator feels that damage to the piece of equipment and/or a safety hazard is created by this condition, the piece of equipment should be taken out of service immediately and the facility manager notified.

3.4.3.1. General Pump Maintenance

According to the manufacturer's recommended maintenance schedule; the electrical cables and pump motor insulation must be checked annually before start-up each season. The thermistor, float switch and any other pump monitoring circuits must also be checked prior to system start-up. For additional information reference the KSB pump operation and maintenance manual located in Volume 1 of the Contractor supplied Operation and Maintenance manual. A maintenance log shall be used to record megger test results. Each year these results can be compared to determine the rate of degradation of the winding insulation. The table information below was provided by the manufacturer.

Item	Maintenance	Frequency
7.2.1	Measurement of Insulation Resistance	After 4,000 hrs, but at least once a year
7.2.2	Checks on Electrical terminals	
7.2.3	Checks on Monitoring sections Visual Checks on support chain/Rope	
7.2.4	Check on leakage chamber	After 16,000 hrs but at least once every 3 years
7.2.5	Oil Change	
	General Overhaul	After 24,000 hrs, but at least once every 5 years

3.4.4. Valve and Gate List

Note minor valves (Under 3 inches) and hose bibs may not be shown or numbered in this table.

Table 2 – Valve and Gate List with Locations

Valve and Gate List				
Valve Num.	Size	Valve Type	Actuator Type	General Location
1A	20"	Butterfly	Electric	Diffuser pool 1
1B	20"	Butterfly	Electric	Diffuser pool 1
2	16"	Butterfly	Electric	Diffuser pool 2
3	16"	Butterfly	Electric	Diffuser pool 3
4	16"	Butterfly	Electric	Diffuser pool 4
FC_FW_4	24"x24"x12"	Butterfly	Electric	Three way diversion valve vault
FC_FW_5	12"	Butterfly	Electric	Pre-sort pool drain
FC_FW_6	4"	Butterfly	Electric	Fish transfer area
FC_FW_7	8"	Butterfly	Electric	North side of sorting facility
FC_FW_8	36"	Knife Gate	Pneumatic	Fish transfer area
FC_FW_9	4"	Butterfly	Electric	Fish transfer area
FC_FW_10	8"	Butterfly	Electric	North side of sorting facility
FC_FW_11	36"	Knife Gate	Pneumatic	Fish transfer area
FC_FW_12	4"	Butterfly	Electric	Fish transfer area
FC_FW_13	8"	Butterfly	Electric	North side of sorting facility
FC_FW_14	36"	Knife Gate	Pneumatic	Fish transfer area
FC_FW_15	4"	Butterfly	Electric	North side of sorting facility
Entrance	6.5'x6'	Gate	Electric	Ladder Entrance
Wash. drain	4"	Globe	Manual	Near the Ladder Entrance

Revise

3.4.5. Maintenance of Structural Features

3.4.5.1. General

The concrete and steel features are expected to operate with minimal maintenance required due to the selection of materials used for this facility. The concrete structures are expected to last many, many years without any problems with the concrete. Some specific comments regarding the features are in following paragraphs.

3.4.5.2. Fish Ladder

Prior to startup each year the fish ladder should be visually inspected to see that no objects and debris are present anywhere within the fish ladder. Visual inspection should also include the condition of concrete surfaces and the various steel items such as fish screens, diffusers, lifting frame, personnel guardrails and walkways located near the entrance. Connector machine bolts and concrete anchors should be visually inspected for corrosion and replaced in kind as needed.

3.4.5.3. Cover Structures

All three of these structures should be visually inspected for corrosion spots or peeling paint in the metal roof and support columns and beams. Corrosion on metal items should be cleaned and metal surfaces recoated with materials as needed to match the initial coating. All fasteners shall be checked for corrosion and replaced in kind as needed.

3.4.5.4. Pre-Sort and Post-Sort Structures

Visually inspect the concrete surface for surface damage as needed every year or so. All steel features such as work platforms, walkways, personnel guard rails, Crowder rails, metal doors and the steel stairs should be inspected for corrosion. All connection fasteners for the work platforms and walkway system should be inspected and any corroded bolts replaced in kind as needed. The floor drainage pipes under the post-sort structure should be inspected to see that no debris has been deposited into the drop inlets. Columns and connections for the fish return pipe system should also be inspected for corrosion. Repaint or repair galvanizing as needed.

3.4.5.5. AWS and FWS Pump Stations

The pump stations should be visually inspected prior to facility startup to see that no debris is present on the metal screens or within the pump station tanks. The metal items and their connections should be inspected for corrosion. Connectors should be replaced in kind as needed.

3.5. OPERATION PROCEDURES

3.5.1. Facility Startup

To startup the Cougar AFCF, complete all items in the Pre-Activation Checklist (section 3.5.1) below, then follow the procedures in the Automatic Startup section (section 3.5.1.2). When automatic startup it is not possible or desirable, Cougar AFCF startup can be done manually. To startup the Cougar AFCF manually, complete all items in the Pre-Activation Checklist (section 3.5.1), then follow the procedures in the Manual Startup section (section 3.5.1.2).

3.5.1.1. Pre-Activation Checklist

Before facility startup, do the following:

POWERHOUSE

- Check that the Sweitzer 351 relays are turned on and functioning properly with correct light indication for fish facility.
- Check that all Fish Facility alarms are in scan on SCADA
- Check that either breaker XJF1 or XJF2 is closed.
- Check that air supply valve number _____to fish facility is open, do this slowly as the "Low Powerhouse Service Air alarm will annunciate" so just crack the valve until both fish facility receiver tanks are full, then open 10 percent.
- Check that all hose bibs and line drains at Fish Facility are closed.
- Slowly open the 4" Fish Facility water supply located in the water treatment room in the powerhouse. (Open slowly to avoid water hammer) Valve Number _____

AWS

- Assure that all bulkheads for the AWS pump intakes have been removed and stored in their proper location.
- Check that the AWS valve pit is dry and that drains are working properly, there may be a small amount of standing water, but not over 1”.
- In the AWS building on the MCC-FCQ1 480 VAC panel close the following breakers:
    - Breaker 4, Fish ladder gate actuator & Exclusion gate hoist.
    - Breaker 5, AWS diffuser valve actuators
    - Breaker 6, Surge protection panel
    - Breaker 7, Receptacle
    - Breaker 8, FLR1 transformer and distribution panel
    - Breaker 9, Surge protection panel
- In the AWS building check that all pertinent breakers are closed in the FLR1 panel
- Check that the 6” caps and ¾” plugs are all removed from the AWS and FWS pump vacuum valves, store them in the AWS building.
- Close or check closed the vacuum breaker isolation valve for each AWS pump
- Check that the drain plug or drain valve is closed on the AWS pump discharge pipe.
- Visually inspect the conductors to each AWS pump and disconnect to assure there is no damage.
- Check that the disconnect switches located at the pumps are closed for each AWS pump
- Check that the fish ladder entrance gate is at least 30%, open and in the manual position.
- Check that the fish screen gate is fully closed.
- Check that AWS diffuser valve FC-AW-7 is open, leave actuator function switch in remote position.
- Check that AWS diffuser valve FC-AW-8 is open, leave in actuator function switch in remote position.
- Check that AWS flow transducer is turned on and functioning properly, you must open the cabinet door; it is located on the fish ladder wall adjacent to where the AWS pipe rises out of the vault.
- Check that the level transmitters are working properly by reading the values for them on the PLC in the FWS house.
- Check that the air receivers for the fish screens are pressured up.
- Test the automatic function of the AWS screen cleaner by going thru each zone one by one and pressing the Screen start button for a few seconds, release the button to stop air flow. (Note: when the red charging light is on, you must wait for the system to recharge before going onto the next screen) Repeat this thru each screen. Note any valves that do not operate properly, and isolate them. Leave the AWS screen cleaner in AUTO mode.

AWS BUILDING

- Check the general condition of the building, lighting, water leaks, rodents etc.
- Check that the room heater is working properly
- Check that the HVAC unit is powered up
- Test run the HVAC unit and assure proper operation and leave the thermostat set at 55 degrees

- Visually inspect the control cabinet components, ensure that there is no burnt or loose wiring, check to make sure it is powered up.
- Check the condition of the main transformer, (CAUTION: you must open door on front of transformer to check; do not open the transformer door without donning the appropriate level of ARCFLASH gear), oil level, leaks etc. note which position the disconnect is in.

FWS

- Assure that all bulkheads for the FWS pump intakes have been removed and stored in their proper location.
- At the FWS building check closed the 600 amp main breaker at panel FXQX
- In the FWS building on the MCC-FCQ2 480 VAC panel Close the following breakers:
    - Breaker 54, 480 Volt receptacle
    - Breaker 55, FLR2 transformer and distribution panel
    - Breaker 56, surge protection panel
    - Breaker 57, Post-sort pool fill valves
    - Breaker 58, Post-sort pool drain valves
    - Breaker 59, Presort pool diversion and drain valve actuators
- In the FWS building check that all pertinent breakers are closed in the FLR2 panel
- Check that the 4” caps and ½” plugs are all removed from FWS pump vacuum valves, store them in the FWS building.
- Open or check open the vacuum breaker isolation valve for each FWS pump
- Check that the drain plug or drain valve is closed on the FWS pump discharge pipe.
- Visually inspect the conductors to each FWS pump and disconnect to assure there is no damage.
- Check that the disconnect switches located at the pumps are closed for each FWS pump
- Check that the level transmitters are working properly by reading the values for them on the PLC in the FWS building.
- Check that the air receivers for the fish screens are pressured up.
- Test the automatic function of the FWS screen cleaner by going thru each zone one by one and pressing the Screen start button for a few seconds, release the button to stop air flow. (Note: when the red charging light is on, you must wait for the system to recharge before going onto the next screen) Repeat this thru each screen. Note any valves that do not operate properly, and isolate them. Leave the FWS screen cleaner in AUTO mode.

FWS BUILDING

- Check the general condition of the building, lighting, water leaks, rodents etc.
- Check that the room heater working is properly
- Check that the HVAC unit is powered up
- Test run the HVAC unit and assure proper operation and leave the thermostat set at 55 degrees
- Visually inspect the control cabinet components, ensure that there is no burnt or loose wiring, check to make sure it is powered up.
- Check the phone communications and verify with Lookout Point Control room that they have SCADA indication of Cougar Fish Facility

CROWDER

- Check that the breaker on the crowder cabinet is closed
- Check the light indication on the crowder cabinet
- Run the crowder full distance travel in both directions and check that the limit switches and lights are working
- Run the crowder lift full raise and lower and check that the limit switches and lights are working.

PRESORT POOL

- Close the presort pool drain valve, check proper light indication
- Operate the false weir valve full open and full close, observe operation and leave in manual operation
- Operate the Presort pool fill valve full open and full close, observe operation and then leave in the full open position

FLUME

- Operate the diverter gate several times and leave diverter gate to the anesthetic tank position

RECOVERY TANK

- Open the water fill valve and fill the tank, then open the air operated knife gate and release the water, allow line to flush for a moment and then close the water valve
- Close the knife gate
- Check for any water leaks from pipes

ANESTHESIA TANK

- Open the fill valve to the anesthesia tank and allow to fill, observe the water level and make sure not to overflow tank. Close the fill valve and open the drain valve.
- Check for any water leaks from pipes

POST-SORT POOL TANKS

- Operate the post-sort pool 1 fill valve full open and then full close, observe operation and light indication
- Operate the post-sort pool 2 fill valve full open and then full close, observe operation and light indication
- Operate the post-sort pool 3 fill valve full open and then full close, observe operation and light indication
- Operate the post-sort pool 1 drain valve full open and then full close, observe operation and light indication
- Operate the post-sort pool 2 drain valve full open and then full close, observe operation and light indication
- Operate the post-sort pool 3 drain valve full open and then full close, observe operation and light indication
- Operate post-sort pool 1, 36” air operated knife gate full open and full close and observe operation, gate should close and seal completely

- Operate post-sort pool 2, 36” air operated knife gate full open and full close and observe operation, gate should close and seal completely
- Operate post-sort pool 3, 36” air operated knife gate full open and full close and observe operation, gate should close and seal completely
- Operate the truck fill valve full open and full closed, observe operation
- Operate each bellows lift and leave them in the full extended position

EMERGENCY GENERATOR

- Remove the access cover to the generator and check oil level, coolant level, battery condition, belt condition and for any leaks.
- Close the main output breaker on the generator
- Place the generator in AUTO position
- Check to make sure the charger is working properly
- Replace the access cover
- On the retaining wall next to the generator check the fuel pressure, it should be _____PSI
- Check the fuel level at the propane tank and note _____ PSI

AUTOMATIC TRANSFER SWITCH (ATS)

- Check that the ATS is powered up
- The ATS should be in AUTO position and switched to normal power source. Press “Reset Status” button if desired.
- Check the condition of the remote alarm panel for the emergency generator, located inside the FWS building on the PLC panel. There should not be any alarms, note if any are present and remedy the issue. Abnormal conditions should be corrected before proceeding.
- Open the main 600 amp breaker at FXQX
- Generator should start up immediately and ATS should transfer load to the generator, check the light indication on the ATS to assure that it transferred properly.
- Allow the generator to warm up and then reclose the 600 amp breaker at FXQX, the generator should go thru a 20 minute cool down cycle and shut down
- Leave the ATS in AUTO position

AIR RECEIVERS

- Check that the AWS air receiver pressure gage is working properly, open the moisture release valve on the bottom of the tank and bleed off any moisture in the tank.
- Check that the FWS air receiver pressure gage is working properly, open the moisture release valve on the bottom of the tank and bleed off any moisture in the tank.
- Check that the Post-Sort Pool knife valve air receiver pressure gage is working properly, open the moisture release valve on the bottom of the tank and bleed off any moisture in the tank.

STORAGE AND EQUIPMENT ROOMS

- Check that both storage rooms and adjacent mechanical and electrical rooms are dry and free of rodents
- Check to see that all lighting is working properly

- Check that heaters are working properly

FACILITY LIGHTING

- Check that all exterior lights are working properly
- Check that all work lights are working properly on post-sort pool and anesthetic tank areas

SECURITY FENCES AND GATES

- Visually inspect the perimeter fences and gates to assure that there are no openings or damage.

TOUCH SCREENS

- Review "System Diagnostics Screen" and clear all. Abnormal conditions should be corrected before proceeding.
- Review "Alarm History Screen" and clear all alarms before starting equipment.
- Review "Entrance Gate" screen and verify unit switched to AUTO and READY lights are active for both automatic and manual control.
- Review "Screen Cleaner" screen and verify AWS and FWS systems indicate "Ready for Auto Operation."
- Review "Power Meter" screen and verify AWS and FWS meter status OKAY.
- Review "Diffuser Valve" screen and verify valves are switched to AUTO and READY lights are active for both automatic and manual control.
- Review "Water Sensor" screen to verify all sensors reporting data. Note -99.9 indicates trouble.
- Review "FWS Pump" screen and confirm FWS pump system is ready for both automatic and manual control.
- Review "AWS Pump" screen and confirm AWS pump system is ready for both automatic and manual control.

3.5.1.2. Automatic Startup

Once all items in the Pre-Activation Checklist (section 3.5.1.1) have been completed, follow the procedures below to start up the Cougar AFCF.

1. Ensure the fish screen gate is down
2. From the touch screen place the entrance gate in AUTO control. Verify the entrance gate is open at least 10 percent.
3. Ensure all actuators are in “remote” operation
4. At the presort pool valve operating station, Check that the flow control potentiometer for the false weir is set to “Min” this ensures flow from the presort pool will not be diverted to the false weir.
5. Check that the presort pool drain valve is closed; this is indicated by a labeled light that says “closed”.
6. Close the breakers for the AWS pumps located in panel MCC-FCQ1 and place each selector switch in “auto”.
7. At the FWS electric room, on panel MCC-FCQ2, close the breakers on all 3 FWS VFDs and place each selector switch in “auto”.
8. To begin FWS pump operations
    a. Locate touch screen in FWS electric room (located on the PLC cabinet)
    b. If necessary, touch the screen to bring the unit out of sleep mode

   c. Go to “Home” screen
   d. Touch the button “FWS pumps”
   e. Place the pumps in “AUTO” control
   f. Touch the button “start pumps”
   g. Touch the button “YES” to confirm you would like to start the pumps
   h. Note: the program will decide which two pumps to start and the PLC will adjust them until Pool 31 water level is in criteria and there is about 1.5ft of differential between the river and pool 1 water elevation. Observe the value for “ER” (set point error), as it approaches zero it will be safe to move on to the AWS system. The Ladder equalizing operation may take up to 20 minutes
   i. Touch the “X” to go to the home screen
9. PLC will pre-set the Entrance gate to the expected gate opening based on TW and AWS discharge (see Table 4).
10. To begin AWS pump operations
   a. Locate touch screen in FWS electric room
   b. If necessary, touch the screen to bring the unit out of sleep mode
   c. Go to “Home” screen
   d. Touch the button “AWS pumps”
   e. Touch the button “Diffuser Valves”
   f. Manually open diffusers 1a and 1b.
   g. Manually close diffusers 2, 3, and 4.
   h. Exit to the home screen and touch “AWS Pumps”
   i. Touch the button “auto control”
   j. Touch the button “start pumps”
   k. Touch the button “YES” to confirm you would like to start the pumps
   l. Observe pump operation until the CFS set point (SV) error is less than 5.0 CFS of the measured flow (PV). CAUTION: If the pumps take longer than 2 minutes to get the measured flow to within 5 cfs of the set point there may be air entrainment. Refer to section 3.6.1
   m. If measured flow is within 5 cfs of the set point then go to the diffuser valve screen and touch “Auto Control”
   n. Note: the program will decide which pumps to start. The program will run the pumps until flow rate matches tailrace based on criteria. The entrance gate will adjust based on minimum pool 1 depth (5 feet) and entrance head (difference between water surface elevations in pool 1 and tailrace: 1.1 – 1.4 feet).
   o. Touch the “X” to go to the home screen
11. Observe operation;
   a. IF THE AWS PUMPS ARE RUNNING AT 100% MAX RPM AND/OR THE AWS FLOW METER DOES NOT INCREASE RAPIDLY TO THE EXPECTED DISCHARGE RATE and remains low, then the AWS pumps have failed establish a siphon and sweep out the residual air in the AWS pipeline system so that the flow meter can function properly. Go to Section 3.6.1 “Trouble Shooting AWS Pumps” for corrective procedures;
   b. if the system is running out of criteria the pumps can be placed in manual operation by touching the “manual operation” button. The keypad can be used to adjust pump speeds.
12. The valves, pumps, and the entrance gate can also be controlled manually

a. WARNING ONLY QUALIFIED PERSONELL SHOULD ATTEMPT MANUAL OPERATION.
b. CLOSING VALVES AT HIGH FLOWS MAY DAMAGE PUMPS.
c. CLOSING THE ENTRANCE GATE AT HIGH FLOWS WILL OVERFLOW THE LADDER
d. For manual control of the pumps touch the button “manual control” and adjust using the keypad.
e. For manual control of the valves touch “diffuser valves” button at the home screen and press “adjust” for the pump that needs to be adjusted. Note the actuator moves closed or open and should not be used in an intermediate position.
f. For entrance gate control; from the home screen touch the button “entrance gate” and then touch the button “manual control”. The opening can be adjusted by touching the “keypad” and entering three numbers corresponding to the percent open desired.

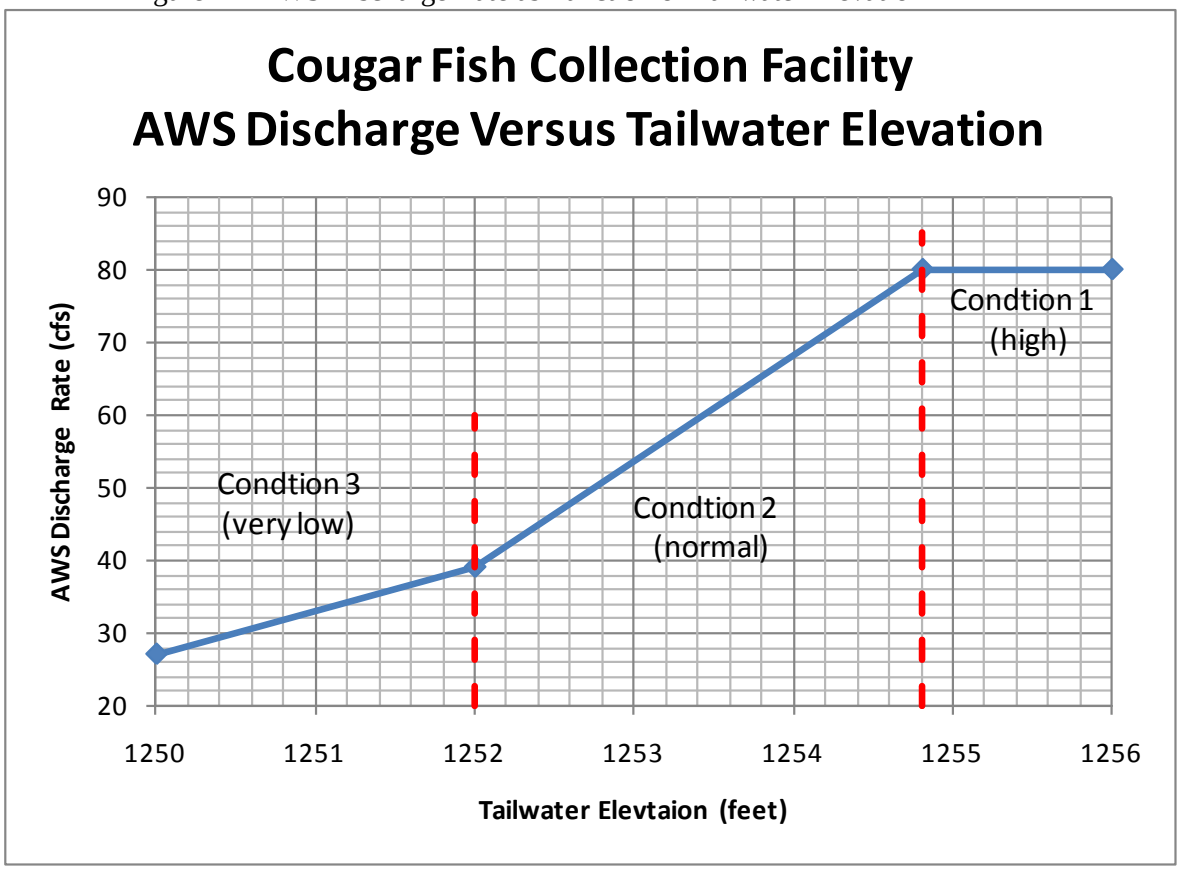
3.5.1.3. Manual Startup

Once all items in the Pre-Activation Checklist (section 3.5.1) have been completed, follow the procedures below to start up the Cougar AFCF manually. (Note: Automatic Startup should be used when possible.)

1. Check current tailwater level (TW staff gage or LT-010)
2. Determine target AWS discharge rate (see Figure 2 or Table 3)
   a. Condition 3 is a rare single AWS pump operation for tailwater elevations below 1252 feet.[1] This condition will occur when the turbine unit discharge is < 300 cfs (normal minimum single unit operation).
   b. Condition 2 represents normal operation in which 1 or 2 units are operating with total discharge ≥ 300 cfs and the tailwater elevation is between 1252 – 1254.8 feet. For condition 2, discharge is increased as a linear function of tailwater elevation.
   c. Condition 1 represents an unusually high tailwater condition where fish ladder criteria may not be fully met.

1. [1] This was the condition during the Commissioning and Endurance Tests in July 2010.

Figure 2 – AWS Discharge Rate as Function of Tailwater Elevation



3. Determine target diffuser valve settings (see Figure 3 or Table 3)
   a. Diffuser valves are either 100% open or fully closed
   b. A minimum of two valves should be 100% open. Diffuser valves (1-A and 1-B) are always open (except when trouble shooting AWS pump system, Section 3.6.1)
   c. More valves are opened with increased tailwater elevation. Above tailwater elevation 1254.2 feet, all diffuser valves are open.

Figure 3 – Diffuser Valve Settings as Function of Tailwater Elevation

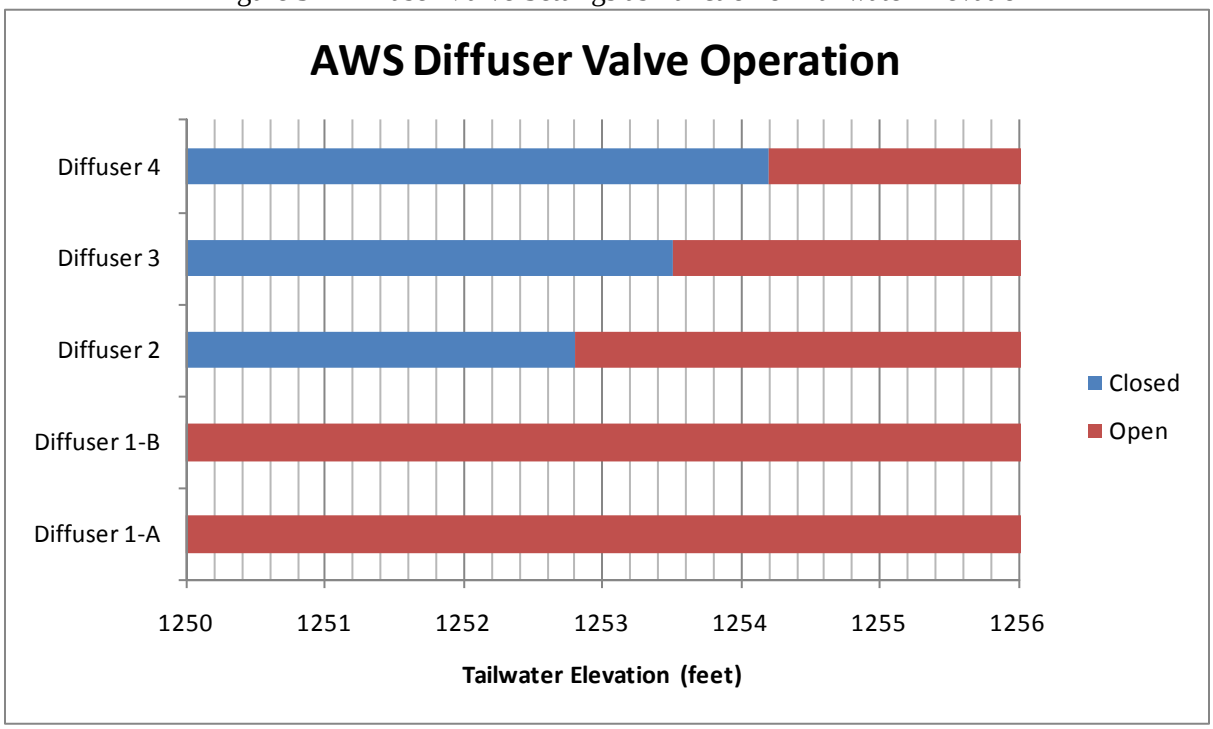


Table 3 shows the combined information for both AWS discharge and the maximum diffuser valve[2] that should be open as a function of tailwater elevation. It also shows the number of AWS pumps in operation. Normally there are two AWS pumps in operation. However in the rare low tailwater operations below 1252 feet (condition 3), there should only be one AWS pump operating.

[2] The maximum diffuser valve is defined as the largest valve number (4 > 3 > 2> 1-B > 1-A) identifying the valve. It is also represents the north-most or farthest downstream from the Powerhouse of the valves that will be open at the given tailwater elevation. Any valves with ID numbers above the maximum valve should be fully closed.

Table 3 - Combined Table for AWS Discharge, Number of Pumps Operating and Maximum Diffuser Valve Open Versus Tailwater Elevation

COMBINED TABLE FOR AWS DISCHARGE AND VALVE SETTING VERSUS TAILWATER ELEVATION								
Tailwater Elevation (ft)	AWS Discharge (cfs)	Number of Pumps Operating	Maximum Diffuser Valve Open		Tailwater Elevation (ft)	AWS Discharge (cfs)	Number of Pumps Operating	Maximum Diffuser Valve Open
1250.0	27	1	1-B		1252.8	51	2	2
1250.1	28	1	1-B		1252.9	52	2	2
1250.2	28	1	1-B		1253.0	54	2	2
1250.3	29	1	1-B		1253.1	55	2	2
1250.4	29	1	1-B		1253.2	56	2	2
1250.5	30	1	1-B		1253.3	58	2	2
1250.6	31	1	1-B		1253.4	59	2	2
1250.7	31	1	1-B		1253.5	61	2	3
1250.8	32	1	1-B		1253.6	62	2	3
1250.9	32	1	1-B		1253.7	64	2	3
1251.0	33	1	1-B		1253.8	65	2	3
1251.1	34	1	1-B		1253.9	67	2	3
1251.2	34	1	1-B		1254.0	68	2	3
1251.3	35	1	1-B		1254.1	70	2	3
1251.4	35	1	1-B		1254.2	71	2	4
1251.5	36	1	1-B		1254.3	72	2	4
1251.6	37	1	1-B		1254.4	74	2	4
1251.7	37	1	1-B		1254.5	75	2	4
1251.8	38	1	1-B		1254.6	77	2	4
1251.9	38	1	1-B		1254.7	78	2	4
1252.0	39	2	1-B		1254.8	80	2	4
1252.1	40	2	1-B		1254.9	80	2	4
1252.2	42	2	1-B		1255.0	80	2	4
1252.3	43	2	1-B		1255.1	80	2	4
1252.4	45	2	1-B		1255.2	80	2	4
1252.5	46	2	1-B		1255.3	80	2	4
1252.6	48	2	1-B		1255.4	80	2	4
1252.7	49	2	1-B		1255.5	80	2	4

4. Close the fish ladder entrance gate
   a. Place entrance gate actuator function switch into local control position manual.
   b. Open entrance gate to 15 percent. Note: the initial entrance gate opening is below biological criteria, no fish will pass because the fish gate screen should be blocking the entrance.
5. At presort pool valve operating station, ensure the flow adjustment potentiometer is set at “max”, this ensures all FWS flow is diverted to the pre-sort pool and fish ladder.
6. At presort pool valve operating station, check that the flow control potentiometer for the false weir is set to “Min” this ensures flow from the presort pool will not be diverted to the false weir.

7. Check that the presort pool drain valve is closed; this is indicated by a labeled light that says "closed".
8. At FWS Electrical Room and on panel MCC-FCQ2, close the breakers on all 3 FWS pumps.
9. Pick two FWS pumps, preferably two pumps with the fewest runtime hours, for operation and move the selector switch for each pump (located on the VFD cabinet) to "hand" position. Perform the following operations for each pump that is selected for operation.
    a. Ensure that a green light indicates the pump is ready
    b. Press the square green button; the pump should begin accelerating to 45 Hz, this is the preset minimum pump RPM. A red light should be lit indicating that the pump is running
    c. Press and hold the arrow up button until the pump starts to accelerate; this may take 5-7 seconds.
    d. Push the arrow up until the display reads 54 Hz (91% max RPM)[3]
10. Observe the water level in fish ladder pool 31 (staff gage or LT-012) ensuring its level is approximately 1.0 foot over the weir crest.
11. Adjust pump speed to meet pool 1 height criteria, see section 3.5.2.3, using the ramp buttons
12. Wait at least 20 minutes to allow the water flow over the weirs to stabilize
13. Open the fish ladder entrance gate to the gate opening for the current tailwater elevation, as shown in Table 4.
    a. Find the current tailwater elevation in left column, move across the same row over to sixth column to obtain % of maximum gate opening. Note that tailwater levels below 1252.7 feet are on the left half of table, and tailwater levels above 1252.8 feet are on the right half of table.
    b. Pool 1 water depth will be less than 5 feet until AWS pumps are started into operation.
    c. The minimum biological opening for fish passage is normally 30 percent (1.5 ft).
    d. The PLC approximates the initial gate opening with the following equation: %Max GO = 20% + 10.6% * (TW-1250)

[3] Note: the minimum RPM for FWS pumps is 45 Hz or 75%.

Table 4 – Expected Entrance Gate Opening (% of Maximum Open) for Start-up Tailwater Elevation

TABLE OF EXPECTED ENTRANCE GATE OPENING VERSUS TAILWATER ELEVATION											
TW Tailwater Elevation (ft)	Qaws AWS Discharge (cfs)	DH Target Entr Head (ft)	Qent Entrance Discharge (cfs)	GO Gate Opening (ft)	% of Max GO		TW Tailwater Elevation (ft)	Qaws AWS Discharge (cfs)	DH Target Entr Head (ft)	Qent Entrance Discharge (cfs)	GO Gate Opening (ft)	% of Max GO
1250.0	27	3.60	45	1.0	20%		1252.8	51	1.25	69	2.6	51%
1250.1	28	3.50	46	1.0	20%		1252.9	52	1.25	70	2.6	52%
1250.2	28	3.40	46	1.0	21%		1253.0	54	1.25	72	2.7	53%
1250.3	29	3.30	47	1.1	21%		1253.1	55	1.25	73	2.7	54%
1250.4	29	3.20	48	1.1	22%		1253.2	56	1.25	75	2.8	55%
1250.5	30	3.10	48	1.1	23%		1253.3	58	1.25	76	2.8	57%
1250.6	31	3.00	49	1.2	23%		1253.4	59	1.25	78	2.9	58%
1250.7	31	2.90	49	1.2	24%		1253.5	61	1.25	79	2.9	59%
1250.8	32	2.80	50	1.2	25%		1253.6	62	1.25	80	3.0	60%
1250.9	32	2.70	51	1.3	26%		1253.7	64	1.25	82	3.0	61%
1251.0	33	2.60	51	1.3	26%		1253.8	65	1.25	83	3.1	62%
1251.1	34	2.50	52	1.4	27%		1253.9	67	1.25	85	3.2	63%
1251.2	34	2.40	52	1.4	28%		1254.0	68	1.25	86	3.2	64%
1251.3	35	2.30	53	1.5	29%		1254.1	70	1.25	88	3.3	65%
1251.4	35	2.20	54	1.5	30%		1254.2	71	1.25	89	3.3	66%
1251.5	36	2.10	54	1.6	31%		1254.3	72	1.25	91	3.4	67%
1251.6	37	2.00	55	1.6	32%		1254.4	74	1.25	92	3.4	68%
1251.7	37	1.90	55	1.7	33%		1254.5	75	1.25	94	3.5	70%
1251.8	38	1.80	56	1.7	35%		1254.6	77	1.25	95	3.5	71%
1251.9	38	1.70	57	1.8	36%		1254.7	78	1.25	97	3.6	72%
1252.0	39	1.60	57	1.9	38%		1254.8	80	1.25	98	3.6	73%
1252.1	40	1.50	59	2.0	40%		1254.9	80	1.25	98	3.6	73%
1252.2	42	1.40	60	2.1	42%		1255.0	80	1.25	98	3.6	73%
1252.3	43	1.30	62	2.2	45%		1255.1	80	1.25	98	3.6	73%
1252.4	45	1.25	63	2.3	47%		1255.2	80	1.25	98	3.6	73%
1252.5	46	1.25	64	2.4	48%		1255.3	80	1.25	98	3.6	73%
1252.6	48	1.25	66	2.4	49%		1255.4	80	1.25	98	3.6	73%
1252.7	49	1.25	67	2.5	50%		1255.5	80	1.25	98	3.6	73%

14. Use the hoist to lift the fish ladder fish screen gate to a point that will clear the water surface by at least 2 ft for all tailrace elevations.
15. Open diffuser valves 1A and 1B. All other valves should be fully closed.
16. Close the diffuser valves (using the actuator controls) that correspond to the current tailwater conditions per Table 3. Close the breakers for the AWS pumps located in panel MCC-FCQ1
17. Pick two AWS pumps for operation and move each selector switch located on the VFD cabinet to "hand" position. Perform the following operations for each pump that is selected for operation.
    a. Ensure that a green light indicates the pumps are ready
    b. Press the square green button; the pump should begin accelerating to 30 Hz, this is the preset minimum pump RPM. A red light should be lit indicating that the pumps are running
    c. Press and hold the arrow up button until the pump starts to accelerate; this may take 5-7 seconds.
    d. Push the arrow up until the display reads 50 Hz (83% max RPM)[4]
18. The AWS pumps will be temporarily noisy while the pipe fills with water, but should quiet within 2 - 5 minutes
19. Set pump speed and fish ladder entrance gate height;
    a. Adjust AWS pump speed to match the target discharge rate determined in step 2
    b. Open or close the fish ladder entrance gate to regulate entrance head to 1.0 – 1.5 feet (entrance head is difference between water level elevations in pool 1 and tailwater) and assure that pool 1 water depth ≥ 5 feet (pool 1 water level ≥ 1253.6 feet)
        i. Opening the gate will reduce pool height for a given flow rate
        ii. Closing the gate will increase pool height for a given flow rate
        iii. The entrance gate should be lowered or raised as a function of DH subject to the following governing rules:

- Minimum Gate Opening (GO) with FWS only = 0.75 feet = 15% GO
- Minimum GO with AWS + FWS = 1.5 feet = 30% GO (Fisheries criteria)
- Maximum GO = 5 feet = 100% GO (Physical limits)
- Minimum Pool depth = 5 feet (Fisheries criteria)
- Optimum entrance head (DH) is between 1.1 – 1.4 feet (average 1.25 feet)

        iv. The target entrance head (DH) is the maximum of the following two values:
            - 1.25 feet ± 0.15 feet
            - 1248.6 + 5.0 – LT-010

See Table 5 to determine recommended adjustments (feet or % opening) in the entrance gate opening based on the latest on entrance head measurement or Pool 1 depth. Changes needed to correct the entrance head are shown in the upper portion of the table, and changes required to raise the Pool 1 depth to the minimum 5 feet are shown in the bottom portion. Note that recommended adjustments preceded by negative signs means the entrance gate opening should be reduced.

    c. Check AWS discharge rate and modify AWS pump speed if entrance gate change was large enough to change the flow rate.

