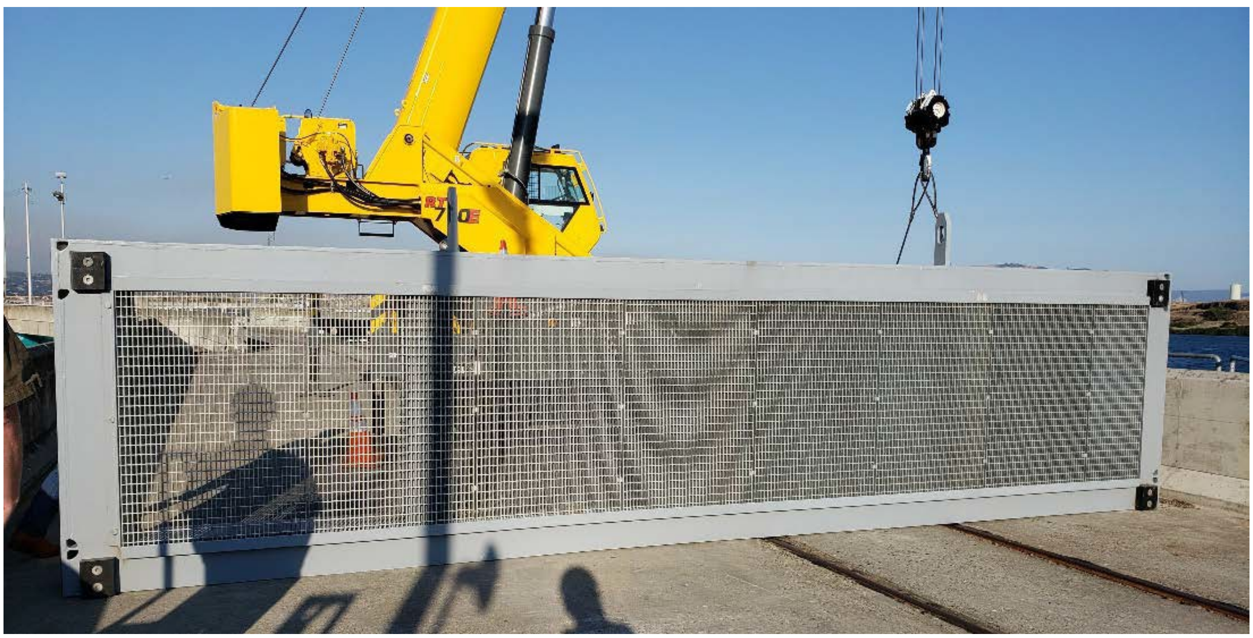
US Army Corps
of Engineers®
Portland District

DESIGN DOCUMENT REPORT NO. JUNE 27, 2025

THE DALLES LOCK & DAM
COLUMBIA RIVER BASIN
THE DALLES, OREGON

The Dalles AWS Backup Debris Management



Design Documentation Report
Plans & Specifications Pre-BCOES Review Submittal
June 2025

EXECUTIVE SUMMARY

1. INTRODUCTION

The Dalles Lock and Dam project is a concrete gravity dam and embankment, spillway, powerhouse, and navigation lock run-of-the-river type facility spanning the Columbia River approximately two miles east of the city of The Dalles, Oregon. One of the features of the facility is the East Fish Ladder (EFL) which provides for upstream fish passage past the dam. The EFL facility has an Auxiliary Water Supply (AWS) and an Auxiliary Water Supply Backup (AWSB) system.

The AWSB system will be required to operate as the additional AWS supply during the upcoming Fish Unit Rehabilitation Project which is expected to have a duration of two years. The AWSB will also be activated in the future, when only one fish unit is being operated. To provide highly reliable and controlled flows, a more reliable debris management method to remove debris, including “beaver sticks” and milfoil, from the face of the trashrack located at the upstream face of the AWSB system piping is needed. This Design Documentation Report (DDR) describes the system which has been designed to provide a more reliable debris management system.

Documentation of the main design criteria, assumptions, and decisions related to the AWSB Debris Management system, including a mechanical *trashrake* to clean the *trashracks*, is the focus of this DDR.

2. CONTRACT DOCUMENTS VS. THE DDR

Refer to project plans and specifications (P&S). They constitute the "contract documents".

Calculations, cost estimates, and the DDR are not contract documents. They should not be shared with construction contract bidders.

3. PURPOSE

The purpose of The Dalles AWSB Debris Management project is to provide an alternative and more reliable means for removing the debris from the trashracks at the intake of the East Fish Ladder AWSB system using a mechanical trashrake.

Currently, operations staff turn off the AWSB system and allow the river currents to remove debris from the screens. The original AWS supplies approximately 5,000 cubic feet per second (cfs) of attraction water to the east, west, and south fish ladder entrances to attract upstream migrating adult fish into the fish ladder from the tailrace. The attraction water is currently supplied to the AWS by two “fish turbine” adjustable blade units located on the west end of the powerhouse. If one or both fish turbine units fail, water supplied to the AWS would be severely limited or eliminated. The East Fish Ladder AWSB was designed and constructed to provide an emergency backup supply of water to the auxiliary water supply (AWS) system. This AWSB system was designed to provide a temporary (maximum 1 year) backup supply of water (approx. 1,400 – 1,600 cfs) to the AWS, when both fish turbine units fail, and the design AWS flow (approx. 5,000 cfs) is not available (USACE, 2024).

The expected construction start date for Fish Unit Rehabilitation Project is late in the year 2032, per the current System Asset Plan (SAP). This project requires the AWSB system to operate during that rehabilitation project to provide adequate flows for fish attraction. This was coordinated during Fish Unit Rehab Phase 1A. Fish Unit Rehab duration is currently scheduled as one year per unit for a total of two years. Flow tests have shown that the AWSB system trashracks have had periodic debris issues and require a more robust debris management strategy during the Fish Unit Rehab. Following Fish Unit Rehab, the backup AWS will be used if one or both of the new propeller Fish Units are forced out of service during adult fish passage season.

4. PROJECT LOCATION

The Dalles Lock and Dam is 192 miles upriver from the mouth of the Columbia River and two miles east of the city of The Dalles, OR (See **Figure 1** in Section 1.1). The Dalles Dam is the second dam upstream from the mouth of the Columbia River. The work area at the site itself is between the AWS Backup Intake trashrack precast concrete piers and the Service Gallery in which the FCQ7 Motor Control Center and nearby PLC are located.

5. DESCRIPTION OF EXISTING FACILITY

The AWSB system is comprised of, from upstream to downstream, an intake trashrack, a stoplog closure system, a 10’ diameter piping section with a butterfly valve, an assembly to bifurcate the flow into two – 7’ piping runs with butterfly valves, and an outlet into the penstock outfall.

Please refer to The Dalles Lock and Dam facility plans and specifications for additional information.

6. DESCRIPTION OF PROPOSED FACILITY

The proposed facility will entail adding mechanical equipment to the AWSB Intake for rotating brush cleaning of the submerged trashracks. The equipment will be anchored to the EL 185.0 deck and the face of the existing precast reinforced concrete piers using post-installed chemical anchors. Existing handrails will be modified to accommodate the equipment clearances and operator safety. New handrails, maintenance platforms, and ladders are included as part of the required layout. See Plate M-101 in Appendix A.

A rotating durable synthetic brush will be used to clear debris from the submerged screens of the AWSB Intake. The brushing machine will be based on a powered rotating brush head to dislodge impinged debris on the AWSB Intake trashracks. The brush will be positioned and powered using a telescoping mechanical boom arm affixed to a trolley chassis traveling on a deck mounted track at EL 176.7. The brush is positioned and indexed over the entire rack surface using the telescoping, slewing, and traveling motions of the equipment. The mechanical equipment is primarily welded steel boxed frame structural fabrications whose movements are internally powered.

The mechanical design of the equipment will be based on a standard product line and is expected to include the structural design of the equipment components/frames, mechanical design of rotational components, design of hydraulic fluid and/or electrical power systems, and the design of the machine control systems; all of which will be detailed by the product manufacturer. The equipment will be designed such that the unit will still be able to perform the cleaning cycle if the rotating brush head encounters a fault and is no longer rotating.

The equipment controls will be a PLC based system which controls the mechanical movements and interlocks of the raking system. Control systems and logic will be developed by the equipment supplier based on the project criteria and cybersecurity requirements. All cleaning cycles will be operator-initiated from the trashrake control panel; based on a completely manual cycle (operator controls all movement of bush head with discrete push button inputs) or an automatic cycle (where the PLC controls the brush movements under the supervision and initiation of an operator). The equipment is intended to only operate while the intake flow control valve has been fully closed so that no flow is going through the trashracks. It will be the responsibility of the operator to confirm the intake flow status and there are no interlocks between the equipment and the flow control valve of the AWSB intake. Water level sensors positioned upstream and downstream from the trashrack will transmit water levels to the facility's SCADA system for monitoring and alarm indication purposes only. No equipment operations will be able to be initiated from the facility's SCADA system.

7. CONSTRUCTION ACCESS

Access to the work area during construction will be from the asphalt and concrete roadway across the top of the embankment and structure for the East Fish Ladder.

Heavy equipment access from the water may not be necessary. The work will likely require rescue and survey boats on duty during above water work. However, it is possible that a contractor will choose to perform part of the construction using barges or boats, especially given that the layout of the system includes small steel platforms mounted on the face of the existing concrete structure. (The bottom-of-steel elevation for the lowest components of the platforms is several feet above the high-water elevation.)

8. CONSTRUCTION SCHEDULE

The expected construction start date for the Fish Unit (FU) Rehabilitation Project is in the year 2032, per the current System Asset Plan (SAP). The schedule for construction of the AWSB Debris Management system will need to be prior to Fish Unit Rehabilitation and is assumed to be approximately two (2) years. It is anticipated that equipment manufacturing and testing will consume the first 12 months beginning in late 2025. Any work that is required to be performed from the water's surface, would be limited to The Dalles winter maintenance period (between December and February) for adult fish facilities.

9. OPERATIONS DURING CONSTRUCTION

It is assumed that the AWSB piping will not be in operation during installation of the proposed equipment. It is not anticipated that the proposed project would require any in-water diving work. A contractor may elect to perform some of the work from barges secured to the concrete pier and there also may be a need to have a rescue boat and personnel on the water during some or all of the construction activities.

10. COST

Construction costs for the proposed work have been estimated by USACE staff (EDR-USACE, 2024) to be $1.4M. The total project cost (design and construction) is estimated to be $2.3M. The construction contract will take less than two years but could be impacted by potentially long lead times for equipment. If necessary, any in-water or on-water work would be completed during the allowable in-water work period.

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PERTINENT DATA

PERTINENT PROJECT DATA THE DALLES LOCK AND DAM - LAKE CELILO		
GENERAL		
Location	Columbia River, Oregon and Washington, River Mile 192	
Drainage Area	Square miles	237,001
RESERVOIR – LAKE CELILO (elevations referenced to 1929 datum 1947 adjustment)		
Normal minimum pool elevation	Feet, msl	155
Normal maximum pool elevation	Feet, msl	160
Maximum pool elevation (PMF regulated, 2009)	Feet, msl	178.4
Minimum tailwater elevation[1]	Feet, msl	76.4
Maximum tailwater elevation (PMF regulated, 2009)	Feet, msl	127.2
Reservoir length (to John Day Dam)	Miles	23.5
Reservoir surface area – normal maximum power pool (EL 160.0)	Acres	9400
Storage capacity (EL. 160.0)	Acre-feet	332,500
Power drawdown pool (EL. 155)	Acre-feet	53,500
Length of shoreline at full pool (EL. 160.0)	Miles	55
FLOOD CONDITIONS		
Probable maximum flood (unregulated)	$feet^3/s$	2,660,000
Probable maximum flood (regulated)	$feet^3/s$	2,060,000
Standard project flood (unregulated)	$feet^3/s$	1,580,000
Standard project flood (regulated)	$feet^3/s$	840,000
100-year flood event (regulated)	$feet^3/s$	680,000
SPILLWAY		
Type	Gate-Controlled Gravity Overflow	
Length	Feet	1,477
Elevation of crest	Feet, msl	121
Number of gates		23
Height (apron to spillway deck)	Feet	130

[1] The minimum tailwater 76.4 feet as shown above is based on an approximate median Bonneville Forebay of 74 feet NGVD29 and a river flow of 100,000 cfs. Both values do go lower and the minimum tailwater elevation recorded between 1990 – 2021 was 71.6 feet.

PREVIOUS AND PLANNED REPORTS

Number	Title	Date
01	The Dalles AWS Backup Debris Management EDR Final Report, Rev 1	April, 2024
02	TDA AWS System Operations & Maintenance Manual; USACE,2019	March, 2019

ACRONYMS

Acronym	Description
AWS	Auxiliary Water Supply
AWSB	Auxiliary Water Supply Backup
DDR	Design Documentation Report
DPS	Distinct Population Segment
EFH	Essential Fish Habitat
EFL	East Fish Ladder
EL	Elevation Level
ESA	Endangered Species Act
ESU	Evolutionary Significant Unit
FU	Fish Unit
NEPA	National Environmental Protection Act
NMFS	National Marine Fisheries Service
NRHP	National Register of Historic Places
OOS	Out of Service
PDT	Product Development Team
ROV	Remote Operated Vehicle
TDA	The Dalles Dam
USACE	United States Army Corps of Engineers
USFWS	United States Fish and Wildlife Service

SECTION 1 - PROJECT BACKGROUND

1.1 HISTORY

The Dalles Lock & Dam is 192 miles from the mouth of the Columbia River near the city of The Dalles, Oregon. The dam is a concrete gravity and embankment structure that was constructed by U.S. Army Corps of Engineers (operationally administered by the Portland District) in the 1950s for the purposes of hydroelectric power generation and maintenance of a navigational pool (Lake Celilo). The construction of the dam also included northern and eastern fish ladders for the passage of fish within the Columbia basin to upstream spawning grounds. The East Fish Ladder (EFL) is the primary and most heavily used of the two systems; likely because of its location within the historical riverbed and the attraction flows produced by the powerhouse. **Figure 1** shows the general layout of The Dalles Lock and Dam facility with the location of the Debris Management system design shown in red.