[4] Note: The Minimum RPM for the AWS Pumps is 30 Hz or 50%.

20. Monitor Tailrace conditions and adjust pump speed, valves and entrance gate to maintain the following criteria:
    a. Weir 31 pool ladder head 1.0 feet +/- 0.1 feet (Check every 10 minutes)
    b. Pool 1 water depth at least 5 feet deep (Check every 30 minutes)
    c. Ladder flow to tailrace differential from 1.1 feet to 1.4 feet (Check every 30 minutes)
    d. The guidance from Table 3 and Table 4 (and PLC operation) are configured to assure that the difference in water level elevations between Pool 2 and Pool 1 is $\leq$ 1 foot
21. Check after 60 minutes: check the tailwater elevation
    a. If no change, then no action is required with AWS pumps or diffuser valves and go to step 19.
    b. If changed, repeat steps 1-a , 1-b, and go to step 18

Table 5 – Manual Operation of Entrance Gate to Regulate Entrance Head (DH)

Entrance Gate Adjustments							
DH = Entrance head = LT-002 - LT-010							
Change Condition:					Action	Change in GO	
IF DH ≤	0.5	ft			Reduce gate opening	-1.0	Feet or -20%
IF DH is between	0.5	ft and	0.8	ft	Reduce gate opening	-0.5	Feet or -10%
IF DH is between	0.8	ft and	1.0	ft	Reduce gate opening	-0.3	Feet or -6%
IF DH is between	1.0	ft and	1.1	ft	Reduce gate opening	-0.1	Feet or -2%
IF DH is between	1.1	ft and	1.4	ft	no change		
IF DH is between	1.4	ft and	1.5	ft	Increase gate opening	0.1	Feet or +2%
IF DH is between	1.5	ft and	1.7	ft	Increase gate opening	0.1	Feet or +2%
IF DH is between	1.7	ft and	2.0	ft	Increase gate opening	0.2	Feet or +4%
IF DH ≥	2.0	ft			Increase gate opening	0.3	Feet or +6%
NOTES:							
* Minimum Allowable GO = 1.5 feet; Maximum Allowable Go = 5.0 feet.							
Y = Pool 1 Depth = LT-002 - Invert Elevation 1248.6 feet							
Change Condition:					Action	Change in GO	
IF Y ≤	4.5	ft			Reduce gate opening	15%	
IF Y is between	4.5	ft and	4.8	ft	Reduce gate opening	10%	
IF Y is between	4.8	ft and	5.0	ft	Reduce gate opening	5%	

3.5.2. Normal Facility Operation

To operate the Cougar AFCF, follow the procedures in the Automatic Normal Operation section (section 3.5.2.2). When automatic operation it is not possible or desirable, Cougar AFCF operation can be done manually. To operate the Cougar AFCF manually, follow the procedures in the Manual Startup section (section 3.5.1.2). For the facility to operate satisfactorily, the normal operating criteria in section 3.5.2.1 must be met.

3.5.2.1. Normal Operating Criteria

The following information details operational criteria for operation of the facility. Any deviation observed should be reported to the engineering design branch at Robert Duncan Plaza.

See plate M-444

Pump output varies to meet these conditions.
See section 3.5.2.4.

LADDER

- Ladder entrance head is 1.25 ft ± 0.15ft
- Pool 1 depth = 5 ft ± 0.1ft
- Ladder pool differential at Pool 31 = 1 ft ± 0.1ft (PLC applies 0.90 ft± 0.1ft)
    - Pool 31 depth = 6.0 ft +/- 0.1ft

3.5.2.2. Automatic Normal Operation

To operate the Cougar AFCF, follow the procedures below. For the facility to operate satisfactorily, the normal operating criteria in section 3.5.2.1 must be met.

1. The selector switch located on the VFD cabinet; should be in "auto" position for each FWS pump (or minimum two operating pumps).
    a. FWS pumps will automatically adjust to meet ladder head (1.0 ± 0.1 feet) at Pool 31 (LT-012) regardless of changes due to operation of false weir, or filling of post-sort ponds.
2. The selector switch located on the VFD cabinet; should be in "auto" position for each AWS pump (or minimum two operation pumps).
    a. Diffuser Valves will adjust automatically when tailwater readings (LT-010) cross a setpoint for open/close of a diffuser valve as shown in Table 6 or Figure 5.
    b. Program will adjust AWS discharge as a direct function of tailwater reading (LT-010) as shown in Table 6 or Figure 4.
    c. Diffuser valves to open or close. The program will run the AWS pumps until flow rate matches tailrace requirements based on criteria. The entrance gate will adjust based on minimum pool 1 depth (5 feet) and entrance head (difference between water surface elevations in pool 1 and tailrace: 1.1 – 1.4 feet) similar in procedure to Table 7.
    d. Touch the "X" to go to the home screen
3. Observe operation and periodically compare pertinent level transmitters against staff gages (some minor differences or variation can be expected in all of these comparisons due to flow turbulence)
    a. Check LT-012 with staff gage at Pool 31.
    b. Check LT-0101 against tailwater staff gage.
    c. Check LT-002 against pool 1 staff gage
4. If the system is running out of criteria the pumps can be placed in manual operation by touching the "manual operation" button. The keypad can be used to adjust pump speeds.
5. The valves, pumps, and the entrance gate can also be controlled manually
    a. WARNING ONLY QUALIFIED PERSONELL SHOULD ATTEMPT MANUAL OPERATION.
    b. CLOSING VALVES AT HIGH FLOWS MAY DAMAGE PUMPS.

c. CLOSING THE ENTRANCE GATE AT HIGH FLOWS WILL OVERFLOW THE LADDER
d. For manual control of the pumps touch the button “manual control” and adjust using the keypad
e. For manual control of the valves touch “diffuser valves” button at the home screen and press “adjust” for the pump that needs to be adjusted. Note the actuator moves closed or open and should not be used in an intermediate position.
f. For entrance gate control; from the home screen touch the button “entrance gate” and then touch the button “manual control”. The opening can be adjusted by touching the keypad button and entering three numbers corresponding to the percent open desired.

3.5.2.3. Manual Normal Operation

When automatic operation it is not possible or desirable, Cougar AFCF operation can be done manually. To operate the Cougar AFCF manually, follow the procedures below. (Note: Automatic Normal Operation should be used when possible.) For the facility to operate satisfactorily, the normal operating criteria in section 3.5.2.1 must be met.

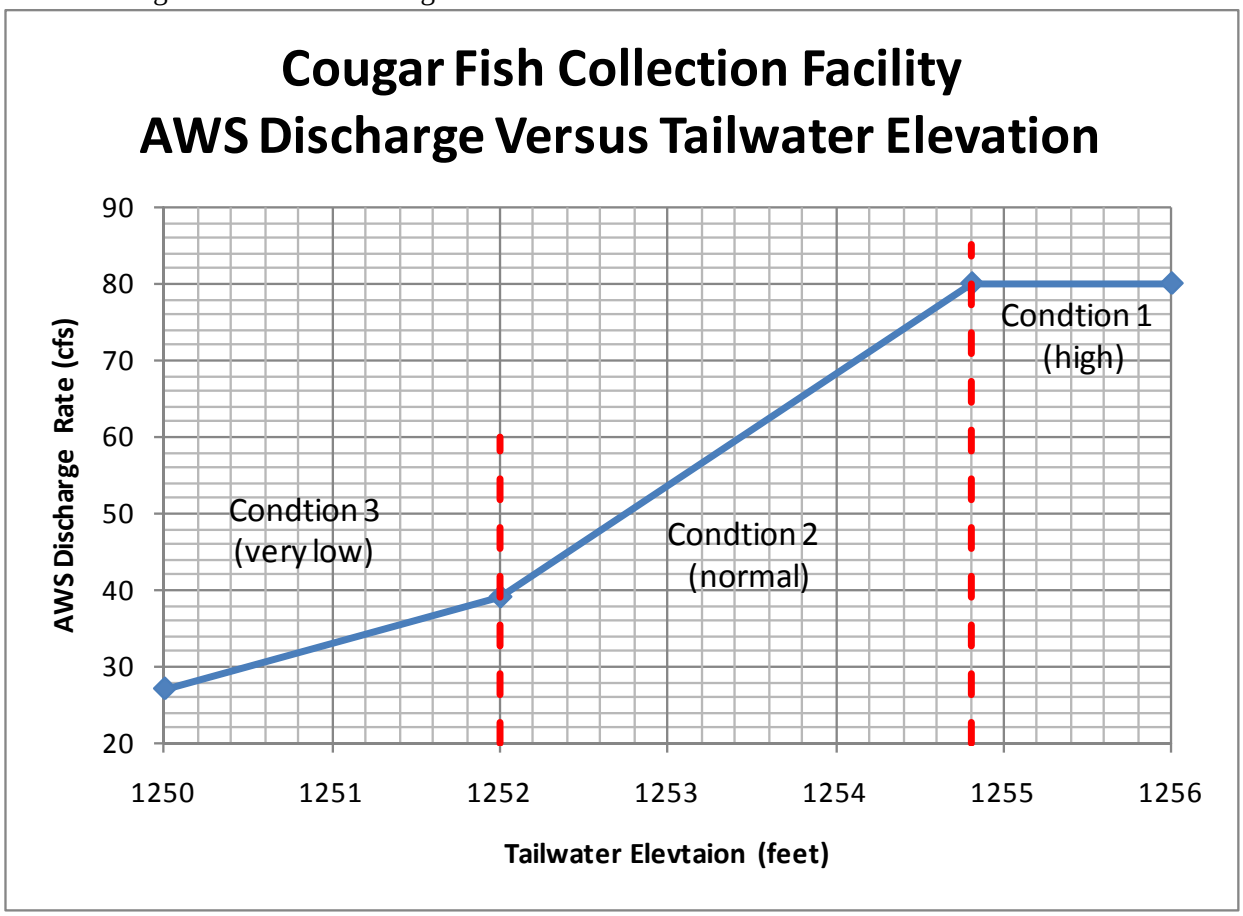
In the event the PLC is unable to control the pumps for automatic operations, there are a number of staff gauges for manual verification of water levels. Operations personnel will need to verify the facility is running within ESA fish criteria during this time.

1. The selector switch located on the VFD cabinet; should be in “auto” position for each FWS pump (or minimum two operating pumps).
   a. FWS pumps will automatically adjust to meet ladder head (1.0 ± 0.1 feet) at Pool 31 (LT-012) regardless of changes due to tailwater change, operation of false weir, or filling of post-sort ponds.
2. The selector switch located on the VFD cabinet; should be in “auto” position for each AWS pump (or minimum two operation pumps).
   a. Diffuser Valves will adjust automatically when tailwater readings (LT-010) cross a setpoint for open/close of a diffuser valve as shown in Table 7 or Figure 5.
   b. Program will adjust AWS discharge as a direct function of tailwater reading (LT-010) as shown in Table 7 or Figure 4.
   c. Diffuser valves to open or close. The program will run the pumps until flow rate matches tailrace based on criteria. The entrance gate will adjust based on minimum pool 1 depth (5 feet) and entrance head (difference between water surface elevations in pool 1 and tailrace: 1.1 – 1.4 feet).
   d. Touch the “X” to go to the home screen
3. For manual control of the following components:
   a. All pumps: touch the button “manual control” for FWS and AWS pumps (or just one, if only one set needs to be in manual) and adjust by entering three numbers corresponding to the percent open desired.
   b. Diffuser valves: touch “diffuser valves” button at the home screen and press “adjust” for the valve that that needs to be opened or closed. Note the actuator moves closed or open and should not be used in an intermediate position.

c. Entrance gate: from the home screen, touch the button “entrance gate” and then touch the button “manual control”. The opening can be adjusted by touching the “keypad” button and entering three numbers corresponding to the percent open desired.

4. Check Ladder Head at Pool 31
   a. Read ladder head at 10 minute intervals
   b. Read ladder head from Staff gage or LT-012
   c. Target ladder head = 1.0 feet ± 0.1 feet
      i. If Ladder head > 1.1 feet, reduce FWS pump speeds (%RPM)
      ii. If Ladder head <0.9 feet, increase FWS pump speeds (% of max RPM)
      iii. Typical percent of max RPM is between 85 – 90%
5. Record tailwater level (TW staff gage or LT-010)
   a. Read tailwater level at 60 minute intervals.
   b. If tailwater elevation changed, then adjust AWS discharge rate (see Table 6 or Figure 4)
   c.

Figure 4 – AWS Discharge Rate as Function of Tailwater Elevation



   d. If tailwater changed such that it has crossed a setpoint for an AWS diffuser valve (see Figure 5 or Table 6), THEN open or close diffuser valve depending on whether the tailrace is rising or falling.
   e. EXAMPLE 1 (Rising TW):
      i. TW < 1252.8 feet in previous reading,

1. Status: Diffuser valves 1-A and 1-B open

ii. TW goes above 1252.8 feet,

iii. THEN open Diffuser Valve 2 (No other change)

f. EXAMPLE 2 (Falling TW)

i. TW > 1254.2 feet in previous reading,

1. Status All Diffuser Valves are open

ii. TW drops below 1254.2 feet

iii. THEN close Diffuser Valve 4

Figure 5 – Diffuser Valve Settings as Function of Tailwater Elevation

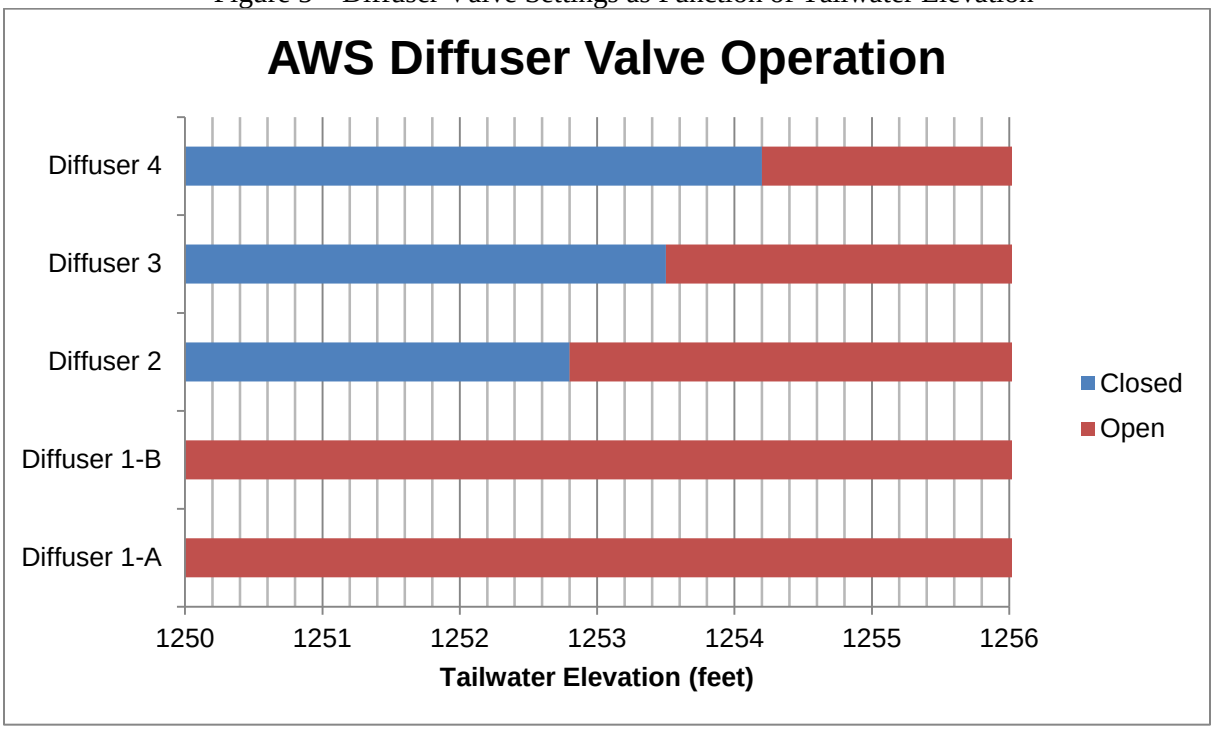


Table 6 – Combined Table for AWS Discharge, Number of Pump Operating and Maximum Diffuser Valve Open Versus Tailwater Elevation

COMBINED TABLE FOR AWS DISCHARGE AND VALVE SETTING VERSUS TAILWATER ELEVATION							
Tailwater Elevation (ft)	AWS Discharge (cfs)	Number of Pumps Operating	Maximum Diffuser Valve Open	Tailwater Elevation (ft)	AWS Discharge (cfs)	Number of Pumps Operating	Maximum Diffuser Valve Open
1250.0	27	1	1-B	1252.8	51	2	2
1250.1	28	1	1-B	1252.9	52	2	2
1250.2	28	1	1-B	1253.0	54	2	2
1250.3	29	1	1-B	1253.1	55	2	2
1250.4	29	1	1-B	1253.2	56	2	2
1250.5	30	1	1-B	1253.3	58	2	2
1250.6	31	1	1-B	1253.4	59	2	2
1250.7	31	1	1-B	1253.5	61	2	3
1250.8	32	1	1-B	1253.6	62	2	3
1250.9	32	1	1-B	1253.7	64	2	3
1251.0	33	1	1-B	1253.8	65	2	3
1251.1	34	1	1-B	1253.9	67	2	3
1251.2	34	1	1-B	1254.0	68	2	3
1251.3	35	1	1-B	1254.1	70	2	3
1251.4	35	1	1-B	1254.2	71	2	4
1251.5	36	1	1-B	1254.3	72	2	4
1251.6	37	1	1-B	1254.4	74	2	4
1251.7	37	1	1-B	1254.5	75	2	4
1251.8	38	1	1-B	1254.6	77	2	4
1251.9	38	1	1-B	1254.7	78	2	4
1252.0	39	2	1-B	1254.8	80	2	4
1252.1	40	2	1-B	1254.9	80	2	4
1252.2	42	2	1-B	1255.0	80	2	4
1252.3	43	2	1-B	1255.1	80	2	4
1252.4	45	2	1-B	1255.2	80	2	4
1252.5	46	2	1-B	1255.3	80	2	4
1252.6	48	2	1-B	1255.4	80	2	4
1252.7	49	2	1-B	1255.5	80	2	4

g. Record entrance head (If Staff Gage: pool 1 elevation – TW)
h. Read tailwater level at 30 minute intervals
i. Entrance head = difference between water surface elevations in Pool 1 (Pool 1 staff gage or LT-002) and Tailrace (TW staff gage or LT-010). The entrance head and Pool 1 depth values can be directly read from the Touch screen for 'Entrance Gate' in the PLC room.

i. Open/close entrance gate to regulate entrance head (1.1 – 1.4 feet) and assure that pool 1 water depth ≥ 5 feet (or pool 1 water level ≥ 1253.6 feet). See Table 7 for recommended adjustments based on entrance head and pool 1 readings.

1. Opening gate will reduce pool height for a given flow rate
2. Closing gate will increase pool height for a given flow rate.
3. The entrance gate should be lowered or raised as a function of DH subject to the following governing rules:
   - Minimum Gate Opening (GO) with FWS only = 0.75 feet = 15% GO
   - Minimum GO with AWS + FWS = 1.5 feet = 30% GO (Fisheries criteria)
   - Maximum GO = 5 feet = 100% GO (Physical limits)
   - Minimum Pool depth = 5 feet (Fisheries criteria)
   - Optimum entrance head (DH) is between 1.1 – 1.4 feet (average 1.25 feet)

ii. The target entrance head (DH) is the maximum of the following two values:

- 1.25 feet ± 0.15 feet
- 1248.6 + 5.0 – LT-010

Table 7 – Manual Operation of Entrance Gate to Regulate Entrance Head (DH)

Entrance Gate Adjustments							
DH = Entrance head = LT-002 - LT-010							
Change Condition:					Action	Change in GO	
IF DH ≤	0.5	ft			Reduce gate opening	-1.0	Feet or -20%
IF DH is between	0.5	ft and	0.8	ft	Reduce gate opening	-0.5	Feet or -10%
IF DH is between	0.8	ft and	1.0	ft	Reduce gate opening	-0.3	Feet or -6%
IF DH is between	1.0	ft and	1.1	ft	Reduce gate opening	-0.1	Feet or -2%
IF DH is between	1.1	ft and	1.4	ft	no change		
IF DH is between	1.4	ft and	1.5	ft	Increase gate opening	0.1	Feet or +2%
IF DH is between	1.5	ft and	1.7	ft	Increase gate opening	0.1	Feet or +2%
IF DH is between	1.7	ft and	2.0	ft	Increase gate opening	0.2	Feet or +4%
IF DH ≥	2.0	ft			Increase gate opening	0.3	Feet or +6%
NOTES:							
* Minimum Allowable GO = 1.5 feet; Maximum Allowable Go = 5.0 feet.							
Y = Pool 1 Depth = LT-002 - Invert Elevation 1248.6 feet							
Change Condition:					Action	Change in GO	
IF Y ≤	4.5	ft			Reduce gate opening	15%	
IF Y is between	4.5	ft and	4.8	ft	Reduce gate opening	10%	
IF Y is between	4.8	ft and	5.0	ft	Reduce gate opening	5%	

3.5.3. Fish Processing Operation Procedures

3.5.3.1. Finger weir

LOCATION:
South end of pre-sort pool
Reference picture in section 2.3.1.

REFERENCE:

- Contract drawing S-118 thru S-124

DESCRIPTION:
The finger weir is a moveable piece of grating that keeps fish from jumping out of the pre-sort pool and keeps any debris from traveling down the ladder.

OPERATION:
The finger weir is adjusted to match the water level of the pre-sort pool. The long handle located on the South East side of the pre-sort pool locks the weir in place. A pin keeps the handle in the locked position. To move the handle, remove the pin, lift the handle, and then use a pole to adjust the grating. Once satisfied with the new position push the handle down and retain it with the pin. See Figure 6

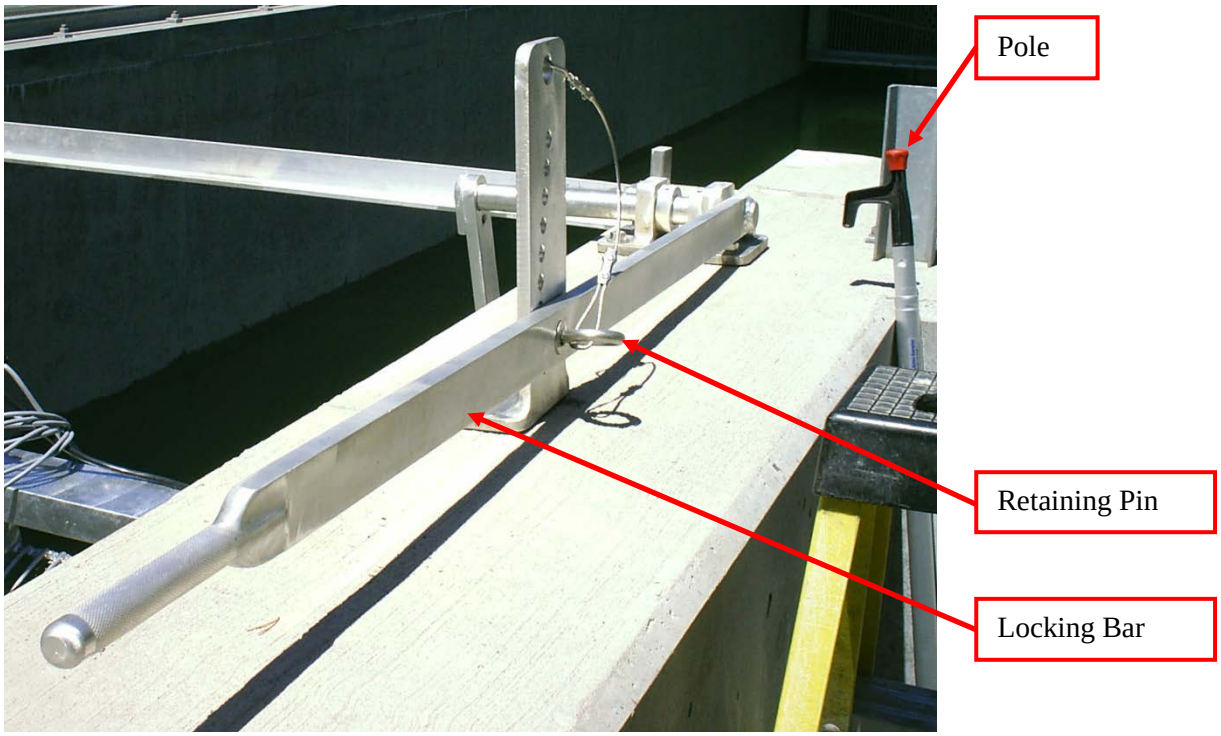


Figure 6 - Finger Weir Handle

3.5.3.2. Crowder

LOCATION:
South end of pre-sort pool (Ready to crowd fish)

North end of pre-sort pool (Parked for storage)
Reference picture in section 2.3.2.

REFERENCE:

- Contract drawing M-432 thru M-441

DESCRIPTION:
The crowder presents a screen barricade at the south side of the pre-sort pool, mechanically forcing fish north to jump into the false weir.

OPERATION:
The crowder is operated from the cabinet located at the North West corner of the pre-sort pool. The crowder is operated by button and will slowly ramp up to full speed in the direction specified until it reaches a ramping sensor that decelerates the crowder down to a stop. The screen moves up and down without any ramping. The buttons do not need to be held to function and the stop button can be pressed at anytime. The Crowder has a traversing speed of 5 FT/MIN; crowding time could be up to 20 Min.

3.5.3.3. False Weir

LOCATION: North end of pre-sort pool. Reference picture in section 2.3.3.

REFERENCE:

- Contract drawing M-415 and M-418

DESCRIPTION:
The False weir presents a hydraulic profile that induces a fish to jump. Once the fish has cleared the false weir, it enters the flume to be processed.

OPERATION:
The false weir is operated from the cabinet on the north west side of the pre-sort pool. See Figure 7. The false weir works by diverting the ladder flow from the pre-sort pool inlet diffusers to the false weir. The three way diversion valve controls this flow in two ways; it separates the flow and then meters the flow to the false weir. Generally the false weir flow is tuned to stimulate the majority of the fish into jumping and then left alone.

AVOID: Operation of the false weir while filling the truck and post-sort pools. These operations will diminish the operation of the false weir and may drive the ladder out of criteria for the duration of operations.

NEVER: Operate the diversion valve at less than 43 percent open with the false weir valve 100 percent open or less than 70 percent open with the false weir valve closed. Prior to closing the diversion valve, the false weir valve should be at least 50 percent open.

CAUTION: The pumps will not run beyond 100% of their rated operation. In the event sorting facility operations utilize the remaining capacity of the pumps the ladder may fall out of criteria.

NOTE: Tailwater elevation will affect flow; there may be some variation if there is a large change in tailwater elevation.

Prior to operation of the false weir:

- Verify that the 8” drain valve is fully open.
- Verify that the 2” drain valve is fully open.
- Ensure false weir valve is at least 50 open. This control is located on the outside of the cabinet.
- Move the diversion valve to 50 percent open. This control is located on the inside of the cabinet.
- During false weir operation; the system is the most efficient if the false weir valve is 100% open and the diversion valve is set from 50% open to 85% open. The water plume should be adjusted with the diversion valve only and flow through the false weir should be minimized if possible (Biologist determined).
- Adjust 8” drain allowing a small stream of water to lubricate the surface of the flume (Biologist determined).
- Fine tune using the 2” drain valve if excess water dilutes the clove oil concentration in the anesthetic tank.
- Fish transfer operations may commence
- After the fish have been processed the diversion valve is set to 100 percent open and the false weir valve is set to 100 percent closed.

TUNING

The false weir requires adjustment to maximize the amount of water presented to the fish in the pre-sort pool and drained on the backside to optimize the amount of water in the flume. The amount of water in the flume should be determined by a biologist. There are two drains for the false weir; one 2 inch diameter drain and one 8 inch diameter drain. The 8 inch drain should be adjusted first and if finer adjustment is needed, the 2 inch drain can be used to more precisely control the flow of water in the flume.

See Figure 8.

False Weir Valve control:
Min: False weir is not active. Flow from the FWS pumps is diverted through the pre-sort diffusers into the pre-sort pool.
Max: Maximum flow that is available goes through the false weir. Caution: The valve is very slow to open and close, adjust in small increments.

Valve position indicator lights

Figure 7 – False Weir Cabinet

ADJUSTING FLOW

Inside the control cabinet there is another potentiometer that controls flow bias. The potentiometer controls the position of the diversion valve. This valve redirects supply flow from the pre-sort pool to the false weir. The flow bias should be adjusted with the false weir flow valve at 100 percent open. The biologists have determined the ideal settings to process fish; the diversion valve control should be set to 5.2 with the false weir valve set to 10.0 and both false weir drains at 100 percent open.

CAUTION: VERIFY BOTH DRAINS ARE OPEN PRIOR TO OPERATING THE FALSE WEIR TO AVOID OVERFILLING TH ANESTHETIC TANK.

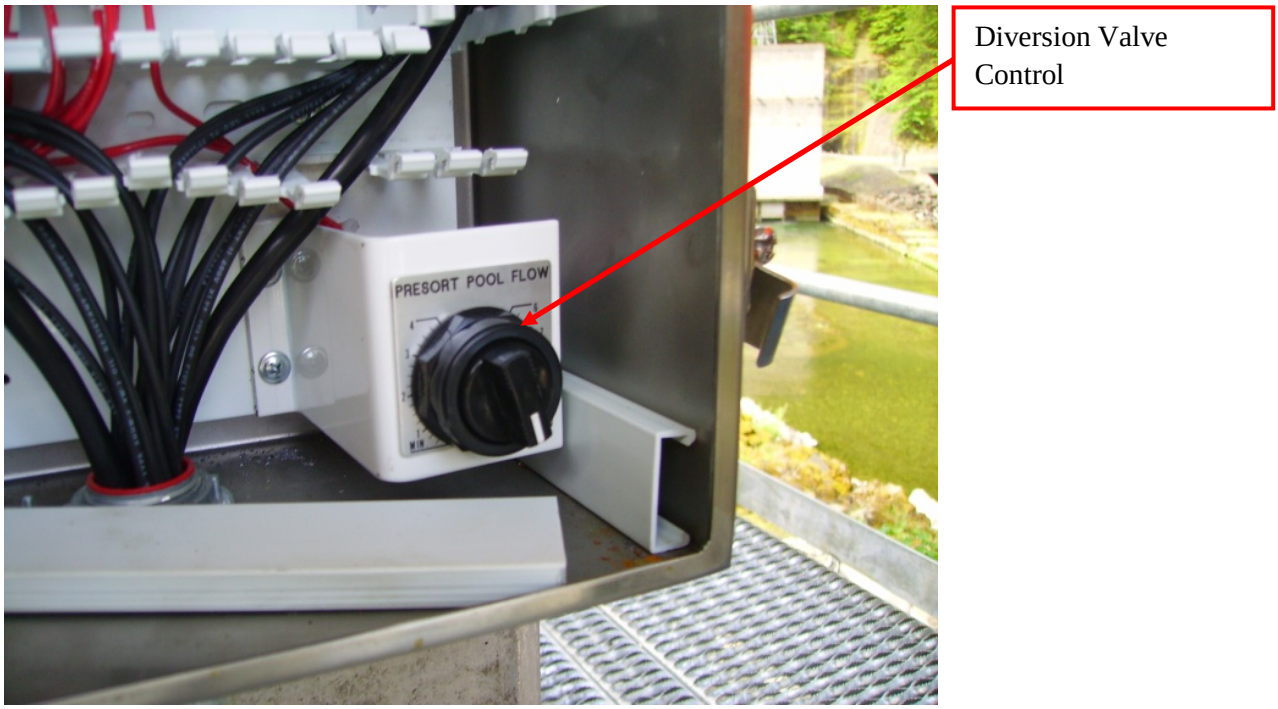


Figure 8 - Inside of Cabinet

Figure 9 – 8 inch Drain Location

3.5.3.4. Switch Gate

LOCATION:

Sorting Facility, second floor.

Reference picture in section 2.4.1.

REFERENCE:

- Contract drawing M-415, M-422 thru M-424

DESCRIPTION:
The switch gate is a separation in the fish transfer flume where fish can be directed to pool 1 or the anesthetic tank.

OPERATION:
An operator may operate the switch gate from two locations; one location is near the crowder operation cabinet and the other is located at the anesthetic tank. A needle valve near the pneumatic cylinder controls the speed of the gate, currently it is set for minimum speed. Recommend keeping the gate speed slow to minimize stress on components and structure.

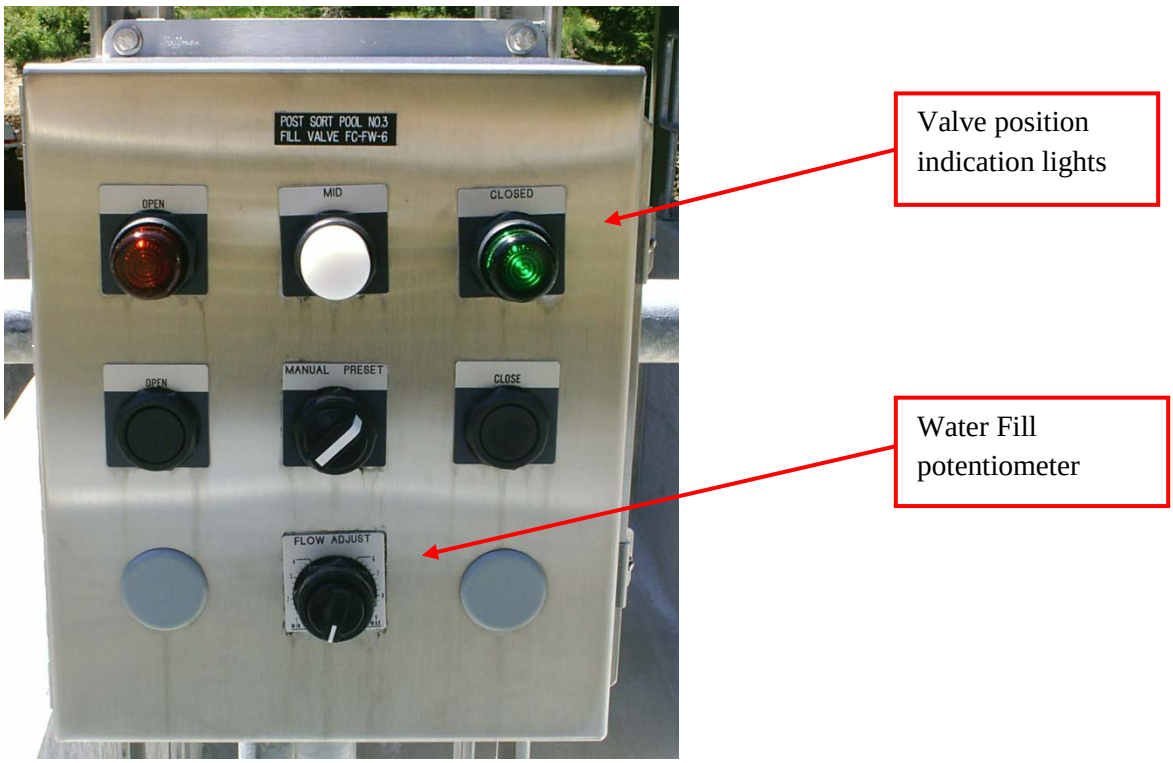
3.5.3.5. Post-Sort Pool Fill Controls

LOCATION:
Sorting Facility, upper level, Eastern side of the post-sort pools.

REFERENCE:
- Contract Drawing E-404

DESCRIPTION:
These control boxes regulate the filling and recirculation of water in the post-sort pools.

OPERATION:
Prior to filling the post-sort pool the operator must ensure the knife gate at the bottom of the pool is closed. To fill the pool the following tasks are completed:
- Set the water fill potentiometer to “max”, after a short period of time water will emerge from the water fill diffuser in the floor of the post-sort pool.
- Observe the water level in the pool until it reaches the overflow drain on the western interior wall of the pool
- Set the water fill potentiometer to a lower level such that the draining water does not overwhelm the overflow drain.



3.5.3.6. Post-Sort Pool Drain Controls

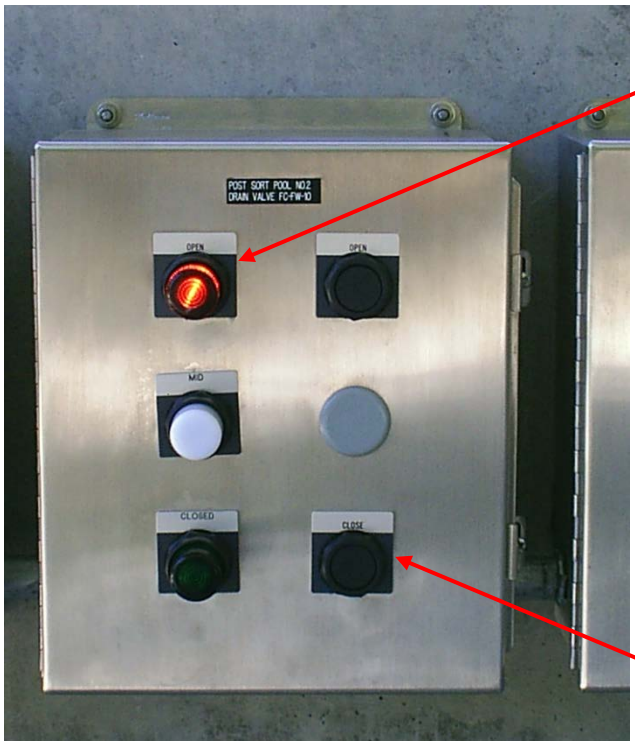
LOCATION:
Sorting Facility, upper level, Western side of the post-sort pools.

REFERENCE:

- Contract Drawing E-404

DESCRIPTION:
These control boxes regulate the draining operation for the post-sort pools.

OPERATION:
Press and hold the open button to open the drain (momentary?)
Press and hold the close button to close the drain.



Valve position indication lights

Valve actuation buttons

3.5.3.7. Truck Fill Pipe Controls

LOCATION:

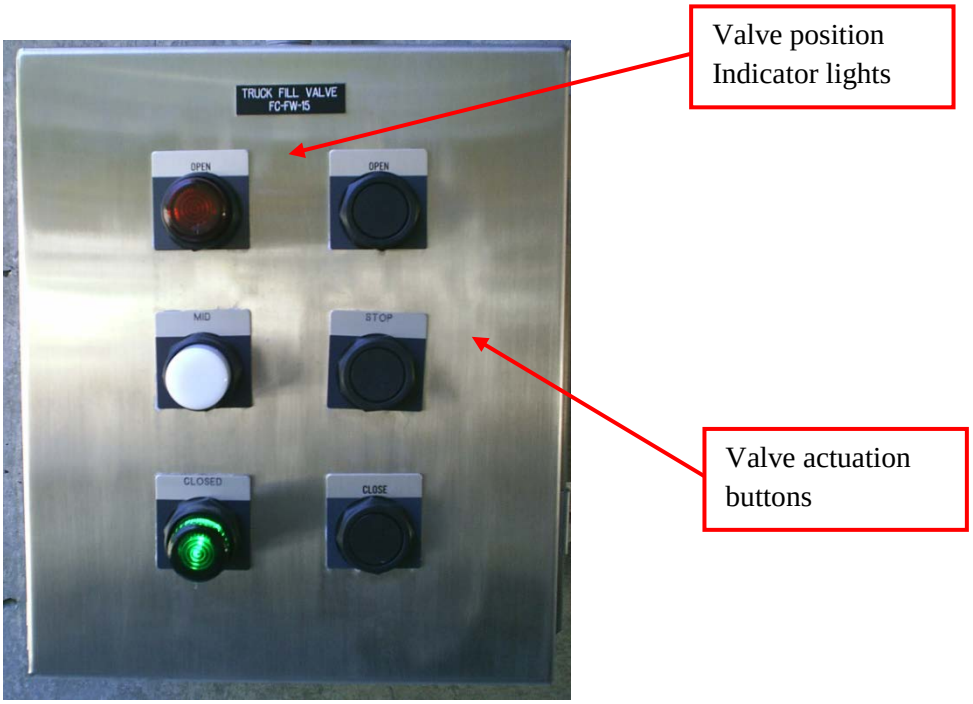
Sorting Facility, Eastern side wall of the lower level.

REFERENCE:

- Contract Drawing E-

DESCRIPTION:

These control boxes regulate the draining operation for the post-sort pools.



OPERATION:
Press the open button to open the drain
Press the stop button to stop the valve in its current position.
Press the close button to close the drain.

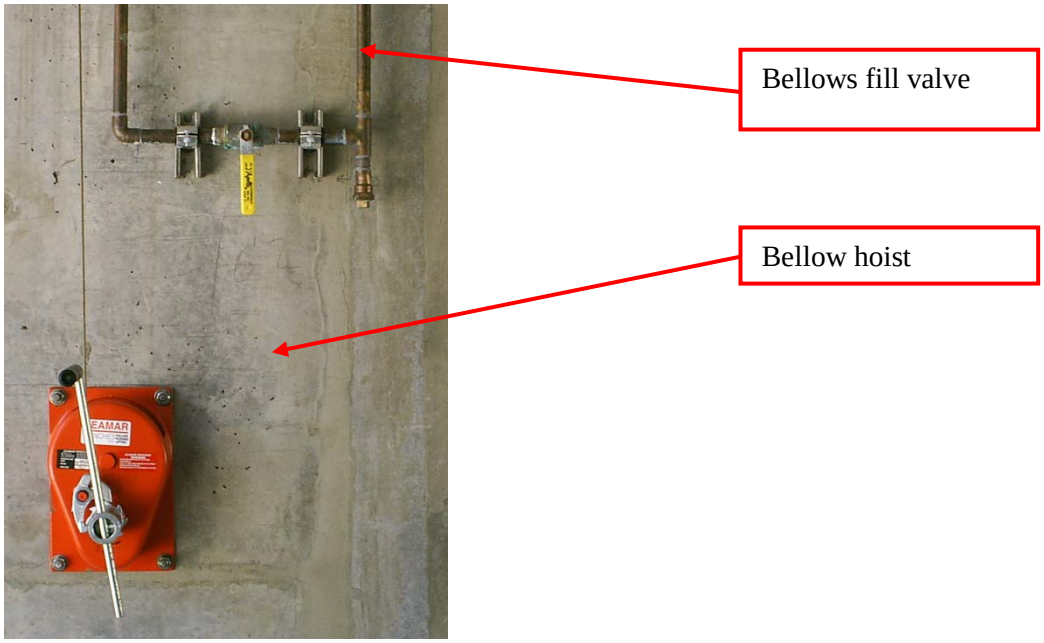
3.5.3.8. Bellow Hoists

LOCATION:
Sorting Facility, lower level, Western side of the fish transfer area.

REFERENCE:
- Contract Drawing E-404

DESCRIPTION:
Manual hand crank hoists, typical for three bellows.

OPERATION:
To deploy the bellows the operator cranks counter clockwise to extend the bellows and clock wise to retract the bellows. Note the manual hoist has a built in friction clutch, it is not necessary to lock it in place.



3.5.3.9. Post-Sort Knife Gate Controls

LOCATION:
Sorting Facility, lower level, Western side of the fish transfer area.

REFERENCE:

- Contract Drawing M-429 and M-430

DESCRIPTION:
The knife gate controls are pneumatic 4 position 2 way detent valves, manually actuated.

OPERATION:
Moving the detent lever will open or close the knife gate valve overhead.

3.5.3.10. Fish Transfer Operation

LOCATION:

Sorting Facility, lower level, beneath the post-sort pools.
Reference picture in section 2.4.4.

REFERENCE:

- Contract Drawing M-429,M-430

DESCRIPTION:

The Fish Transfer operation involves the use of the post-sort pool controls, the truck fill pipe, the bellows hoists, the knife gate control valves, four pairs of vise grips, and a drain valve located on the truck.

OPERATION:

A fish transfer operation will include the following steps:

1. Identify the post-sort pool that will transfer the fish.
2. Start draining the water from the identified post-sort pool by using the post-sort pool drain controls.
3. Maneuver the fish truck so the opening in the top of the truck tank is aligned with the truck fill pipe.
4. Fill the truck tank with water using the fill valve control box, monitor the truck tank water level and fill until water flows out of the vents at the top of the truck tank.
5. Maneuver the fish truck so the opening in the top of the truck tank is aligned with the bellows assembly that is associated with the drained pool.
6. Once the pool has drained a light will indicate….For the follow on contract
7. Attach the bellows to the opening on the top of the truck tank and secure using the four vise grips. This connection must be sealed, ensure the vise grips are securely fastened and evenly distributed around the lip of the bellow assembly.
8. Start filling the bellows with water by turning on the bellows fill valve.
9. Observe the bellows vent valve, and once water begins to come, out close the valve.
10. Open the knife gate.
11. Open the truck drain valve.
12. The operator must observe the process and then close the truck drain valve once the water level in the truck tank is approximately 12” below the top of the tank.
13. Disconnect the bellows assembly and hoist the bellows upward to clear any obstacles on the truck.

3.5.3.11. Anesthetic Tank

LOCATION:
Sorting Facility, second floor.
Reference picture in section 2.4.6.

REFERENCE:

- Contract drawing M-425, M-426.

DESCRIPTION:
The Anesthetic tank is a large aluminum tank attached to the end of the flume. It has a 2 inch fill valve, aeration system, 1inch drain valve, 2 inch flume drain, and marine plywood lids.

OPERATION:
A biologist will determine the concentration of clove oil to use with a filled tank of water.
The 2 inch flume drain empties water into the open drain for the facility.
The 1 inch drain empties the water in the rocky area on the bottom level of the facility.
The aeration system uses filtered compressed air and an aeration stone to oxygenate the water A biologist will determine the rate of infusion and when to use the system

3.5.3.12. Recovery Tank

LOCATION:
Sorting Facility, second floor, South West corner
Reference picture in section 2.4.1.

REFERENCE:

- Contract drawing M-427

DESCRIPTION:
The recovery tank is a large stainless steel tank outfitted with a globe valve

OPERATION:
A globe valve is used to fill the tank with water and provide water circulation. A biologist will determine the rate of recirculation water needed by the fish. Anesthetized fish are placed in the tank to recover. Once a biologist has determined the fish is able to function properly the knife gate is opened and the fish are returned to the river. The knife gate is operated by button. See Figure 10.

Figure 10 – Recovery Tank

Insert Recovery Tank Picture Here

3.5.4. Normal Facility Shutdown

To shut down the Cougar AFCF AWS system, follow the procedures in section 3.5.4.1 AWS System Shutdown. To shut down the entire Cougar AFCF, follow the procedures in sections 3.5.4.2 (Facility Shutdown), 3.5.4.3 (Dewatering Procedure), and 3.5.4.4 (Winterization).

3.5.4.1. AWS System Shutdown

To shut down the Cougar AFCF AWS system, follow the procedures below.

1. From AWS screen, press the "stop pumps" push button and confirm
2. Change to manual control of Entrance Gate and lower to 30% opening or 18 inches (minimum opening for fish passage)
   a. Pool 1 may drop below 5 feet if TW is low. Use biological discretion on whether or not to lower to minimum gate opening (15%) or 9 inches to raise depth in pool 1.
3. Leave AWS air relief valves closed—i.e. No Change to either FWS or AWS Vacuum Valves/air relief valves
4. Leave all diffuser valves in current settings
5. AWS Pumps must be shut down for 24 to 48 hours prior to raising the fish screen gate out of the water

3.5.4.2. Facility Shutdown

To shut down the Cougar AFCF for the season, follow the procedures below, and in sections 3.5.4.3 (Dewatering Procedure) and 3.5.4.4 (Winterization). To shut down only the AWS system, follow the procedures in section 3.5.4.1 AWS System Shutdown.

1. From AWS screen, press the "stop pumps" push button and confirm
2. Change to manual control of Entrance Gate and lower to 30% opening or 18 inches (minimum opening for fish passage)
   a. Pool 1 may drop below 5 feet if TW is low. Use biological discretion on whether or not to lower to minimum gate opening (15%) or 9 inches to raise depth in pool 1.
3. Open AWS Vacuum Breaker/air relief valves located on top of each AWS pump can and below Air Relief Valves (FWS Vacuum Valves/air relief valves are always stay open).
   a. Rotate valve actuator until the pointer on the unit says "open"
   b. Opened air valves will allow water to drain out of AWS piping
4. Wait 4 hours then close all diffuser valves (Valves 1-A, 1-B, 2, 3, 4)
5. AWS Pumps must be shut down for 24 to 48 hours prior to dewatering the facility or raising the fish screen gate out of the water

3.5.4.3. Dewatering Procedure

After completing the Facility Shutdown procedures (section 3.5.4.2) follow the procedures below to dewater the Cougar AFCF.

1. Close the fish screen gate at the fish ladder entrance to prevent any additional fish from entering the fish ladder. Continue to operate the fish ladder, if necessary, long enough to allow fish in transit to reach and enter the pre-sort pool.
2. Change to manual control of the FWS pumps
3. Initiate drawdown of the fish ladder flow from 21 cfs to a level allowing visual inspection for fish presence and fish recovery (approximately 6 to 10 cfs). Will need to shut off one of FWS Pump when reducing flow below 10 cfs (55% of max RPM). Flow level in the fish ladder can be adjusted by changing the output of pumps (down to approximately 6 cfs) and by diverting flow from the pre-sort pool through an overflow line leading to the diffuser chambers. These procedures will also permit control of the water level in the pre-sort pool while retaining function of other fish handling facility features.
4. Recover any remaining fish as necessary

   a. Process any fish found in the pre-sort pool or recovered from the fish ladder. Processed fish may be released to the tailrace via the return flume or moved to the post-sort pools.
   b. Load fish retained in the post-sort pools for transport to a release site.
5. Drain the pre- and post-sort pools. Wash down and clean the entire fish handling facility
6. Shut off last FWS pump (status—all pumps are off)
7. Close entrance gate to protect ladder against debris intrusion during high water levels, when not operation, and when shutting down for season (leave open if temporary shutdown). The control system limits gate closure to 15% open, thus full gate closure is not possible from the touch-screen. To fully close the entrance gate you must place the actuator switch in "local", then select close using integral switch. After lowering, move switch to "stop" and open disconnect.

3.5.4.4. Winterization

After completing the Dewatering Procedure (section 3.5.4.3) follow the procedures below to winterize the Cougar AFCF.

1. Close the 3" water supply valve to fish facility located in powerhouse
2. Open the hose bib located on the wall next to the truck fill valve
3. Remove the plugs on all three bellows fill valves and open the valves on the bellows fill valves
4. Open the 3" water supply line drain located under the upper work area and above emergency generator
5. Open all hose bib valves at fish facility
6. Open the 3" water supply line drain valve located next to powerhouse and under a 12" manhole access cover.
7. At the AWS pump discharge header, locate a 1" plug on header and remove, to drain header. (NOTE: this may be changed to a 2" ball valve later)
8. At the FWS pump discharge header, locate the 2" ball valve and open to drain header. (NOTE: This valve does not currently exist but will be installed during the follow on contract)
9. Open the drain in the anesthetic tank
10. Open the 12" knife valve on the fish recovery tank
11. Open the 2" fill valve on the recovery tank
12. Open the drain valve on the presort pool
13. Open the presort pool fill valve
14. Open the false weir fill valve
15. Open the drain valves to the post-sort pools (3 each)
16. Close the Post-sort pool fill valves (3 each)
17. Open the knife valves to all 3 post-sort pools to allow water to drain out on ground
18. Close the air supply valve to post-sort pool knife valves, located next to the receiver inside the room next to valves.
19. Close the air supply to knife valve receiver located inside of storage room next to knife gate valves
20. Open the knife gate receiver tank drain valve located in the storage room and leave open
21. Close the air supply valve to the FWS air receiver tank
22. Open the FWS air receiver tank drain
23. Crank down all three bellows on knife gates
24. Open the 480VAC breakers on MCC-FCQ2 supply to FWS pumps (3 each)
25. Open the 480VAC breaker on MCC-FCQ2 supply to diversion valve and supply valve presort pool
26. Open the 480VAC breaker on MCC-FCQ2 supply to post-sort pool fill valves
27. Open the 480VAC breaker on MCC-FCQ2 supply to post-sort pool drain valves and truck fill valve
28. Position the crowder under the roof overhang to the parked position
29. At the FWS screen cleaner station turn FWS screen cleaner to on
30. Open the vacuum relief air vent ball valve on all three FWS pumps

31. At the AWS screen cleaner station turn AWS screen cleaner to on
32. Set the FWS building heater thermostat to 50 degrees
33. Set the storage room heater thermostat to 50 degrees
34. Turn the Emergency genset ATS to off position
35. Turn the Emergency genset to off position
36. Close the air supply valve to the AWS air receiver tank
37. Open the AWS air receiver tank drain
38. Close the entrance gate located at the fish ladder entrance
39. Close the fish screen gate
40. Open the 480VAC breakers on panel MCC-FCQ1 supply to AWS pumps (3 each)
41. Open the 480VAC breaker on panel MCC-FCQ1 supply to Ladder gates actuator & hoist
42. Open the 480VAC breaker on panel MCC-FCQ1 supply to AWS diffuser valve actuators
43. Open the vacuum relief valve on all three AWS pumps by manually operating the valve at the pump to the open position
44. Open the vacuum relief valve air vent ball valve for all three AWS pumps
45. Set AWS building heater thermostat to 50 degrees
46. Close the fish facility 2" air supply valve located in the powerhouse

3.5.5. Emergency Operations

3.5.5.1. Planned Power Outage

Follow the same steps as detailed if the outage is anticipated to last longer than the following times:

a. Duration the generator can run and
b. Acceptable duration for leaving fish in partially filled pools. (2010 field observations have shown that fish will continue to try swimming upstream even through the depth in the pool diminishes in the upstream direction during a generator-powered single pump operation.)

SHUT OFF ALL PUMPS PRIOR TO SHUTTING DOWN POWER.
(This helps preserve the life of the pumps.)

3.5.5.2. Un-planned Power Outage (Type II)

A Type-Two emergency power outage is typically unplanned and results from electrical grid failure caused by such things as downed power lines or transformer issues. During grid failure, both turbine units immediately shut down and all flow from the forebay is diverted to the regulating outlet. Basic minimum electrical service is provided to the fish collection facility from a propane powered generator that is designed to start automatically when the electrical power supply is disrupted. Normal fish collection facility operation is not possible under these conditions. The AWS system will shut down and the FWS system will provide 10 cfs of flow to the pre-sort pool and fish ladder until the collection facility can be shut down. This discharge will prevent the ladder pools from draining entirely; most or all flow will discharge through orifices only.

1. Fish Collection Facility Startup during Type II Power Outage: Fish collection facility operation would not be initiated under a Type II Emergency Powerhouse Outage condition.
2. Fish Collection Facility Shut Down during Power Outages.
   a. Procedure for Shut Down under a Type II Emergency Powerhouse Outage
      i. The fish facility propane powered emergency generator automatically starts and the ATS (automatic transfer switch) closes and transfers power from generator to panel MCC-FCQ2. One FWS pump should start.

ii. AWS pumps will be automatically shut down as power supply is no longer sufficient to support their operation.

iii. Flow from the FWS system drops to 10 cfs (and single FWS pump operation) through the pre-sort pool and fish ladder. Water service to the fish handling area may be limited or no longer available.

iv. Initiate drawdown of the fish ladder flow from 10 cfs to a level allowing visual inspection for fish presence and fish recovery. Recover any remaining fish as necessary (this is detailed in Appendix A). Some fish may be coaxed to exit from the fish ladder entrance. Flow level in the fish ladder can be adjusted by changing the FWS pump output (down to approximately 6 cfs) and by diverting flow from the pre-sort pool through an overflow line leading to the diffuser chambers. These procedures will also permit control of the water level in the pre-sort pool.

v. Process any fish found in the pre-sort pool or recovered from the fish ladder. The flumes may not be functioning. Fish may be transported and released to the tailrace or moved to the post-sort pools.

vi. Load fish retained in the post-sort pools for transport to a release site.

vii. Drain the pre- and post-sort pools. Wash down and clean the entire fish handling facility, if possible.

viii. Shut down the FWS system, drain water lines, and secure all facility features for the non-operating season.

3.5.6. Power

3.5.6.1. Primary Feeder Breakers

LOCATION: Powerhouse Control Room. Reference Figure 11.

IDENTIFICATION: XJ1F and XJ2F (also shown as XJF1 and XJF2)

Figure 11 – Primary Feeder Breakers

REFERENCE: Contract Drawing E-601, sheet 19/54 depicts one-line distribution diagram showing electrical location of XJ1F and XJ2F. Contract Drawing E-802, sheet 48/54 depicts breaker control schematic.

DESCRIPTION: Feeder circuit breakers XJ1F and XJ2F operate at 6.9KV and supply electrical power to the entire fish collection facility. XJ1F is energized through hydroelectric generator No.1 and/or the BPA transmission line. XJ2F is connected to the hydroelectric generator No.2 bus. Circuit breakers XJ1F and XJ2F are electrically interlocked such that both cannot be closed simultaneously. If one breaker is in the test or draw-out position, the other breaker is still operational.

OPERATION: Circuit breakers XJ1F & XJ2F can be operated locally at the unit or remotely from a SCADA terminal. Switching from one circuit breaker to another will disrupt power to the Fish Collection Facility since both circuit breakers cannot be closed simultaneously. Prior to opening XJ1F or XJ2F the Fish Collection Facility control systems should be placed in manual from any touch screen, and all pumps (variable speed drives) should be stopped. An orderly system shutdown will prevent abrupt removal of power to the equipment while loaded, and should prevent damage to VFD power electronics. After closing XJ1F or XJ2F all pumps should be restarted from the local touch screen, and all control systems returned to automatic.

CAUTION: The load-break switches at the pad mounted transformer are physically connected to XJ1F and XJ2F feeders, thus can back-feed the load side of XJ1F or XJ2F with 6,900 volts. Prior to servicing or working on XJ1F or XJ2F ensure the equipment is de-energized, the appropriate load-break switch on the pad mounted transformer is open, and all appropriate grounds are in place.

SCADA ALARMS

- COMMAND FAILURE: Breaker XJ1F (or XJ2F) failed to close or open following a SCADA command.
- POWER LOSS OR INVALID STATE: 52A & 52B auxiliary contacts from XJ1F (or XJ2F) appear as both being closed or open, which is an invalid state.

3.5.6.2. Pad Mounted Transformer

LOCATION: Adjacent to AWS Electrical Bldg. Reference Figure 12.

IDENTIFICATION: FT1

Figure 12 – Pad Mounted Transformer

REFERENCE: Contract Drawing E-601, sheet 19/54 depicts one-line distribution diagram showing electrical location of FT1 and alternate source switches.

DESCRIPTION: The Fish Collection Facility transformer is rated 1000KVA, 6.9KV-480V, and is fed from circuit breakers XJ1F and XJ2F. This transformer supplies electrical power to the entire fish collection facility. The transformer has two internal load-break switches on the primary to permit paralleling of sources. The available switch positions are as shown below. Normally the load-break switches are in the "Source A & B" position and power is controlled through circuit breakers XJ1F or XJ2F.

- OFF
- SOURCE A (XJ1F)
- SOURCE B (XJ2F)
- SOURCES A & B

OPERATION: The load-break switches permit must be operated at the transformer with a hot stick. Normally feeder breaks XJF1 and XJF2 should be opened prior to any switching operation. Note that switching from one source to another will disrupt power to the Fish Collection Facility. Prior to any power switching operation the Fish Collection Facility control systems should be placed in manual from any touch screen, and all pumps (variable speed drives) should be stopped. An orderly system shutdown will prevent abrupt removal of power to the equipment while loaded, and prevent potential damage to VFD power electronics. After restoring normal power, all pumps should be restarted from the local touch screen, and all control systems returned to automatic. Prior to servicing or working on transformer FT1 ensure the unit is de-energized, both XJ1F and XJ2F are locked open, and appropriate grounds are in place.

CAUTION: The pad mounted transformer contains approximately 587 gallons of Envirotemp FR3 Fluid. Reference the Material Safety Data Sheet for chemical characteristics, hazard data, reactivity data, control measures, and precautions for safe handling and use. The transformer pad contains a lockable drain valve and liquid level switch to detect fluid leaks or accumulated precipitation. The drain should normally be closed, and water should not be allowed to accumulate within the spill containment pad. The liquid level alarm is connected to the SCADA system.

3.5.6.3. Emergency Generator and Automatic Transfer Switch (ATS)

LOCATION: Sorting facility behind electric room. Reference Figure 13.

Figure 13 – Emergency Generator

REFERENCE:

- Contract drawing E-601, sheet 19/54 depicts one-line distribution diagram showing electrical location of generator and automatic transfer switch (ATS).
- Contract drawing E-604, sheet 22/54 depicts one-line diagram of MCC-FCQ2.
- Contract drawing E-704, sheet 32/54 depicts ATS interface to PLC.
- Contract drawing E-705, sheet 33/54 depicts generator annunciator interface to PLC.

DESCRIPTION: The 150KW propane generator provides power to the FWS portion of the fish collection facility which includes all devices connected to MCC-FCQ2. The AWS portion of the facility (MCC-FCQ1) is not connected to an emergency generator. Upon loss of normal power from the powerhouse, the ATS commands the genset to start, then connects MCC-FCQ2 to the emergency generator. Following restoration of normal power the genset will re-transfer MCC-FCQ2 back to the powerhouse feeder, following a preset time-delay.

Since the ATS is an open transfer type, all operating loads will momentarily lose power when switching between normal and emergency sources. All running VFD's and other loads not connected to an uninterruptable power supply will need to be restarted.

OPERATION:
The emergency generator and ATS can be operated in manual or automatic. Normally the equipment is configured to run automatically while the fish facility is operational and processing fish.

If the generator is in the automatic position the generator main breaker must be closed, and is located inside the generator cabinet. It is always good practice to check this breaker on routine inspections. If the generator receives a start command and the breaker is not closed, the generator will only run long enough to burn the propane inside the line between the shut off valve and the generator, as the shut off valve is supplied from the generator breaker. The generator will then shutdown with a "Low Fuel Pressure" fault.

If there is any fault present on the generator while an automatic or manual start command is given, the generator will crank but not start. All faults must be cleared prior to starting the unit.

The generator supplies power to only the FWS portion of the fish facility. If the fish collection system is running and there is a loss of normal power, the emergency generator will start up. Within approximately one minute the PLC will automatically attempt to start one FWS pump. A single FWS pump will maintain adequate water in the presort tank and ladder to sustain life for any trapped fish until normal power is restored or a shutdown can be performed.

TESTING
The generator may be tested in automatic or manual modes. Do not test in automatic while the fish collection system is operational, as FWS power will be lost.

Manual Testing

1. Set "Manual/Off/Auto" switch located inside the generator access panel to manual start position. The generator should start up immediately.
2. Stop the by setting "Manual/Off/Auto" switch to off.

Automatic Testing:

1. Verify "Manual/Off/Auto" switch in "Auto"
2. Verify generator main circuit breaker is closed
3. Verify the ATS is in "Auto
4. Open the main FWS disconnect switch FXQX

5. Upon loss of power after opening FXQX the generator will start and the ATS will transfer the FWS electrical loads from MCC-FCQ2 to the generator.
6. To finish testing and transfer power back to the normal supply close the main disconnect switch FXQX.
7. There is a programmed 20 minute time delay before the ATS will re-transfer to the normal supply and shut-down the generator. However; this can be bypassed by turning the ATS H-O-A switch to the off position, which will cause the transfer to occur within a few seconds.
8. The generator will cool down unloaded and shut down automatically.

CHARGING SYSTEM

The generator is equipped with 12 volt battery charger that outputs 2 amp or 10 amps. If there is only light demand on the battery it will maintain a constant 2 amp float charge, but if the demand exceeds 2 amps the charger will automatically charge as high a 10 amps.

Note that if the 120VAC supply to the charger is off for a period of time and the battery drops below 12volts, the charger will not operate, as it is only designed as a float charger and not for recharging a dead battery. If the power is going to be off any length of time the battery should be disconnected to prevent unwanted discharge.

FUEL TANK

- The fuel system is equipped with a Hanson Tank Model P-1150 LP fuel tank, with 1150 gallon capacity
- Propane vapor withdrawal fuel system and approximately 10 to 20% of the fuel tank capacity will be needed for fuel expansion. It is important to keep the tank filled above 20% for reliable operation.
- The fuel line is located underground after it leaves the tank and re-emerges from the concrete pad that the generator is setting on. There is a regulator and shut of valve on the concrete wall. The line then goes back under the pad and then re-emerges into the generator housing.
- There is an emergency fuel shut off push button located on the North side of the FWS building.

3.5.7. Controls

3.5.7.1. Variable Frequency Drive-AWS Pumps

LOCATION: AWS Electric Building.

IDENTIFICATION: VFD-004, VFD-005, and VFD-006

REFERENCE:

- Drawing E-602, sheet 20/54 depicts one-line distribution diagram showing electrical location of AWS Pumps.
- Drawing E-608, sheet 26/54 depicts Pump VFD control schematic.

DESCRIPTION: There are three AWS pumps and each is controlled by a variable frequency drive (VFD).

Two AWS pumps are considered essential for normal operation, while the remaining is a backup or standby unit. Under automatic *AWS Pump System* control one or two units may be called to run as determined by the river elevation. Under automatic *AWS Pump System* control the VFD's operate in unison as required to maintain adequate AWS flow. If a VFD is switched to manual, start/stop and speed control must be performed by a local operator. Automatic *AWS Pump System* control is not permitted when any VFD is operated in manual mode.

<u>OPERATION:</u>
Each VFD permits manual or automatic control of an AWS pump by setting the Hand-Off-Auto selector switch. The normal or default setting is "Auto".

OFF: When the Hand-Off-Auto selector switch is set to "Off" the VFD is disabled.

HAND: When the Hand-Off-Auto selector switch is set to "Hand" a pump may be operated manually by pressing the green run button on the digital human interface module "HIM". The unit may be stopped by pressing the red button on the digital human interface module. The pump speed may also be controlled through the HIM by pressing the up or down arrows. It the *AWS Pump System* is running in automatic and a VFD is manually started, the *AWS Pump System* will switch to manual mode and automatic control will cease.

AUTO: When the Hand-Off-Auto selector switch is set to "Auto" the digital human interface module is locked out, except for the stop button. A VFD/pump may start, stop, or change speed at any time while the AWS Pump System is running in automatic, as determined from SCADA or a local touch screen.

HIM OPERATION: Reference the full O&M manual for complete operating and programming instructions.

AUTO EXERCISE: Each pump should be exercised every 30 days (720 hours). Automatic exercising is achieved by swapping the standby pump with a running pump. Automatic pump swapping will occur under normal operating conditions while the AWS Pump System is in automatic mode. Automatic exercising will not occur when the diesel genset is operating, the standby pump is unavailable, the *AWS Pump System* is not in automatic mode, or the river level is so low that only one pump is required to operate. Note that automatic exercising is based on computed standby time and not run-time hours as reported by the VFD. If a VFD is placed in "Manual" or "Off" it is not in standby and excluded from auto exercise tracking. The VFD standby counter is reset after the pump is operated.