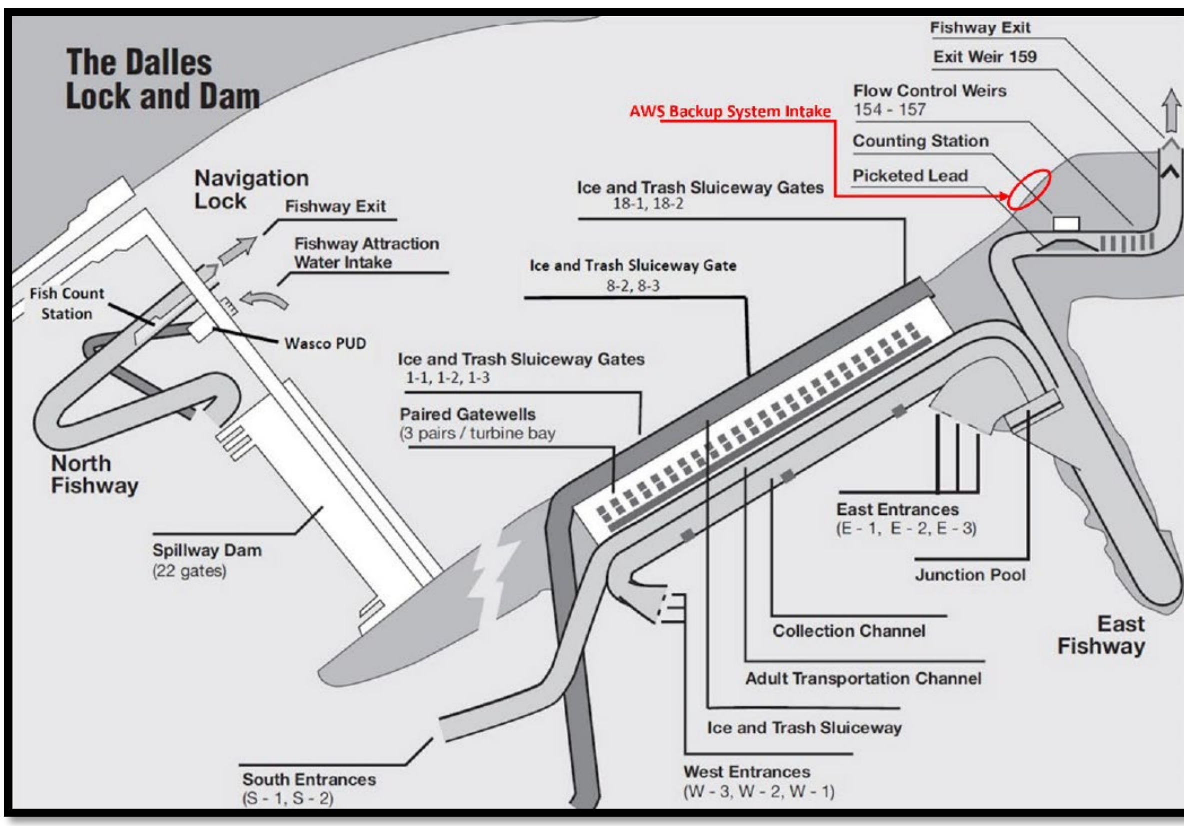

Figure 1 - The Dalles Dam Fish Ladder System (USACE, 2022)

The EFL is a pool and weir ladder located at the eastern extension of the powerhouse providing passage for Salmon, Steelhead, and several listed species of the Endangered Species Act (ESA). A key aspect of the ladder functionality is the attraction flow at the inlet; which in the case of the EFL is normally provided by attraction flow units (approx. 5,000 cfs, ea.). An Auxiliary Water Supply Backup (AWSB) System was completed in 2020 that addressed risk profiles that had been studied since 2008 to provide an alternative source of attraction flow in the event that the turbine units failed (original to construction of the project). The AWSB is an auxiliary water source for the east, west, and south entrances of the EFL, consisting of a forebay inlet structures w/ protective trashracks, 10-ft diameter penstock through the eastern non-overflow concrete dam, 120-inch isolation and emergency shutoff valve, bifurcation to 7-ft diameter conduits, 84-Inch diameter on/off control valves, and interconnection with the attraction flow system. **Figure 2** shows the general layout of the AWSB system.

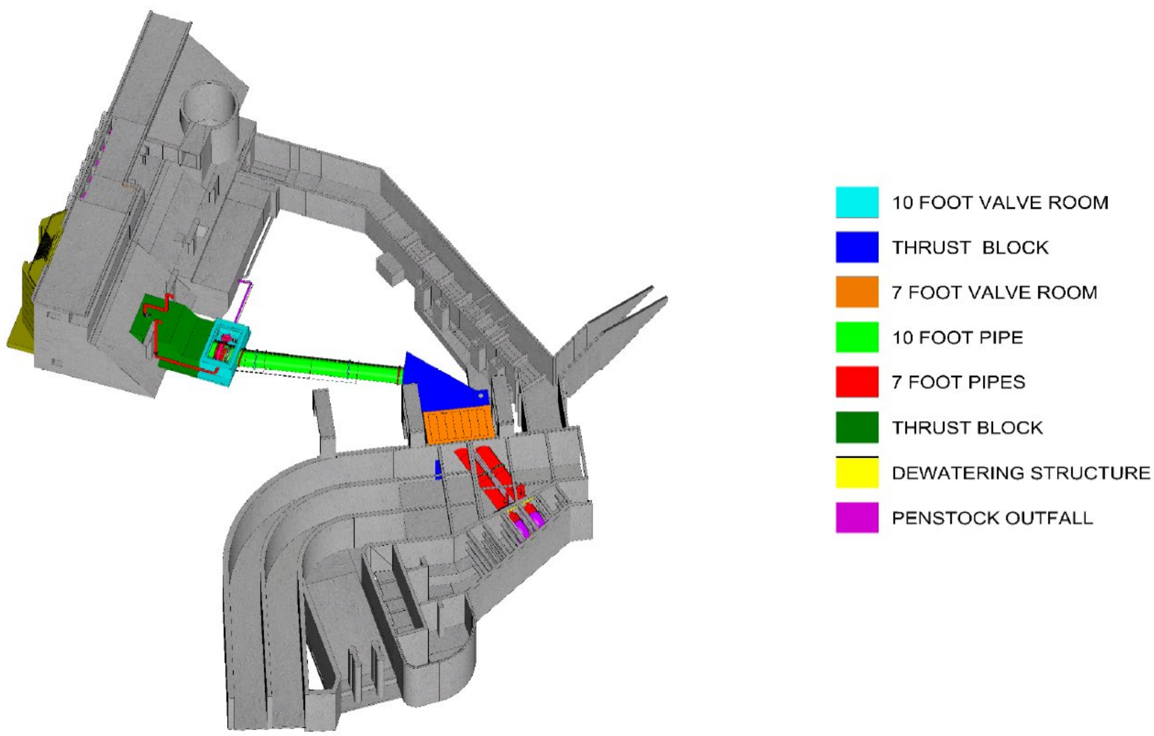

Figure 2 - AWSB System (USACE, 2019)

1.2 PROJECT DESCRIPTION

The AWSB intake is protected by trashracks (stiff steel “screens”) that are installed into a slot within the forebay intake structure that was added as part of the AWSB system in 2020. The inlet trashrack is comprised of 11 identical six-foot tall by 24-foot-wide panels which can be stacked in any order to isolate the intake from debris and fish using screening W15-W-2, 1-1/4” x 3/16” steel bar grating secured to the steel frame of the trashrack. **Figure 3** shows a typical trashrack panel.

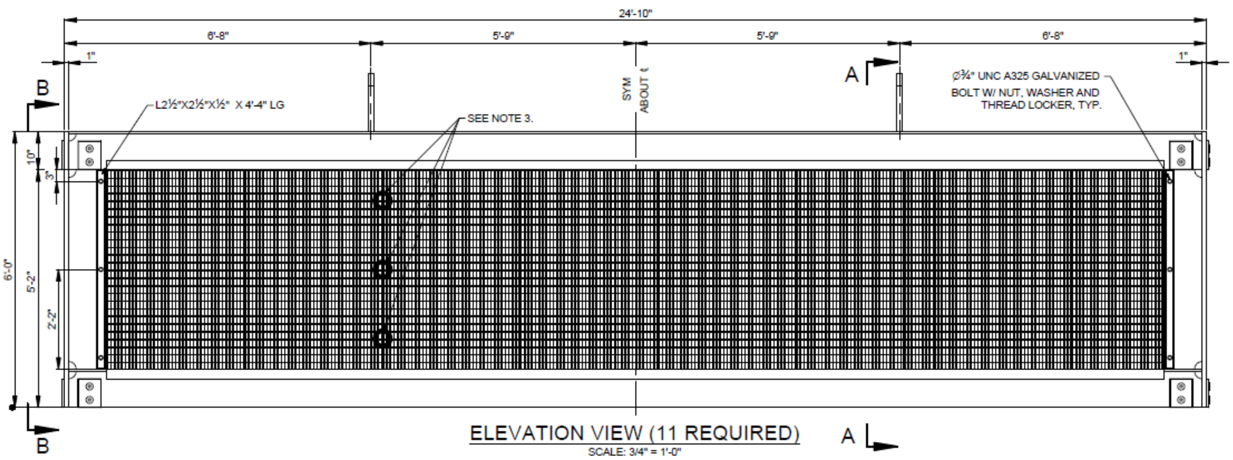

Figure 3 - Trashrack Panel (USACE, 2015)

The main goal of this Project is to provide a mechanical method for dislodging debris from the trashracks at the EFL AWSB system intake. Currently, operations staff must shut down the AWSB system to let river currents clear accumulated debris from the screens. The alternatives analysis presented in the USACE report entitled “The Dalles AWS Backup Debris Management EDR Final Report, Rev 1”, dated April 2024, resulted in the determination to proceed with Alternative 11 (dedicated mechanical rotating brush), along with Alternative ME-1 (level sensors).

1.3 EXISTING CONDITIONS

The AWSB intake is protected by 1-1/4” square bar grating which is affixed uniformly to eleven (11) structural panels. The grating prevents debris suspended in the river flow from entering the AWSB piping. The suspended debris is primarily aquatic grasses, however some small-diameter woody twigs or leaves carried by the river may be present. There is little to no non-organic material that has been known to collect on the intake.

Debris matting was surveyed with a Remotely Operated Vehicle (ROV) by USACE in 2022 which noted instances of material collections which constitute a blockage mat as can be seen below in **Figure 4**. Conditions ranged from clean to fully blocked. The matting of rack bars was variable with the depth and the right side (when observed from the lake side of the screens) had more debris collected. Rack bars near the water surface had lower accumulations but did exhibit impingement of aquatic grasses pinched between the bar grating and L brackets as can be seen below in **Figure 5**.

Figure 4 - Bottom Panel Debris Matting (USACE, 2022)

Figure 5 - Top Panel (USACE, 2022)

1.4 AWSB INTAKE OPERATIONS

The AWSB intake is intended to provide supplemental attraction flow when a single operational fish turbine unit is in service or to replace the flows of both fish turbine units in case that both units fail or are removed from service. The nominal flows of both fish turbine units combined is 5,000 cfs. The AWSB intake provides 1,400 to 1,600 cfs of flow for the east entrance only (if both units are offline) when operating alone or as a combined flow totaling 4,000 cfs for two entrances when operating with a single fish turbine unit. Supplemental operation with both fish turbine units is not an operational condition. The performance of the AWSB intake is crucial to achieving the flows required when both turbine units are offline since extended outages are anticipated during the refurbishment of the fish turbine units.

Operation of the AWSB intake requires a full penstock and the motorized operation of the 7-ft dia. conduit valves, 10-ft penstock valves, proper setting of vent/purge valves, and the correct scheme of entrance weirs to be enacted (refer to TDA AWS System Operations & Maintenance Manual; USACE, 2019). Generally, the current system is shut down for passive cleaning when the differential across the trashracks reaches 2-ft (difference between forebay headwaters and intake water surface just behind the trashracks). A maximum of a 4-ft differential was noted after 2.5 weeks of continuous operation in February 2019; resulting in 2x daily differential checks and ROV inspection after prolonged operation.

1.5 MAIN PROJECT FEATURES

The intake trashrack and trashrake cleaning system has the following characteristics (See Plates M-101, M-102, and M-103 in Appendix A):

1.5.1 Trashrake Mechanical Brush

A rotating durable synthetic brush will be used to clear debris from the submerged screens of the AWSB intake. The brush will be positioned and powered using a telescoping mechanical boom arm affixed to a trolley chassis traveling on a deck mounted track at EL 176.7. The brush is positioned and indexed over the entire rack surface using the telescoping, slewing, and traveling motions of the equipment. The mechanical equipment is primarily welded steel boxed frame structural fabrications whose movements are internally powered.

1.5.2 Structural

The AWSB system intake is not part of the original dam. The intake was installed and commissioned in 2018. Subsequent work was undertaken after 2018 and completed in the 2020 timeframe. This work included the installation of precast, modular, reinforced concrete piers on an underwater foundation slab. The piers were anchored to the original structure.

The AWSB Debris Management project will call for the installation of equipment on the forebay deck of the AWSB system intake and also mounted to the face of the piers using post-installed chemical anchors. Underwater construction is not expected. The existing handrails will be modified to provide equipment clearance and protection. New handrails, platforms, and ladders will be included as part of the required layout.

1.5.3 Electrical and Controls

Electrical supply to the equipment will be from a 480V 3φ Motor Control Center (MCC) FCQ7 in the dam service gallery near the AWS intake at EL 168.0. The equipment controls will be internal and provide manual operation of the cleaning brush over the entire intake surface. External level sensors upstream and downstream from the AWS trashracks will be added to provide feedback to both the brush controls and the external plant controls about the differential across the trashracks for planning cleaning operations and will tie into the Fish SCADA system by using the existing PLC cabinet located in the service galley near MCC FCQ7.

1.5.4 Survey Datum & Control

Project Datum:

- Horizontal – Oregon Coordinate Reference System, Columbia River East, North American Vertical Datum of 1983, adjustment of 2011, Geoid 12B
- Vertical – National Geodetic Vertical Datum of 1929 (NGVD29)

Project Survey Control:

- Project survey control information was provided by the USACE and is shown on the contract drawings.

1.5.5 Relevant Elevations

A summary of the relevant elevations and design features for the AWS Intake are listed below:

Water Surface Elevations (WSE)

- Minimum WSE Forebay El. 155.0
- Maximum WSE Forebay El. 160.0
- Forebay WSE Normal Range El. 157.0 – El. 159.5

Structural Elevations

- Forebay Deck El. 185.0
- Upper Platform Walking Surface El. 176.7
- Lower Platform Walking Surface El. 170.4
- Nominal Bottom of Steel (Lower Platform Steel Support Strut) El. 160.0
- Trashrack Invert El. 104.0
- Penstock Centerline El. 116.5
- Top of Trashrack Stack El. 170.0

1.5.6 Trashrack Differential Head

Trashracks are needed to prevent clogging and debris damage of the downstream piping system. Trashrack type and size of openings depend on the pool elevation, intake elevation, the size of the outlet conduit, the reservoir trash conditions, type of control device used, use of the water, and the need to exclude the trash.

The maximum allowable differential head across a trashrack is five (5) feet, which conforms to the requirements of EM-1110-2-2400 *Structural Design and Evaluation of Outlet Works*. This head corresponds to an 83% blockage, per the blockage rating table excerpt below as provided in the *AWS Debris Management Engineering Design Report* (EDR) per **Figure 6** below:

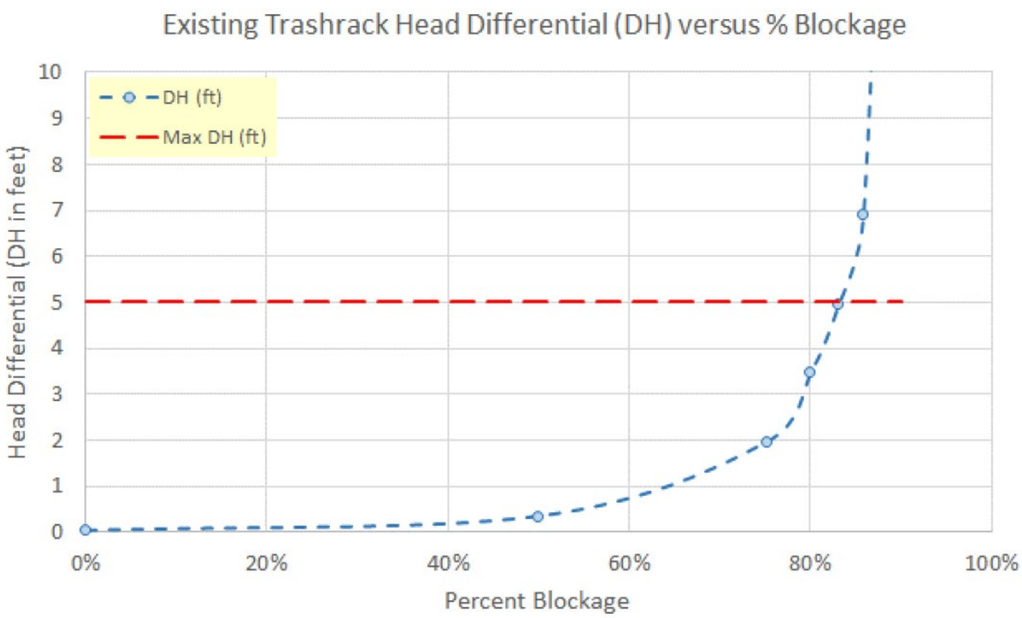

Figure 6 - AWS Trashrack Head Differential % Blockage Rating

1.6 REFERENCES

1.6.1 General Project References

- Records & Studies
    - TDA AWS Intake Record Drawings; USACE, 2020
    - TDA AWS Intake O&M Manual; USACE, 2019
    - TDA AWS Debris Management EDR; USACE, 2024
    - TDA Record Drawings; USACE
- USACE Engineer Regulations
    - ER 5-1-14 USACE Quality Management System
    - ER 415-1-10: Contractor Submittal Procedures
    - ER 1110-1-12: Quality Management
    - ER 1110-1-8155: Specifications
    - ER 1110-1-8159: Engineering and Design-DRCHECKS
    - ER 1110-2-1150: Engineering and Design for Civil Works Projects
    - ER 1165-2-217: Civil Works Review Policy

- State of Oregon
    - State of Oregon Specialty Code(s)
- USACE Engineer Manuals
    - EM 385-1-1: Safety and Occupational Health (SOH) Requirements
    - EM 1110-2-2000: Standard Practice for Concrete for Civil Works Structures.
    - EM 1110-2-2400: Structural Design and Evaluation of Outlet Works
    - EM 1110-2-1424: Lubricants and Hydraulic Fluids
    - EM 1110-2-2610: Mechanical and Electrical Design for Lock and Dam Operating Equipment, 2013
- American Welding Society (AWS)
    - AWS D1.1-2020: American Welding Society, Structural Welding Code - Steel
    - AWS D1.6-2017: American Welding Society, Structural Welding Code – Stainless Steel
- American Institute of Steel Construction (AISC)
    - AISC: Manual of Steel Construction (16th edition)
    - AISC 360-22: Specification for Structural Steel Buildings
- American Society of Civil Engineers (ASCE)
    - ASCE 7-22: Minimum Design Loads and Associated Criteria for Buildings and Other Structures
- National Fire Protection Association (NFPA)
    - NFPA 30: Flammable and Combustible Liquids Code (2021)
    - NFPA 70: National Electrical Code (2020)

SECTION 2 - BIOLOGICAL CRITERIA

2.1 BACKGROUND

The EFL provides for upstream fish passage past the dam via an AWS system and an AWSB system, which supply attraction water to migrating fish. The AWSB will be used during the upcoming Fish Unit Rehabilitation Project (expected duration of two years), when one of the two fish turbines are taken out of operation during annual maintenance (December through February), or if one or both fish turbines were to fail. The proposed debris management system on the upstream face of the AWSB system piping is needed to clear debris from the trashrack, which will allow for reliable and controlled flows in the AWSB to facilitate successful fish passage.

2.2 REFERENCES AND STANDARDS

Installation of the debris management equipment will be conducted in accordance with existing requirements guiding protection of salmonids, including the following:

- NMFS (2020). Endangered Species Act Section 7(a)(2) Biological Opinion and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Response for the Continued Operation and Maintenance of the Columbia River System.

- USACE (2024a). 2024 Fish Passage Plan Lower Columbia & Lower Snake River Hydropower Projects March 2024 – February 2025. Chapter 3, The Dalles Dam.

- USACE (undated). Approved work windows for fish protection for waters within National Park boundaries, Columbia River, Snake River, and Lakes by watercourse

- USFWS (2020). Endangered Species Act - Section 7 Consultation Biological Opinion. Columbia River System Operations and Maintenance of 14 Federal Dams and Reservoirs Washington, Oregon, Idaho, and Montana. U.S. Fish and Wildlife Service Reference: 01EWFW00-2017-F-1650 July 24, 2020

- USFWS (2008). Biological opinion on the continued operation and maintenance of the Willamette River Basin Project and effects to Oregon chub, bull trout, and bull trout critical habitat Designated under the Endangered Species Act. U.S. Fish and Wildlife Service, Oregon Fish and Wildlife Office. July 11, 2008.

2.3 SPECIES OF CONCERN

Federally listed salmonids under the jurisdiction of NMFS occur in the vicinity and migrate beyond The Dalles Dam. These include:

- Snake River Fall Chinook Salmon evolutionary significant unit (ESU) (*Oncorhynchus tshawytscha*)

- Snake River spring/summer Chinook salmon ESU (*O. tshawytscha*)

- Upper Columbia River spring Chinook salmon ESU (*O. tshawytscha*)
- Lower Columbia River Coho Salmon (*O. kisutch*)
- Snake River sockeye salmon ESU (*O. nerka*)
- Snake River Steelhead distinct population segment (DPS) (*O. mykiss*)
- Upper Columbia River Steelhead DPS (*O. mykiss*)
- Middle Columbia River steelhead DPS (*O. mykiss*)

Upstream migrants are present at the dam year-round, whereas downstream migrating juvenile salmonids and shad are present primarily from April through November. The federally listed bull trout (*Salvelinus confluentus*), which is under the jurisdiction of USFWS, has also been periodically documented in the vicinity of the fish ladders, as well as Pacific lamprey (*Entosphenus tridentatus*). Adult peak passage timing is summarized in **Table 1** below.

Table 1 - The Dalles Dam Adult Fish Peak Passage Timing*

Species	Peak Period
Spring Chinook	April 13 – May 23
Summer Chinook	June 6 – August 1
Fall Chinook	September 2 – September 23
Sockeye	June 20 – July 10
Steelhead	July 9 – September 23
Coho	September 3 – October 25
Lamprey	June 29 – August 1

Source: USACE 2024, Table TDA-3.
*(based on yearly counts since 1957, except lamprey since 2000)

All work would be conducted in accordance with the Fish Passage Plan (USACE 2024a), which outlines measures for fish passage and protection. It is assumed that dewatering will not be required for installation of the debris management system. While on-water work will be conducted from barges, potential fish impacts related to sound or vibration from barge operation or drilling equipment are anticipated to be negligible, and no water quality impacts are expected. Therefore, the effects to listed or sensitive fish species are anticipated to be minimal.

2.4 CRITERIA

The depth (40-45 feet) of the AWS backup system minimizes the entrainment potential of listed juvenile salmon. Because of this, and because the location in the forebay is much less likely to entrain juvenile salmon, NMFS did not require juvenile fish screen criteria to be enforced at the intake during development of the AWSBS DDR in 2014.

The existing 0.75" trashrack clear spacing is being carried forward as a design criterion for maximum clear spacing for alternatives in this EDR (USACE 2024b [EDR Final Report, Rev1]).

Criteria Specifications:

Trashrack Flow Rates

a. Minimum design flow rate per DDR (USACE 2021 Draft) = 1,400 cfs.

b. Estimated range of operating discharge through trashrack:

   1,440 – 1,600 cfs

c. Flow changes resulting from modifications:

- System flow rates shall not be reduced by more than 10 cfs.
- This flow restriction translates to an added headloss of 1 foot.
    - This represents a limit in the increase in the systemic headloss as the result of modifications to the trashrack, added piping and/or porosity plate; and/or any new upstream structure.
- The 10 cfs flow reduction limit is based on the following assumptions:
    - Minimum forebay = 155 ft NGVD29
    - Maximum design AWS conduit Water level = 89.5 feet
    - System design head loss coefficients increased by 5%
    - Computed AWS discharge = 1410 cfs.
    - Minimum AWS discharge per criteria = 1,400 cfs
    - Net difference: 10 cfs.
- Any proposed modifications should not cause an increase in the AWSB intake velocities at or near the surface. (Increased surface velocities could entrain juvenile fish.)

Trashrack approach velocities:

a. Average over intake opening: 1.2 – 1.3 ft/s

b. Average through screen openings: 1.7 – 1.9 ft/s

c. Estimated local maximum near Intake: 2.5 – 4.5 ft/s

   (1) At approximately 40 feet depth

The original TDA AWS BS DDR (USACE draft 2021) identified risks as low given more than 80% of the juvenile fish are distributed within the upper 30 feet of the water column. Adult salmon and lamprey were not expected and have not been observed to be impinged upon the trashrack, given the intake is located downstream (approximately 65 feet) and deeper (more than 30 feet) the fish ladder exit to the forebay.

2.5 IN-WATER WORK WINDOW

Any in-water work would be conducted within The Dalles winter maintenance period (between December and February) for adult fish facilities, which includes the auxiliary water supply, as described in the 2024 Fish Passage Plan (USACE 2024a).

SECTION 3 - HYDRAULIC ANALYSIS

The AWSB Intake is situated within the EFL forebay within the eastern non-overflow dam embankment groin and may be subject to unusual turbulence or currents due to the proximity of adjacent features and the prevailing flows within the waterway.

3.1 DESIGN ASSUMPTIONS

The concept of a mechanical brush which dislodges impinged debris from the trashracks, but does not remove the debris from the waterway, relies heavily on the assumption that a swift enough current exists to carry the dislodged debris away from the intake. The design also predominantly relies on the assumption that the AWSB intake is shut down during bushing cycles so that the dislodged debris will not relodge itself immediately after brushing due to the operational intake flow velocities.

3.2 ANALYSIS METHODS

A Computational Fluid Dynamics (CFD) model was developed to predict flow velocities along the face of the intake screen and based on the waterway bathymetry, geometry of existing structures, and waterway flow data provided by USACE to confirm the basic design assumptions that flow velocities are sufficient to carry raked debris away from the intake and used to estimate loads on the proposed trashrake with brush head system. The computer program Flow-3D[2] was used for the analysis and is an industry standard for solving free surface flow problems. **Figure 7** shows the extent of the coarse model. The model extends 8,500 ft upstream of the spillway. The bathymetry used was obtained from the USACE[3] from their survey done in 1999.

[2] Flow-3D, Flow Science, Inc. Santa Fe, NM, 2022.
[3] USACE Bathymetry Survey, 1999.

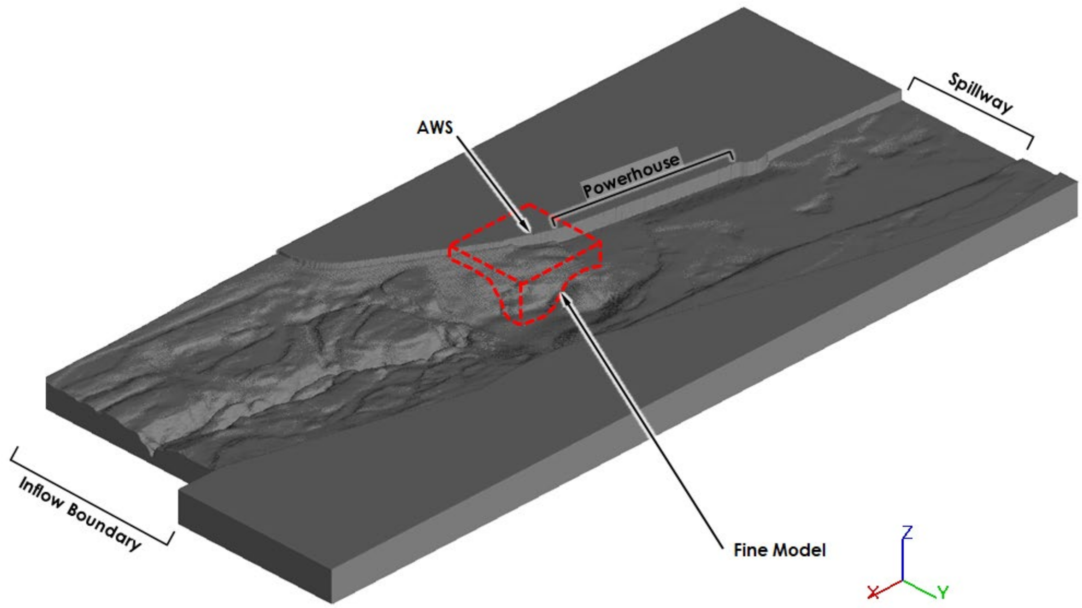

Figure 7 - Coarse Model Layout

The Flow-3D model was run under a one-fluid, free-surface flow condition utilizing the gravity and viscosity/turbulence options available within Flow-3D. This is the methodology recommended by Flow Science for these types of problems. Key numerical options used in this analysis are described in **Table 2** below.