VFD AUX FAULT: A message of "F02 - Aux Fault" indicates the VFD has been faulted by at least one externally connected device. This typically occurs during power-up, and can be reset by pressing the red stop button on the HIM, or switching the selector switch to "OFF" then back to desired position. The PLC will also attempt to automatically reset the fault if the H-O-A is in the "Auto" position. If the "F02 - Aux Fault" persists it is caused by one of the following.

- Local disconnect switch at pump is open.
- Moisture detected inside submersible pump. Check "pumpsafe" module at VFD cabinet.
- Loss of phase detected. Check phase loss relay at VFD cabinet.

- Motor over temperature detected. Check “pumpsafe” module at VFD cabinet.

CAUTION: While the unit is running avoid opening the load-break (disconnect) switch, which is located adjacent to the pump. Always stop the VFD and open the VFD disconnect switch prior to opening the pump disconnect. Prior to servicing or working on a VFD ensure the equipment is de-energized, the appropriate disconnect switch is open, and all appropriate grounds are in place.

STATUS

- RUN LIGHT (RED): Indicates VFD is supplying electrical power to the pump motor.
- POWER LIGHT (GREEN): Indicates 120VAC control power at VFD is available.
- HIM STATUS: Reference the full O&M manual for accessing and viewing VFD data.

SCADA ALARMS

Reference alarm summary matrix for additional information.

- VFD NETWORK ERROR: PLC to VFD communications failure or VFD is de-energized.
- VFD INTERNAL ALARM OR FAULT: VFD Internal fault or alarm has occurred. Alarm also includes external remote disconnect switch, pump motor moisture sensor, pump motor thermal switch, and VFD phase monitor relay. Reference VFD user manual for listing of all internal fault and alarm codes.
- VFD DISABLED OR NOT IN AUTO: Hand-off-Auto selector switch not in “Auto” or VFD not enabled.

3.5.7.2. Variable Frequency Drive-FWS Pumps

LOCATION: FWS Electric Building.

IDENTIFICATION: VFD-001, VFD-002, and VFD-003

REFERENCE:

- Drawing E-604, sheet 22/54 depicts one-line distribution diagram showing electrical location of FWS Pumps.
- Drawing E-608, sheet 26/54 depicts Pump VFD control schematic.

DESCRIPTION: There are three FWS pumps and each is controlled by a variable frequency drive (VFD). Two FWS pumps are considered essential for normal operation, while the remaining is a backup or standby unit. Under automatic *FWS Pump System* control two units always run when normal power is available. If only standby generator power is available then only one unit operates under automatic *FWS Pump System* control. During automatic *FWS Pump System* control the VFD’s operate in unison as required to maintain adequate water elevation in ladder pool #31. If a VFD is switched to manual, start/stop and speed control must be performed by a local operator. Automatic *FWS Pump System* control is not permitted when any VFD is running in manual mode.

OPERATION:

Each VFD permits manual or automatic control of an FWS pump by setting the Hand-Off-Auto selector switch. The normal or default setting is “Auto”.

OFF: When the Hand-Off-Auto selector switch is set to “Off” the VFD is disabled.

HAND: When the Hand-Off-Auto selector switch is set to “Hand” a pump may be operated manually by pressing the green run button on the digital human interface module “HIM”. The unit may be stopped by pressing the red button on the digital human interface module. The pump speed may also be controlled through the HIM by pressing the up or down arrows. It the *FWS Pump System* is running in automatic and a VFD is manually started, the *FWS Pump System* will switch to manual mode and automatic control will cease.

AUTO: When the Hand-Off-Auto selector switch is set to “Auto” the digital human interface module is locked out, except for the stop button. A VFD/pump may start, stop, or change speed at any time while the FWS Pump System is running in automatic, as determined from SCADA or a local touch screen.

HIM OPERATION: Reference the full O&M manual for complete operating and programming instructions.

AUTO EXERCISE: Each pump should be exercised every 30 days (720 hours). Automatic exercising is achieved by swapping the standby pump with a running pump. Automatic pump swapping will occur under normal operating conditions while the FWS Pump System is in automatic mode. Automatic exercising will not occur when the diesel genset is operating, the standby pump is unavailable, or the *FWS Pump System* is not in automatic mode. Note that automatic exercising is based on computed standby time and not run-time hours as reported by the VFD. If a VFD is placed in “Manual” or “Off” it is not in standby and excluded from auto exercise tracking. The VFD standby counter is reset after the pump is operated.

VFD AUX FAULT: A message of “F02 - Aux Fault” indicates the VFD has been faulted by at least one externally connected device. This typically occurs during power-up, and can be reset by pressing the red stop button on the HIM, or switching the selector switch to “OFF” then back to desired position. The PLC will also attempt to automatically reset the fault if the H-O-A is in the “Auto” position. If the “F02 - Aux Fault” persists it is caused by one of the following.

- Local disconnect switch at pump is open.
- Moisture detected inside submersible pump. Check “pumpsafe” module at VFD cabinet.
- Loss of phase detected. Check phase loss relay at VFD cabinet.
- Motor over temperature detected. Check “pumpsafe” module at VFD cabinet.

<u>CAUTION:</u> While the unit is running avoid opening the load-break (disconnect) switch, which is located adjacent to the pump. Always stop the VFD and open the VFD disconnect switch prior to opening the pump disconnect. Prior to servicing or working on a VFD ensure the equipment is de-energized, the appropriate disconnect switch is open, and all appropriate grounds are in place.

STATUS

- RUN LIGHT (RED): Indicates VFD is supplying electrical power to the pump motor.
- POWER LIGHT (GREEN): Indicates 120VAC control power at VFD is available.
- HIM STATUS: Reference the full O&M manual for accessing and viewing VFD data.

SCADA ALARMS

Reference alarm summary matrix for additional information.

- VFD NETWORK ERROR: PLC to VFD communications failure or VFD is de-energized.
- VFD INTERNAL ALARM OR FAULT: VFD Internal fault or alarm has occurred. Alarm also includes external remote disconnect switch, pump motor moisture sensor, pump motor thermal switch, and VFD phase monitor relay. Reference VFD user manual for listing of all internal fault and alarm codes.
- VFD DISABLED OR NOT IN AUTO: Hand-off-Auto selector switch not in "Auto" or VFD not enabled.

3.5.7.3. PLC Controlled Actuators for Entrance Gate and Valves

LOCATION: AWS Diffuser Valves and Fish Ladder Entrance Gate

IDENTIFICATION:

- VAM-007: Pool 1, Valve #1A
- VAM-008: Pool 1, Valve #1B
- VAM-009: Pool 2, Valve #2
- VAM-010: Pool 3, Valve #3
- VAM-011: Pool 4, Valve #4
- GAM-001: Ladder Entrance Gate

REFERENCE:

- Drawing E-401, sheet 08 of 54 depicts physical location of actuators.
- Drawing E-602, sheet 20 of 54 one-line diagram shows electrical location of actuators.
- Drawing E-610, sheet 28 of 54 shows disconnect switch enclosures.
- Drawing E-717, sheet 45 of 54 contains valve schedule and connection diagrams.

DESCRIPTION: The electric actuators are used to operate the AWS diffuser valves and fish ladder entrance gate. The AWS diffuser valve actuators require 480V and are fed from a single 40A feeder from the AWS electric building. The entrance gate actuator is fed from a separate 480V, 30A feeder from the AWS electric building. The actuators are not connected to the emergency generator circuit.

OPERATION: The actuators can be operated both locally and remotely as described below. The normal or default actuator setting is "Remote" with the hand/auto lever in "Auto". See MFR installation and maintenance instructions for manual hand-wheel operations.

Local Control

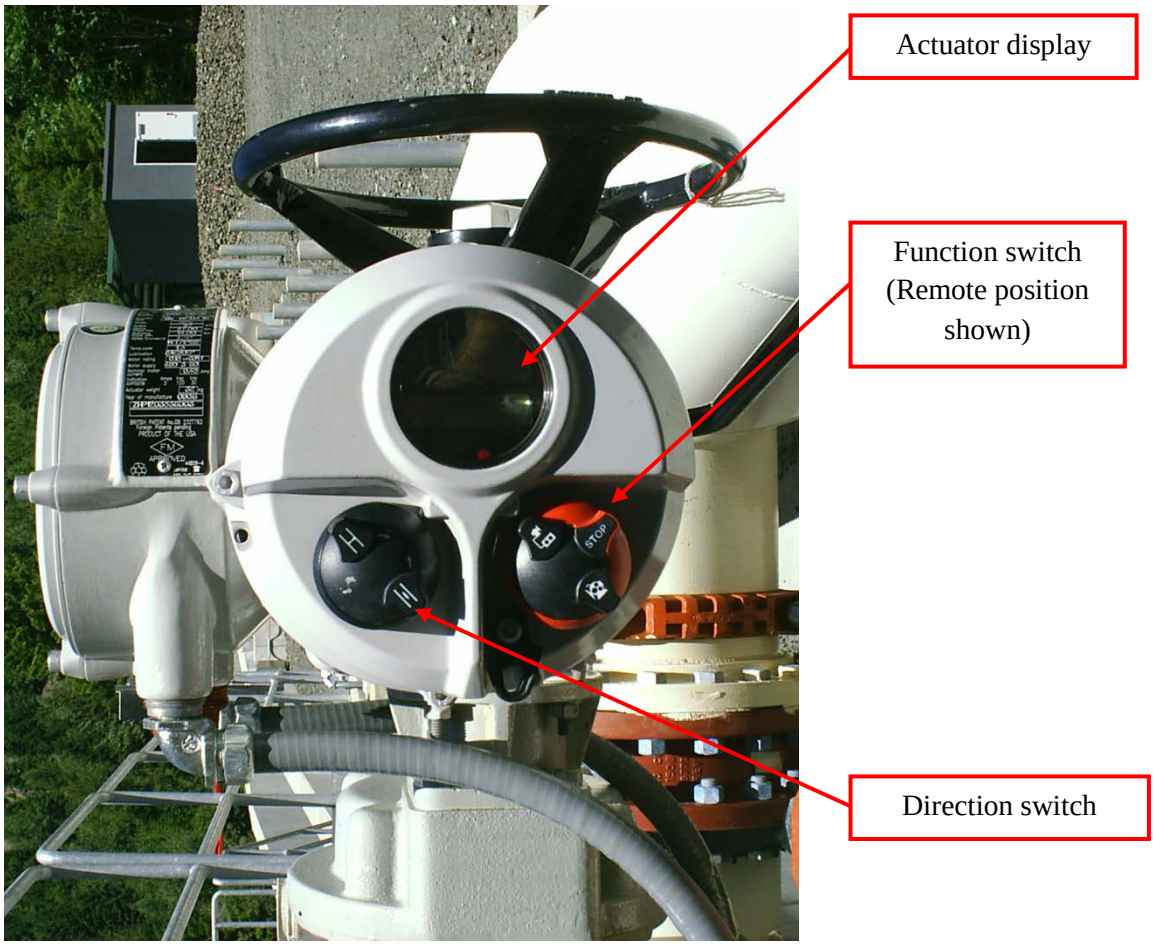
- With the red selector switch set to "Local" (counterclockwise), the black “Open/Close” sector switch can be used to change the gate or valve position. The actuator will stop automatically upon reaching full open or close. To stop movement mid-position, turn the red selector switch clockwise to "Stop".

Remote Control

- With the red selector switch set to "Remote", a Fish Collection Facility touch-screen can be used to operate the actuator. To stop movement, turn the red selector clockwise to "Stop".

Local Indication

- When fully open two LEDs turn red, the open symbol is shown, and "Open Limit" is displayed.
- During mid-travel two LEDs turn amber, % open is shown, and "Stopped" is displayed when there is no actuator movement.
- When fully closed two LEDs turn green, the closed symbol is shown, and "Closed Limit" is displayed.



<u>CAUTION:</u> Prior to servicing or working on any actuator ensure unit is de-energized and the local disconnect switch is locked open. Only authorized personnel shall service equipment.

<u>SCADA ALARMS</u>

Reference alarm summary matrix for additional information.

- ACTUATOR NETWORK ERROR: Communication problem or loss of power has occurred.
- ACUTATOR INTERNAL ALARM: Actuator detected internal fault or alarm event.
- ACTUATOR SW NOT IN REMOTE: Red selector switch at actuator not in “Remote” position.

3.5.7.4. Stand Alone Electric Actuators for Valves

LOCATION: FWS Sorting Facility

IDENTIFICATION:

- VAM-001: Post-Sort Pool 1, Drain Valve #FC-FW-7
- VAM-002: Post-Sort Pool 2, Drain Valve #FC-FW-10
- VAM-003: Post-Sort Pool 3, Drain Valve #FC-FW-13
- VAM-004: Post-Sort Pool 1, Fill Valve #FC-FW-6
- VAM-005: Post-Sort Pool 2, Fill Valve #FC-FW-9
- VAM-006: Post-Sort Pool 3, Fill Valve #FC-FW-12
- VAM-12A: Pre-Sort Pool, 24” Diversion Valve #FC-FW-4A
- VAM-12B: Pre-Sort Pool, 12” Diversion Valve #FC-FW-4B
- VAM-013: Pre-Sort Pool, Drain Valve #FC-FW-5
- VAM-014: Truck Fill Valve #FC-FW-15

REFERENCE:

- Drawing E-404, sheet 08 of 54 depicts physical location of actuators & control cabinets.
- Drawing E-604, sheet 22 of 54 one-line diagram shows electrical location of actuators.
- Drawing E-610, sheet 28 of 54 shows disconnect switch enclosures.
- Drawing E-717, sheet 45 of 54 contains valve schedule and connection diagrams.

DESCRIPTION: Electric actuators are used to operate various presort, post-sort, and truck fill valves as listed above. All valve actuators require 480V and are fed from various circuit breakers from the FWS electric building. The actuators may be operated under emergency generator power.

OPERATION: The actuators can be operated both locally and remotely as described below. The normal or default actuator setting is “Remote” with the hand/auto lever in “Auto”. See MFR installation and maintenance instructions for manual hand-wheel operations.

Local Control

- With the red selector switch set to "Local" (counterclockwise), the black “Open/Close” sector switch can be used to change valve position. The actuator will stop automatically upon reaching full open or close. To stop movement mid-position, turn the red selector switch clockwise to "Stop". Note that the actuators are not readily accessible from the ground and should be remotely controlled as described as below.

Local Indication

- When fully open two LEDs turn red, the open symbol is shown, and "Open Limit" is displayed.
- During mid-travel two LEDs turn amber, % open is shown, and "Stopped" is displayed when there is no actuator movement.
- When fully closed two LEDs turn green, the closed symbol is shown, and "Closed Limit" is displayed.

Remote Control

- With the red selector switch on the actuator set to "Remote", a remote operator station can be used to control the actuator and valve.
- Drain Valves for Sorting Pools (See Figure 14)
    - Open or Close pushbutton must be held to operate valve. Releasing a button stops movement.
- Fill Valves for Post-Sort Pools
    - With the cabinet selector switch in Manual, the Open or Close pushbutton must be held to operate valve. Releasing a button stops movement.
    - With the cabinet selector switch in Auto, the rotary potentiometer is used to set valve position. On the potentiometer dial, 0% corresponds to closed, while 100% corresponds to fully open.
- Presort Pool Diversion Valves
    - With the cabinet selector switch Off, the 24” valve will close and the 12” valve will open.
    - With the cabinet selector switch On, the 24” valve can be adjusted by rotary potentiometer located on the cabinet door. The rotary potentiometer for the 12” valve is located inside the cabinet and is not normally changed. On the potentiometer dial; 0% corresponds to closed, while 100% corresponds to fully open.
- Truck Fill Valve
    - Open or Close pushbuttons initiate valve action. Movement continues until the Stop pushbutton is pressed or open/close limit reached.
    - Cabinet lights: Green indicates closed, red indicates open, white indicates position between open & closed.

Remote Indication

- Cabinet lights: Green indicates closed, red indicates open, white indicates any position between open & closed.

Figure 14 –Controls for Drain Valves for Sorting Pools

CAUTION: Prior to servicing or working on any actuator ensure unit is de-energized and the local disconnect switch is locked open. Only authorized personnel shall service equipment.

SCADA ALARMS

Equipment is not connected to SCADA system, thus remote alarming is not available.

3.5.7.5. AWS Air Burst Cabinet

LOCATION: Adjacent to river at AWS intake screens

IDENTIFICATION: AWS Screen Cleaner

REFERENCE: Contract Drawing E-713, sheet 41/54 depicts cabinet layout and schematic diagram.

DESCRIPTION:

- There are five vertical intake screens, each subdivided into four zones. Zone 1 is the lowest in the water, while zone 4 is the highest and is typically not submerged. There are 20 solenoid valves, one for each zone within each vertical screen.

- Automatic Zone Selection:
  a. Zone 1 only 1250.0 < River elevation < 1252 ft.
  b. Zones 1 – 2 1250.0 < River elevation < 1254 ft.
  c. Zones 1 – 3 1250.0 < River elevation < 1256 ft.
  d. Zones 1 – 4 1250.0 < River elevation < 1259 ft.

- During an automatic cleaning cycle, each solenoid valve is configured to operate for 3 seconds on and 1 second off. The transition time (delay) between screens is currently set for 3 seconds.
- The minimum air tank pressure required to begin an automatic cleaning cycle or transition to the next vertical screen is 95 PSI. If the tank pressure drops below 95 PSI mid cycle the system will hold before processing the next screen. If the tank pressure does not recover within 5 minutes an incomplete sequence alarm is generated and the system resets.
- The minimum tank pressure required operate any valve is 75 PSI. If the tank pressure drops below 75 PSI the automatic cleaning process will hold. If the tank pressure does not recover within 5 minutes an incomplete sequence alarm is generated and the system resets.

OPERATIONAL MODES

The AWS air burst cabinet permits manual or automatic control of the AWS screen cleaner system by setting the Hand-Off-Auto selector switch. The normal or default setting is "Auto".

- OFF: When the Hand-Off-Auto selector switch is set to "Off" the screen cleaner is disabled.
- HAND: When switched to "Hand" an individual screen may be cleaned by setting the appropriate zone via the selector switch and pressing the desired push-button. The air blast will continue as long as the push-button is pressed. For example, to manually clean the upper most section of screen 5 set the zone selector switch to 4 and hold the screen 5 pushbutton. No automatic cleaning cycles will occur when the switch is not in "Auto". The "Ready" light must be illuminated to operate in manual.
- AUTO: When switched to "Auto" all submerged screens will be automatically cleaned based on the zone selection criteria, assuming the system ready light is illuminated. Auto cleaning cycles are initiated by the following events.
    e. Pressing and holding any of the 5 cabinet pushbuttons for at least 3 seconds continuously.
    f. Touch screen in the FWS electric room.
    g. Differential pressure across the intake screens exceeds 0.6ft. A high differential cleaning event will cycle no more than once every 10 minutes to prevent depleting the air supply, even if a high differential condition persists following a cleaning cycle.
    h. Time based every 12 hours. Start at 12:00am and 12:00pm.

STATUS

- READY LIGHT (GREEN)
    i. In "Hand" mode the green ready light is continuously illuminated when no PLC problems are detected, the tank air pressure is above 75 PSI.
    j. In "Auto" mode the green ready light is continuously illuminated when no PLC problems are detected, the tank air pressure is above 95 PSI, water level transmitters LT-010 & LT-011 are functional, the river elevation is between 1250.0 and 1259.0 ft, and the system is not already operating an automatic cleaning cycle.
    k. During an automatic cleaning cycle the green light will flash.

- CHARGING LIGHT (RED)

l. If the air tank pressure is between 25 and 95 PSI and increasing, the charging light is illuminated. Beyond 95 PSI the air tank is assumed to be fully charged. Below 25 PSI the air tank is considered discharged and not in service.

SCADA ALARMS

Reference alarm summary matrix for additional information.

- INCOMPLETE SEQUENCE: An automatic cleaning cycle did not complete within 5 minutes.
- PLC HARDWARE TROUBLE: A problem with the I/O hardware has been detected.
- SUSTAINED LOW PRESSURE: Receiver tank pressure remained below 95 PSI for 120 seconds and the system is in either "Auto" or "Manual".
- SUSTAINED VERY LOW PRESSURE: Receiver tank pressure remained below 75 PSI for 60 seconds and the system is in either "Auto" or "Manual".
- CLEANING CYCLE FAILED: A differential pressure across the intake screens exceeding 0.6ft remains immediately following an automatic cleaning cycle.
- SUSTAINED DIRTY SCREEN: A differential pressure across the intake screens exceeding 1.0ft exists for 11 minutes or longer.
- WATER RANGE ERROR: The measured river level is not between 1250.0 and 1259.0ft.
- CLEANING CYCLE ABORTED. Automatic cleaning cycle aborted due following: A) H-O-A selector switched from "Auto". B) I/O Hardware error detected. C) Water level sensor failure or out-of-range error. D) Incomplete sequence due to low air pressure.
- SYSTEM NOT IN AUTO: Cabinet selector switch not in "Auto" position.

3.5.7.6. FWS Air Burst Cabinet

LOCATION: Adjacent to river at FWS intake screens

IDENTIFICATION: FWS Screen Cleaner

REFERENCE: Contract Drawing E-712, sheet 40/54 depicts cabinet layout and schematic diagram.

DESCRIPTION:

- There are two vertical intake screens, each subdivided into four zones. Zone 1 is the lowest in the water, while zone 4 is the highest and is typically not submerged. There are 8 solenoid valves, one for each zone within each vertical screen.
- Automatic Zone Selection:
  m. Zone 1 only 1250.0 < River elevation < 1252 ft.
  n. Zones 1 – 2 1250.0 < River elevation < 1254 ft.
  o. Zones 1 – 3 1250.0 < River elevation < 1256 ft.
  p. Zones 1 – 4 1250.0 < River elevation < 1259 ft.
- During an automatic cleaning cycle, each solenoid valve is configured to operate for 4 seconds on and 1 second off. The transition time (delay) between screens is currently set for 3 seconds.
- The minimum air tank pressure required to begin an automatic cleaning cycle or transition to the next vertical screen is 95 PSI. If the tank pressure drops below 95 PSI mid cycle the system will

hold before processing the next screen. If the tank pressure does not recover within 5 minutes an incomplete sequence alarm is generated and the system resets.

- The minimum tank pressure required operate any valve is 75 PSI. If the tank pressure drops below 75 PSI the automatic cleaning process will hold. If the tank pressure does not recover within 5 minutes an incomplete sequence alarm is generated and the system resets.

OPERATIONAL MODES

The FWS air burst cabinet permits manual or automatic control of the FWS screen cleaner system by setting the Hand-Off-Auto selector switch. The normal or default setting is "Auto".

- OFF: When the Hand-Off-Auto selector switch is set to "Off" the screen cleaner is disabled.
- HAND: When switched to "Hand" an individual screen may be cleaned by setting the appropriate zone via the selector switch and pressing the desired push-button. The air blast will continue as long as the push-button is pressed. For example, to manually clean the upper most section of screen 2 set the zone selector switch to 4 and hold the screen 2 pushbutton. No automatic cleaning cycles will occur when the switch is not in "Auto". The "Ready" light must be illuminated to operate in manual.
- AUTO: When switched to "Auto" all submerged screens will be automatically cleaned based on the zone selection criteria, assuming the system ready light is illuminated. Auto cleaning cycles are initiated by the following events.
    q. Pressing and holding any of the two cabinet pushbuttons for at least 3 seconds continuously.
    r. Touch screen in the FWS electric room.
    s. Differential pressure across the intake screens exceeds 0.6ft. A high differential cleaning event will cycle no more than once every 10 minutes to prevent depleting the air supply, even if a high differential condition persists following a cleaning cycle.
    t. Time based every 4 hours. Start at 1:30am, 5:30am, 9:30am, 1:30pm, 5:30pm, & 9:30pm.

STATUS

- READY LIGHT (GREEN)
    u. In "Hand" mode the green ready light is continuously illuminated when no PLC problems are detected, the tank air pressure is above 75 PSI.
    v. In "Auto" mode the green ready light is continuously illuminated when no PLC problems are detected, the tank air pressure is above 95 PSI, water level transmitters LT-013 & LT-014 are functional, the river elevation is between 1250.0 and 1259.0 ft, and the system is not already operating an automatic cleaning cycle.
    w. During an automatic cleaning cycle the green light will flash.
- CHARGING LIGHT (RED)

    If the air tank pressure is between 25 and 95 PSI and increasing, the charging light is illuminated. Beyond 95 PSI the air tank is assumed to be fully charged. Below 25 PSI the air tank is considered discharged and not in service.

SCADA ALARMS

Reference alarm summary matrix for additional information.

- INCOMPLETE SEQUENCE: An automatic cleaning cycle did not complete within 3 minutes.
- PLC HARDWARE TROUBLE: A problem with the I/O hardware has been detected.
- SUSTAINED LOW PRESSURE: Receiver tank pressure remained below 95 PSI for 120 seconds and the system is in either “Auto” or “Manual”.
- SUSTAINED VERY LOW PRESSURE: Receiver tank pressure remained below 75 PSI for 60 seconds and the system is in either “Auto” or “Manual”.
- CLEANING CYCLE FAILED: A differential pressure across the intake screens exceeding 0.6ft remains immediately following an automatic cleaning cycle.
- SUSTAINED DIRTY SCREEN: A differential pressure across the intake screens exceeding 1.0ft exists for 11 minutes or longer.
- WATER RANGE ERROR: The measured river level is not between 1250.0 and 1259.0ft.
- CLEANING CYCLE ABORTED. Automatic cleaning cycle aborted due following: A) H-O-A selector switched from “Auto”. B) I/O Hardware error detected. C) Water level sensor failure or out-of-range error. D) Incomplete sequence due to low air pressure.
- SYSTEM NOT IN AUTO: Cabinet selector switch not in “Auto” position.

3.5.7.7. Touch Screens

LOCATION: FWS Electric Building.

IDENTIFICATION: FWS PLC Cabinet

REFERENCE:
- Drawing E-703, sheet 31/54 depicts PLC cabinet layout and power schematic.

DESCRIPTION:
The touch screen is used to control and monitor various devices and systems of the fish collection system. There are individual status and/or control screens for the following: Current status, Alarm history, AWS/FWS pump systems, Water level sensors, Diffuser valves, Screen cleaner systems, Fish ladder entrance gate, and AWS/FWS digital power meters. For some it may be easier to use a plastic stylus instead of a finger to press the virtual buttons.

OPERATION:
The MAIN screen is used to access all other screens and is shown in Figure 15. Each blue button opens other Fish Collection Facility screens as labeled. The date and time match the local PLC clock and cannot be modified.

The alarm object provides a brief listing of recent alarms. For additional alarm information go to the alarm “HISTORY” and/or alarm “STATUS” screens.

The “ACK ALM” button can be used to acknowledge individual alarms, as selected by the up/down arrows. The “ACK ALL” button will acknowledge all current alarms. Acknowledging an alarm does not

clear an alarm, even if it is no longer present. Alarm clearing can be performed on the alarm history screen.

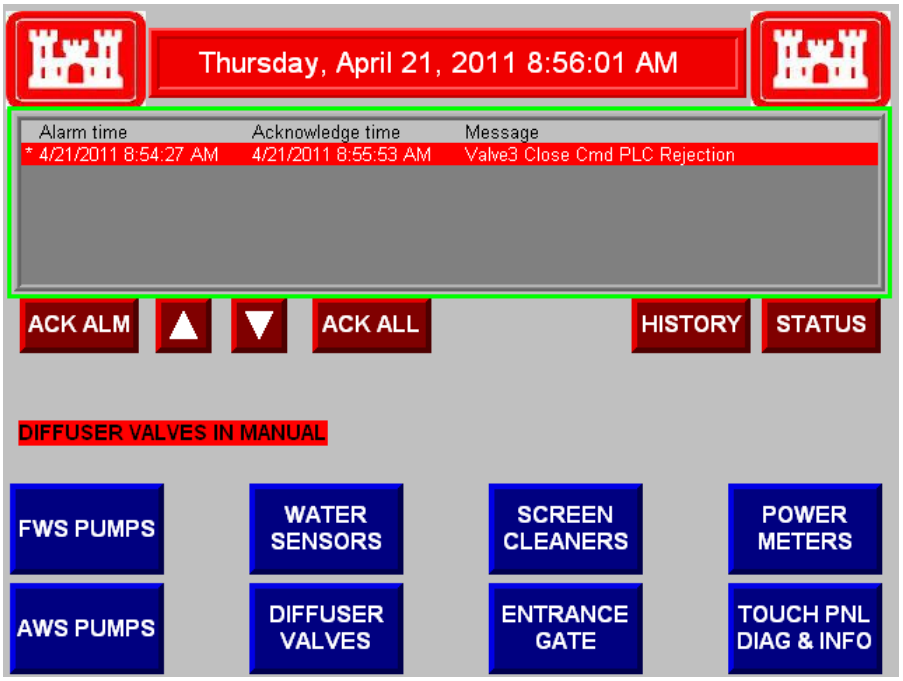


Figure 15 – Main Touch Screen

The FWS PUMP screen is shown in Figure 16, and is used to control and monitor the FWS Pump System. The upper screen displays the status of each VFD. A red background behind "Pump No." indicates running, while a green background indicates off. "Available" or "Not-Available" status is displayed for each non-running pump, and indicates whether unit is available for automatic startup.

The green "START PUMPS" button starts the FWS pumping system. A confirmation "yes/no" screen is displayed after pressing the button. Once the system is started the controller determines how many pumps should operate, regardless of Auto/Manual control selection.

The red "STOP PUMPS" button stops the FWS pumping system. A confirmation "yes/no" screen is displayed after pressing the button. Following confirmation to stop all pumps, the controller will shut-down all VFD's that have their H-O-A switch in "auto".

The "AUTO CONTROL" push button sets the control mode for the FWS pump system. In automatic mode the pump speed is adjusted by the controller. If the green "Ready" symbol above the button is not visible then the system cannot be placed in "Auto". The red "NOT READY" symbol indicates flow sensor trouble, water level sensor trouble, no pumps available, or at least one pump is running in manual.

- CO represents Controller Output, and should match the Pump Speed shown.
- SP is the water level Set Point for ladder pool #31 and cannot be changed.
- PV represents Process Variable and is the actual water level measured in pool #31.

- ER is the difference between SP and PV and is normally +/- 0.1 ft. with both pumps running. Note that with only one pump running the system cannot maintain a 0.9 ft water level at ladder pool #31, resulting in a high error.

The “MANUAL CONTROL” push button sets the control mode for the FWS Pump Control System. In manual mode the pump speed is adjusted through the “Key Pad” setting. The “Key Pad” pump speed setting must be between 75% and 100% of maximum. If a red “NOT READY” symbol is visible above button then either no pumps are available or at least one pump is running in manual.

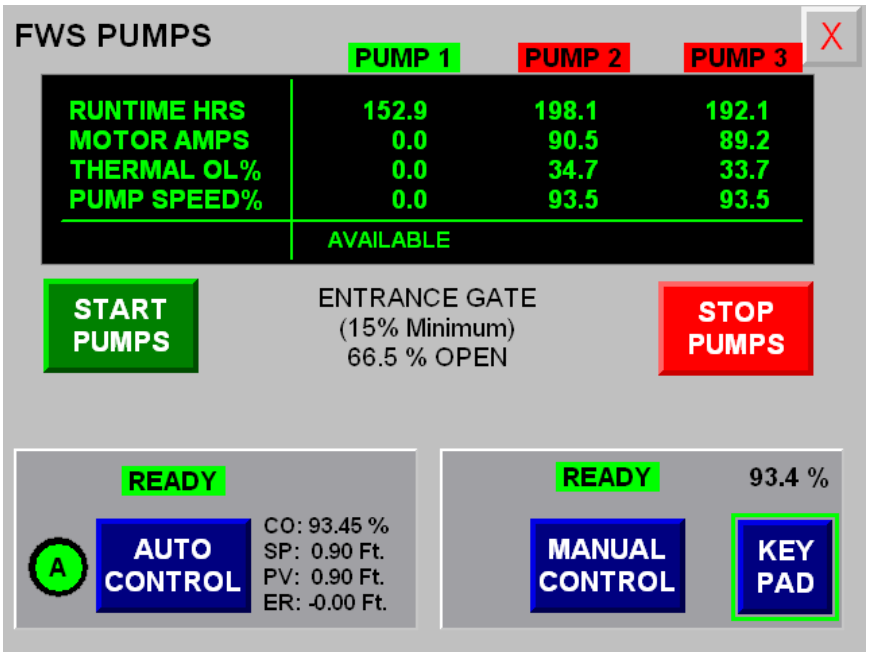


Figure 16 – FWS Pumps Touch Screen

The AWS PUMP screen is shown in Figure 17, and is used to control and monitor the AWS Pump System. The upper screen displays the status of each VFD. A red background behind “Pump No.” indicates running, while a green background indicates off. “Available” or “Not-Available” status is displayed for each non-running pump, and indicates whether unit is available for automatic startup.

The green “START PUMPS” button starts the AWS pumping system. A confirmation “yes/no” screen is displayed after pressing the button. Once the system is started the controller determines how many pumps should operate, regardless of Auto/Manual control selection.

The red “STOP PUMPS” button stops the AWS pumping system. A confirmation “yes/no” screen is displayed after pressing the button. Following confirmation to stop all pumps, the controller will shut-down all VFD’s that have their H-O-A switch in “auto”.

The “AUTO CONTROL” push button sets the control mode for the AWS pump system. In automatic mode the pump speed is adjusted by the controller. If the green “Ready” symbol above the button is not

visible then the system cannot be placed in “Auto”. The red “NOT READY” symbol indicates flow sensor trouble, water level sensor trouble, no pumps available, or at least one pump is running in manual.

- CO represents Controller Output, and should match the pump speed shown.
- SP is the desired water flow Set Point and is automatically determined.
- PV represents Process Variable and is the actual flow measured.
- ER is the difference between SP and PV and is normally within +/- 5.0 CFS.

The “MANUAL CONTROL” push button sets the control mode for the AWS Pump Control System. In manual mode the pump speed is adjusted through the “Key Pad” setting. The “Key Pad” pump speed setting must be between 50% and 100% of maximum. If a red “NOT READY” symbol is visible above button then either no pumps are available or at least one pump is running in manual.