Table 2 - Flow-3D Numerical and Physical Options

Parameter	Description
Turbulence	Turbulence utilized the implicit renormalized group theory (RNG) κ-ε model. The RNG κ-ε model is similar to the standard two-equation κ-ε model and is the turbulence model recommended for most hydraulic applications.
Pressure	Pressure calculations were made using the generalized minimum residual implicit pressure-velocity solver and the dynamically adjusted pressure convergence tolerance setting available within Flow-3D. This pressure solver setup is the default setting in Flow-3D and is recommended for most hydraulic applications.
Momentum Advection	A second-order momentum advection option was used for all simulations. The second-order option was adopted for this analysis as it has been found to best capture the secondary, swirling flows and eddies that will be present/generated within the existing and proposed conveyance systems.
Meshing	The CFD modeling approach utilized Cartesian (i.e., x-, y-, z-) coordinates. The minimum mesh dimensions used in the analysis were 20 feet. Number of active cells was about 2,600,000.

At the upstream boundary the total desired river flow was input. At the location of the powerhouse a “sink” was input to the model that would draw off the desired powerhouse flow over the area of the intakes. At the spillway an outflow boundary was used with a prescribed water level. This mimics the operation of a gated spillway that maintains the selected water level and passes out of the model the difference in flow between the river flow and the powerhouse flow.

A second model, using a finer mesh resolution, was developed that focused on the area around the AWS intake. **Figure 8** shows the extent of the model relative to the intake location.

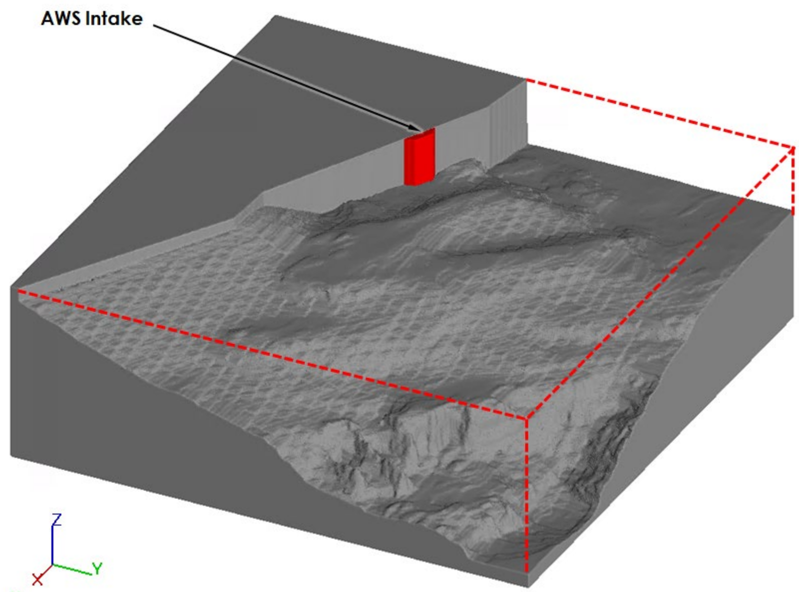

Figure 8 - Fine Model Layout

The model is 880 ft square. Two meshes are used, a 2-ft mesh covering the whole model and a smaller mesh with 1-ft cells closer to the intake. The other model parameters listed in **Table 1** were the same in both models. The boundary conditions for this smaller model are taken directly from the results obtained in the coarse model using a “grid overlay.” A snapshot of the velocities on each face are taken from the coarse model and used as the boundary for the fine model.

3.3 ANALYSIS RESULTS

The model was run at a 100-yr river flow of 680,000 cfs. The powerhouse was discharging 375,000 cfs, with the remaining 305,000 cfs going through the spillway. **Figure 9** shows a plot of the surface velocities for this case. The velocity varies considerably in the river channel with higher velocities generally corresponding to the deeper areas and lower velocities in the shallow areas.

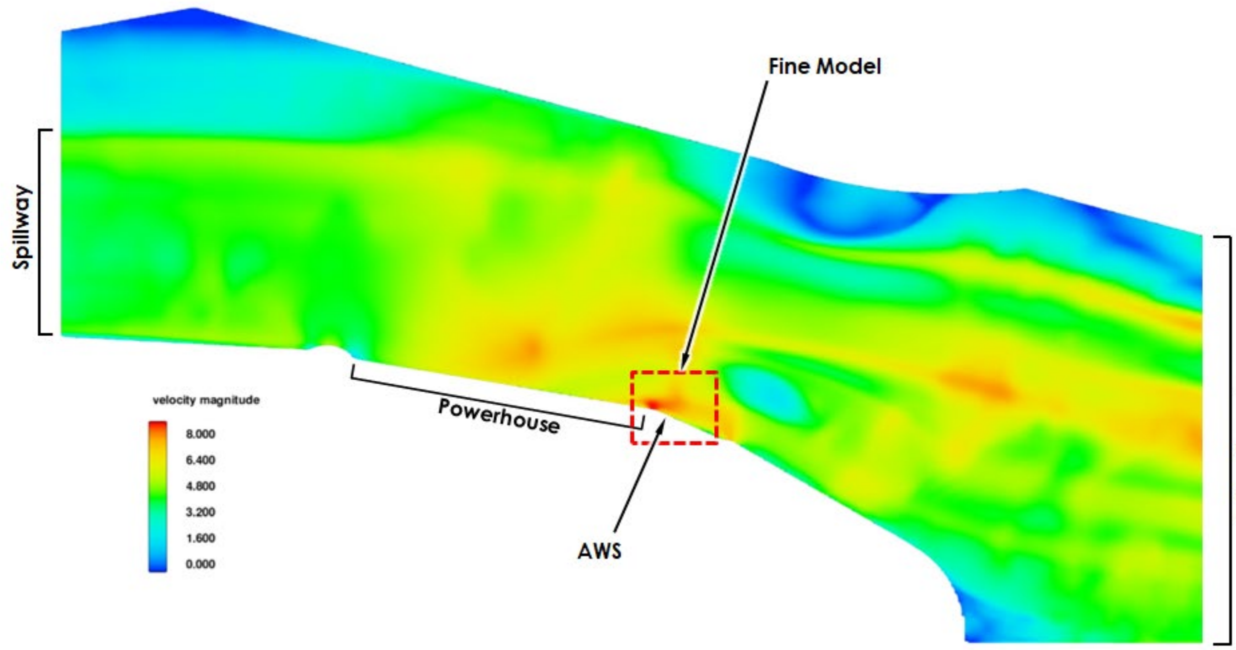

Figure 9 - Coarse Model Surface Velocities

Figure 10 shows a color map of the velocities in front of the ASW intake. The section is taken at El. 130 – about 30 ft below the water surface. The peak velocity is about 8 ft/sec at the flow concentration at the upstream corner of the intake but generally lower along the face of the trashrack. A series of similar plots at vertical 10-ft intervals from El. 110 to El 160 is shown in Appendix C.

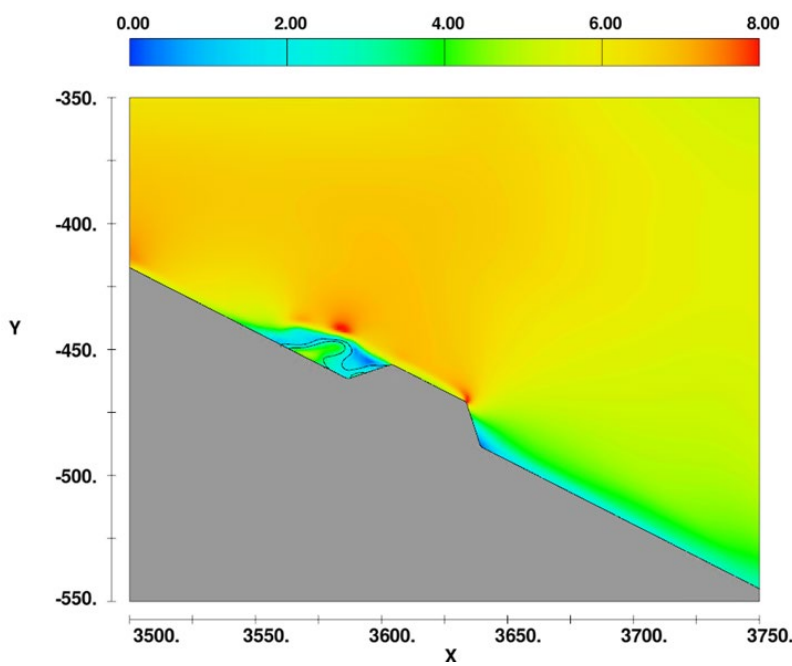

Figure 10 - Fine Model Surface Velocities

Figure 11 shows a plot of the vertical profile of the velocity magnitude. The transect is taken at the center of the rack 1.5 ft from the face. The maximum velocity is about 5.5 ft/sec.

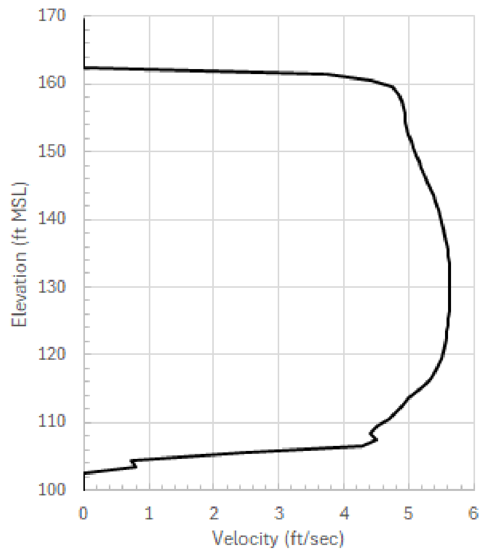

Figure 11 - Vertical Velocity Profile

A similar analysis was performed using a river flowrate which is expected to be exceeded 95% of the time, i.e., during low flow periods. This analysis is presented in Appendix C. The analysis shows that the sweeping velocity across the face of the trashrack during low flow events is approximately 0.7 fps, which should be sufficient to carry dislodged debris downstream.

3.4 DESIGN RECOMMENDATIONS

The analysis confirmed that the velocities are swift enough to carry away dislodged debris and that under maximum flows the trashrake equipment must be supplied to accommodate 5.5 ft/s drag forces. It is expected that the operation of the rake would not occur at maximum river flows, but the maximum conditions will be coordinated with the requirements of the rake.

SECTION 4 - CIVIL DESIGN

The proposed project will have little work that has typically been associated with civil design. In order to route electrical and control wiring from the service gallery to the trashrake and associated devices, four conduits (four at 1-1/2”) will need to be installed in two relatively short lengths of vegetated areas and across the asphalt roadway atop the embankment off the end of the dam. The amount of asphalt to be removed and replaced will be minimal (less than 12 square yards). The intent will be to restore the pavement with six inches of asphalt over six inches of aggregate subbase and eight inches of aggregate base material or to match the existing asphalt and aggregate thicknesses, whichever is greater. The asphalt and aggregate materials and installation will be to Oregon Department of Transportation (ODOT) standards. Trenching in excavated areas will be backfilled with the removed materials and seeded using a locally sourced, readily available grass seed mix.

SECTION 5 - ENVIRONMENTAL DESIGN

USACE supports ecosystem sustainability as a mission focus for all project development and land management decisions. This focus reflects protection of our natural resources under numerous federal laws, including the National Environmental Protection Act (NEPA), Clean Water Act, Coastal Zone Management Act, Endangered Species Act, Fish and Wildlife Coordination Act, Magnuson Fishery Conservation and Management Act, Migratory Bird Treaty Act and many more. (USACE 2021)

Because the proposed AWS backup debris management work has a minimal footprint within the existing facility and is not ground disturbing, the following regulatory requirements will not require additional evaluation of documentation. USACE (2019) made these determinations based on the findings summarized below:

- National Environmental Policy Act (NEPA) - USACE determined that the proposed action qualifies as a categorical exclusion as described by USACE's regulations for implementing NEPA, 33 CFR Part 230. This action can be excluded from further NEPA documentation.

- Bald and Golden Eagle Protection Act - There is no potential for impact to preferred nesting, rearing, or foraging habitat, and no potential for a 'take' of bald or golden eagles.

- Clean Air Act - Any equipment used during construction will be required to meet State emission standards, with all emissions being temporary and localized.

- Clean Water Act - Proposed work will not cause discharge of fill or polluted material into Water of the United States.

- Coastal Zone Management Act - The project is not located within Oregon or Washington Coastal Zones.

- Federal Endangered Species Act - The proposed action will not occur in water or change the flow of water and there will be no effect to salmonids. (see Section 2)

- Magnuson-Stevens Fishery Conservation and Management Act – Essential Fish Habitat (EFH) for coho salmon and Chinook salmon occurs in the Columbia River. The proposed action will not affect any EFH or the habitat of prey base(s) because no in-water will occur and there be no change to water flow.

- Marine Mammal Protection Action - The project will not take place in-water and will therefore not affect marine mammals or marine mammal habitats.

- Marine Protection, Research, and Sanctuaries Act - The proposed action does not require disposal of materials into the ocean.

- Migratory Bird Treaty Act - The proposed action will not result in the take (including killing, capturing, selling, trading, and transport) of any migratory birds.

- National Historic Preservation Act – USACE determined that the work will have No Effect on any historic properties and/or other cultural resources and will have No Effect on The Dalles Dam's NRHP eligibility. (see Section 9)

- Rivers and Harbors Act - The Columbia River is subject to Section 10 of the Rivers and Harbors Act, which addresses navigability in Waters of the United States. The proposed action will not create any barriers to navigation and is in compliance with the Act.

SECTION 6 - STRUCTURAL DESIGN

The project will add mechanical equipment to the AWS intake for rotating brush cleaning of the submerged trashracks. The equipment will be anchored to the EL 185.0 deck and the face of the existing precast reinforced concrete piers using post-installed chemical anchors. Existing handrails will be modified to accommodate the equipment clearances and operator safety. New handrails, maintenance platforms, and ladders are included as part of the required layout.

6.1 DESIGN ASSUMPTIONS

The structural design includes post-installed chemical anchors, replacement and additional handrails, miscellaneous equipment baseplates with leveling grout, level sensor supports, and steel platforms.

As-built details of the AWSB intake concrete piers on Plates SC-203, SC-703, and Farwest Shop Drawing R-1 (Precast Sections) were used to formulate the design approach to the maintenance platforms. (See Appendix A)

The AWS intake is expected to be in excellent condition. Therefore, improvements or repairs to the concrete structure of the AWS intake are not expected.

Selected data sources (including existing facility documentation) are listed within this DDR. Critical assumptions and decisions are provided.

Please see Appendix B for the structural calculations.

6.2 SERVICE LIFE

The water pool levels are not expected to exceed the platform steel members, therefore, AISC 360 & ASCE 7 were used in the design of the platforms. The AISC 360 and ASCE 7 specifications do not specifically specify a set number of years for the design service life of structures. Rather, they focus on ensuring structures meet certain performance criteria over their intended lifespan. Strength, stability, and serviceability are all taken into account. It is assumed that the platform will be periodically inspected over this period for corrosion, wear, and other damage and will be maintained under a well-defined maintenance program.