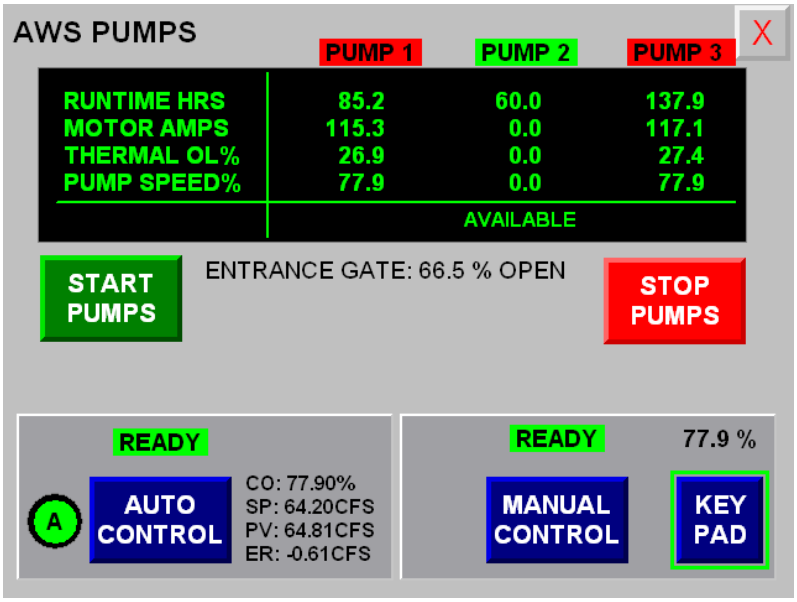
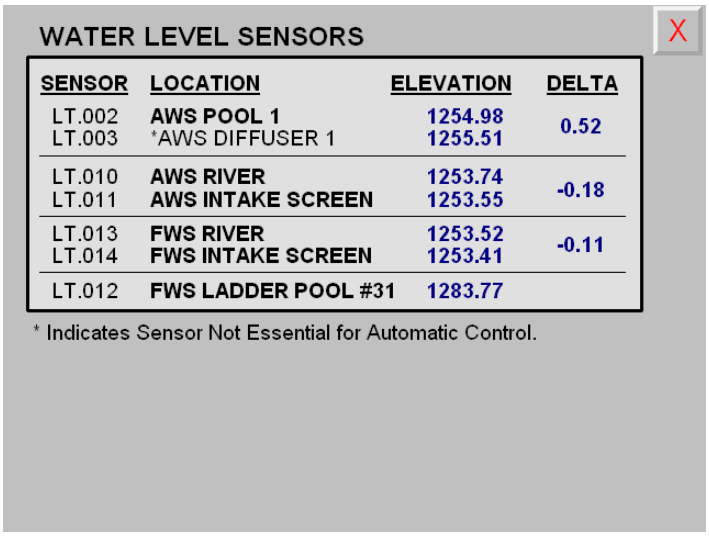


Figure 17 – AWS Pumps Touch Screen

The WATER LEVEL SENSOR screen is shown in Figure 18 and displays water elevations for various locations throughout the system. A value of -99.9 indicates sensor trouble and the actual water level or elevation is unknown.

<u>REFERENCE:</u>

- Drawing E-718, sheet 46 of 54 has level sensor schedule.
- Drawings E-401, sheet 8 of 54 depicts physical location of LT.002 & LT.003.
- Drawings E-402, sheet 9 of 54 depicts physical location of LT.010 & LT.011.
- Drawings E-403, sheet 10 of 54 depicts physical location of LT.013 & LT.014.
- Drawings E-404, sheet 11 of 54 depicts physical location of LT.012.



WATER LEVEL SENSORS

SENSOR	LOCATION	ELEVATION	DELTA
LT.002	AWS POOL 1	1254.98	0.52
LT.003	*AWS DIFFUSER 1	1255.51	
LT.010	AWS RIVER	1253.74	-0.18
LT.011	AWS INTAKE SCREEN	1253.55	
LT.013	FWS RIVER	1253.52	-0.11
LT.014	FWS INTAKE SCREEN	1253.41	
LT.012	FWS LADDER POOL #31	1283.77	

* Indicates Sensor Not Essential for Automatic Control.

Figure 18 –Water Lever Sensors Touch Screen

The DIFFUSER VALVE screen is shown in Figure 19, Figure 20, and Figure 21. This screen permits automatic control of all five valves or manual control of individual valves. The valve actuator "Local-Off-Remote" switch position, valve opening, and alarm information is also displayed.

SCADA ALARMS:

- FCF VALVE SYSTEM FAILED TO MANUAL – NOTIFY OPERATOR. Indicates AWS diffuser valve system jumped from automatic control to manual control due to valve actuator trouble, network trouble, or any valve actuator switch not in "remote".

The "AUTO CONTROL" push button sets the control mode for the AWS diffuser valve system. In automatic mode all five valves are adjusted by the controller. If the green "READY" symbol near the button is not visible then the system cannot be placed in "Auto". The red "NOT READY" symbol indicates at least one of the valve actuators are not switched to "Remote", a network problem exists, or an actuator has an internal alarm. Other conditions causing "NOT READY" are AWS river level sensor trouble (LT.010) and at least one valve with analog positioning disabled.

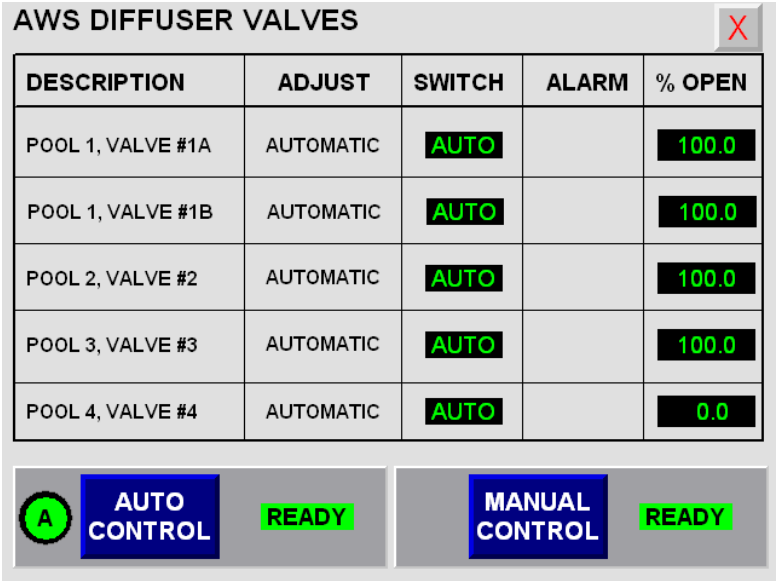


Figure 19 – Diffuser Valve Touch Screen (Automatic Mode)

The “MANUAL CONTROL” push button sets the control mode for the AWS diffuser valve system. In manual mode the valves are individually adjusted by an operator. If the green “READY” symbol near the button is not visible then no actuators can be remotely controlled. A “NOT READY” symbol indicates no actuator is switched to “Remote”, all have network problems, all are unpowered, or all have internal alarms. Manual remote valve positioning is either fully open or close, thus a stop pushbutton is not provided.

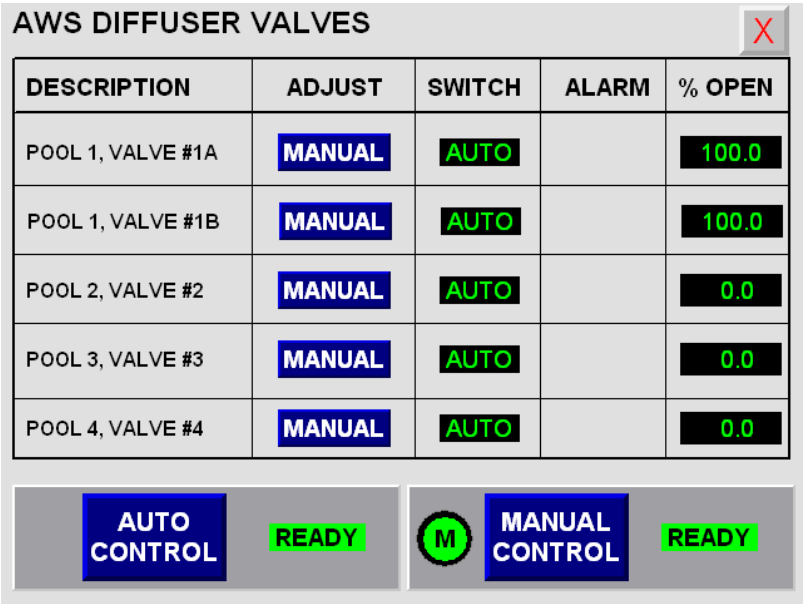


Figure 20 – Diffuser Valve Touch Screen (Manual Mode)

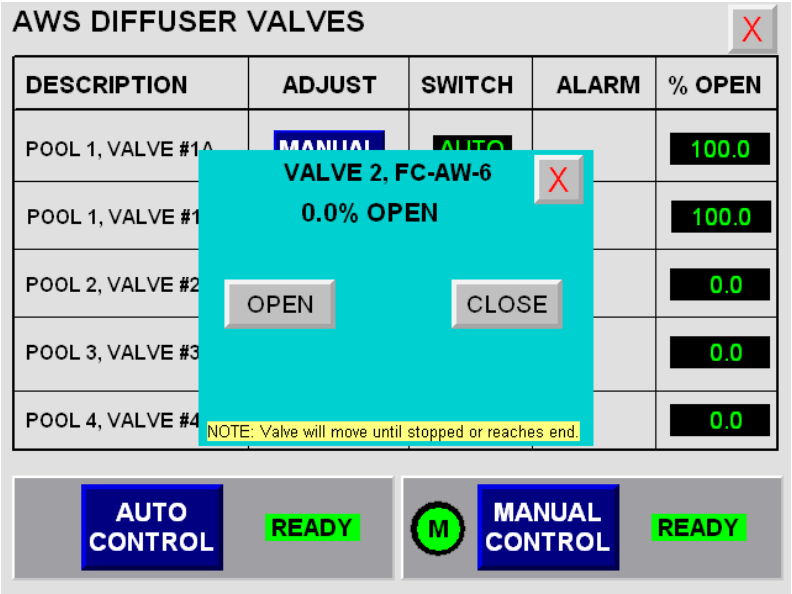


Figure 21 – Diffuser Valve Touch Screen (Manual Mode Operation)

The ENTRANCE GATE screen is shown in Figure 22. This screen permits manual and automatic control of the fish ladder entrance gate. The gate actuator "Local-Off-Remote" switch status, gate opening, and alarm information is also displayed.

The "AUTO CONTROL" push button sets the control mode for the entrance gate system. In automatic mode the gate position is adjusted by the controller. If the green "Ready" symbol above the blue push button is not visible then the system cannot be placed in "Auto". The red "NOT READY" symbol indicates the gate actuator is not switched to "Remote", has a network problem, or has an internal alarm. Other conditions causing "NOT READY" are AWS river level sensor trouble (LT.010), Ladder Pool #1 water level sensor trouble (LT.002), or analog positioning is disabled within the actuator.

- CO represents Controller Output, and should normally match the gate opening shown.
- SP is the differential head Set Point and is automatically determined.
- PV represents Process Variable and is the actual differential head measured.
- ER is the difference between SP and PV and is normally within +/- 0.15 Ft.

The maximum gate opening is 95%. The minimum gate opening is determined as follows:

- 10% open when no AWS pumps are running
- 20% + 0.80*(LT.010-1250.0) open when any AWS pump runs.
- 30% open any other time.

The "MANUAL CONTROL" push button sets the control mode for the entrance gate system. In manual mode the gate position is adjusted through the "Key Pad" setting. The "Key Pad" gate position setting must be between minimum and 95% of maximum as described above. If the green "READY" symbol near the button is not visible then no actuators can be remotely controlled. A "NOT READY" symbol indicates the actuator is not switched to "Remote", the unit is unpowered, a network problem exists, or there is an internal actuator alarm or fault.

SCADA ALARMS: “GATE SYSTEM FAILED TO MANUAL – NOTIFY OPERATOR.” Indicates the gate system jumped from automatic control to manual control due to gate actuator trouble, network trouble, actuator switch not in “remote”, or level sensor trouble.

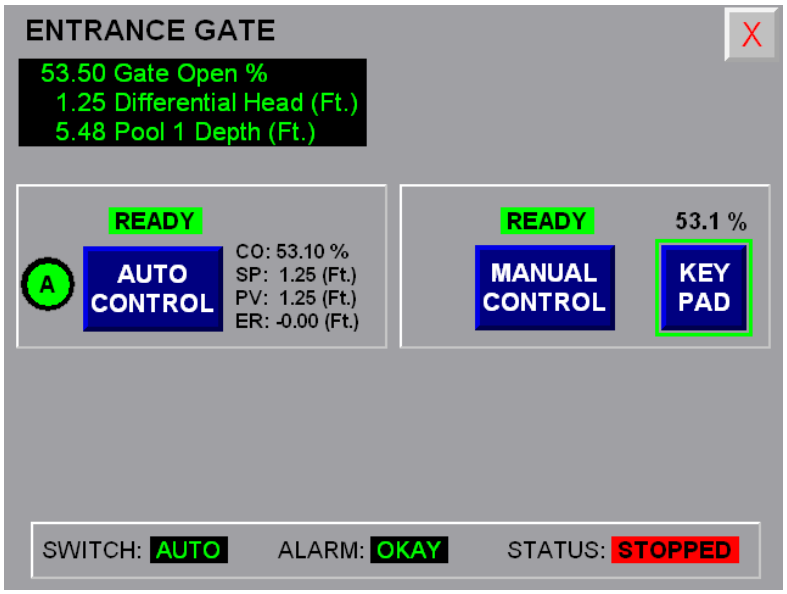


Figure 22 – Entrance Gate Touch Screen

The ALARM HISTORY screen is shown in Figure 23, and is used to acknowledge, clear, and sort system alarms. Note that the “clear all” button will clear all alarms, even if the alarm is still active.

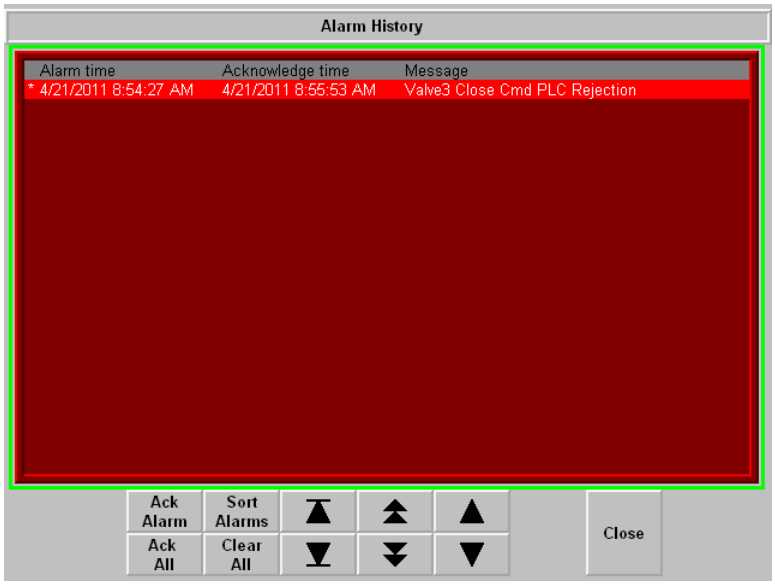


Figure 23 – Alarm History Touch Screen

The ALARM STATUS screen is used to display active alarms and shown in Figure 24. The “reset status” button restarts the accumulated time shown. The touch screen does not have a horn to silence.

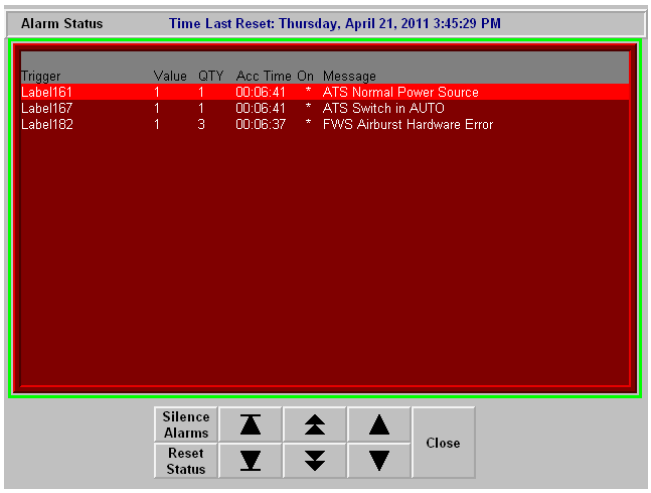


Figure 24 – Alarm Status Touch Screen

The AIRBURST screen is shown in Figure 25. The screen permits a manually triggered cleaning cycle start, and provides general status of the AWS and FWS screen cleaner systems. Any display showing -99.9 indicates sensor trouble. The "Reset Counter" pushbutton will zero the cleaning cycle counter.

"Ready for Auto Operation" should normally be displayed as shown below. If not visible then one or more of the following has occurred.

1. The selector switch on the control cabinet is not set to "Auto."
2. The air tank pressure is below 95PSI,
3. An airburst cleaning cycle is in-progress.
4. A required sensor is not functioning, as indicated by -99.9 on screen.
5. A PLC network or hardware error exists.

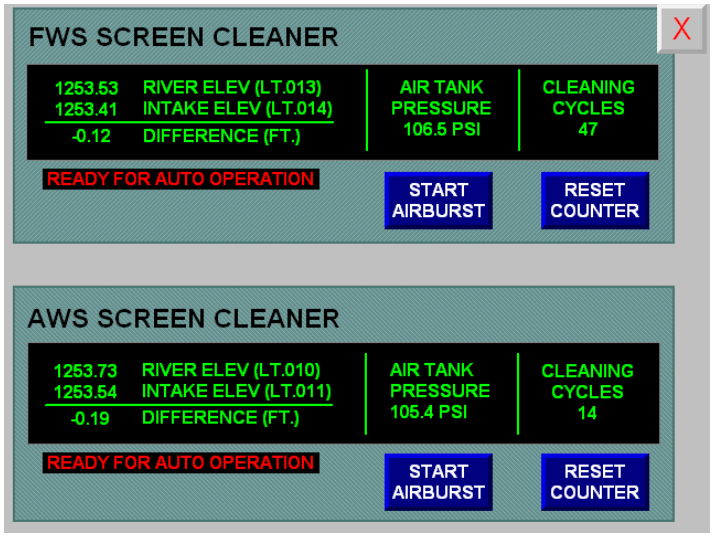


Figure 25 – Airburst Screen Cleaners Touch Screen

The power meters screen is shown in Figure 26. Real time power consumption as measured from the FWS motor control center and AWS motor control center is displayed. Any cell displaying -99.9 indicates meter trouble or loss of communications.

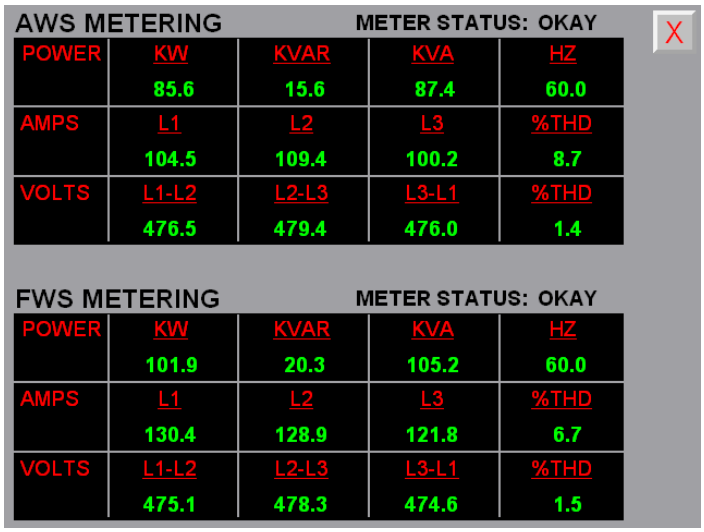


Figure 26- Power Meter Touch Screen for AWS and FWS Pumps

3.5.7.8. SCADA

LOCATIONS: Cougar and Lookout point Control Rooms

DESCRIPTION:

SCADA screens are used to monitor various hardware and systems of the Fish Collection Facility. The screens include real-time data for the AWS/FWS pump systems, Water level sensors, Diffuser valves, Screen cleaner systems, Fish ladder entrance gate, Primary feeder circuit breakers, Genset/ATS position, AWS/FWS digital power values, and Alarm status.

ALARM STATUS SCREEN:

The FCF Alarm Status screen is shown in Figure 27 and can be used to disable alarms during off-season when the system is not running. Flashing red text indicates a new alarm that has not yet been acknowledged. Solid red text indicates an alarm persists following acknowledgement. Solid black text indicates a normal condition. A disabled alarm will not appear in the alarm summary object located in the header bar, but will still appear on the alarm status screen shown below if active. Purple colored text indicates the alarm status is unknown due to a communications problem. Any loss of communications should be investigated and corrected without delay.

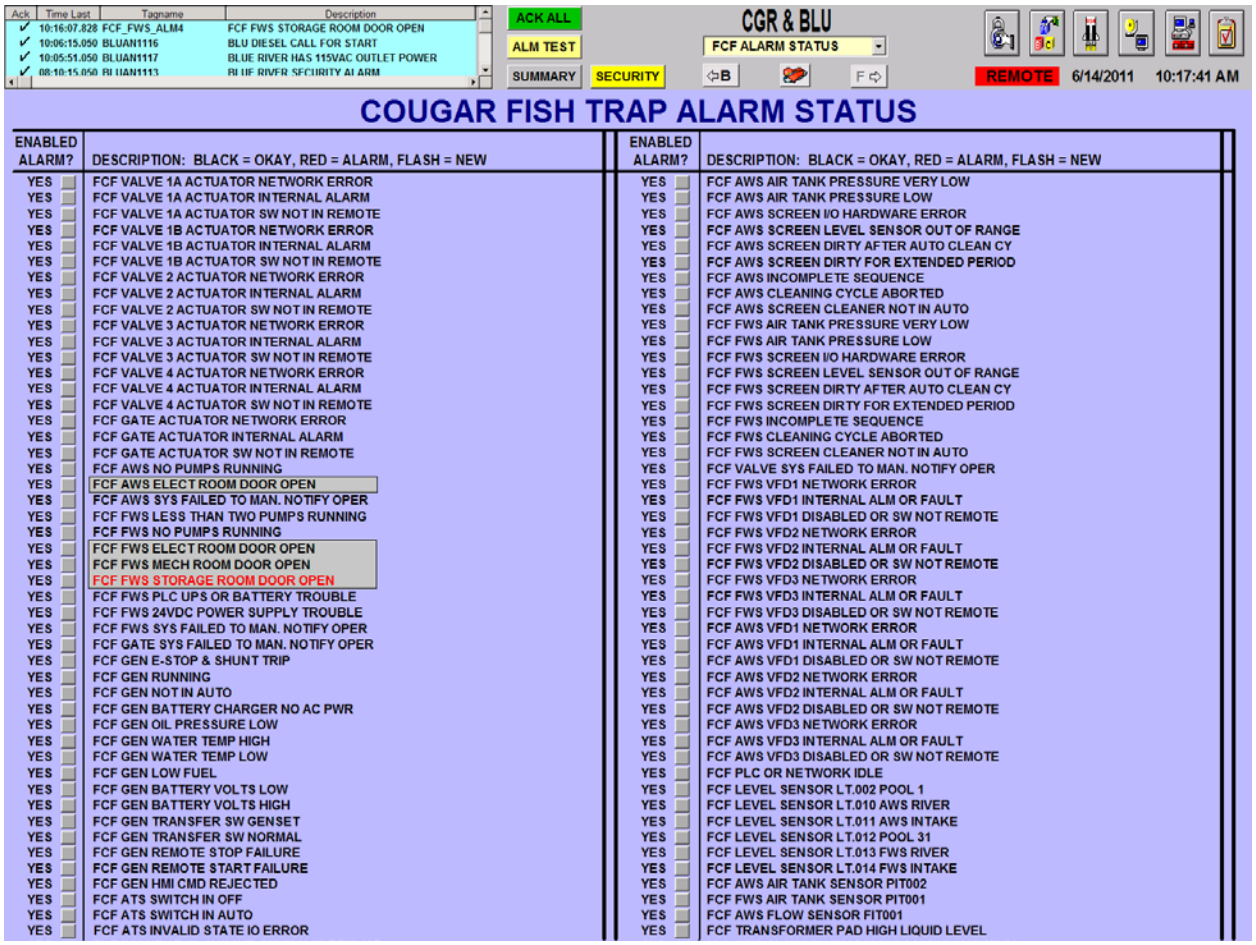


Figure 27 – FCS Alarm Status Screen

<u>OVERVIEW SCREEN:</u>

The FCF System Overview screen is shown in Figure 28 and is primarily used to monitor various hardware and systems. The data displayed is similar to the local touch-screen(s), except remote control of the FCF is not permitted. The only remote operation permitted from a SCADA terminal is switching specific systems into AUTOMATIC & MANUAL control modes, and operating XJF1 and XJF2 breakers.

The AWS Diffuser Valves System, AWS Pump System, FWS Pump System, and Entrance Gate System can be remotely placed in MANUAL or returned to AUTO if necessary by pressing the correct blue push-buttons on the screen. Note that individual gate, pump or valve control is not permitted through SCADA and must be done at the Fish Collection Facility.

Circuit breakers XJF1 & XJF2 can be operated from a SCADA terminal by clicking on the rectangular object from the main cougar control screen (not shown). Switching from one circuit breaker to another will disrupt power to the Fish Collection Facility since both circuit breakers cannot be closed simultaneously. Prior to opening XJF1 or XJF2 the Fish Collection Facility control systems should be placed in manual from any touch screen, and all pumps (variable frequency drives) should be stopped. An orderly system shutdown will prevent abrupt removal of power to the equipment while loaded, and

should prevent damage to VFD power electronics. After closing XJ1F or XJ2F all pumps should be restarted from the local touch screen, and all control systems returned to automatic.

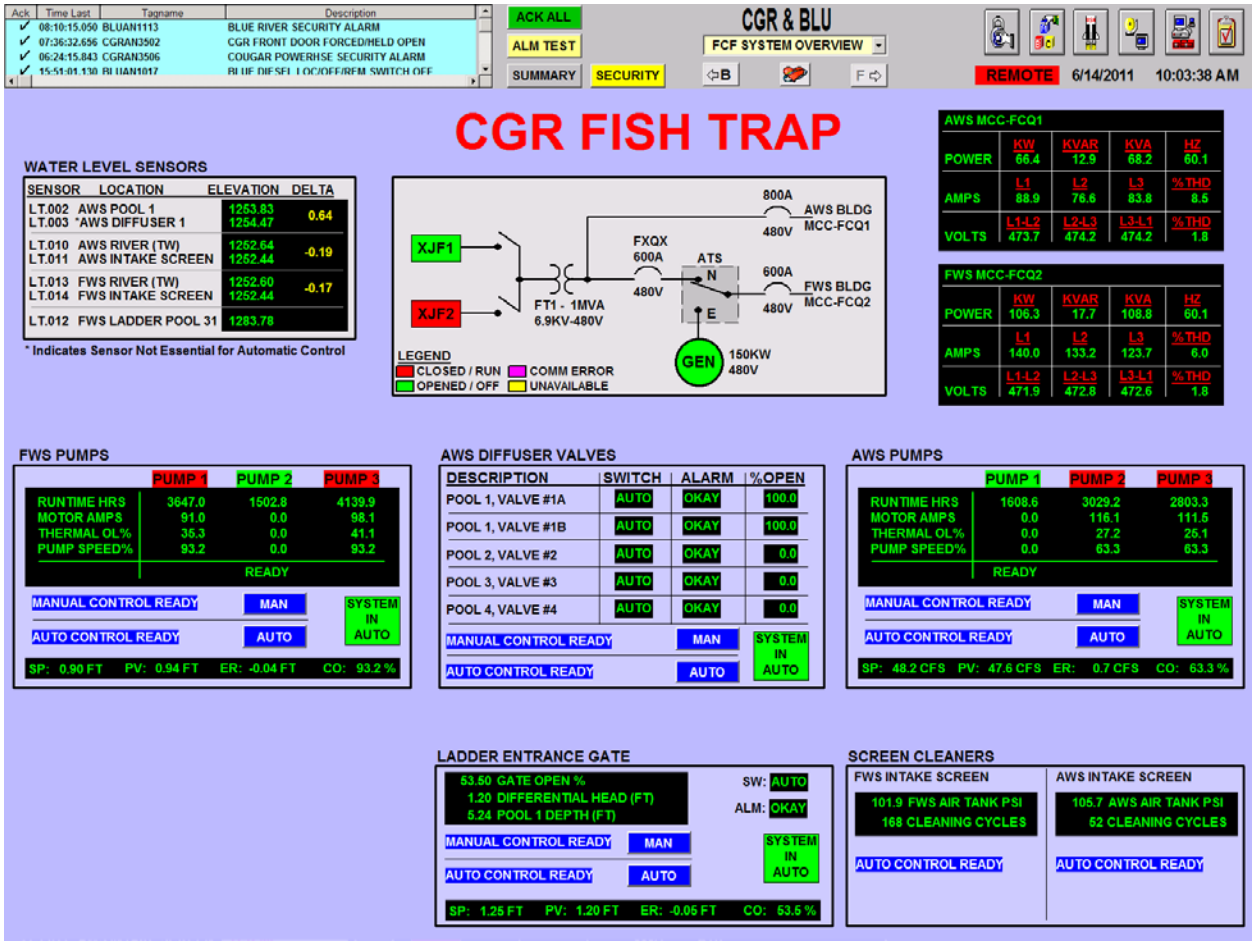


Figure 28 – FCF Overview Screen

POWER METER SCREEN:

The power meter screen for XJ1F and XJF2 feeders is shown in Figure 29. Real time power data and energy consumption is displayed for each feeder.

Hourly energy use for the entire fish collection facility is displayed for BPA reporting. Note that hour number 25 in the table is only used during day light saving time in the fall. Question marks will appear in the table following a SCADA server restart, indicating MWH values are unknown. However; the question marks will automatically change to data following a normal hourly update, or when the update button is pressed.

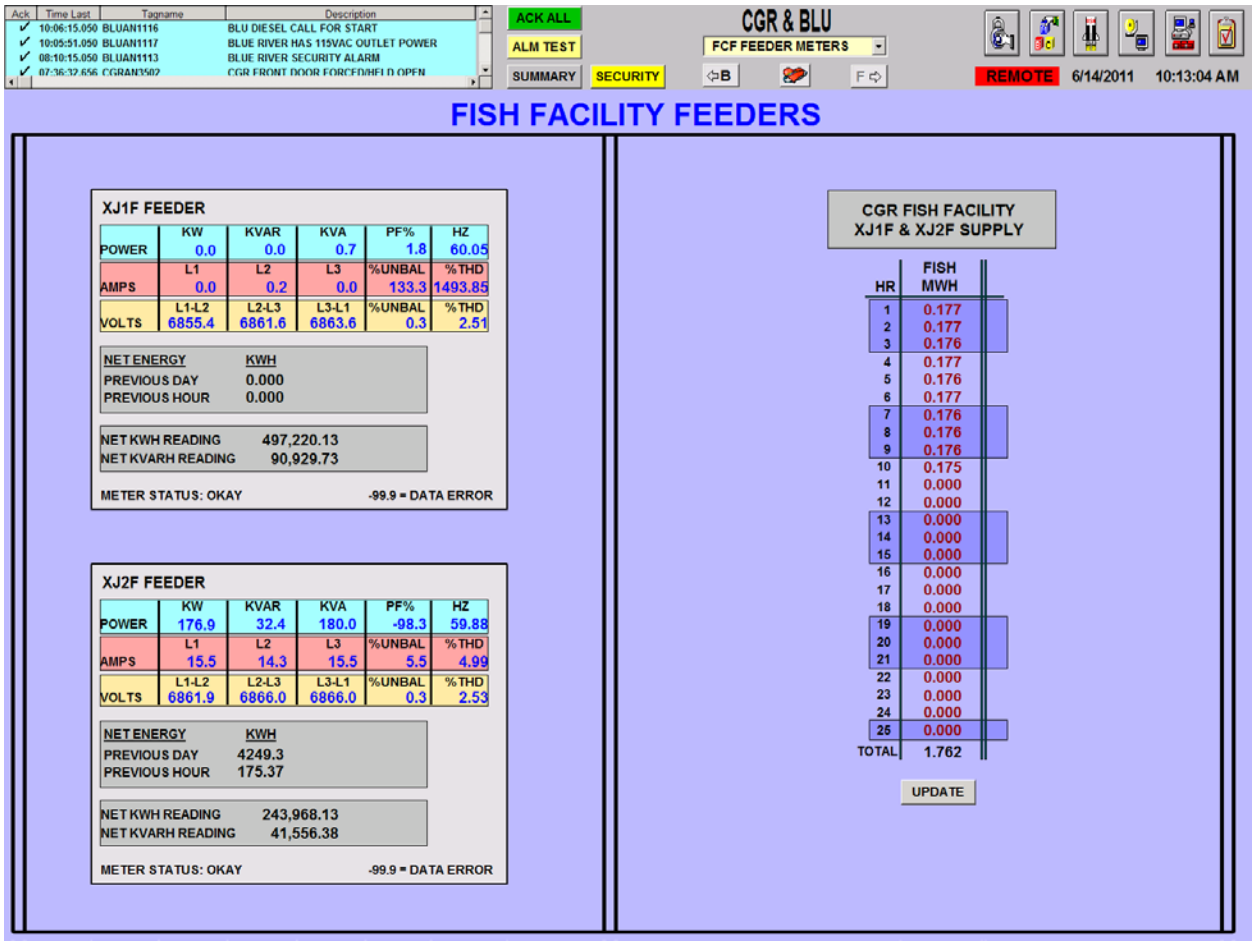


Figure 29 - Power Meter Screen for XJ1F and XJF2 Feeders

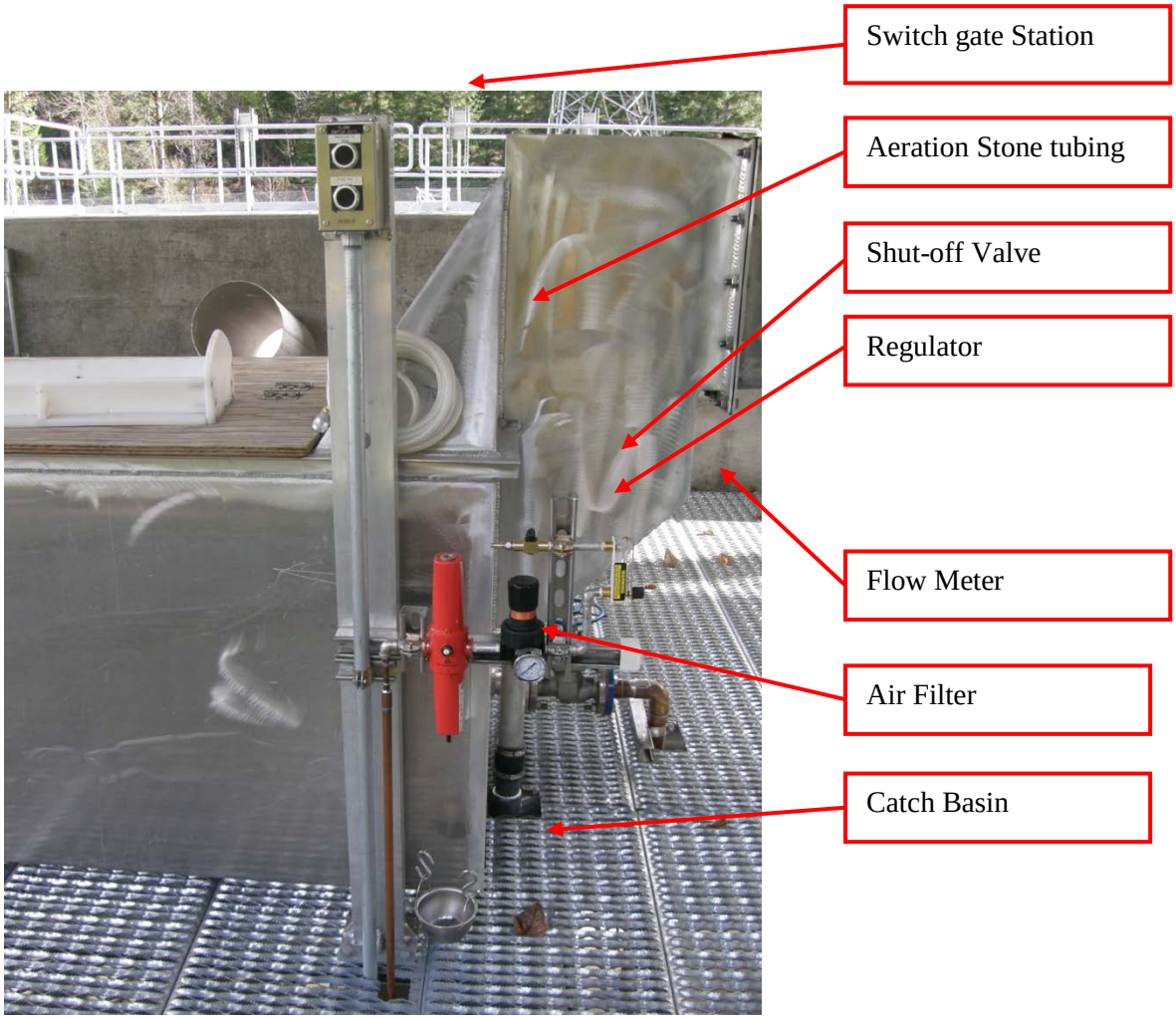
3.5.8. Aeration System

OPERATION:

The aeration system uses filtered compressed air and an aeration stone to oxygenate the water. A biologist will determine the rate of infusion and when to use the system. To operate the system the following items must be done:

- Ensure Shut-off Valve is closed
- Attach the Aeration Stone tubing
- Set the air pressure regulator to the aeration stone's recommended operation pressure
- Ensure the flow meter is at 0 flow
- Open the shut-off valve
- A biologist will determine when it is necessary to use the equipment.