6.3 DESIGN CRITERIA

The structural design includes chemical anchors, structural steel, and grout.

6.3.1 Material Properties

Refer to the project plans and specifications. Selected material information is mentioned for convenience, as needed within this DDR. Typically, material standards refer to ASTM/ANSI standards.

Table 3 below illustrates the materials used in the structural design and their mechanical properties.

Table 3 - Properties of Structural Materials

Material	Yield Strength, Fy (psi)	Compressive Strength, f'c (psi)	Modulus of Elasticity, E (psi)	Additional
Concrete				
Existing	-	5,000		
New	-	4,000		
Grout				
ASTM C1107	-	5,000		
Steel Reinforcement				
ASTM A615	60,000		29,000,000	
Structural Steel		**Ultimate Strength Fu (psi)**		
ASTM A36	36,000	58,000	29,000,000	Plates
ASTM A500 Gr.C	50000	62,000	29,000,000	HSS
ASTM F1554 Gr.55	55,000	75,000	29,000,000	Anchors
ASTM A572 Gr.50	50,000	65,000	29,000,000	Angles
ASTM A992	50,000	65,000	29,000,000	W Shapes

6.3.2 Loads:

Loads and load combinations conform to Engineer Manuals and ASCE 7-22. Structural and mechanical engineers coordinated to design structures for the attached or supported mechanical equipment. Hydraulic loads for the brush assembly were estimated on a preliminary basis as an output of the hydraulic modeling and were used for the preliminary formulation of the mechanical equipment. Development and design resulting from specific design loading will be a required element of the mechanical equipment supplier's submittals.

6.3.2.1 *Load Categories: Usual, Unusual, and Extreme*

The minimum pool and full pool levels are located at EL. 155 & EL.160 respectively. The bottom of the fixed platform steel members below the grating is at EL.160. The water pool levels are not expected to exceed the elevation of the platform steel members. The full pool level will be selected as the usual water surface & extreme water surface; however, the unusual water surface will not be utilized.

6.3.2.2 *Dead:*

Dead loads consist of the self-weight of steel, granting all structures and fixed equipment. Steel unit weight is 490 PCF based upon AISC values for structural shapes. Concrete unit weight is assumed to be 150 PCF. The water unit weight for calculations is considered to be 62.4 PCF. Granting load is assumed to be 8 PSF. An additional 10% will be included to account for bolts, welds, coating, paint etc.

6.3.2.3 *Live:*

Live loads for any platform, catwalks, sidewalks, etc., will be in accordance with ASCE 7-22, but not less than 100 PSF as shown in the table below in **Table 4**. Live Loads will not be reduced.

Table 4 - Live Loads

Type	Uniform Load (lb/ft^2)	Concentrated Load (lbs)
Walkways/elevated platform	100	300
Handrails	50	200

6.3.2.4 *Wind:*

The wind loads were developed using ASCE 7-22 and ASCE Hazards Tool. The wind load parameters are shown below:

- Basic wind speed: 105 MPH
- Exposure: D
- Enclosure: Open
- Risk Category: III
- Surface Roughness Category: D
- Wind directionality factor K_d:0.85
- Topographic Factor K_{zt}:1.00
- Gust effect factor G:0.85
- Ground Elevation Factor K_e:1.0
- Velocity Pressure Coefficient Kz:1.43

6.3.2.5 *Snow:*

The snow loads were developed using ASCE 7-22 and ASCE Hazards Tool. Ground snow load considered to be 51 PSF. The snow load parameters are shown below:

- Exposure Category Ce:0.8
- Thermal Factor Ct:1.2

6.3.2.6 *Seismic:*

Seismic loads were determined using ASCE 7-22, ASCE Hazard Tool and the USGS 2018 Data with a location of (Latitude: 45.615, Longitude: -121.138). Site Class B/C was assumed to determine ground motions. Seismic lateral and seismic vertical loads will be considered. The seismic load parameters are shown below:

- Latitude = 45.615
- Longitude= -121.138
- Site Class: B/C
- Seismic Design Category: B
- Seismic Importance Factor I*e*: 1.25

Design ground motions are based on Maximum Credible Earthquake (MCE) which is the largest earthquake that can reasonably be expected to be generated by a specific source on the basis of seismological and geological evidence. MCE is considered since the platforms to be added were assumed to be non-critical. Seismic data is presented below:

- S_S:0.46g
- S_1:0.17g
- S_{MS}:0.42g
- S_{M1}:0.17g
- S_{DS}:0.28g
- S_{D1}:0.11g
- T_L:16s
- PGA_M:0.2g

- S_A:0.28g Based on the “Two Period Design Spectrum Graph” ASCE 7-22
- V_{S30}:760 m/s

The seismic data provided will be applied to the base of the structure. An amplification factor will be applied to the structures design at a different height. The amplification factor was determined using Table D.1 from the USACE EM 1110-2-2107, “Design of Steel Structures” which uses factors on gravity dams based on the height of the dams. An extract of Table D.1 is shown in **Table 5** below.

Table 5 - Measured Amplification Factors (EM 1110-2-2107, "Design of Hydraulic Steel Structures”)

Table D.1
Measured Amplification Factors

Dam	Height (ft)	Event	Maximum Acceleration (g)		Amplification Factor
			Base	Crest	
Dworshak	717	Lincoln, MT (2017)	0.00186	0.0168	9.06
Chief Joseph	236	Nisqually (2001)	0.0023	0.011	4.69
Wynoochee	175	Nisqually, WA (2001)	0.010	0.0361	3.58
		Satsop, WA (1999)	0.012	0.0343	2.97
Detroit	463	Scotts Mills (1993)	0.021	0.164	7.72
Hakkagawa	171	Honshu (2007)	0.17	0.87	5.12
Gin-Mian	115	Meinong (2016)	0.25	0.31	1.24
Takou	252	Tohoku Aftershock (2011)	0.38	1.79	4.71
Kasho	152	Western Tattori (2000)	0.54	2.09	3.87

An Amplification factor of 5 will be assumed to obtain conservative results.

- A:5
- S_{SA}:2.3g
- S_{1A}:0.85g
- S_{MSA}:2.1g
- S_{M1A}:0.85g
- S_{DSA}:1.4g
- S_{D1A}:0.55g
- PGA_{MA}:1g
- S_{AA}:1.4g

6.3.2.7 *Load Combinations:*

Load combinations were obtained from ASCE 7-22 using LRFD for strength design. Load combinations used are shown below:

- LC1: 1.4D
- LC2: 1.2D+1.6L+0.3S
- LC3: 1.2D+1.0S+L
- LC4: 1.2D+1.0S+0.5(W_Z+W_Y)
- LC5: 1.2D+1.0S+0.5(W_Z-W_Y)
- LC6: 1.2D+1.0(W_Z+W_Y) +L+0.3S
- LC7: 1.2D+1.0(W_Z -W_Y) +L+0.3S
- LC8: 0.9D+1.0(W_Z+W_Y)
- LC9: 0.9D+1.0(W_Z -W_Y)
- LC10: 1.2D+E_V+E_H+L+0.15S
- LC11: 1.2D+E_V -E_H+L+0.15S
- LC12: 0.9D-E_V+E_H
- LC13: 0.9D-E_V -E_H

6.4 DESIGN METHODS

6.4.1.1 *Concrete & Grout*

Reinforced concrete and grout designs were completed in accordance with the methods and requirements of ACI-318(22), Oregon Specialty Structural Code, and applicable provisions of EM 1110-2-2400.

6.4.1.2 *Structural Steel*

Structural steel features were designed in accordance with AISC 360-22, Specifications for Steel Buildings using the LFRD methodology, Oregon Specialty Structural Code, and applicable provisions of EM 1110-2-2400; utilizing SAP 2000 design tools.

6.4.1.3 *Post-Installed Anchors*

Post-Installed chemical anchors were designed in accordance with the methods and requirements of ACI-318(22); utilizing Hilti Profis Engineering Suite.

6.4.1.4 *Handrails*

Replacement handrails or modifications will be supplier-designed in accordance with the requirements of OSHA 1910.29.

6.5 DESIGN CALCULATIONS

The calculations associated with the design methodology are presented in Appendix B.

6.6 STRUCTURAL ITEMS AND FEATURES

Two maintenance platforms, the Fixed Access Platform and the Roller Brush Access Platform, are designed to maximize the efficiency and maintenance simplicity of the trash rake machinery. The Fixed Access Platform will allow access to provide maintenance to the top member of the trash rake machinery and land at a higher elevation than the Roller Brush Access Platform. The Roller Brush Access Platform allows access to the roller brush of the trash rake machinery, which sits at a lower elevation (see **Figure 12)**. Both maintenance platforms and the related ladders, handrails, etc. will be anchored to the existing concrete dam using ASTM F1554 Gr.55 anchors, and their dimensions are based on the existing dam geometry.

The grating was designed to resist a 100 psf uniform load and a point load of 1,000 lbs. Grating span on the Fixed Access Platform is about 3 feet, but for simplicity, the grating load on the Fixed Access Platform was designed for a 4-foot span to account for the Roller Brush Access Platform.

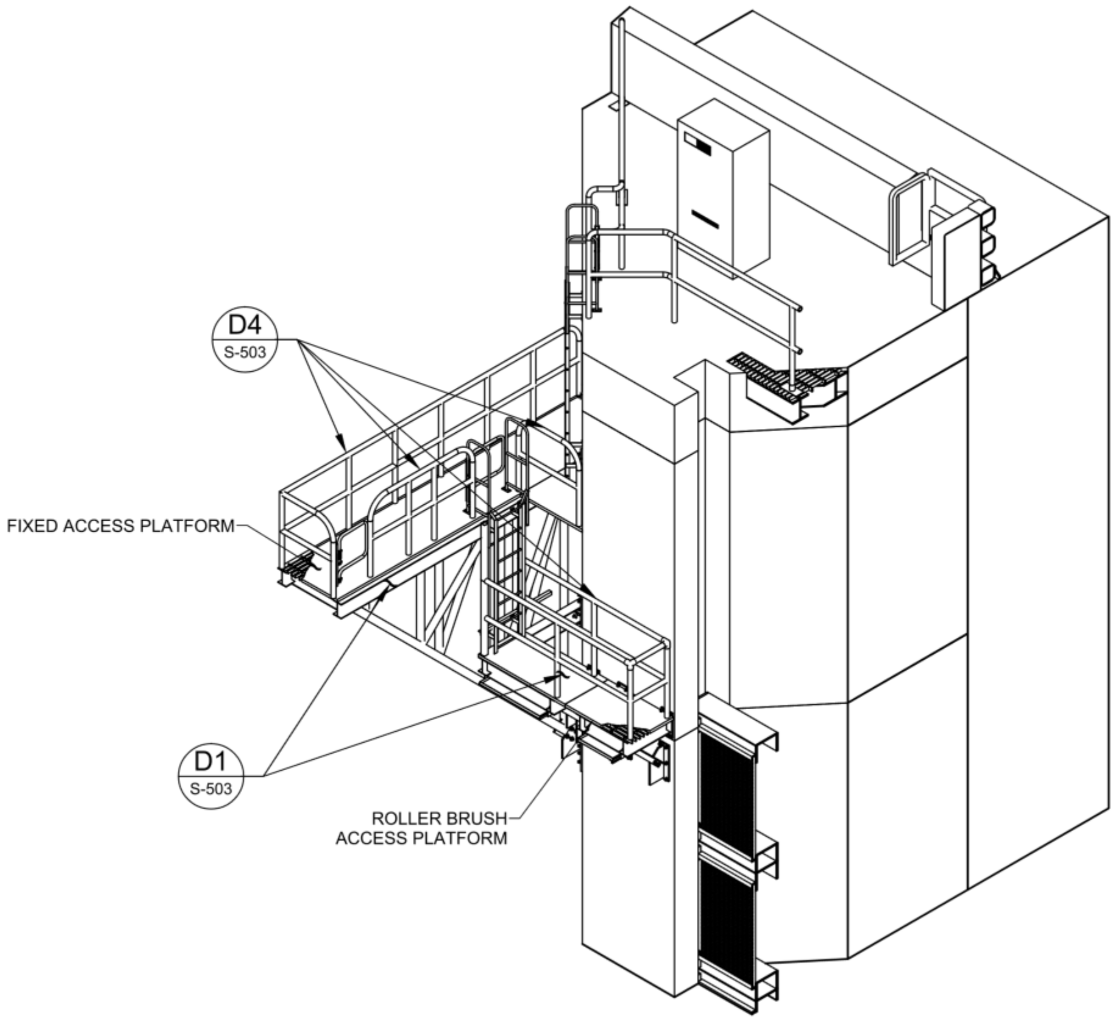

Figure 12 – Iso View Fixed Access Platform and Roller Brush Access Platform

6.7 RECOMMENDATIONS

It is recommended that the structural elements, intended to provide equipment access for operations and maintenance as described herein and shown on Plates S-101 and M-101 in Appendix A, be incorporated into the design. These elements include the fixed access platform, roller brush access platform, interconnecting ladders, handrails (with modifications to existing handrails as needed), containment trays, and supporting structural steelwork. Access by ladders is considered the most efficient solution to provide operator access to the multiple platform levels shown on the drawings; as such it is recommended to incorporate safety swing gates, OSHA compliant handrail systems, tie-off points for the connection of fall restraint harnesses, and walkthrough ladder returns with safe climb features into the design as bought out products from suppliers. All new structural elements are recommended to be attached to existing precast concrete surfaces with post-installed chemical anchors.

SECTION 7 - MECHANICAL DESIGN

As part of the project, mechanical equipment will be provided for brushing the existing, submerged trashracks. The brushing machine will be based on a powered rotating brush head to dislodge impinged debris on the AWSB Intake trashracks with the brush positioned and powered using a telescoping mechanical boom arm affixed to a trolley chassis traveling across an intake face-mounted track (Upper Rail) at EL 180.2. The brush is positioned and indexed over the entire rack surface using the hydraulically or electrically powered telescoping, slewing, and traveling motions of the equipment.

7.1 DESIGN ASSUMPTIONS

The mechanical equipment design will be a modification of a standard product line for a large water intake cleaning system. The equipment will dislodge debris from the trashracks, but natural flow of the river has been assumed as the main mechanism to remove dislodged debris from the vicinity of the AWSB intake when the intake flow is isolated. Furthermore, it is noted that the EDR (USACE, 2024) concluded that a rotating brush head would provide sufficient cleaning force to adequately dislodge debris. This assumption has not been independently verified but is aligned with general industry guidance and experience with cleaning of intakes, given the types of debris noted.

7.2 DESIGN CRITERIA

The mechanical design of the equipment will be based on a standard product line and is expected to include the structural design of the equipment components/frames, mechanical design of rotational components, design of hydraulic fluid and/or electrical power systems, and the design of the machine control systems; all of which will be detailed by the product manufacturer.