CAUTION: Do not over pressurize the system. Match system pressure to the aeration stone limit.



3.6. TROUBLESHOOTING

3.6.1. AWS Pumps

Problem 1: At AWS pump startup, the AWS pump operation remains at 100% Max RPM, and this problem is caused by the failure of the AWS to properly establish a siphon by failing to sweep residual air out of the AWS Pipeline system. The discharge is essentially open channel flow with air running along the top of the pipeline. With air in the system, the flow meter will not read accurately and will persistently read lower than the PLC target discharge. If the discharge reading fails to reach the target PLC discharge rate, the AWS pumps will run continuously at 100% max RPM in attempt to reach the unattainable target discharge rate. To correct the problem, the siphon in the AWS system must be established.

1. Check to see if any actuators for Air vacuum/ Air Release (AV) Valves for the AWS (not FWS) pumps are open
    a. If so, close any open AWS air valves.

   b. Observe pump operations, noise should improve back to normal
   c. If it does not, then Go to Step 2
2. Close all diffuser valves EXCEPT 1-A and 1-B
   a. Go to touch screen in FWS building
      i. if necessary, touch screen to bring out of sleep mode
   b. Go to "Diffuser Valves" screen
      i. Select "Manual" operation on "diffuser Valve" screen
      ii. Close all diffuser valves except 1-A and 1-B (if tailwater is lower than 1252 feet, may need to close 1-B as well)
      iii. Go back to home screen by touching 'X'
   c. Go to "AWS Pumps" and observe data
      i. Are the pumps now running below 100% max RPM and is the AWS discharge within reasonable parameters?
      ii. IF YES, then return the 'diffuser valve' screen and select 'Automatic' operation
      iii. IF NO, then go to step 3

3. Open Air Vacuum (AV) Valves and force air from system
   a. Open AV valves located on top of each AWS pump can and below the air valve assembly (These are manual valves that are just above grating).
   b. Rotate valve actuator until the pointer on the unit says "open"
   c. Close all diffuser valves except Valve 1-A
   d. Manually increase AWS Pump Speed to 95-99% to force air out of system both vertically through AV or out end of pipe at valve 1-A.
   e. Observe the top of the vacuum breaker/air release valves while depressing the hexagonal shaft located at the top of the valve and wait for water to comes up to the top and rotate valve actuator until the pointer on the valve says "close" (water may not always reach top of air valve in a particular can, but still OK to close valve)
   f. Repeat operation for all three AV valve/pump combinations
   g. If the problem persists, Go to Step 4:
   h.
4. Check for air leaks at all of the piping joints (This may be indicated by water leakage or hissing sounds). The AWS system will be routinely operating under a siphon. If air is allowed into the system, the siphon will break and flow meter will not function properly. If an air leak is detected, the leak needs to be sealed. The pumps will experience long term wear if this problem is not attended to as soon as possible.

Problem 2: AWS Pumps become noisier with gravelly or popping noises (indicating cavitation and/or increased vibrations), imbalanced and high amperage rates observed between the two operating pumps. The cause of this problem is similar to Problem 1, where the siphon in the AWS pipe system has failed and the discharge in the AWS pipes is running open channel (with air running above the water level in the pipe) instead of full flow.

1. Check to see if any actuators for Air vacuum/ Air Release (AV) Valves for the AWS (not FWS) pumps are open
   a. If so, close any open AWS air valves.

   b. Observe pump operations, noise should improve back to normal
   c. If it does not, then Go to Step 2
2. Check to see if the pumps and diffuser valves are being operated per 3 (or Table 6)
   a. If not, correct the operation (Automatic control should follow those tables.)
   b. If Yes, Check to see if the entrance gate is operating in criteria (pool 1 ≥ 5 feet and entrance head between 1.1 -1.4 feet)
      i. If Not, Correct the entrance gate operation (Automatic control should keep it in the criteria)
   c. If Yes to all above. there are two choices:
      i. Interim (quick) adjustment: Try changing pumps. (Please report the specific pump that must be removed from operation to Mechanical Design in Robert Duncan Plaza.)
      ii. More permanent solution: Go to Step 3 (AWS piping system needs to have trapped air removed from system)
3. Open Air Vacuum (AV) Valves and force air from system
   a. Open AV valves located on top of each AWS pump can and below the air valve assembly (These are manual valves that are just above grating).
   b. Rotate valve actuator until the pointer on the unit says "open"
   c. Close all diffuser valves except Valve 1-A
   d. Increase AWS Pump Speed to 95-99% to force air out of system both vertically through AV or out end of pipe at valve 1-A.
   e. Observe the top of the vacuum breaker/air release valves while depressing the hexagonal shaft located at the top of the valve and wait for water to comes up to the top and rotate valve actuator until the pointer on the valve says "close" (water may not always reach top of air valve in a particular can, but still OK to close valve)
   f. Repeat operation for all three AV valve/pump combinations
   g. Pump noise will be initially high and then will quiet down within 2- 5 minutes.
   h. If the problem persists, Go to Step 4:
4. Check for air leaks at all of the piping joints (This may be indicated by water leakage or hissing sounds). The AWS system will be routinely operating under a siphon. If air is allowed into the system, the siphon will break and the pumps wills not operate smoothly. If an air leak is detected, the leak needs to be sealed. The pumps will experience long term wear if this problem is not attended to as soon as possible.

Pumps should resume normal operations without vibrations after these procedures. If problem persists, contact Mechanical Design or Hydraulic Design at Robert Duncan Plaza.

3.6.2. Emergency Generator Charts and Alarms

TROUBLE SHOOTING

To identify faults, you may check the remote alarm panel inside the FWS building and/or remove the access door that covers the control panel inside the generator. On the generator select the faults screen to review any faults. The generator will not start if there is a fault present. Note that certain faults will shunt trip the generator breaker and it must be reclosed after the fault has been cleared.

Emergency Generator Troubleshooting Guide

PROBLEM	CAUSE	CORRECTION
Engine won't crank	1. 15 amp fuse blown. 2. Loose or corroded or defective battery cables. 3. Defective starter contactor. 4. Defective starter motor. 5. Dead or Defective Battery. 6. 5 amp fuse blown.	1. Replace fuse. 2. Tighten, clean or replace. 3. Replace contactor. 4. Replace starter motor. 5. Remove, change or replace battery. 6. Replace fuse
Engine cranks but won't start	1. Out of fuel. 2. Fuel solenoid (FS) is defective 3. Open wire #14A from Engine Control circuit board. 4. Spark plugs defective.	1. Replenish fuel 2. Replace solenoid. 3. Reconnect wire. 4. Clean, re-gap or replace plugs.
Engine starts hard, runs rough	1. Flame arrestor (air cleaner) plugged or damaged. 2. Plugged fuel line 3. Defective spark plugs. 4. Fuel pressure incorrect.	1. Clean or replace as needed 2. Unclog fuel line. 3. Clean, re-gap or replace plugs. 4. Confirm fuel pressure to regulator is as recommended in SPECS
Engine starts then shuts down.	1. Engine oil level is low. 2. Engine is overheated. 3. Defective low oil pressure switch	1. Check oil and add oil as needed. 2. Check cooling system for leaks. 3. Replace switch.
Engine starts then shuts down.	1. Defective coolant temperature switch 2. Defective control module circuit board 3. Coolant level is low 4. Defective low coolant level switch	1. Replace switch 2. Replace board. 3. Repair leak - add coolant 4. Replace switch
AUTO/OFF/MANUAL Switch at OFF Engine continues to run	1. Defective AUTO/OFF/MANUAL switch 2. Open/disconnected wire #15A between AUTO/OFF/MANUAL switch and Control Module circuit board. 3. Defective control Module circuit board	1. Replace switch 2. Reconnect/close wire. 3. Replace board.
No AC output from generator	1. Check main line circuit breaker. 2. Check circuit breaker & fuses. 3. Transfer switch set to NORMAL position 4. Generator internal failure. 5. Thermal circuit breaker open.	1. Reset ON or CLOSED 2. Reset and replace, if necessary. 3. Set to GENERATOR position. 4. Contact nearest authorized dealer for assistance 5. Auto-reset – Wait 5 min. and attempt restart.

REMOTE ANNUNCIATION

The generator is provided with a remote annunciator located on the front of the PLC cabinet in the FWS electric room. Certain annunciator points are also tied to the PLC/SCADA system for monitoring from Lookout Point.

SCADA ALARMS

Automatic Transfer Switch

- ATS INVALID STATE IO ERROR
- ATS SWITCH IN AUTO
- ATS SWITCH IN OFF

Generator

- GEN TRANSFER SW NORMAL
- GEN TRANSFER SW GENSET
- GEN BATTERY VOLTS HIGH
- GEN BATTERY VOLTS LOW
- GEN LOW FUEL
- GEN WATER TEMP HIGH
- GEN WATER TEMP LOW
- GEN OIL PRESSURE LOW
- GEN BATTERY CHARGER NO AC PWR
- GEN NOT IN AUTO
- GEN RUNNING
- GEN E-STOP & SHUNT TRIP
- GEN HMI CMD REJECTED (Not Used)
- GEN REMOTE START FAILURE (Not Used)
- GEN REMOTE STOP FAILURE (Not Used)

3.6.3. Facility SCADA Alarms

See APPENDIX D-SCADA ALARMS for a table containing facility SCADA alarms with their associated priority level, possible causes, effects, and procedures to follow.

3.7. INTRUSION DETECTION

3.7.1. Security Switches

LOCATIONS: Various structures and rooms throughout facility.

DEVICE IDENTIFICATION: ZS-001, ZS-002, ZS-003, ZS-004

REFERENCE:

- Drawing E-406, sheet 13/54 shows physical location of FWS electric room switch.
- Drawing E-407, sheet 14/54 shows physical location of mechanical & storage room switches.
- Drawing E-409, sheet 16/54 shows physical location of AWS electric room switch.
- Drawing E-704, sheet 32/54 depicts security switch interface to PLC for FWS sorting facility.
- Drawing E-710, sheet 38/54 depicts security switch interface to PLC for AWS electric room.

- Drawing E-718, sheet 46/54 includes security switch schedule for entire project.

DESCRIPTION:

Security switches are installed at each door of the electrical, mechanical, and storage rooms. All switches are connected to the PLC/SCADA system for remote monitoring and historical data logging. Model GE 2507AD switches are installed, which are an industrial wide-gap surface mount type with dual SPDT reed contacts.

4. APPENDICIES

4.1. APPENDIX A-PLATES

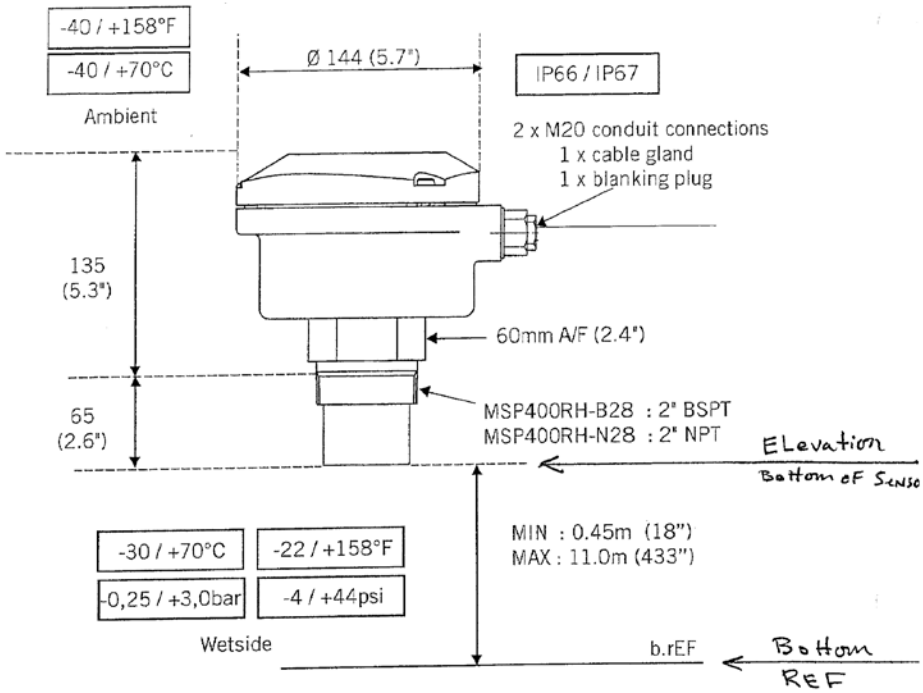
Note: Plates are contract drawings, not as-constructed drawings, and should be replaced by as-constructed drawings when available.

4.2. APPENDIX B-LOCATION INFORMATION FOR LEVEL TRANSMITTERS

Ultrasonic Level Sensor Locations		Cougar Adult Fish Facility		6-Jun-10
Drawing Label	Description	Elevation @ Nearest Horizontal surface above sensor	Elevation @ Horizontal surface directly below sensor	Elevation @ bottom of sensor
LT-002	Ultrasonic Sensor	1264.58	1248.59	1263.62
LT-003	Ultrasonic Sensor	1264.58	1249.37	1263.62
LT-010	Ultrasonic Sensor	1262.06	River Bottom	1261.58
LT-011	Ultrasonic Sensor	1262.05	1244.42	1260.37
LT-012	Ultrasonic Sensor	1288.54	1278.27	1287.94
LT-013	Ultrasonic Sensor	1256.98	River Bottom	1256.52
LT-014	Ultrasonic Sensor	1257.00	1244.98	1255.95

Additional Elevations		Notes: Weir 31 measurement was taken just down the ladder from LT-012. The pre-sort pool measurement was done at the top of the wall above the pool.
Top of weir 31	1282.84	
Pre-sort Pool	1288.59	

Ultrasonic Sensor-Mobrey MSP400RH


-40 / +158°F
-40 / +70°C
Ambient
Ø 144 (5.7")
IP66 / IP67
2 x M20 conduit connections
1 x cable gland
1 x blanking plug
135
(5.3")
60mm A/F (2.4")
65
(2.6")
MSP400RH-B28 : 2" BSPT
MSP400RH-N28 : 2" NPT
ELevation
Bottom eF Sense
MIN : 0.45m (18")
MAX : 11.0m (433")
-30 / +70°C
-22 / +158°F
-0,25 / +3,0bar
-4 / +44psi
Wetside
b.rEF
Bottom
REF

U.S. ARMY CORPS OF ENGINEERS

OFFICE SYMBOL: CENWP-EC-DS

PROJECT: Cougar Trap and Haul Facility	COMPUTED BY: Michael Crump	DATE: 6/9/2010
SUBJECT: Staff Gages Info	CHECKED BY:	SHT. OF
		PART:

GAGE PLACEMENT CHART

GAGE NUMBER	GAGE LOCATION	ELEVATION VALUES	
		TOP OF GAGE	BOTTOM OF GAGE
1	POST SORT POOL NO. 1	1278.0	1270.5
2	POST SORT POOL NO. 2	1278.0	1270.5
3	POST SORT POOL NO. 3	1278.0	1270.5
4	PRE SORT POOL	7.0	2.0
5	UPPER FISH LADDER MONOLITH NO. 31	2.0	0.0
6	FISH LADDER POOL # 1 MONOLITH - INTERIOR "East"	1259.0	1250.0
7	FISH LADDER POOL # 1 MONOLITH - INTERIOR "West"	1259.0	1250.0
8	FISH LADDER POOL # 1 MONOLITH - EXTERIOR	1259.0	1250.0
9	FISH LADDER ENTRANCE MONOLITH - EXTERIOR	1259.0	1250.0

NOTES :

1. STAFF GAGES LOCATIONS IN THE VARIOUS PLACES ARE APPROXIMATE AND MAY BE SHIFTED SLIGHTLY FOR BETTER VISIBILITY UP ON GOVERNMENT APPROVAL.
2. NUMBERS SHOWN IN THE DETAILS ARE FOR ILLUSTRATIVE PURPOSES. ACTUAL NUMBERS SHALL BE AS SHOWN IN THE GAGE PLACEMENT CHART.
3. THE CONTRACTOR SHALL BE RESPONSIBLE FOR ACCURATELY PLACING THE STAFF GAGES AT THE ELEVATIONS SHOWN IN THE CHART WITHIN 1/4 INCH PLUS OR MINUS.
4. THE STAFF GAGE IN FISH LADDER POOL #31 SHALL BE PLACED SUCH THAT THE ZERO LEVEL IS AT THE LEVEL OF THE TOP OF THE OVERFLOW WEIR JUST DOWNSTREAM.
5. THE STAFF GAGE IN THE PRE-SORT POOL SHALL BE PLACED SUCH THAT THE 7.0 FT LEVEL IS PLACED THREE FEET DOWN FROM THE TOP OF THE ADJACENT PRE-SORT WALL..

StaffGageElevs4CougarDrawings.xls

4.3. APPENDIX C- HYDRAULIC DATA

1. Tailwater Rating Curve versus Powerhouse and Total Project Discharge

The following rating curves were developed from a calibrated HEC-RAS model (Ref. Cougar AFCF DDR Appendix H). Figure 30 covers the full range of Project operation between minimum discharge and 100-year Flood. Figure 31 covers the normal range of Project operation from normal minimum Powerhouse discharge (300 cfs) to maximum Powerhouse discharge (1350 cfs). The line in both figures represents Powerhouse discharge when there is no RO discharge. The points off the line represent powerhouse discharge (or no PH discharge) with RO discharge rate indicated by the legend.

Figure 30– Cougar Tailwater Elevation at AFCF Fish ladder Entrance Verses Powerhouse Discharge Rate (Minimum Discharge to 100 year Flood)

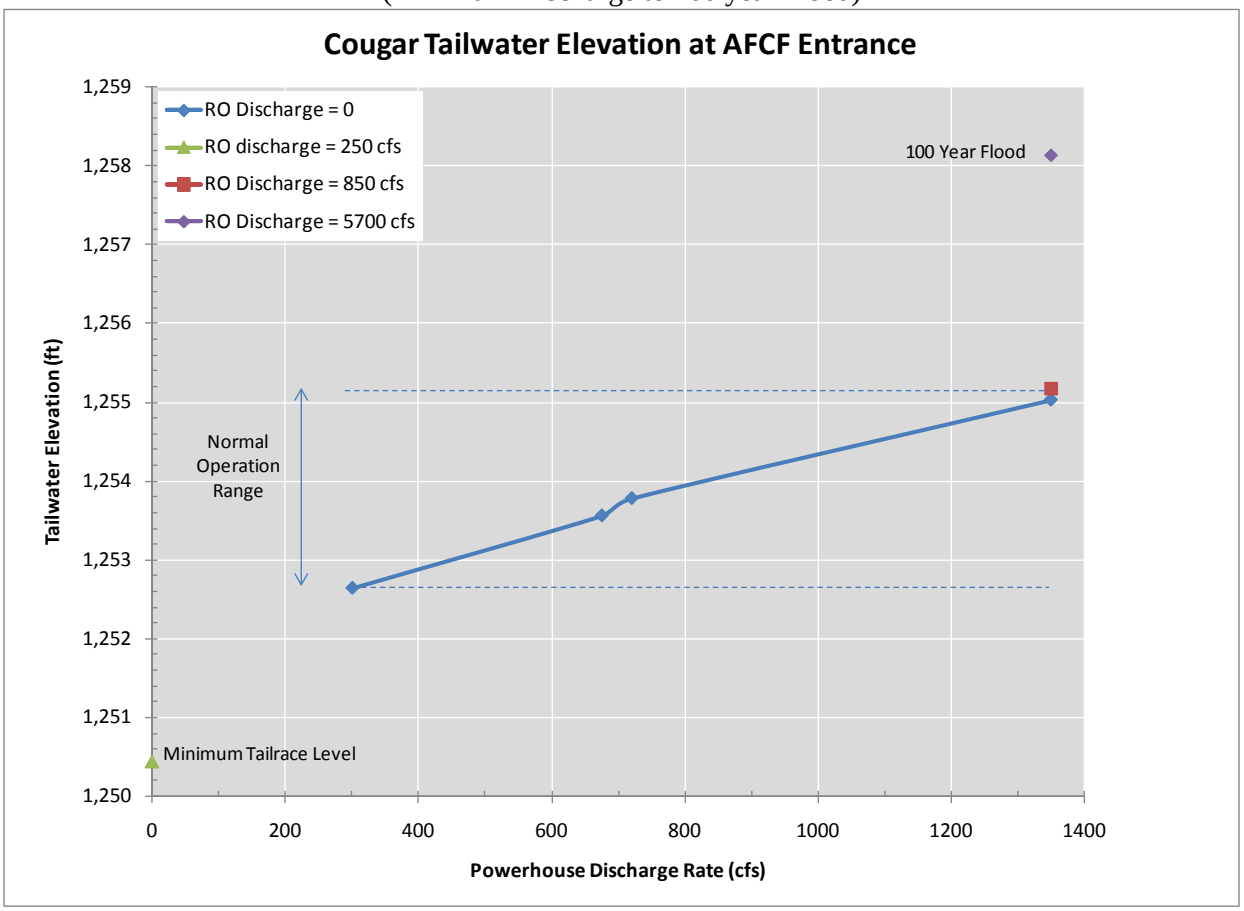


Figure 31 – Cougar Tailwater Elevation at AFCF Fish Ladder Entrance Verses Powerhouse Discharge Rate (Normal Operation Range)

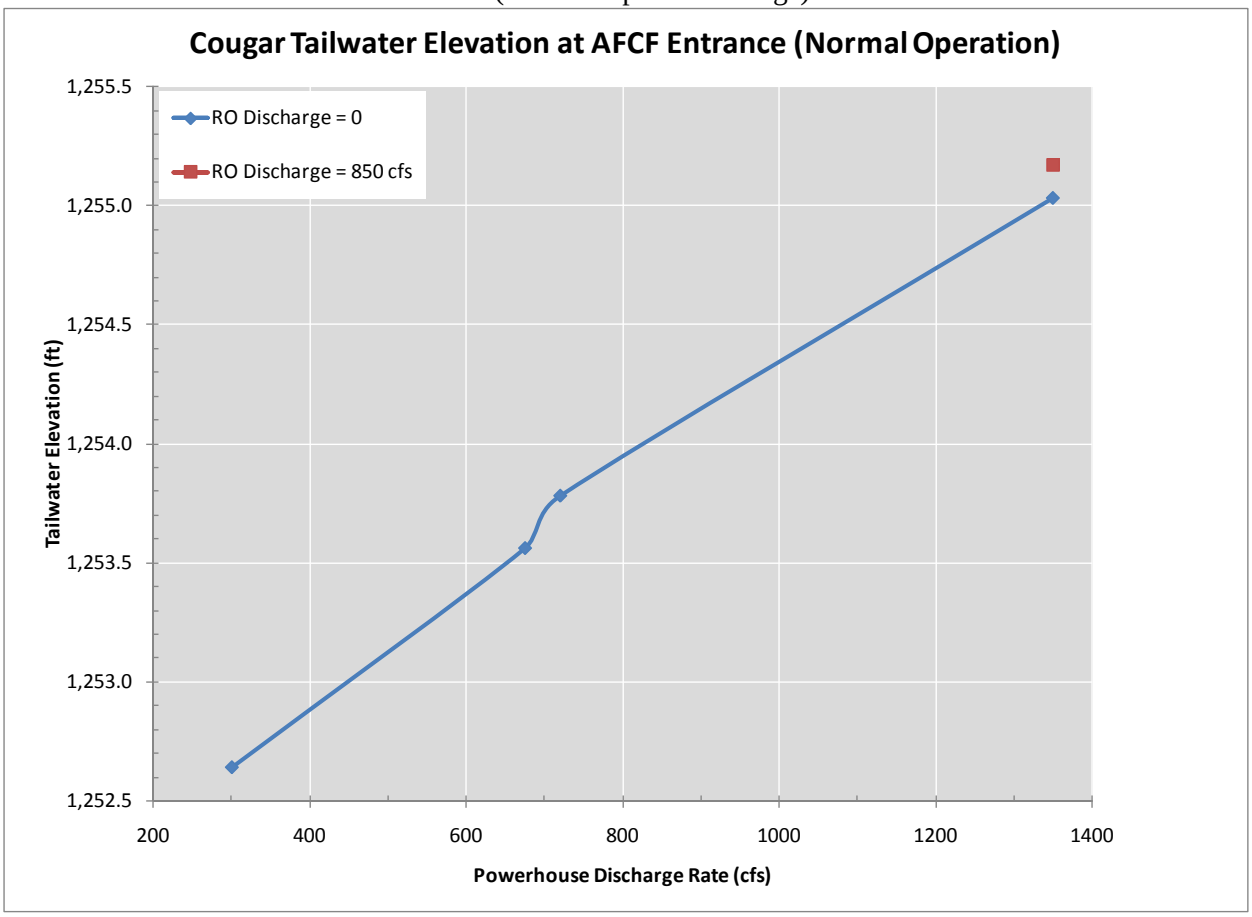


Table 8 – Percent of Maximum RPM for AWS Pumps versus Tailwater Elevation

Table for Percent of Max RPM for AWS pumps vs. Tailwater Elevation

Table 9 - Percent of Maximum RPM for FWS Pumps versus Tailwater Elevation required to meet 1-foot Ladder Head at Pool 31

Table for Percent of Max RPM for FWS vs. Tailwater Elevation Required to meet Ladder Head Criteria at Pool 31

4.4. APPENDIX D-SCADA ALARMS

SCADA ALARMS (CGR & LOP CONTROL ROOMS)

Draft Version 09_02_10

ITEM	SCADA TAG	SCADA DESCRIPTION	PRIORITY	POSSIBLE CAUSE	EFFECT	PROCEDURE	CONTACT PERSON
1	FCF_ANL01	FCF LEVEL SENSOR LT.002 POOL 1	Low	Device Trouble, No Power, Broken Wire	-99.9 Displayed at SCADA PC. No Auto Entrance Gate Control.	Operate Entrance Gate in Manual.	
2	FCF_ANL09	FCF LEVEL SENSOR LT.010 AWS RIVER	Med	Device Trouble, No Power, Broken Wire	-99.9 Displayed at SCADA PC. No Auto Entrance Gate Control. No Auto Diffuser Valve Control. No Auto AWS Airburst Operation.	Operate Entrance Gate in Manual. Operate Diffuser Valves in Manual. Manually activate screen cleaner as req'd.	
3	FCF_ANL10	FCF LEVEL SENSOR LT.011 AWS INTAKE	Low	Device Trouble, No Power, Broken Wire	-99.9 Displayed at SCADA PC. No Auto AWS Airburst Operation.	Manually activate screen cleaner as req'd.	
4	FCF_ANL11	FCF LEVEL SENSOR LT.012 POOL 31	Med	Device Trouble, No Power, Broken Wire	-99.9 Displayed at SCADA PC. No Auto FWS Pump Control.	Manually control water level at Pool #31.	
5	FCF_ANL12	FCF LEVEL SENSOR LT.013 FWS RIVER	Low	Device Trouble, No Power, Broken Wire	-99.9 Displayed at SCADA PC. No Auto FWS Airburst Operation.	Manually activate screen cleaner as req'd.	
6	FCF_ANL13	FCF LEVEL SENSOR LT.014 FWS INTAKE	Low	Device Trouble, No Power, Broken Wire	-99.9 Displayed at SCADA PC. No Auto FWS Airburst Operation.	Manually activate screen cleaner as req'd.	
7	FCF_ANL14	FCF AWS AIR TANK SENSOR PIT002	Low	Device Trouble, No Power, Broken Wire	-99.9 Displayed at SCADA PC. No Auto AWS Airburst Operation.	Monitor Diff Press across screens & manually activate screen cleaner as req'd.	
8	FCF_ANL15	FCF FWS AIR TANK SENSOR PIT001	Low	Device Trouble, No Power, Broken Wire	-99.9 Displayed at SCADA PC. No Auto FWS Airburst Operation.	Monitor Diff Press across screens & manually activate screen cleaner as req'd.	
9	FCF_ANL16	FCF AWS FLOW SENSOR FIT001	Low	Device Trouble, No Power, Broken Wire	-99.9 Displayed at SCADA PC. No Auto AWS Pump Control.	Manually control AWS Pumps	
10	FCF_ACT0_ALM0	FCF VALVE 1A ACTUATOR NETWORK ERROR	Low	Device Trouble, No Power, Broken Cable	No Auto Diffuser Valve System Control	Operate All Diffuser Valves in Manual.	
11	FCF_ACT0_ALM1	FCF VALVE 1A ACTUATOR INTERNAL ALARM	Low	Device Trouble	No Auto Diffuser Valve System Control	Operate All Diffuser Valves in Manual.	
12	FCF_ACT0_ALM2	FCF VALVE 1A ACTUATOR SW NOT IN REMOTE	Low	Device Switch in Local or Stop Position	No Auto Diffuser Valve System Control	Operate All Diffuser Valves in Manual.	
13	FCF_ACT1_ALM0	FCF VALVE 1B ACTUATOR NETWORK ERROR	Low	Device Trouble, No Power, Broken Cable	No Auto Diffuser Valve System Control	Operate All Diffuser Valves in Manual.	
14	FCF_ACT1_ALM1	FCF VALVE 1B ACTUATOR INTERNAL ALARM	Low	Device Trouble	No Auto Diffuser Valve System Control	Operate All Diffuser Valves in Manual.	
15	FCF_ACT1_ALM2	FCF VALVE 1B ACTUATOR SW NOT IN REMOTE	Low	Device Switch in Local or Stop Position	No Auto Diffuser Valve System Control	Operate All Diffuser Valves in Manual.	
16	FCF_ACT2_ALM0	FCF VALVE 2 ACTUATOR NETWORK ERROR	Low	Device Trouble, No Power, Broken Cable	No Auto Diffuser Valve System Control	Operate All Diffuser Valves in Manual.	
17	FCF_ACT2_ALM1	FCF VALVE 2 ACTUATOR INTERNAL ALARM	Low	Device Trouble	No Auto Diffuser Valve System Control	Operate All Diffuser Valves in Manual.	
18	FCF_ACT2_ALM2	FCF VALVE 2 ACTUATOR SW NOT IN REMOTE	Low	Device Switch in Local or Stop Position	No Auto Diffuser Valve System Control	Operate All Diffuser Valves in Manual.	
19	FCF_ACT3_ALM0	FCF VALVE 3 ACTUATOR NETWORK ERROR	Low	Device Trouble, No Power, Broken Cable	No Auto Diffuser Valve System Control	Operate All Diffuser Valves in Manual.	
20	FCF_ACT3_ALM1	FCF VALVE 3 ACTUATOR INTERNAL ALARM	Low	Device Trouble	No Auto Diffuser Valve System Control	Operate All Diffuser Valves in Manual.	
21	FCF_ACT3_ALM2	FCF VALVE 3 ACTUATOR SW NOT IN REMOTE	Low	Device Switch in Local or Stop Position	No Auto Diffuser Valve System Control	Operate All Diffuser Valves in Manual.	
22	FCF_ACT4_ALM0	FCF VALVE 4 ACTUATOR NETWORK ERROR	Low	Device Trouble, No Power, Broken Cable	No Auto Diffuser Valve System Control	Operate All Diffuser Valves in Manual.	
23	FCF_ACT4_ALM1	FCF VALVE 4 ACTUATOR INTERNAL ALARM	Low	Device Trouble	No Auto Diffuser Valve System Control	Operate All Diffuser Valves in Manual.	
24	FCF_ACT4_ALM2	FCF VALVE 4 ACTUATOR SW NOT IN REMOTE	Low	Device Switch in Local or Stop Position	No Auto Diffuser Valve System Control	Operate All Diffuser Valves in Manual.	
25	FCF_ACT5_ALM0	FCF GATE ACTUATOR NETWORK ERROR	Low	Device Trouble, No Power, Broken Cable	No Auto Entrance Gate System Control	Operate Entrance Gate in Manual.	
26	FCF_ACT5_ALM1	FCF GATE ACTUATOR INTERNAL ALARM	Low	Device Trouble	No Auto Entrance Gate System Control	Operate Entrance Gate in Manual.	
27	FCF_ACT5_ALM2	FCF GATE ACTUATOR SW NOT IN REMOTE	Low	Device Switch in Local or Stop Position	No Auto Entrance Gate System Control	Operate Entrance Gate in Manual.	
28	FCF_GATE_ALM0	FCF GATE SYS FAILED TO MAN. NOTIFY OPER	Med	Entrance Gate System jumped from Auto to Manual control due to Equipment trouble, Network trouble, or Gate Actuator Switch not in Remote.	No Automatic Entrance Gate Control.	Document alarms causing jump to manual. System can be returned to Auto via touch screen or SCADA only when READY FOR AUTO indicator visible..	
29	FCF_AWS_ALM1	FCF AWS NO PUMPS RUNNING	Med	No AWS Power, Drive Trouble, Pump Trouble, VFD(s) manually turned off or switched to MAN, AWS pump system manually stopped.	Insufficient tailwater attraction flow at fish ladder entrance.	If power available, trouble shoot system ASAP.	
30	FCF_AWS_ALM7	FCF AWS SYS FAILED TO MAN. NOTIFY OPER	Med	AWS Pump System jumped from Auto to Manual control due to equipment trouble, network trouble or any AWS VFD being operated in Man.	No Automatic AWS Pump Control	Document alarms causing jump to manual. System can be returned to Auto via touch screen or SCADA only when READY FOR AUTO indicator visible..	