7.2.1 System Requirements

A summary of the design criteria for the mechanical brush are listed below:

- Equipment Location — El. 170.3; AWSB Intake Forebay
- Maximum Operational Depth — EL 104.0
- Trashrack Size — 23-ft W (clear) x 66-ft H
- Trashrack Details — Vertical; 1-1/4” x 3/16” steel bar grating
- Normal Brush Force — 100-lbs (min)
- Brush Width — 5-ft (approx.)
- Brush Power — Hydraulic

- Telescoping Boom Power Hydraulic
- Boom Slewing Power Hydraulic
- Trolley Travel Power Electric

7.2.2 Machine Structural

The structural fabrications will be primarily welded (or bolted) boxed fabrications from ASTM A36, ASTM A 572 (gr 50), or ASTM 500 (HSS shapes); stresses will be code allowable or 60% (36% shear) of the yield points of the materials involved. Fabrications will be painted with a marine-grade hi-solids epoxy coating system or galvanized. All anchors to the existing concrete will be using ASTM F1554 (GR 55 min) epoxy anchors.

7.2.3 Machine Mechanical

Details and minimum requirements of the mechanical components including shafts, pins, wheels, gears, bearings, and other mechanical components will be developed by the equipment supplier.

7.2.4 Machine Power

The power will be supplied by a 480V (AC) 3-phase (ungrounded delta) electrical supply which powers electric motors for the electrical motors and hydraulic fluid power systems. Hydraulic systems will utilize biodegradable Environmentally Acceptable Lubricants (EAL) in accordance with the EAL provisions of EM 1110-2-1424; Lubricants and Hydraulic Fluids, 2016.

7.2.5 Cleaning Head Brushes

The equipment head cleaning head brushes will be provided by the equipment supplier in excess of what would typically be supplied for 2 years of operation to allow an extent of experimentation in the brush specification for long-term operations. Initially, 3 types of brushes will be supplied, with bristles manufactured from nylon, polypropylene, and Tampico (natural fibers). It is assumed that reinforced steel fibers or steel/stainless steel bristles are not preferred given the application.

7.2.6 Control Systems

The controls will be a PLC based system which controls the mechanical movements and interlocks of the raking system. Control systems and logic will be developed by the equipment supplier based on the project criteria and cybersecurity requirements. All cleaning cycles will be operator-initiated from the trashrake control panel; based on a completely manual cycle (operator controls all movement of bush head with discrete push button inputs) or an automatic cycle (where the PLC controls the brush movements under the supervision and initiation of an operator). The equipment will only operate while the intake flow control valve has been fully closed, and no flow is going through the trashracks; this will be the responsibility of the operator to confirm the intake status and there are no interlocks between the equipment and the flow control valve of the AWSB intake.

7.2.7 Access and Safety

Access to the equipment will be provided by a fixed access platform on the forebay structure and a trolley mounted platform that tracks movement of the trolley for access to the serviceable mechanical equipment. In accordance with EM 385-1-1, access to either platform requires a 100% tie-off to fall arrest anchors located on the concrete wall of the forebay (near the access ladder) and the equipment trolley structure. Operators and mechanics who tie off will be required tie off to the trolley anchorage points while on the trolley platform to minimize the pendulum effect of a fall while only tied off to forebay wall mounted anchors.

7.3 DESIGN METHODS

The design of machine systems is based on a standard product line which has been developed in accordance with relevant design principles and guidance from AISC, ASME, and EM 1110-2-2610: Mechanical and Electrical Design for Lock and Dam Operating Equipment, 2013.

7.4 DESIGN CALCULATIONS

Design calculations for the mechanical equipment will be performed by the equipment vendor/manufacturer and are typically submitted for review and approval as part of the procurement process within the project construction contract.

7.5 RECOMMENDATIONS

Additional details of the as-designed features and relevant coordination points with related project scope will be summarized as the design develops during the procurement of the mechanical equipment. It is recommended that the mechanical design of the mechanical brushing machine be based around a commercially available trashrake system as modified for use in this application.

SECTION 8 - ELECTRICAL DESIGN

The provision of electrical power to the AWS Intake forebay deck and interconnection of the remote provisions of the brushing machine controls with the EFL/Plant Control SCADA systems will be provided for mechanical brush operation.

8.1 DESIGN ASSUMPTIONS

The following assumptions have been made with regards to the design of the debris management equipment.

- Existing PLC cabinet has sufficient I/O points as spare for interface between the existing Fish SCADA system and the field devices.
- Existing PLC cabinet has sufficient physical space to install new a new terminal block to terminate new incoming field wiring.

The proposed equipment has the following nominal electrical loads as shown in **Table 6** below:

Table 6 - Electrical Loads (Atlas Polar)

ELECTRICAL

Power Source: 3 Phase, 60 Hz Ungrounded Delta
Supply Voltage: 208, 230, 460 and 600 Volts (3 Phase), (208 & 230 Volts only in Single Phase)

Nominal Current Draw (Amperes)	Three Phase Supply Voltage			
	208 Volt	230 Volt	460 Volt	600 Volt
Hydraulic Motor (15 HP)	48.3	35.2	17.6	17
Travel Motor (1 HP)	4.1	3.2	1.6	1.4
Control Panel	8	8	8	8
Oil Heater (500W)	3	2.5		
Boom Heater (optional) (1200W)	14	12		
Brush Head Motor (5 HP)	17	14	7	6

8.2 DESIGN CRITERIA

The electrical and controls design includes electrical power supply to the brushing machinery and control feedback to the EFL SCADA.

8.2.1 480 VAC Service

The power distribution system will be rated 480 VAC, 3-phase and will provide service to the cleaning brush equipment. The existing MCC FCQ7 is in the service gallery near east fish ladder exit at EL. 168 and will be utilized for supplying power to the cleaning brush equipment. Design considerations include the following:

- Electrical termination and distribution equipment required for distribution of the power supply including raceways and cables.
- Utilization of existing MCC FCQ7 spare compartment 1D.

The single line diagram for MCC FCQ7 is shown below in **Figure 13.**

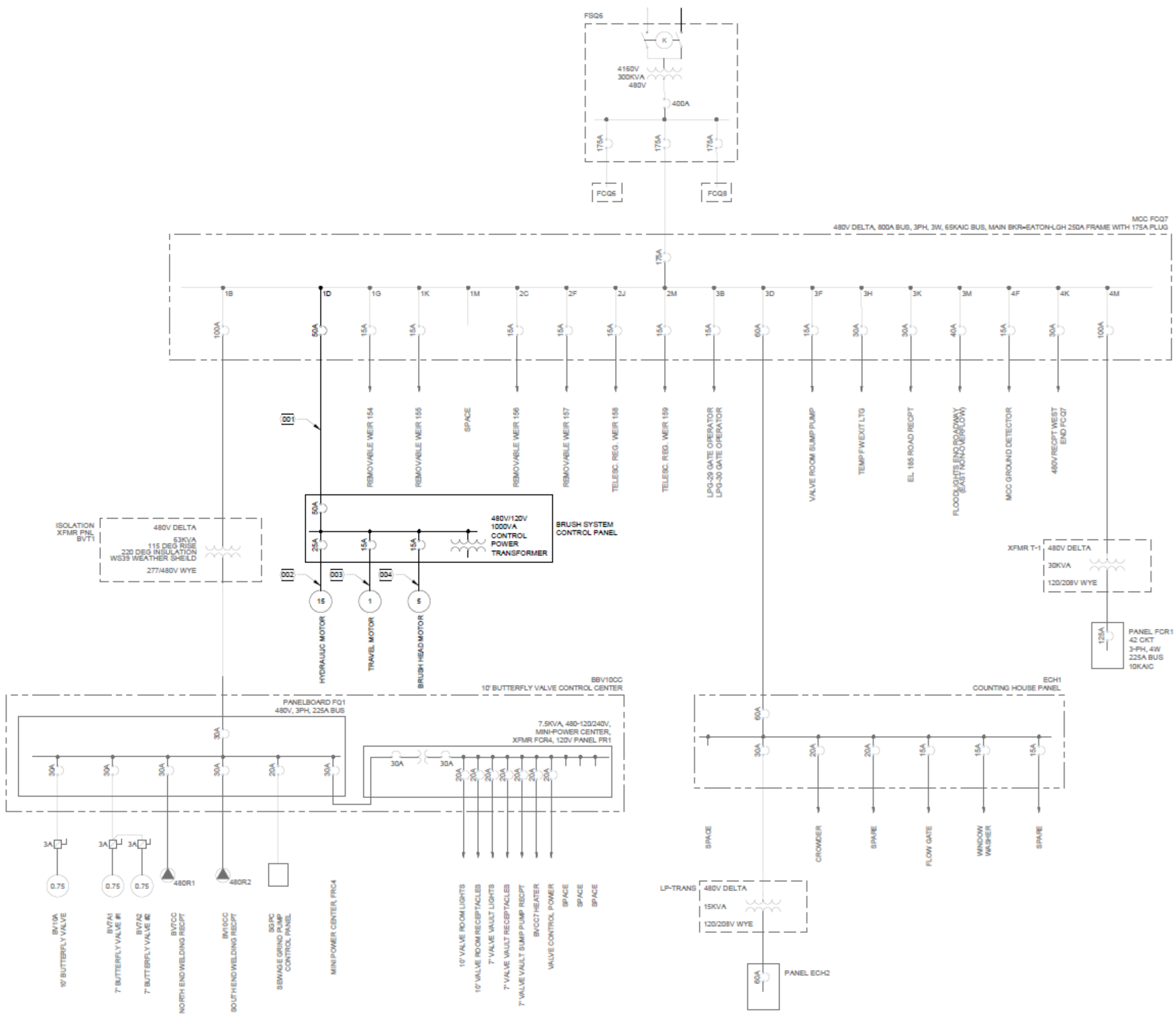

Figure 13 - Single-Line Diagram

8.2.2 Raceway

Rigid galvanized steel (RGS) & plastic-coated rigid steel conduit will be used for distributing the power & signal cabling. RGS conduit will be used for all raceways above grade. PVC-coated rigid steel conduit (Sch 80) will be used for raceways below ground.

8.2.3 Wire and Cable

Exposed low voltage power and control cable will be low-smoke zero-halogen (LSZH) jacked multi-conductor cable. The power and control cable will include the following features:

- The power for the cleaning brush will be supplied from the existing Motor Control Center (MCC) FCQ7.
- Class B stranded copper conductors
- Cross-Linked Polyethylene (XLP) insulation (XHHW-2)
- Class B grounding conductor
- Flame retardant low-smoke zero-halogen (LSZH) overall jacket
- 90°C temperature rating
- 600-volt rating

8.2.4 Instrumentation & Control System

Two ultrasonic level sensors will be installed to measure the water surface levels and differential water level across the AWSB system trashrack in the form of two 4-20mA signals. These level sensors will be sonar based, similar to the existing sensors found on site. The level sensors will be located on the upstream and downstream side of the trashrack. The upstream sensor will be mounted to the north wall of the dam using a fabricated bracket similar to those existing on site. The downstream sensor will be mounted to the pier grating located above the trashrack. The signals will be tied into the Fish SCADA system by using the existing East Exit Fish SCADA PLC cabinet (shown below in **Figure 14**) which is located in the service galley near MCC FCQ7. A comparison of the 4-20mA level signals will be done at the East Exit Fish SCADA PLC and if they are outside a specified threshold (2 feet), indication pilot lights ‘AWS BACKUP INTAKE WATER LEVEL DIFF. HIGH’ at the East Exit Fish SCADA PLC and the Brush System Control Panel will illuminate. Additionally, indication pilot lights ‘AWS BACKUP INTAKE BRUSH IN OPERATION’ and ‘AWS BACKUP INTAKE BRUSH TROUBLE ALARM’ will be installed and utilized at the East Exit Fish SCADA PLC. Only indication/status signals will be generated as a result of this system (no control commands). A conceptual layout of the local control panel for the trashrake brush system is shown below in **Figure 15**.

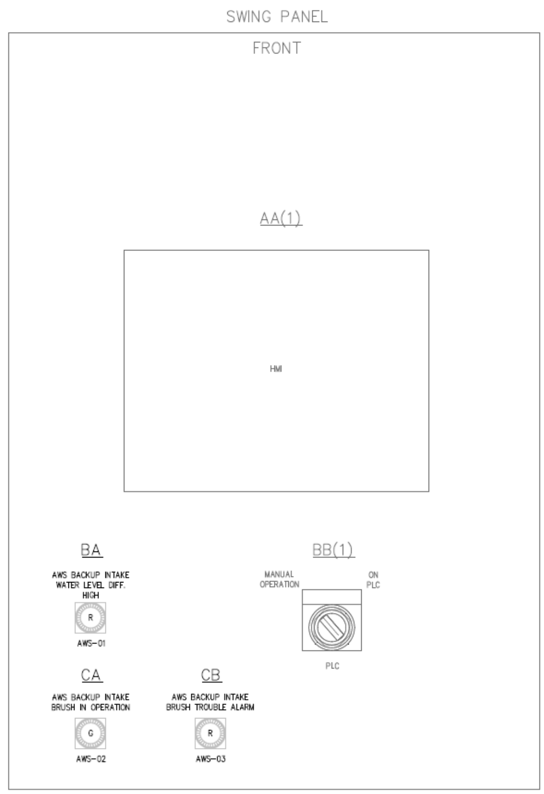

Figure 14 - East Exit Fish SCADA PLC

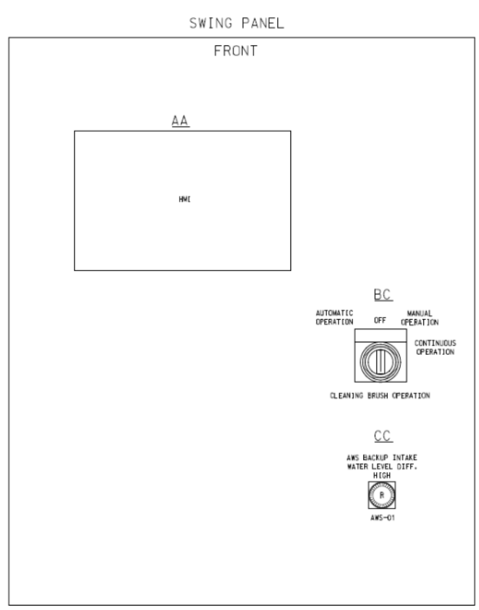

Figure 15 - Brush System Control Panel Layout (Conceptual – Design Provided by Manufacturer)

8.3 DESIGN METHODS

8.3.1 480VAC Power Distribution

A new power circuit is required for the new rotating brush & Brush System Control Panel (32.4A @ 480VAC). The design team conducted an electrical capacity analysis using SKM Power Tools and it was determined that the new rotating brush & Brush System Control Panel can be fed from the existing Dalles Dam electrical system via MCC FCQ7 compartment 1D. Refer to 8.4 Design Calculations.