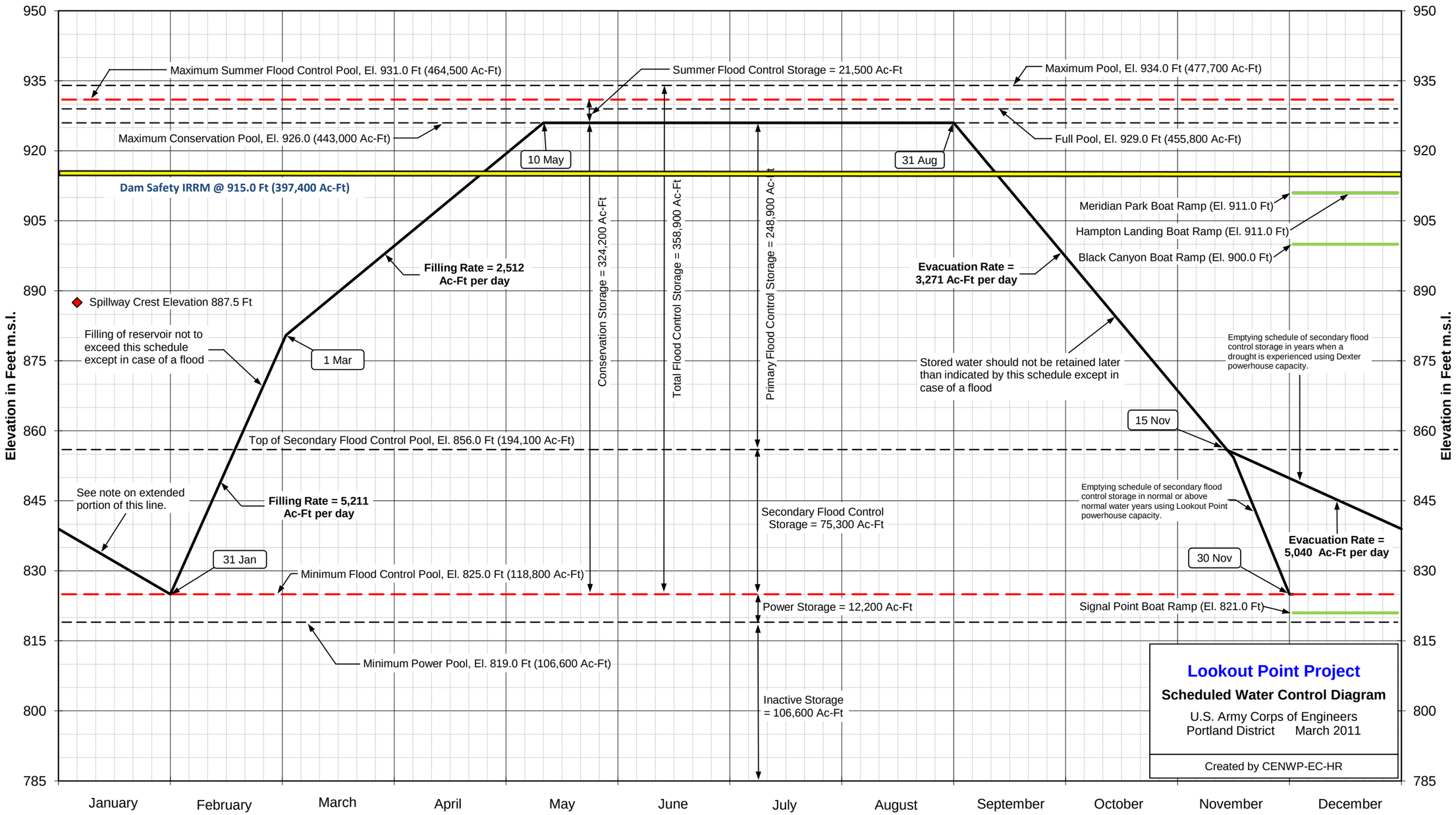
ITEM	SCADA TAG	SCADA DESCRIPTION	PRIORITY	POSSIBLE CAUSE	EFFECT	PROCEDURE	CONTACT PERSON
31	FCF_FWS_ALM0	FCF FWS LESS THAN TWO PUMPS RUNNING	High	No normal power to FWS, Drive Trouble, Pump Trouble, VFD(s) manually turned off or switched to MAN, emergency Generator supplying FWS Electrical Power.	With single FWS pump operating fish cannot ascend ladder or enter pre-sort pool.	If emergency genset supplying FWS power then condition normal. However; if normal power will be unavailable for 24 plus hours, fish should be evacuated from ladder & presort pool. Situation should be monitored very closely to ensure VFD's auto start following transition to/from genset power.	
32	FCF_FWS_ALM1	FCF FWS NO PUMPS RUNNING	High	No FWS Power, Drive Trouble, Pump Trouble, VFD(s) manually turned off or switched to MAN, FWS pump system manually stopped.	Without any FWS pumps operating, water will quickly drain from ladder, stranding fish.	Fish evacuation from pre-sort pool and ladder should occur immediately. Loss of normal power supply should start emergency genet. Trouble shoot system prior to attempting restart.	
33	FCF_FWS_ALM7	FCF FWS SYS FAILED TO MAN. NOTIFY OPER	Med	FWS Pump System jumped from Auto to Manual control due to equipment trouble, network trouble or any FWS VFD being operated in Man.	No Automatic FWS Pump Control	Document alarms causing jump to manual. System can be returned to Auto via touch screen or SCADA only when READY FOR AUTO indicator visible..	
34	FCF_GEN_ALM01	FCF GEN E-STOP & SHUNT TRIP	High	Emergency Generator Emergency Stop Activated with Breaker Shunt Trip	Emergency Generator Not Available	Trouble shoot emergency generator and return to service immediately.	
35	FCF_GEN_ALM02	FCF GEN RUNNING	High	Emergency Generator Running	Generator only powers 1 FWS Pump	Restore to Normal Power Supply ASAP	
36	FCF_GEN_ALM03	FCF GEN NOT IN AUTO	High	Emergency Generator Not In Automatic	Emergency Generator Not Available	Return to Automatic Immediately	
37	FCF_GEN_ALM04	FCF GEN BATTERY CHARGER NO AC PWR	Med	Emergency Genset Alarm	Genset Battery Charger not Charging	Troubleshoot ASAP.	
38	FCF_GEN_ALM05	FCF GEN OIL PRESSURE LOW	Med	Emergency Genset Alarm	Possible Equipment Damage if Operated	Troubleshoot ASAP.	
39	FCF_GEN_ALM06	FCF GEN WATER TEMP HIGH	Med	Emergency Genset Alarm	Possible Equipment Damage if Operated	Troubleshoot ASAP.	
40	FCF_GEN_ALM07	FCF GEN WATER TEMP LOW	Med	Emergency Genset Alarm	Possible Equipment Damage if Operated	Troubleshoot ASAP.	
41	FCF_GEN_ALM08	FCF GEN LOW FUEL	Med	Emergency Genset Alarm	Insufficient Fuel	Troubleshoot ASAP.	
42	FCF_GEN_ALM09	FCF GEN BATTERY VOLTS LOW	Med	Emergency Genset Alarm	Genset may not start or operate.	Troubleshoot ASAP.	
43	FCF_GEN_ALM10	FCF GEN BATTERY VOLTS HIGH	Med	Emergency Genset Alarm	Genset may not start or operate.	Troubleshoot ASAP.	
44	FCF_GEN_ALM11	FCF GEN TRANSFER SW GENSET	High	ATS Transfer to Genset Power Source	Limited Power from Genset Supply	Restore to Normal Power Supply ASAP	
45	FCF_GEN_ALM12	FCF GEN TRANSFER SW NORMAL	Low	ATS Transfer to Normal Power Source	None	None	
46	FCF_GEN_ALM13	FCF GEN REMOTE STOP FAILURE	Low	Genset Remote Stop Cmd Failed	N/A	Feature Not Used	
47	FCF_GEN_ALM14	FCF GEN REMOTE START FAILURE	Low	Genset Remote Start Cmd Failed	N/A	Feature Not Used	
48	FCF_GEN_ALM15	FCF GEN HMI CMD REJECTED	Low	Genset Remote Cmd Rejected by PLC	N/A	Feature Not Used	
49	FCF_GEN_ALM16	FCF ATS SWITCH IN OFF	High	Automatic Transfer Switched to OFF	ATS will not transfer to genset upon power loss	Place ATS Switch in AUTO position.	
50	FCF_GEN_ALM17	FCF ATS SWITCH IN AUTO	Low	Automatic Transfer Switched to AUTO	Normal	None	
51	FCF_GEN_ALM18	FCF ATS INVALID STATE IO ERROR	High	ATS Selector SW not in valid state	Unknown	Troubleshoot ASAP.	
52	FCF_SCA_ALM00	FCF AWS AIR TANK PRESSURE VERY LOW	Med	AWS Tank Pressure Below 75psig	No Automatic Screen Cleaner Operation. Powerhouse Air System possibly drained.	Troubleshoot ASAP.	
53	FCF_SCA_ALM01	FCF AWS AIR TANK PRESSURE LOW	Low	AWS Tank Pressure Below 95psig	No Automatic Screen Cleaner Operation. Powerhouse Air System possibly drained.	Troubleshoot ASAP.	
54	FCF_SCA_ALM02	FCF AWS SCREEN I/O HARDWARE ERROR	Low	AWS PLC Hardware Error	No Automatic Screen Cleaner Operation.	Troubleshoot AWS Remote I/O Cabinet.	
55	FCF_SCA_ALM03	FCF AWS SCREEN LEVEL SENSOR OUT OF RANGE	Med	Sensor LT.010 < 1250 or > 1259.0 Ft.	No Automatic Screen Cleaner Operation.	Troubleshoot LT.010 ASAP	
56	FCF_SCA_ALM04	FCF AWS SCREEN DIRTY AFTER AUTO CLEAN CY	Low	Differential head across screens > 0.6 ft.	Airburst system not cleaning screens.	Troubleshoot ASAP.	
57	FCF_SCA_ALM05	FCF AWS SCREEN DIRTY FOR EXTENDED PERIOD	Med	Differential head across screens > 1.0 ft.	Airburst system not cleaning screens.	Troubleshoot ASAP.	
58	FCF_SCA_ALM06	FCF AWS INCOMPLETE SEQUENCE	Low	Airburst Cycle could not complete due to low air pressure.	Airburst system not cleaning screens.	Troubleshoot ASAP.	
59	FCF_SCA_ALM07	FCF AWS CLEANING CYCLE ABORTED	Low	SS moved from Auto during cleaning cycle. Hardware error occurred during cycle. Lt.010 out of range during cycle. Incomplete Sequence Occurred.	Airburst system not cleaning screens.	Troubleshoot ASAP.	
60	FCF_SCA_ALM08	FCF AWS SCREEN CLEANER NOT IN AUTO	Med	Cabinet Selector Switch not in AUTO.	Airburst system not cleaning screens.	Return to Automatic Immediately	
61	FCF_SCF_ALM00	FCF FWS AIR TANK PRESSURE VERY LOW	Med	FWS Tank Pressure Below 75psig	No Automatic Screen Cleaner Operation. Powerhouse Air System possibly drained.	Troubleshoot ASAP.	

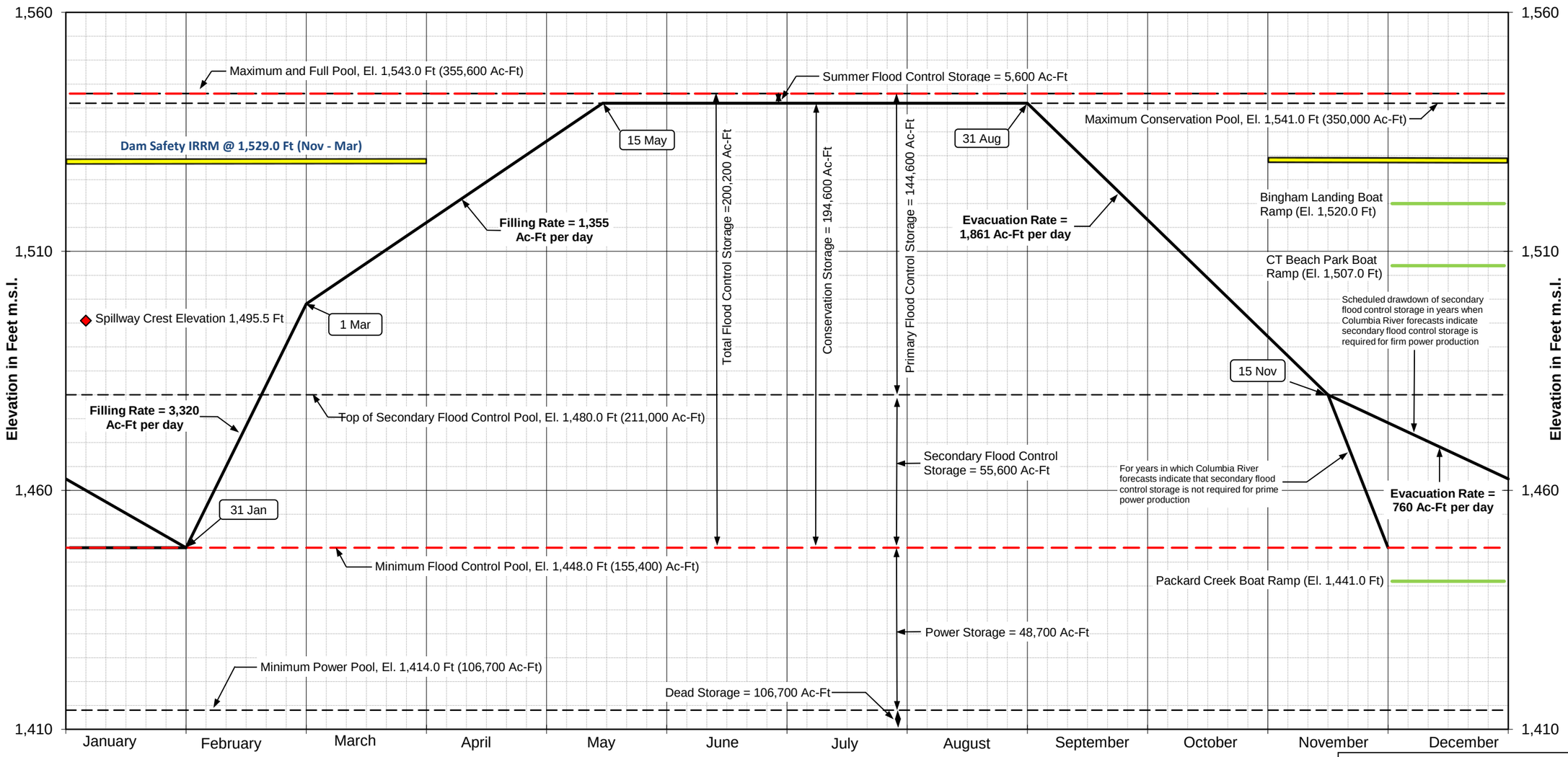
ITEM	SCADA TAG	SCADA DESCRIPTION	PRIORITY	POSSIBLE CAUSE	EFFECT	PROCEDURE	CONTACT PERSON
62	FCF_SCF_ALM01	FCF FWS AIR TANK PRESSURE LOW	Low	FWS Tank Pressure Below 95psig	No Automatic Screen Cleaner Operation. Powerhouse Air System possibly drained.	Troubleshoot ASAP.	
63	FCF_SCF_ALM02	FCF FWS SCREEN I/O HARDWARE ERROR	Low	FWS PLC Hardware Error	No Automatic Screen Cleaner Operation.	Troubleshoot AWS Remote I/O Cabinet.	
64	FCF_SCF_ALM03	FCF FWS SCREEN LEVEL SENSOR OUT OF RANGE	Med	Sensor LT.013 < 1250 or > 1259.0 Ft.	No Automatic Screen Cleaner Operation.	Troubleshoot LT.013 ASAP	
65	FCF_SCF_ALM04	FCF FWS SCREEN DIRTY AFTER AUTO CLEAN CY	Low	Differential head across screens > 0.6 ft.	Airburst system not cleaning screens.	Troubleshoot ASAP.	
66	FCF_SCF_ALM05	FCF FWS SCREEN DIRTY FOR EXTENDED PERIOD	Med	Differential head across screens > 1.0 ft.	Airburst system not cleaning screens.	Troubleshoot ASAP.	
67	FCF_SCF_ALM06	FCF FWS INCOMPLETE SEQUENCE	Low	Airburst Cycle could not complete due to low air pressure.	Airburst system not cleaning screens.	Troubleshoot ASAP.	
68	FCF_SCF_ALM07	FCF FWS CLEANING CYCLE ABORTED	Low	SS moved from Auto during cleaning cycle. Hardware error occurred during cycle. Lt.013 out of range during cycle. Incomplete Sequence Occurred.	Airburst system not cleaning screens.	Troubleshoot ASAP.	
69	FCF_SCF_ALM08	FCF FWS SCREEN CLEANER NOT IN AUTO	Med	Cabinet Selector Switch not in AUTO.	Airburst system not cleaning screens.	Return to Automatic Immediately	
70	FCF_VALV_ALM0	FCF VALVE SYS FAILED TO MAN. NOTIFY OPER	Med	Entrance Gate System jumped from Auto to Manual control due to Equipment trouble, Network trouble, or Gate Actuator Switch not in Remote.	No Automatic Entrance Gate Control.	Document alarms causing jump to manual. System can be returned to Auto via touch screen or SCADA only when READY FOR AUTO indicator visible..	
71	FCF_VFD1_ALM0	FCF FWS VFD1 NETWORK ERROR	Med	VFD Comm Trouble, No Power, Broken Cable	Pump not available or ready to operate automatically.	Troubleshoot ASAP. Maintain one backup pump at all times.	
72	FCF_VFD1_ALM1	FCF FWS VFD1 INTERNAL ALM OR FAULT	Med	VFD Internal Fault or Alarm. Includes Remote Disconnect SW, Pump Moisture Sensor, Pump Thermal SW, and Phase Monitor.	Pump not available or ready to operate automatically.	Troubleshoot ASAP. Maintain one backup pump at all times.	
73	FCF_VFD1_ALM2	FCF FWS VFD1 DISABLED OR SW NOT REMOTE	Med	VFD Not Enabled or Switch not in AUTO.	Pump not available or ready to operate automatically.	Return VFD to Automatic Immediately	
74	FCF_VFD2_ALM0	FCF FWS VFD2 NETWORK ERROR	Med	VFD Comm Trouble, No Power, Broken Cable	Pump not available or ready to operate automatically.	Troubleshoot ASAP. Maintain one backup pump at all times.	
75	FCF_VFD2_ALM1	FCF FWS VFD2 INTERNAL ALM OR FAULT	Med	VFD Internal Fault or Alarm. Includes Remote Disconnect SW, Pump Moisture Sensor, Pump Thermal SW, and Phase Monitor.	Pump not available or ready to operate automatically.	Troubleshoot ASAP. Maintain one backup pump at all times.	
76	FCF_VFD2_ALM2	FCF FWS VFD2 DISABLED OR SW NOT REMOTE	Med	VFD Not Enabled or Switch not in AUTO.	Pump not available or ready to operate automatically.	Return VFD to Automatic Immediately	
77	FCF_VFD3_ALM0	FCF FWS VFD3 NETWORK ERROR	Med	VFD Comm Trouble, No Power, Broken Cable	Pump not available or ready to operate automatically.	Troubleshoot ASAP. Maintain one backup pump at all times.	
78	FCF_VFD3_ALM1	FCF FWS VFD3 INTERNAL ALM OR FAULT	Med	VFD Internal Fault or Alarm. Includes Remote Disconnect SW, Pump Moisture Sensor, Pump Thermal SW, and Phase Monitor.	Pump not available or ready to operate automatically.	Troubleshoot ASAP. Maintain one backup pump at all times.	
79	FCF_VFD3_ALM2	FCF FWS VFD3 DISABLED OR SW NOT REMOTE	Med	VFD Not Enabled or Switch not in AUTO.	Pump not available or ready to operate automatically.	Return VFD to Automatic Immediately	
80	FCF_VFD4_ALM0	FCF AWS VFD1 NETWORK ERROR	Med	VFD Comm Trouble, No Power, Broken Cable	Pump not available or ready to operate automatically.	Troubleshoot ASAP. Maintain one backup pump at all times.	
81	FCF_VFD4_ALM1	FCF AWS VFD1 INTERNAL ALM OR FAULT	Med	VFD Internal Fault or Alarm. Includes Remote Disconnect SW, Pump Moisture Sensor, Pump Thermal SW, and Phase Monitor.	Pump not available or ready to operate automatically.	Troubleshoot ASAP. Maintain one backup pump at all times.	
82	FCF_VFD4_ALM2	FCF AWS VFD1 DISABLED OR SW NOT REMOTE	Med	VFD Not Enabled or Switch not in AUTO.	Pump not available or ready to operate automatically.	Return VFD to Automatic Immediately	
83	FCF_VFD5_ALM0	FCF AWS VFD2 NETWORK ERROR	Med	VFD Comm Trouble, No Power, Broken Cable	Pump not available or ready to operate automatically.	Troubleshoot ASAP. Maintain one backup pump at all times.	
84	FCF_VFD5_ALM1	FCF AWS VFD2 INTERNAL ALM OR FAULT	Med	VFD Internal Fault or Alarm. Includes Remote Disconnect SW, Pump Moisture Sensor, Pump Thermal SW, and Phase Monitor.	Pump not available or ready to operate automatically.	Troubleshoot ASAP. Maintain one backup pump at all times.	
85	FCF_VFD5_ALM2	FCF AWS VFD2 DISABLED OR SW NOT REMOTE	Med	VFD Not Enabled or Switch not in AUTO.	Pump not available or ready to operate automatically.	Return VFD to Automatic Immediately	
86	FCF_VFD6_ALM0	FCF AWS VFD3 NETWORK ERROR	Med	VFD Comm Trouble, No Power, Broken Cable	Pump not available or ready to operate automatically.	Troubleshoot ASAP. Maintain one backup pump at all times.	

ITEM	SCADA TAG	SCADA DESCRIPTION	PRIORITY	POSSIBLE CAUSE	EFFECT	PROCEDURE	CONTACT PERSON
87	FCF_VFD6_ALM1	FCF AWS VFD3 INTERNAL ALM OR FAULT	Med	VFD Internal Fault or Alarm. Includes Remote Disconnect SW, Pump Moisture Sensor, Pump Thermal SW, and Phase Monitor.	Pump not available or ready to operate automatically.	Troubleshoot ASAP. Maintain one backup pump at all times.	
88	FCF_VFD6_ALM2	FCF AWS VFD3 DISABLED OR SW NOT REMOTE	Med	VFD Not Enabled or Switch not in AUTO.	Pump not available or ready to operate automatically.	Return VFD to Automatic Immediately	
89	FCF_SYS_ALM0	FCF PLC OR NETWORK IDLE	High	Controller Logic Not Executing &/or Device Network Idle.	No Systems Operating in Auto and no data is updating. System is not being controlled.	Return PLC to RUN mode immediately. Operate system in maunual until PLC operational.	
90	FCF_FWS_ALM2	FCF FWS ELECT ROOM DOOR OPEN	Low	Door Not Fully Closed.	None	None	
91	FCF_FWS_ALM3	FCF FWS MECH ROOM DOOR OPEN	Low	Door Not Fully Closed.	None	None	
92	FCF_FWS_ALM4	FCF FWS STORAGE ROOM DOOR OPEN	Low	Door Not Fully Closed.	None	None	
93	FCF_AWS_ALM2	FCF AWS ELECT ROOM DOOR OPEN	Low	Door Not Fully Closed.	None	None	
94	FCF_FWS_ALM5	FCF FWS PLC UPS OR BATTERY TROUBLE	Med	UPS Trouble or Failed Battery	System Controller & Network Switched not protected from loss of supply power.	Trouble shoot UPS ASAP.	
95	FCF_FWS_ALM6	FCF FWS 24VDC POWER SUPPLY TROUBLE	Med	Loss of FWS Cabinet PS-4 Power Supply	No Ethernet switch power. No Remote monitoring of system. No FWS Security, ATS, or UPS monitoring. No FWS Screen Cleaner Control.	Trouble shoot Power Supply ASAP.	

4.5. APPENDIX E-OPERATOR WALKTHROUGH POWERPOINT

4.6. APPENDIX F-DEVICENET CONFIGURATION AND EQUIPEMENT PARAMETERS


Maximum Summer Flood Control Pool, El. 931.0 Ft (464,500 Ac-Ft)
Summer Flood Control Storage = 21,500 Ac-Ft
Maximum Pool, El. 934.0 Ft (477,700 Ac-Ft)
Maximum Conservation Pool, El. 926.0 (443,000 Ac-Ft)
Full Pool, El. 929.0 Ft (455,800 Ac-Ft)
10 May
31 Aug
Dam Safety IRRM @ 915.0 Ft (397,400 Ac-Ft)
Meridian Park Boat Ramp (El. 911.0 Ft)
Hampton Landing Boat Ramp (El. 911.0 Ft)
Black Canyon Boat Ramp (El. 900.0 Ft)
Filling Rate = 2,512 Ac-Ft per day
Evacuation Rate = 3,271 Ac-Ft per day
Spillway Crest Elevation 887.5 Ft
Conservation Storage = 324,200 Ac-Ft
Total Flood Control Storage = 358,900 Ac-Ft
Primary Flood Control Storage = 248,900 Ac-Ft
Filling of reservoir not to exceed this schedule except in case of a flood
1 Mar
Stored water should not be retained later than indicated by this schedule except in case of a flood
Emptying schedule of secondary flood control storage in years when a drought is experienced using Dexter powerhouse capacity.
15 Nov
Top of Secondary Flood Control Pool, El. 856.0 Ft (194,100 Ac-Ft)
See note on extended portion of this line.
Filling Rate = 5,211 Ac-Ft per day
Secondary Flood Control Storage = 75,300 Ac-Ft
Emptying schedule of secondary flood control storage in normal or above normal water years using Lookout Point powerhouse capacity.
Evacuation Rate = 5,040 Ac-Ft per day
31 Jan
30 Nov
Minimum Flood Control Pool, El. 825.0 Ft (118,800 Ac-Ft)
Power Storage = 12,200 Ac-Ft
Signal Point Boat Ramp (El. 821.0 Ft)
Minimum Power Pool, El. 819.0 Ft (106,600 Ac-Ft)
Inactive Storage = 106,600 Ac-Ft
Lookout Point Project
Scheduled Water Control Diagram
U.S. Army Corps of Engineers
Portland District March 2011
Created by CENWP-EC-HR
Elevation in Feet m.s.l.
950
935
920
905
890
875
860
845
830
815
800
785
January
February
March
April
May
June
July
August
September
October
November
December



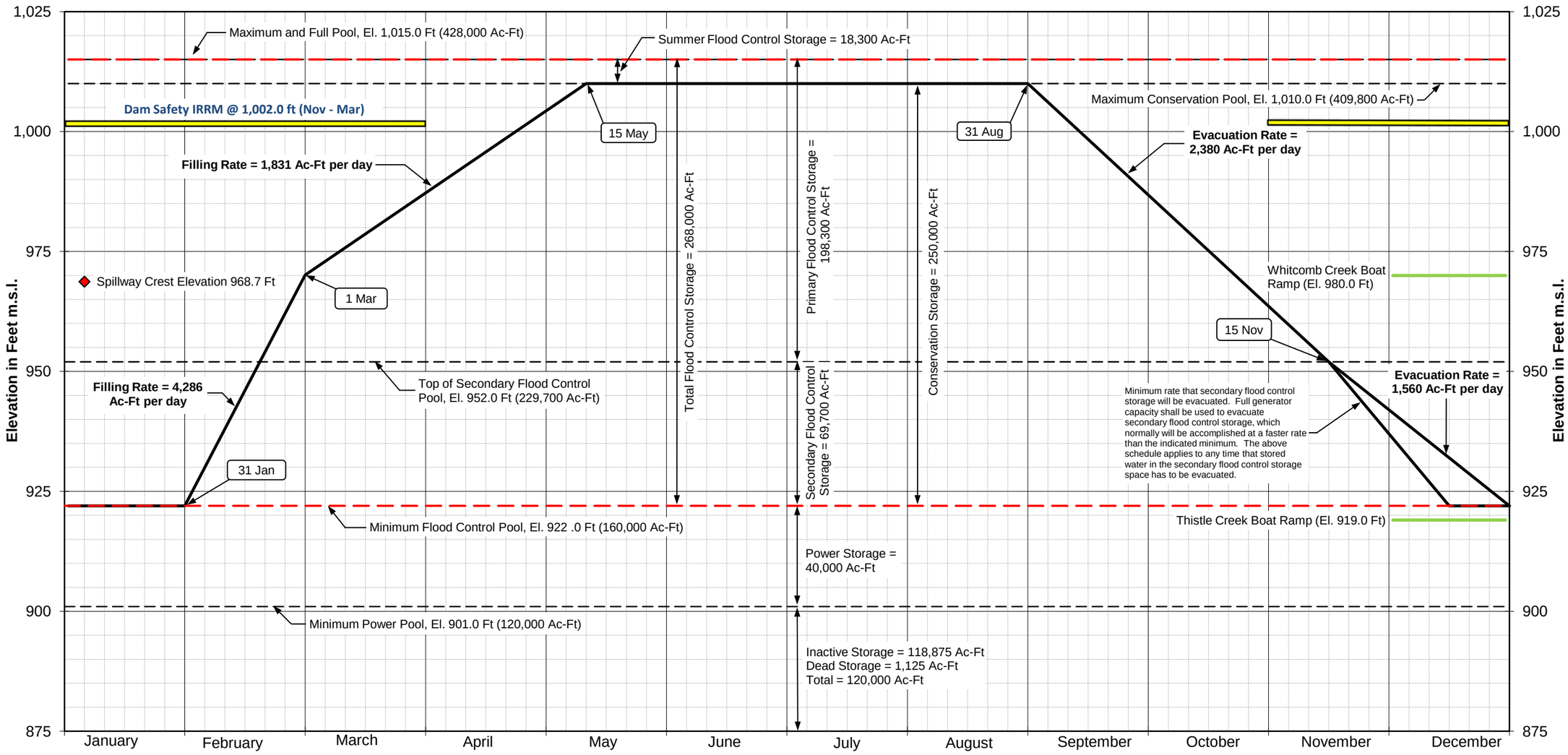
Notes:
Pool elevations and corrsponding storage applicable at 2400 hours.

Hills Creek Project

Scheduled Water Control Diagram

U.S. Army Corps of Engineers
Portland District March 2011

Created by CENWP-EC-HR

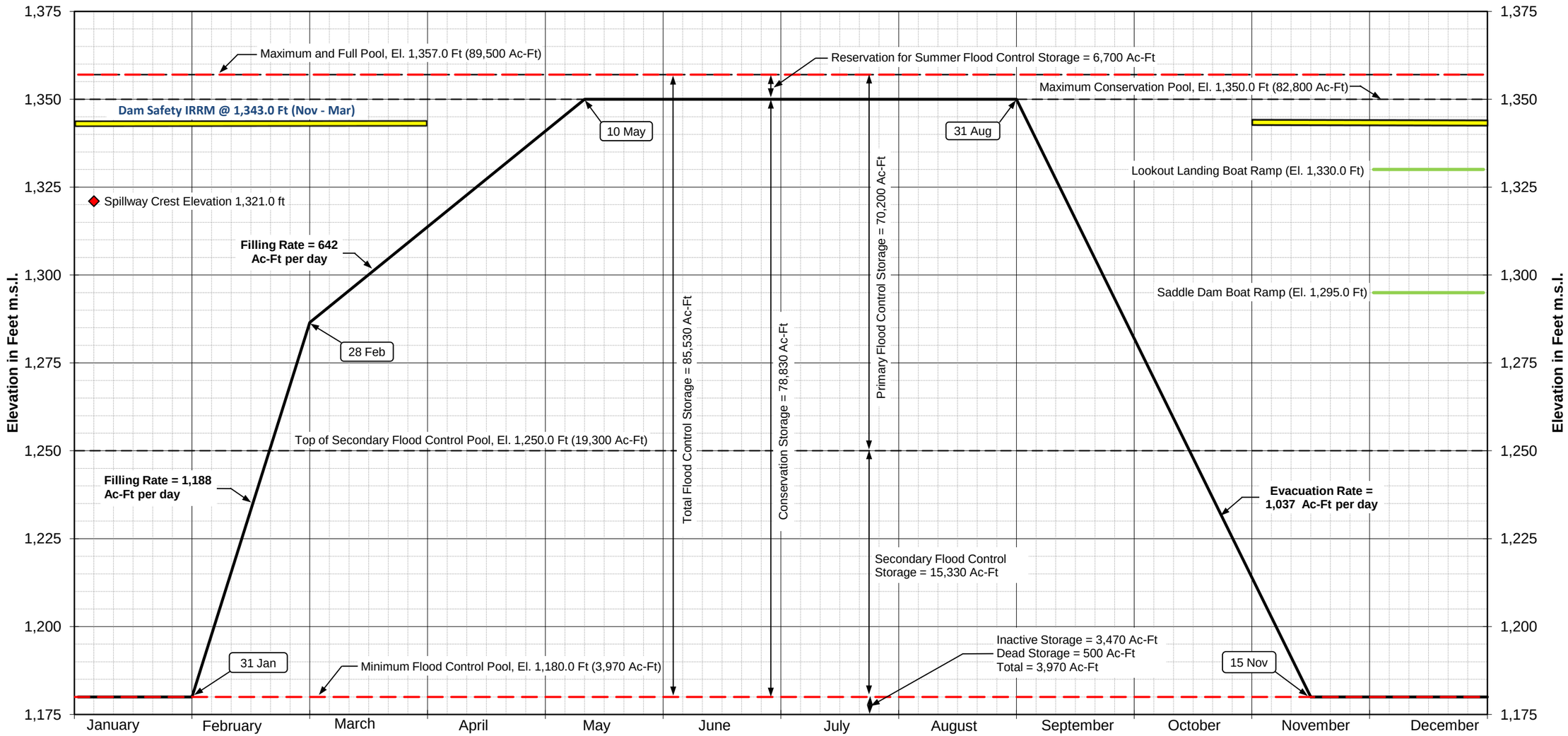


Green Peter Project

Scheduled Water Control Diagram

U.S. Army Corps of Engineers
Portland District March 2011

Created by CENWP-EC-HR

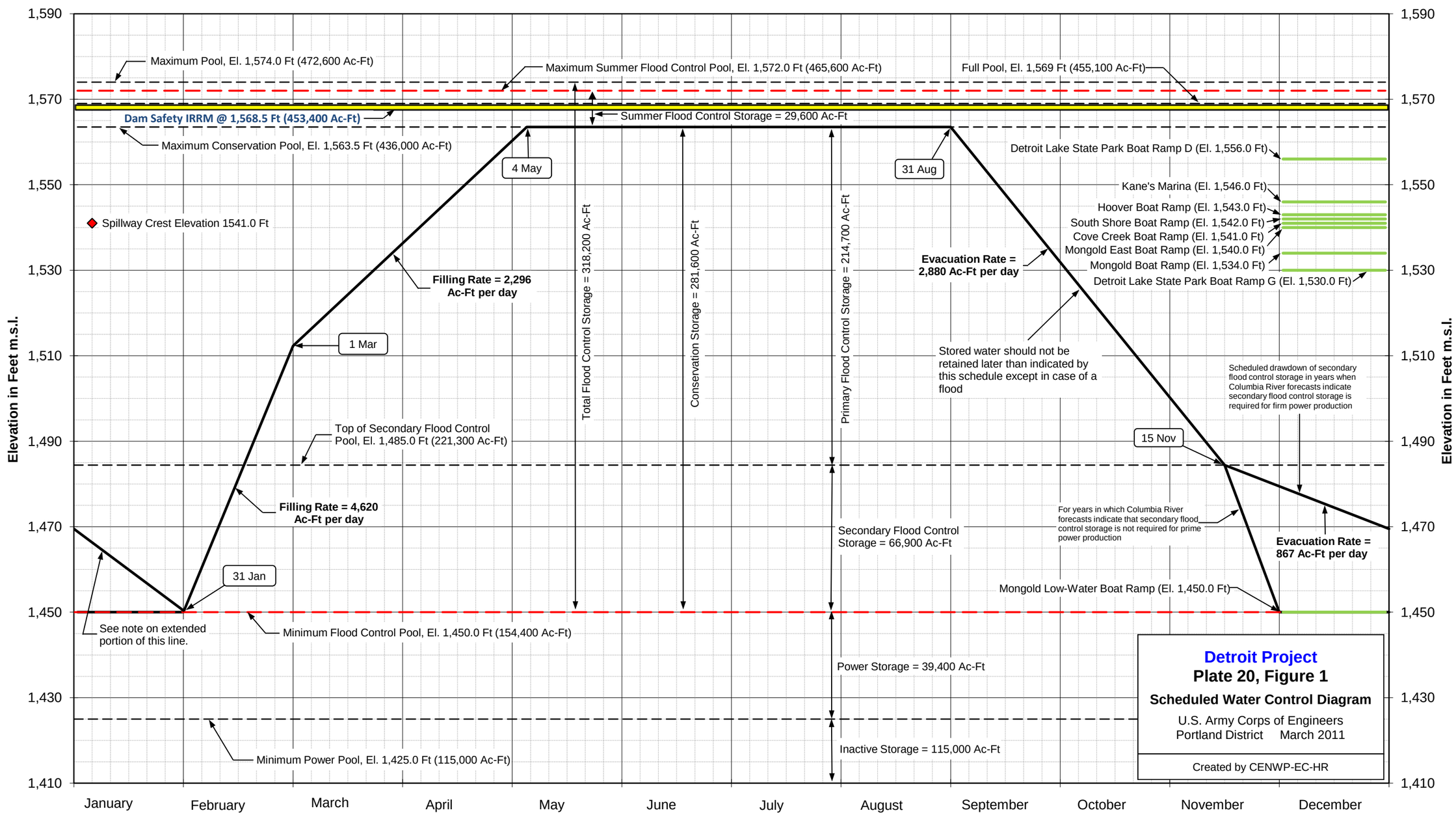


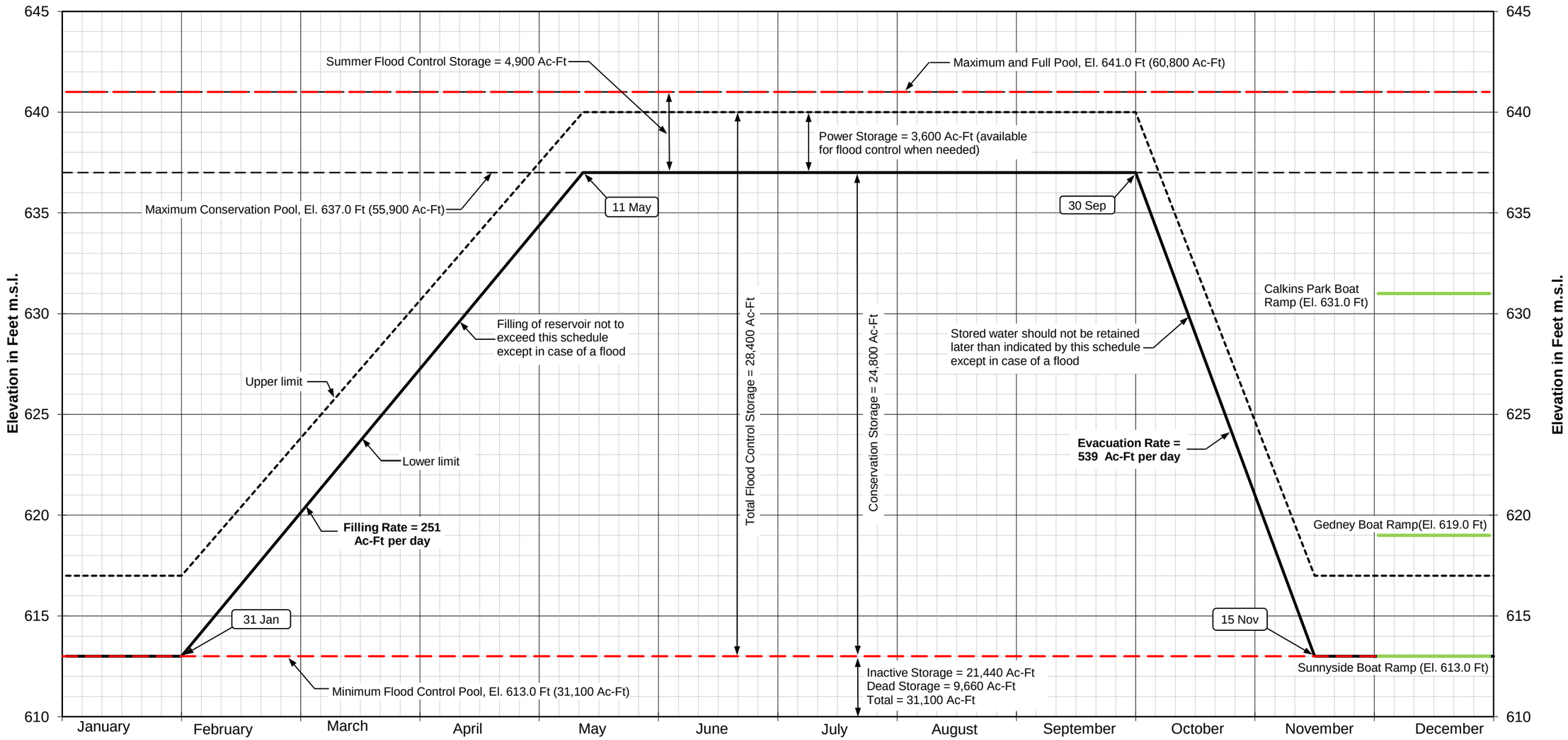
Blue River Project
Chart 8

Scheduled Water Control Diagram

U.S. Army Corps of Engineers
Portland District March 2011

Created by CENWP-EC-HR


Elevation in Feet m.s.l.
1,590
1,570
1,550
1,530
1,510
1,490
1,470
1,450
1,430
1,410
January
February
March
April
May
June
July
August
September
October
November
December
Maximum Pool, El. 1,574.0 Ft (472,600 Ac-Ft)
Maximum Summer Flood Control Pool, El. 1,572.0 Ft (465,600 Ac-Ft)
Full Pool, El. 1,569 Ft (455,100 Ac-Ft)
Dam Safety IRRM @ 1,568.5 Ft (453,400 Ac-Ft)
Summer Flood Control Storage = 29,600 Ac-Ft
Maximum Conservation Pool, El. 1,563.5 Ft (436,000 Ac-Ft)
4 May
31 Aug
Detroit Lake State Park Boat Ramp D (El. 1,556.0 Ft)
Kane's Marina (El. 1,546.0 Ft)
Hoover Boat Ramp (El. 1,543.0 Ft)
South Shore Boat Ramp (El. 1,542.0 Ft)
Cove Creek Boat Ramp (El. 1,541.0 Ft)
Mongold East Boat Ramp (El. 1,540.0 Ft)
Mongold Boat Ramp (El. 1,534.0 Ft)
Detroit Lake State Park Boat Ramp G (El. 1,530.0 Ft)
Spillway Crest Elevation 1541.0 Ft
Total Flood Control Storage = 318,200 Ac-Ft
Conservation Storage = 281,600 Ac-Ft
Primary Flood Control Storage = 214,700 Ac-Ft
Filling Rate = 2,296 Ac-Ft per day
Evacuation Rate = 2,880 Ac-Ft per day
1 Mar
Stored water should not be retained later than indicated by this schedule except in case of a flood
Scheduled drawdown of secondary flood control storage in years when Columbia River forecasts indicate secondary flood control storage is required for firm power production
Top of Secondary Flood Control Pool, El. 1,485.0 Ft (221,300 Ac-Ft)
15 Nov
Filling Rate = 4,620 Ac-Ft per day
Secondary Flood Control Storage = 66,900 Ac-Ft
For years in which Columbia River forecasts indicate that secondary flood control storage is not required for prime power production
Evacuation Rate = 867 Ac-Ft per day
31 Jan
Mongold Low-Water Boat Ramp (El. 1,450.0 Ft)
See note on extended portion of this line.
Minimum Flood Control Pool, El. 1,450.0 Ft (154,400 Ac-Ft)
Power Storage = 39,400 Ac-Ft
Inactive Storage = 115,000 Ac-Ft
Minimum Power Pool, El. 1,425.0 Ft (115,000 Ac-Ft)
Detroit Project
Plate 20, Figure 1
Scheduled Water Control Diagram
U.S. Army Corps of Engineers
Portland District March 2011
Created by CENWP-EC-HR

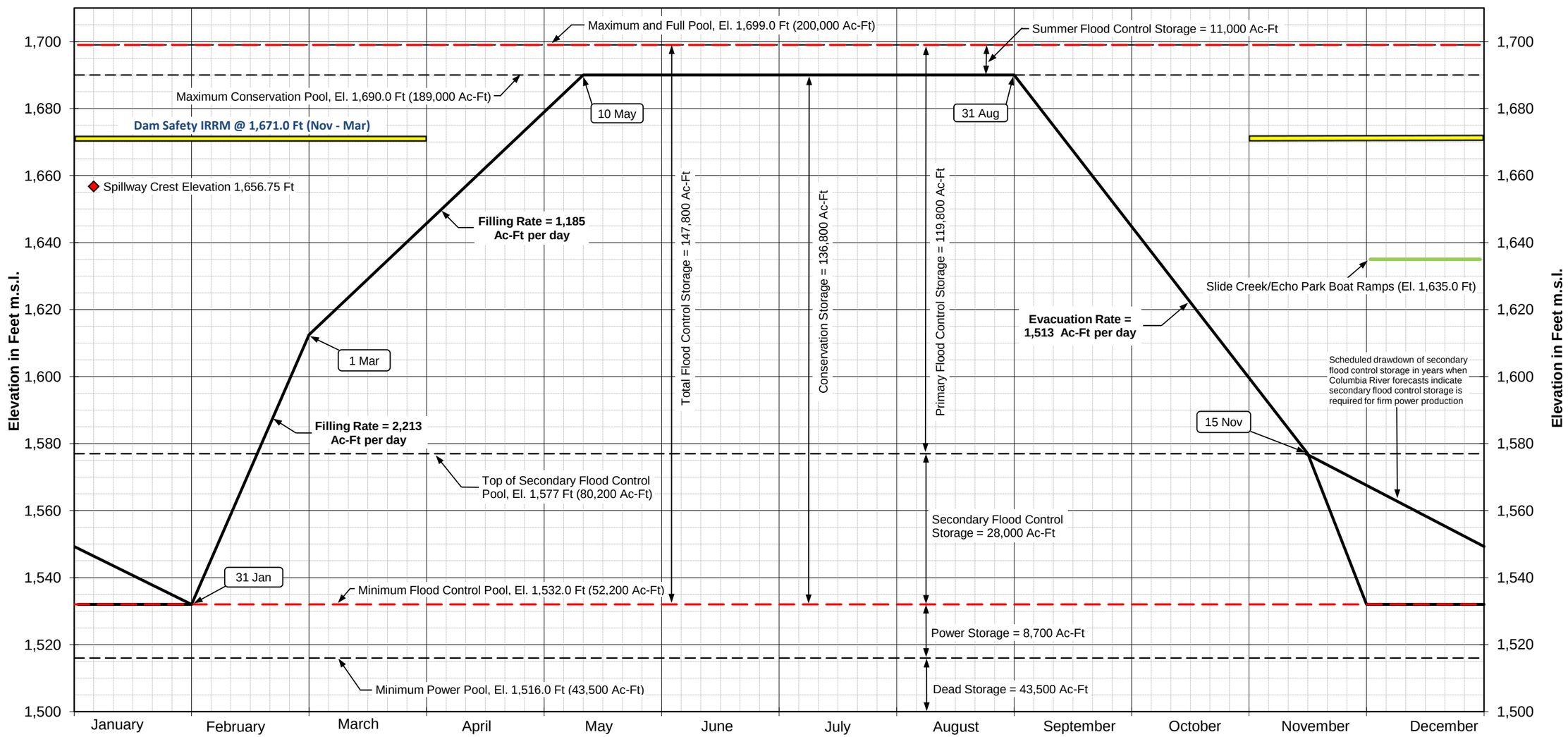


Foster Project

Scheduled Water Control Diagram

U.S. Army Corps of Engineers
Porltna District March 2011

Created by CENWP-EC-HR

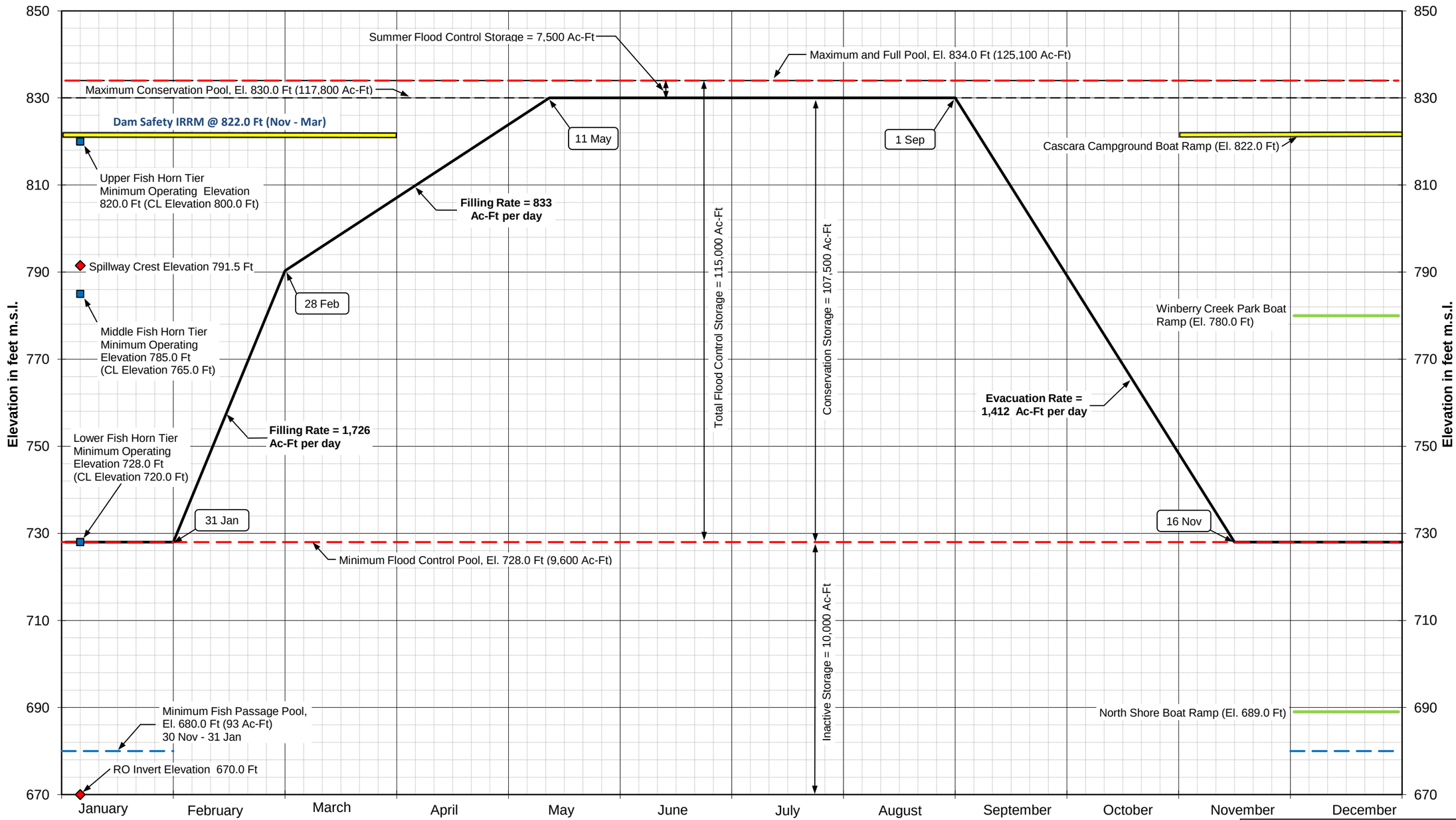


Cougar Project
Plate 11

Scheduled Water Control Diagram

U.S. Army Corps of Engineers
Portland District March 2011

Created by CENWP-EC-HR

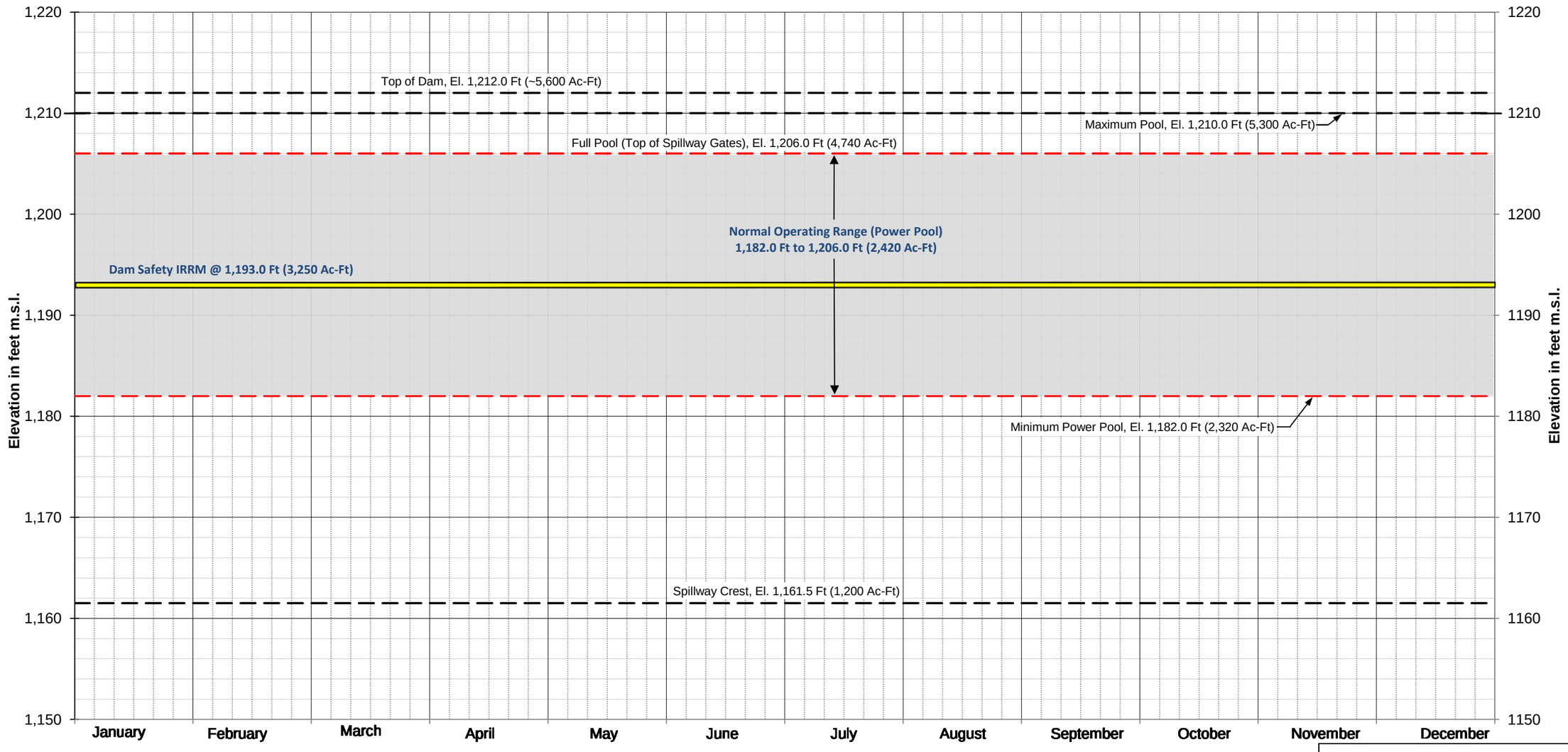


Fall Creek Project

Scheduled Water Control Diagram

U.S. Army Corps of Engineers
Portland District March 2011

Created by CENWP-EC-HR



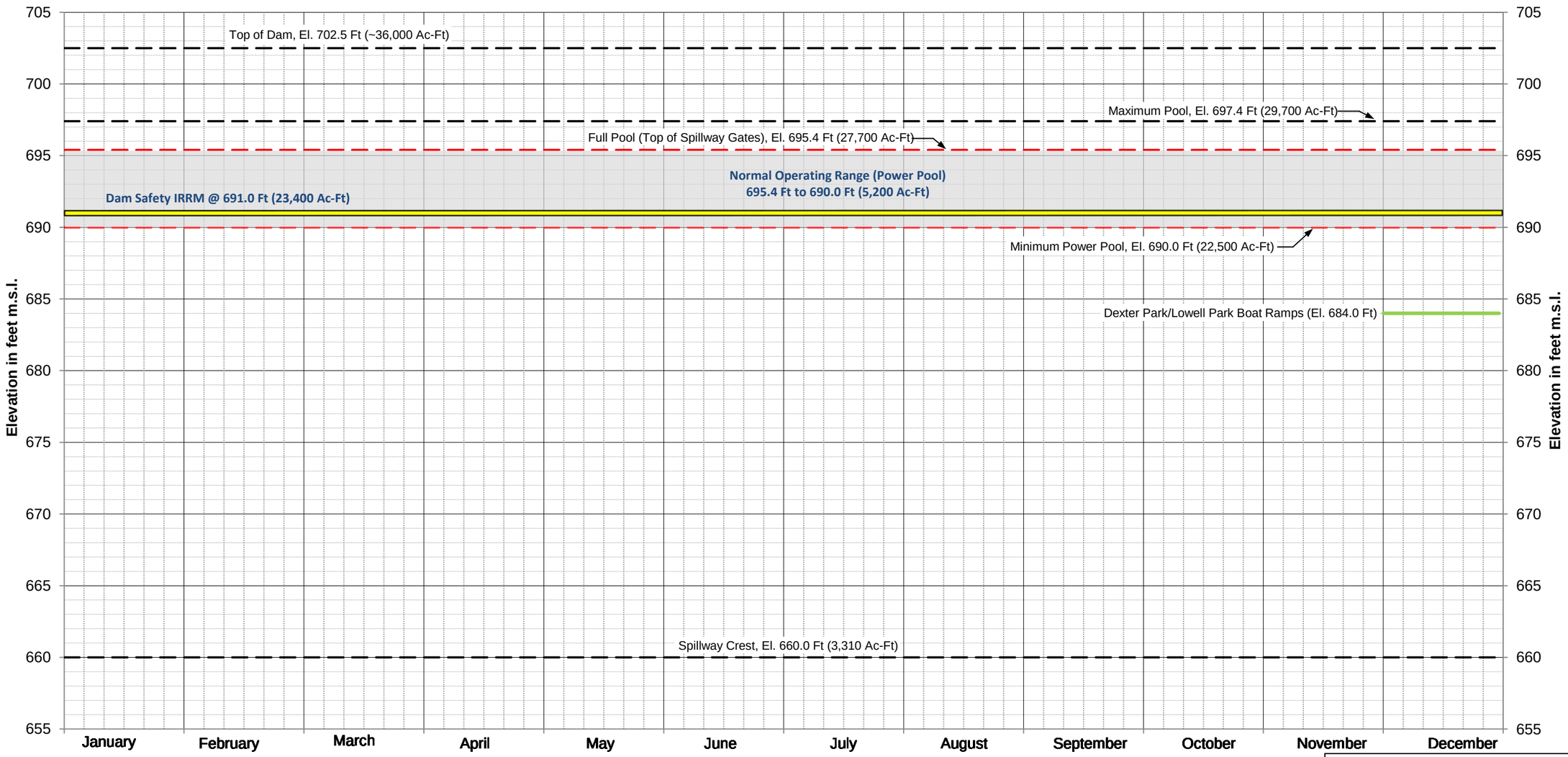
Notes:
Pool elevations and corrsponding storage applicable at 2400 hours.

Big Cliff Project

Scheduled Water Control Diagram

U.S. Army Corps of Engineers
Portland District March 2011

Created by CENWP-EC-HR



Notes:
Pool elevations and corrsponding storage applicable at 2400 hours.

Dexter Project
Plate 7-2.1, P103.1
Scheduled Water Control Diagram
U.S. Army Corps of Engineers
Portland District March 2011

Created by CENWP-EC-HR

Adult Chinook Outplant Form

Hatchery: _____ **Date:** _____

Driver: _____ **Truck/unit number:** _____

Water temp at collection site: _____ **Anesthetic:** _____

Tank Temperature - Start - _____ **End -** _____

Loading time-Start: _____ **Loading time-End:** _____

Antibiotic injections: Oxtytetracycline: ☐ Erythromycin ☐ none ☐

	Finclipped	Non Finclipped	Total
Male			
Female			
Jack			
Total			

Hauling time - Start: _____ **Hauling Time - End:** _____

Release Stream: _____

Release Site: _____

Water Temperature at release site: _____

Release Method: _____

Mortalities: _____ **Likely mortalities:** _____

Comments/Tags: _____

_____

_____

Adult Winter Steelhead Outplant Form

Hatchery: _____ **Date:** _____

Driver: _____ **Truck/unit number:** _____

Water temp at collection site: _____ **Anesthetic:** _____

Tank Temperature - Start - _____ **End -** _____

Loading time-Start: _____ **Loading time-End:** _____

Antibiotic injections: Oxytetracycline: ☐ Erythromycin ☐ none ☐

	Non Finclipped
Male	
Female	
Total	

Hauling time - Start: _____ **Hauling Time - End:** _____

Release Stream: _____

Release Site: _____

Water Temperature at release site: _____

Release Method: _____

Mortalities: _____ **Likely mortalities:** _____

Comments/Tags: _____

_____

_____

Tentative Gate Rehabilation and Ops Schedule (dates and actions are subject to change as planning is ongoing and is a working document)

Legend			
RO	Spillway	RM&E	Other

Project	Min Conservation Pool (ft)	Spillway Crest (ft)	Max Conservation Pool (ft)	WY2017												WY2018											
				Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Hills Creek	1448	1495.5	1541										Spillway Gate 2 15 July - 15 Sept *Maintain 20 ft below spillway crest*												Spillway Gate 3 15 July - 15 Sept Maintain 20 ft below spillway crest		
Lookout Point	825	887.5	926																								
Dexter	690	660	695																								
Fall Creek	728	791.6	30					RO 1 15 February - 15 September *Installation and removal of bulkhead: 715 ft; Max flood control available*												RO 2 15 February - 15 September *Installation and removal of bulkhead: 715 ft; Max flood control available*									
Cottage Grove	750	791	790																								
Dorena	770.5	835	832																								
Fern Ridge	353	358.5	373.5																								
Blue River	1180	1321	350													Spillway Gate 2 15 Sept - 15 Nov *Maintain 20 ft below spillway crest*											
Cougar	1532	656.75	690													Spillway Gate 1 15 Sept - 15 Nov *Maintain 20 ft below Spillway crest*											Spillway Gate 2 15 Sept - 15 Nov *Maintain 20 ft below Spillway crest*
Green Peter	922	968.7	1010																								
Foster	613	596.8	637		Fish Weir Oct 15 - Apr 15 *Maintain El 614-616 ft*												Fish Weir Oct 15 - Apr 15 *Maintain El 614-616 ft*										
Detroit	1450	1541	563.5																								
Big Cliff	1182	111.5	1205.8																								

1. NOTIFICATION PROTOCOL FOR FLOW DEVIATIONS AND POWER GENERATION REQUESTS

1.1. This section describes specific reporting protocol to be followed for reporting events to the Services. Information will be provided to the WATER stakeholders regarding events reported to the Services as described above. The Action Agencies would provide the following information during reporting:

- Location of deviation - subbasin/project/specific site (if applicable);
- Date/time of deviation;
- Type of deviation (flow/ramp/hazardous spill/water quality exceedances);
- Type of emergency operation (if applicable);

1.2. Type and severity of spill (if applicable); The USACE will provide notification to researchers in the event of an emergency or other adverse conditions are identified that may impact research activities or result in potential unsafe conditions or damage to scientific equipment. Direct notification will be completed by the USACE for real-time events with coordination occurring through the WATER Research, Monitoring and Evaluation (RM&E) Team.

Notification directly to the Services will occur under the following situations:

- Ramp rate target deviations;
- Instream flow target deviations;
- Identified adverse water quality conditions;
- Emergency operations that may impact ESA-listed fish; and
- Hazardous spills.

1.3. For activities occurring in or around reservoirs, dams, or other facilities by researchers or other entities, notification must be made to the USACE. The notification must be formally written and should list the location, date and time located in vicinity, nature of research, and type of physical activity.

1.4. Ramp Rates, Flow Targets, and Flood Risk Management Operations
The USACE project operations staff that are onsite have the ability to identify and report deviations from the required ramp rates and instream flows. Although this would provide near-immediate notification for external reporting purposes, the USACE also initiated reviewing operations records at each Willamette project on a 48-hour basis to track project performance and report any deviations in a timely and coordinated fashion. The purpose of this is to provide the ability to identify the more "minor" deviations that may occur that are not readily identified by staff in the field.

1.5. Flow data assessed for deviations from instream flow and ramp rate targets are based on preliminary data (provisional) that is subject to change. Flow data used for reporting is provisional and may be modified by the USGS following periodic updates to the rating curves for each gage site. Flows in the Willamette mainstem are measured at Salem and Albany. Specific gage sites are listed in subbasin Chapters.

1.6. Down Ramp Rates. Check to ensure language is correct. The USACE will report ramp rate deviations that exceed by two-fold the required down ramp rate. An example would be if the target is 0.1 foot/hour, reporting would occur if the ramping exceeds 0.2 foot/hour. Similar reporting would occur if the daily maximum (24 hour) flow decrease (1 ft/24 hours) is exceeded by 25%. These bounds alleviate excessive and unnecessary reporting and coordination between the USACE and

Services that would be required unless otherwise modified herein. Ramp rate targets are in RPA 2.6.4 of the BiOp (NMFS 2008).

1.7. Instream Flows. The USACE will report instream flow deviations that exceed 5% of the target flow value due to project operations. For example, if the minimum flow required is 1,500 cubic feet per second (cfs), reporting would occur if the minimum instantaneous flow dropped to 1,425 cfs or below. These bounds would alleviate excessive and unnecessary reporting and coordination between the USACE and Services that would be required unless otherwise modified herein. Instream flow targets are in RPA 2.4 of the BiOp (NMFS 2008).

1.8. Flow/Stage Reductions. The USACE will report any flow reduction below projects of more than 50% per hour or 1 foot per hour. Reporting will also occur if a flow reduction occurs that is 50% per 24 hours. Exceedances that are less than 25% outside of criteria will not be reported but may be discussed at interagency coordination meetings to reduce superfluous reporting. Flow reduction guidelines are in Table 9.2-4 of the BiOp (NMFS 2008).

- Magnitude of deviation;
- Duration of deviation;
- Cause of deviation;
- Measures taken to minimize the deviation;
- Measures implemented or proposed to ensure that similar incidents do not recur;
- Any identified or potential biological impacts; and
- Follow-up recommendations, if applicable.

1.9. Time of Notification. The USACE will contact (email or phone call) ODFW and the Services within 24 hours of identifying any reportable incident. Although information relating to the incident may not be immediately available, initial contact will be made within the first 24 hours of when the incident is identified. A complete written notification to the Services will be completed within 48 hours of identification and will include the reporting information previously discussed, if available at the time of reporting.

1.10. Requests for Changes in Power Generation. At times, BPA may request changes in generation produced at the WVP dams based on load needs. This can either be caused by excessive energy on the grid, or a need for more generation caused by weather conditions. Requests received by USACE Reservoir Regulation will be reviewed by operations fish biologists to determine if any impacts to aquatic resources, including ESA-listed fish, may result. The USACE will then request modifications or potentially deny the request if impacts are identified and cannot be avoided.

1.11. If a region wide power shortage is anticipated, a power system emergency could be declared. In this scenario, the USACE will identify impacts and provide notification to the ODFW, USFWS, and NMFS prior to implementation. Notification will address any perceived impacts on water quality, fish facility operations, or flow changes that may deviate from flow or ramp rate targets. Updates will be provided to WATER through the WFPOM Team.

ACRONYMS AND ABBREVIATIONS

°C	degrees Celsius
°F	degrees Fahrenheit
BiOp	Biological Opinion
BPA	Bonneville Power Administration
cfs	cubic feet per second
CO_2	carbon dioxide
COP	Configuration/Operation Plan
CPUE	catch per unit effort
CWA	Clean Water Act
ESA	Endangered Species Act
EWEB	Eugene Water and Electric Board
FMWQ	Flow Management and Water Quality (Team)
HMT	Hatchery Management Team
GBT	gas bubble trauma
gpm	gallon(s) per minute
HGMP	Hatchery and Genetic Management Plan
IHOT	Integrated Hatchery Operations Team
IRRM	interim risk reduction measure(s)
mg/L	milligram(s) per liter
MOU	Memorandum of Understanding
MW	megawatt(s)
NMFS	National Marine Fisheries Service
NWS-RFC	National Weather Service Northwest River Forecast Center
ODEQ	Oregon Department of Environmental Quality
ODFW	Oregon Department of Fish and Wildlife
OERS	Oregon Emergency Response System
O&M	operations and maintenance
OMET	Operational Measures Evaluation Team
RM	river mile(s)
RM&E	research, monitoring, and evaluation
RO	regulating outlet(s)
RPA	reasonable and prudent alternative
SCAB	Steelhead and Chinook above Barriers (Committee)
SCADA	Supervisory Control and Data Acquisition
TDG	total dissolved gas
USACE	U.S. Army Corps of Engineers
USFS	U.S. Forest Service
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
UWR	Upper Willamette River
WATER	Willamette Action Team for Ecosystem Restoration
WFOP	Willamette Fish Operations Plan
WFFDWG	Willamette Fish Facility Design Working Group
WFPOM	Willamette Fish Passage Operations and Maintenance (Team)

WTC	water temperature control
WVP	Willamette Valley Project