8.3.2 Raceway Routing

Four (4) new conduits (2-power, 2-signal) will be installed and routed from existing aluminum junction box located above MCC FCQ7 to two (2) new pullboxes located outside the service gallery doors. From the new pullboxes, four (4) new conduits shall be surface mounted to the south embankment toward the east roadway to an additional set of two (2) pullboxes. The new conduit will run from the new pullboxes and be mounted to a series of stanchion posts located approximately every 5 feet parallel to the east roadway. The new conduit will transition below grade and cross the existing asphalt roadway via a new 4-wide electrical ductbank toward the north side of the dam. The conduit will emerge on the north side of the roadway and be routed/mounted to another series of stanchion posts parallel with the roadway. The conduit will be routed to another set of two (2) new pullboxes mounted on the north embankment. Spare raceways (1-power, 1-signal) will not be continued beyond the pullboxes mounted on the north embankment. Two (2) new conduits (1-power, 1-signal) from this new pullbox will be routed on the outside of the parapet wall to the existing piers. At the existing piers the conduit runs will transition to the top of parapet wall. The conduit runs will then run down the north embankment toward the intake forebay deck where the new brush system control panel will be installed.

One (1) power conduit shall be routed from the Brush System Control Panel to the trashrake support/chassis to provide a raceway for the brush motors.

One (1) signal conduit shall be routed from the Brush System Control Panel to the upstream level sensor located on the upstream side of the trashrack, mounted to the north wall of the dam.

One (1) signal conduit shall be routed from the Brush System Control Panel to the downstream level sensor located on the downstream side of the trashrack, mounted to the north wall of the dam.

Two (2) signal conduits will be installed routed from existing East Exit Fish SCADA PLC to existing aluminum junction box located above MCC FCQ7.

Refer to the Conduit Schedule (Plate E-701) & Cable Schedule (Plate E-702) for more details.

Note: Use of Ground Penetrating Radar (GPR) will be required to determine the location of (if any) existing utilities prior to excavation.

8.4 DESIGN CALCULATIONS

A complete power load flow analysis is included in Appendix E and is summarized below in **Table 7**.

Table 7 - Load Flow Analysis

The Dalles Dam
TDA AWS Debris Management Project
AC ELECTRICAL LOAD SCHEDULE

May 2, 2025
Revision No: 4

Description	Connected Load						Peak Maximum Demand*			
	HP	Eff	kW	pf	kVA	kVar	Factor	Max kW	Max kVA	Max kVar
MCC FCQ7										
Panelboard FQ1 - 1B			5.89		7.18	4.09	0.64	3.79	4.74	0.00
N. 480V Outlet (BV7CC)			0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00
S. 480V Outlet (BV10CC)			0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00
BV10A	0.75	0.80	0.70	0.86	0.81	0.41	0.00	0.00	0.00	0.00
BV7-1A & 2A	1.50	0.80	1.40	0.86	1.63	0.83	0.00	0.00	0.00	0.00
Sewage Grinding Pump Control Panel (SGPC)			0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00
FR1			3.79	0.80	4.74	2.84	1.00	3.79	4.74	0.00
Brush System Control Panel - 1D			21.55	0.80	26.94	16.16	1.00	21.55	26.94	16.16
Removable Weir 154 - 1G	1.50	0.80	1.40	0.86	1.63	0.83	1.00	1.40	1.63	0.83
Removable Weir 155 - 1K	1.50	0.80	1.40	0.86	1.63	0.83	0.00	0.00	0.00	0.00
Removable Weir 156 - 2C	1.50	0.80	1.40	0.86	1.63	0.83	0.00	0.00	0.00	0.00
Removable Weir 157 - 2F	1.50	0.80	1.40	0.86	1.63	0.83	0.00	0.00	0.00	0.00
Telesc. Reg. Weir 158 - 2J	3.00	0.80	2.80	0.86	3.25	1.66	1.00	2.80	3.25	1.66
Telesc. Reg. Weir 159 - 2M	3.00	0.80	2.80	0.86	3.25	1.66	1.00	2.80	3.25	1.66
LPG-29 & LPG-30 Gate Operator - 3B			8.00	0.80	10.00	6.00	0.00	0.00	0.00	0.00
ECH1 - 3D			15.19		18.01	9.64	0.55	8.39	10.00	3.70
FCQ7 flow gate (blue motor)	1.00	0.80	0.93	0.86	1.08	0.55	1.00	0.93	1.08	0.80
FCQ7 Panel ECH2			4.00	0.80	5.00	3.00	0.70	2.80	3.50	2.10
FCQ7 Window crowder screw motor	5.00	0.80	4.66	0.86	5.42	2.77	1.00	4.66	5.42	0.80
FCQ7 window brush motor (1, 2 & 3)	6.00	0.80	5.59	0.86	6.50	3.32	0.00	0.00	0.00	0.00
Valve Room Sump Pump - 3F	2.00	0.80	1.86	0.86	2.17	1.11	1.00	1.86	2.17	1.11
TEMP FW Exit LTG - 3H			4.00	0.80	5.00	3.00	1.00	4.00	5.00	3.00
480V Recept El. 185 Road - 3K			0.00	0.80	0.00	0.00	0.00	0.00	0.00	0.00
Floodlights ENO (East Non-Overflow) Roadway - 3M			6.66	1.00	6.66	0.00	1.00	6.66	6.66	0.00
MCC Ground Detector - 4F			4.00	0.80	5.00	3.00	1.00	4.00	5.00	3.00
480V Recept West End FCQ7 (100% heater 18A) - 4K			15.00	0.80	18.75	11.25	1.00	15.00	18.75	11.25
Panelboard FCR1 - 4M			4.00	0.80	5.00	3.00	0.70	2.80	3.50	2.10
~~**FCQ7 480V Outlets FSC8**~~			~~20.78~~	~~1.00~~	~~20.78~~	~~0.00~~	~~1.00~~	~~20.78~~	~~20.78~~	~~0.00~~
FCQ7 MCC- TOTAL	**0.00**		**97.33**		**117.70**	**63.88**		**75.05**	**90.88**	**44.47**
			142 amp at 480 volts					109 amps at 480 volts		

Additionally, short circuit and arc flash analyses were performed. The results are included in Appendix F, Short Circuit and Arc Flash Analysis Report.

As part of the electrical design, conduit fill calculations were performed per NEC. The results of the calculations can be found in **Table 8** below.

Table 8 – Conduit Fill Calculations

CONDUIT FILL CALCULATIONS						
CONDUIT				DESCRIPTION		
NO.	I.D.	SIZE	TYPE	FUNCTION	CABLE(S)	PERCENT CONDUIT FILL
001	MCC-q1	1 1/2"	RGS	POWER	3#4, 1#10 G	17.95%
002	MCC-q2	1 1/2"	RGS/PVC	POWER	3#4, 1#10 G	17.95%
003	MCC-q3	1 1/2"	RGS	POWER	3#4, 1#10 G	17.95%
004	MCC-q4	1 1/2"	RGS	POWER	3#4, 1#10 G	17.95%
005	MCC-q5	1"	RGS	POWER	3#10, 1#10 G, 6#12, 2#14 G	35.23%
006	MCC-s1	1 1/2"	RGS/PVC	SPARE	-	-
007	MCC-s2	1 1/2"	RGS	SPARE	-	-
008	MCC-s3	1 1/2"	RGS	SPARE	-	-
009	IOR-u1	1 1/2"	RGS	SIGNAL	10#14, 2-TSP #16	22.17%
010	IOR-u2	1 1/2"	RGS/PVC	SIGNAL	10#14, 2-TSP #16	22.17%
011	IOR-u3	1 1/2"	RGS	SIGNAL	10#14, 2-TSP #16	22.17%
012	IOR-u4	1 1/2"	RGS	SIGNAL	10#14, 2-TSP #16	22.17%
013	IOR-u5	1 1/2"	RGS	SIGNAL	10#14, 2-TSP #16	22.17%
014	IOR-u6	3/4"	RGS	SIGNAL	1-TSP #16	16.75%
015	IOR-u7	3/4"	RGS	SIGNAL	1-TSP #16	16.75%
016	IOR-s1	1 1/2"	RGS/PVC	SPARE	-	-
017	IOR-s2	1 1/2"	RGS	SPARE	-	-
018	IOR-s3	1 1/2"	RGS	SPARE	-	-
019	IOR-s4	1 1/2"	RGS	SPARE	-	-

Additionally, conductor derating calculations were performed per NEC 310.15(C)(1). The results of the calculations can be found in **Table 9** below.

Table 9 – Conductor Derating Calculations

CONDUCTOR DERATING CALCULATIONS										
CABLE/CONDUCTORS						DESCRIPTION				
CKT	CKT I.D. (SEE NOTE 1)	NO. COND.	SIZE	INSULATION	RATED VOLTAGE	RACEWAY ROUTING	CURRENT CARRYING CONDUCTORS WITHIN RACEWAY	CONDUCTOR AMPACITY	CIRCUIT AMPACITY	DERATED CONDUCTOR AMPACITY (PER NEC 310.15(C)(1)
001	MCC-q1	-	3#4, 1#10 G	600V	480VAC	MCC-q1, MCC-q2, MCC-q3, MCC-q4	3	85	50	85
002	MCC-q2	-	3#10, 1#10 G	600V	480VAC	MCC-q5	9	30	21	21
003	MCC-q3	-	3#12, 1#14 G	600V	480VAC	MCC-q5	9	20	2.1	14
004	MCC-q4	-	3#12, 1#14 G	600V	480VAC	MCC-q5	9	20	7.6	14

8.5 DESIGN RECOMMENDATIONS

It is recommended that the new brush system be fed by MCC FCQ7 compartment 1D. Additionally, it is recommended that the East Exit Fish SCADA PLC upstream & downstream level differential alarm setpoint be set at 2 feet.

SECTION 9 - CULTURAL RESOURCES

The Dalles Dam is greater than 50 years old and is, therefore, considered a historic structure and potentially eligible for listing on the National Register of Historic Places (NRHP). USACE completed an NRHP eligibility evaluation for the Dam in 2015 and determined that it meets multiple NRHP criteria for evaluation regarding the property's age, integrity, and historic significance, though it has not yet been listed. Because of its age and eligibility status, modification to the structure of The Dalles Dam, including AWSB system debris management structures, requires evaluation to confirm protection of significant cultural and historic resources under the National Historic Preservation Act (NHPA) and other related cultural/historic resources protection laws and regulations. To comply with NHPA requirements, Washington Department of Archaeology and Historic Preservation (DAHP), Oregon State Historic Preservation Office (SHPO), affected Native American Tribes/Tribal Historic Preservation Offices (THPOs) and other interested parties were consulted.

USACE determined that the proposed work meets the definition of an 'undertaking' as defined by 36 CFR 800.16(y) under the NHPA. In consultation with USACE's Seattle District Technical Center of Expertise, Preservation of Historic Buildings and Structures (NWS-TCX), it was previously determined that the work will be (USACE 2019):

(a) relatively small-scale;

(b) the resulting AWS feature will cause minimal visual intrusion beneath the existing fish ladder arcade;

(c) the AWS installation will not require the removal of any significant contributing components or aspects of the powerhouse and EFL;

(d) the additional deficiencies and maintenance needs that have been identified and proposed as "follow-on work" to the 2016 AWS construction effort will similarly be relatively small-scale, cause minimal to no visual intrusion and will not require the alteration or removal of any historically significant contributing components or aspects of The Dalles Dam; and

(e) although retrofitting of the AWS will take place in the Dalles Dam non-overflow monolith, the relatively small scale and low visibility of the new feature will not pose a visual intrusion to the essential design and operational qualities of The Dalles Dam that were present during the historic period (1957-1973). In accordance with 36 CFR 800.5[b], the Corps has determined the proposed on-dam actions will have No Adverse Effect on The Dalles Dam and will not adversely affect the property's NRHP eligibility.

USACE reviewed previous cultural assessments and surveys for cultural resources and historic properties in the immediate vicinity and determined that no cultural resources or historic properties are likely present within the proposed area of potential effect (APE). The Dalles Dam occurs within the vicinity of culturally significant areas important to the

Confederated Tribes and Bands of the Yakama Nation (Yakama), Confederated Tribes of the Warm Springs Reservation of Oregon (CTWSRO), Confederated Tribes of the Umatilla Indian Reservation (CTUIR) and Nez Perce Tribe (Nez Perce), but USACE has determined that no locations where significant cultural or traditional practices have occurred or may occur will be affected by the proposed activities. Therefore, USCAE determined that proposed activities will have No Effect on any historic properties and/or other cultural resources, and No Effect on The Dalles Dam NRHP eligibility.

USACE notified DAHP, SHPO, Yakama, CTWSRO, CTUIR, Nez Perce, and the U.S. Forest Service – Columbia River Scenic Area of the NRHP effects determination in 2015. The following responses were received:

- DAHP responded to the determinations of effect with an official concurrence letter dated September 22, 2015

- SHPO responded with an official concurrence letter dated September 30, 2015, and deferred to the decision of DAHP regarding overall determination of effects regarding possible effects to the historic built environment.

- the Tribes and USFS declined to offer comments and/or chose to not offer comments regarding this undertaking (USCE 2019)

It is assumed that USACE will confirm with DAHP that the final design is consistent with the previous effects determination. Because the proposed structure is similar to previous evaluated alternatives and does not extend above existing structures (gantry crane) in height, it is anticipated that DAHP’s effects determination will not change.

SECTION 10 - DAM SAFETY

Dam safety programs aim to achieve the viability of dam structures, particularly during large flood and/or seismic events, and the functional capacity to retrain or release water safely so as to avoid undue risk to the public, environment, or property.

10.1 DESIGN ASSUMPTIONS

The improvements proposed to the AWSB intake, including the mechanical brushing equipment, electrical power improvements, anchorages, instrumentation, and controls communications are isolated to augment the existing functions of the AWSB intake for the EFL system. The added equipment is negligible when compared to the mass of the eastern non-overflow dam and will have no effect on the behavior of the mass concrete gravity structures. Furthermore, as the functionality of the AWSB intake is limited to EFL operations and has no impact on the ability of the power project to pass flows through the spillway or powerhouse, the underlying dam safety of The Dalles Power project is therefore concluded to be unaffected by the proposed improvements.

SECTION 11 - CONSTRUCTION

The proposed telescopic trashrake system requires mounting to a horizontal galvanized steel beam for lateral functionality. The horizontal beam is structurally founded on two vertical galvanized pedestal beams, with connection plates on both ends, which are anticipated to be set on leveling plates and grout. Connection to the concrete surface of the trashrack gallery precast concrete is anticipated to be made through retrofitted embedded hardware, using a chemical, epoxy anchoring system with post-installed anchor rods.

The contractor will also need to install anchor rods, using a template, to the forebay face of the concrete trashrack pier. Following that, the contractor will install the structural steel, lower and upper, face-mounted platforms.

It is anticipated that the contractor will need to occupy sections of the dam access road directly over the AWSB system intake structure to enable transfer of materials and equipment to support the trashrack installation.

Heavy equipment access from the water may not be necessary. The work will likely require rescue and survey boats on duty during overwater work. However, it is possible that a contractor will choose to perform part of construction using barges or boats, especially given that the layout of the system includes small steel platforms mounted on the face of the existing concrete structure. (The bottom-of-steel elevation for components of the platforms is several feet above the high-water elevation.)

11.1 ENVIRONMENTAL, HEALTH, AND SAFETY

The installation work for the trashrack pedestal beams will require the contractor to make appropriate planning and coordination arrangements with the facility and provide a detailed Environmental, Health, and Safety (EH&S) safety plan that considers the following work safety planning items, and OSHA requirements.

- Personnel working at heights over water. Regardless of the contractor’s means and methods for the execution of the installation, contractor personnel will be exposed to working at heights and over the water; therefore, the contractor must provide fall protection if the distance from the walking/working surface to the water's surface is 6 feet (1.8 m) or more. Until such time the contractor means and methods are known, the following determinations apply. *(Source OSHA website. Author Russel B. Swanson, Director, Directorate of Construction regarding the requirements for fall protection and U.S. Coast Guard-approved life jackets and buoyant work vests during construction activities over water. https://www.osha.gov/laws-regs/standardinterpretations/1999-09-28)*
    - 29 CFR 1926.501(b)(1) states that "each employee on a walking/working surface (horizontal and vertical surface) with an unprotected side or edge

which is 6 feet (1.8 m) or more above a lower level shall be protected from falling by the use of guardrail systems, safety net systems, or personal fall arrest systems." The preamble to the standard states the term "lower-level surface" includes liquids (volume 59 of the Federal Register, page 40,681). Therefore, employers must provide fall protection during construction activities when employees are working 6 feet or more above the water.

  - When fall protection is provided on walking/working surfaces located above water, and no drowning hazard exists, employees do not need to wear U.S. Coast Guard-approved life jackets or buoyant work vests. Section 1926.106(a) states that "employees working over or near water, where the danger of drowning exists, shall be provided with U.S. Coast Guard-approved life jacket or buoyant work vests." In general, when continuous fall protection is used (without exception) to prevent employees from falling into the water, the employer has effectively removed the drowning hazard, and life jackets or buoyant work vests are not needed (but see below regarding the use of nets).
  - When using Safety Nets as fall protection, U.S. Coast Guard-approved life jackets or buoyant work vests are usually required. The use of safety nets as fall protection during marine construction activities usually will not eliminate the drowning hazard. In this case there is a risk that materials heavy enough to damage the nets may fall. Therefore, the personal flotation device and the other applicable requirements of §1926.106 apply. Also, the §1926.106 requirements apply during the installation of the nets.
  - The use of fall protection, including fall protection that eliminates drowning hazards, does not relieve the contractor from having to provide ring buoys and a lifesaving skiff under §1926.106(c) and (d). The requirements in §1926.106(c) and (d) for ring buoys and a skiff address the hazard of falls that may occur in the event of a failure of the operation of fall protection devices or a lapse in their use. Therefore, ring buoys and a skiff must be provided irrespective of the fall protection provided on the marine construction site.

- Personnel working above an active or inactive AWSB system intake (including adoption of facility lock-out tag out procedures)
- Personnel working at or around active (energized) electrical panels and equipment
- Maintenance of traffic vs. personnel safety
- Environmental control measures (Personnel and Equipment)
- Emergency planning.

11.2 SECURITY

The contractor’s workforce shall submit all identified workforce personnel Government issued Identification cards well in advance of the anticipated commencement date for construction activities at the facility. To avoid any potential delays to the construction program, it is anticipated that this process will begin immediately, post-contract award.

It is anticipated that most of the work shall be performed from land-based contractor operations, however, contractor safety requirements emanating from working at heights above water may require the intermittent or continuous presence of a duly manned safety/rescue boat positioned adjacent to the works for the duration of the installation program. It is unknown, at this point, what size of boat or mooring requirements the contractor-proposed rescue boat will present to daily operations and securing of the boat outside of work hours. As such, facility security personnel should consider partial daily crew attendance arriving by water and how such daily arrivals by water could be officially facilitated, including logging approved personnel at site via sign-in and out procedures.

11.3 BASIC CONSTRUCTION ASSUMPTIONS

It is assumed that the Contractor will be afforded clear access to the trashrack gallery work area, partial road occupancy of the roadway directly above the AWS intake, and an accessible material lay-down area that will be identified by the facility.

It is assumed that the Contractor will be self-sufficient and independent of facility utility needs, until final connections are made during commissioning of the M&E components of the trash rake proposed. The contractor will be expected to provide appropriate sanitation measures with capacities based upon the workforce numbers, and construction debris, trash collection and disposal as required.

11.4 CONSTRUCTION METHODOLOGY

The physical installation of the telescopic hydraulic trash rake will require the following steps. While the following is a general listing of the steps involved with installing the equipment, detailed means and methods are the responsibility of, and will be provided by, the supply and construction contractors:

- Confirm trashrake pedestal beam embedded hardware plate locations through prior assembly of units and use of templates. Transfer embedment hardware to concrete coring locations atop gallery precast through survey.

- Perform top-down concrete coring of assumed one-inch-diameter by 12-inch-deep concrete core at embedment hardware locations. Assume four locations per pedestal (and eight total). Clean and prepare concrete cores per chemical bonding manufacturer recommendations and set embedment hardware. Perform installed survey to re-affirm embedment hardware location, ensuring plumbness of embedded hardware set using epoxy or grout. Allow sufficient time for the setting of embedded hardware conforming to manufacturer recommendations.

- Fit pedestal beams and the traversing beam in accordance with trashrake manufacturer guidelines. Use of levelling plate and grout will be required to ensure traversing beam is appropriately set. Allow sufficient time for leveling grout to set, prior to the application of additional loads from the telescopic trashrake unit.

- Install traversing telescopic trashrake unit to the horizontal beam. It is unknown at this juncture whether the proposed unit will require additional gangways or personnel access areas behind the unit for commissioning and O&M purposes. As information becomes available regarding the installation of M&E components to the physically assembled and installed pedestal, traversing gantry beam and trashrake unit, this section will be updated.

11.5 M&E CONSTRUCTION REQUIREMENTS TO SUPPORT FACILITY CONNECTIVITY

Construction requirements to support I/O, power and hydraulic requirements of the unit at the facility will be identified. Connectivity runs, panel hook-ups etc. to be identified and impacts to operations anticipated should be laid out in the design.

11.6 COMMISSIONING OF TRASHRAKE

Prior to the commissioning of the trash rake, a 100% visual inspection shall be made underwater to ensure that the intake remains free of material/equipment and or tooling that may have fallen through the water column during construction activities. Any debris, equipment, or tooling lost during construction within 50 ft of the intake tunnel shall be removed from the water at no cost to the project, PRIOR to commencement of commissioning activities.

Commissioning of the trashrake shall be as per Manufacturers guidelines will be further expanded within the following M&E section related to the trashrake.

SECTION 12 - OPERATIONS AND MAINTENANCE

This section will be developed during the design process to capture operations and maintenance criteria which may be relevant to the design criteria of the individual components.

12.1 DESIGN ASSUMPTIONS

Design assumptions related to the operation and maintenance of the trashrake and rotating brush head that were made during the preparation of the drawings and specifications include the following:

- The flow through the AWSB system piping and trashrack will be stopped during trashrack cleaning operations.
- Cleaning operations will generally occur during overnight hours; a cleaning operation will be manually initiated by a facility operator at the trashrake's main control panel to be located on the concrete piers at Elevation 185.0. This is anticipated to occur every two or three days. There will be two operational strategies once the cleaning sequence is manually initiated; one will be an automatic cleaning routine with parameters that can be programmed into the control system; and the other will be fully manual with the operator controlling the vertical and horizontal movement of the trashrake and rotating brush head.
- Information regarding water levels upstream and downstream from the face of the trashrack and equipment status shall be transmitted to the facility's control room.
- An alarm condition will be communicated to the facility's control room calling for a cleaning cycle to be initiated if the differential between the water surfaces as measured by the level sensors on the upstream and downstream sides of the trashrack reaches two feet; facility staff shall be able to adjust the two feet initiation threshold as operational experience increases. Future modifications could involve integrating the AWSB flow control valve with the level sensing function of the trashrake to automatically initiate a cleaning cycle.
- Routine maintenance operations will be accomplished without having to be on or in the water.
- The trashrake will be able to operate if the rotating mechanism of the brush head is disabled.

12.2 SAFETY

The safety of operations and maintenance personnel have been considered by providing railings at the edges of the piers and maintenance platforms and having secure tie off points for fall protection and arrest harnesses, each with a pullout capacity of 5,000 pounds. Safe access to the equipment has been provided for by the incorporation into the design of two platforms, one at Elevation 176.7 to readily access the machine head of the trashrake and one at Elevation 170.4 to access the trashrake’s rotating brush head.

12.3 SECURITY

While the trashrake status and alarms will be monitored in the facility’s control room, the trashrake will be operated locally and cybersecurity requirements will be incorporated into the trashrake controls.

12.4 OPERATIONS

The main control panel for the trashrake is on the top of the concrete piers at Elevation 185.0. Status and alarms for the trashrake will be monitored in the facility’s control room but actual cleaning operations will be initiated manually by a facility operator locally at the trashrake’s control panel. A water surface level differential threshold indicating condition will send an alarm to the facility’s control room to call for a manually initiated cleaning cycle. The operational intent is for flow to be stopped in the AWSB piping prior to cleaning operations being initiated.

12.5 MAINTENANCE

The project has been designed to facilitate maintenance personnel to perform routine maintenance from the upper/lower access platforms. The upper platform facilitates access to the rake machinery and the lower platform facilitates brush head replacement and maintenance of the brush head mechanical components. Additional maintenance topics are:

- The hydraulics and controls will be accessed from the trolley platform. Various filters and controls will need to be periodically checked and occasionally replaced. The trashrake supplier will provide an operations and maintenance manual with information related to maintenance activities and schedules.

- Movement mechanisms and cylinders will be accessed from either the upper or lower platform. All hydraulics must be monitored, and leaks cannot be tolerated. Corrective maintenance procedures and components will be detailed in the operations and maintenance manual supplied by the vendor.

- Brush heads will need to be periodically replaced based on use.

- Hydraulic oils shall be EAL (biodegradable) per USACE guidelines. Catchment, containment, and drips trays must be monitored.

Additionally, the project has been designed to enable the removal of the trashrack sections with minimal interference from the trashrake equipment.

SECTION 13 - COST AND VALUE

Note: This section will be completed by USACE staff.

13.1 DESIGN ASSUMPTIONS

Body text.

13.2 DESIGN CRITERIA

Body text.

13.3 DESIGN METHODS

Body text.

13.4 DESIGN CALCULATIONS

Body text.

13.5 ANALYSIS RESULTS

Body text.

13.6 DESIGN DECISIONS

Body text.

13.7 DESIGN RECOMMENDATIONS

Body text.

SECTION 14 - CONCLUSIONS AND RECOMMENDATIONS

14.1 CONCLUSIONS

The project objective is to provide a means of cleaning the AWSB system intake trashracks during idle intake periods to lessen the water level differential across the trashracks. The project team's concluded approach, based on the initial conclusions and direction of the EDR report, is to clean the trashracks with a mechanical rotating brush intake cleaning system from an existing equipment product line to avoid the operational hurdles and challenges of prototyping a completely bespoke solution.

This project is not anticipated to result in any adverse effects to the hydraulics of the AWSB intake. The hydraulic design of the project verified that the velocities at minimum flows are 0.7 ft/s and considered generally swift enough to move dislodged floating debris downstream. Furthermore, the 100-year river flow (680,000 CFS) resulted in a maximum cross flow velocity of 5.5 ft/s; which has been used to preliminarily estimate drag forces on the machinery.

Additionally, the project is not anticipated to result in adverse effects to basic parameters of The Dalles Dam Hydroelectric & Navigational Project including dam safety, environmental systems, waterway biology, and cultural resources, while contributing to the viability of the EFL as the primary means of upstream passage of fish species.

14.2 RECOMMENDATIONS

The recommendations for the design of the AWSB Intake trashrack cleaning system are based on a telescoping boom mounted rotating bristle brush as summarized in the criteria within this DDR. The following bullets summarize the recommended design basis of the various aspects of the project:

- Pavement repairs and trenching required for power and controls will utilize standard ODOT details.

- The mechanical equipment associated with the rotating brush (also referred to as the trashrake) will be supplied from an equipment product line developed for cleaning similar style intakes. The equipment will be mounted on the upstream forebay structure and accessed from a fixed access platform with a transition to a traveling trolley platform. The equipment supplier will coordinate the details of the equipment and mounting systems with the Installation Contractor.

- Structures to be included in the project are fixed upper and lower operator/mechanic platforms which will project from the AWSB intake deck and are accessed by a series of ladders for operational and maintenance needs of the mechanical systems and brush head. The platforms will be fabricated from structural steel and anchored to the vertical concrete wall of the intake with post-installed epoxy anchor rods.

- Electrical power supplied will be fed from MCC FCQ7 in the service gallery of the eastern non-overflow dam, which has sufficient capacity for the loads stated in the DDR. Power and data conduits will be routed from the service gallery around the dam monoliths to the eastern embankment, where the conduits will cross the access road with a shallow trench and be face mounted to the upstream parapet wall to the AWSB intake.

- The control of the equipment will be from the vendor supplied control system using operated initiated cycles. The status of the machinery and AWSB intake differential water levels will be sent to the East Exit Fish SCADA PLC where the equipment status and differential alarm data will be monitored by the plant SCADA system.

SECTION 15 - REFERENCES

NMFS (National Marine Fisheries Service). 2020. Endangered Species Act Section 7(a)(2) Biological Opinion and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Response for the Continued Operation and Maintenance of the Columbia River System.

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USACE (US Army Corps of Engineers). 2021. The Dalles East Fish Ladder Auxiliary Water Backup System Design Document Report (DDR, engineering during construction draft). Prepared by Walla Walla District in DDR phase and updated by Portland District, as of March 2021.

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USFWS (US Fish and Wildlife Service). 2008. Biological opinion on the continued operation and maintenance of the Willamette River Basin Project and effects to Oregon chub, bull trout, and bull trout critical habitat Designated under the Endangered Species Act. U.S. Fish and Wildlife Service, Oregon Fish and Wildlife Office. July 11, 2008.

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