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Portland District

WILLAMETTE VALLEY SYSTEM OPERATIONS AND MAINTENANCE

PROGRAMMATIC ENVIRONMENTAL IMPACT STATEMENT APPENDIX N *AND* BIOLOGICAL ASSESSMENT APPENDIX A: IMPLEMENTATION AND ADAPTIVE MANAGEMENT PLAN

August 22, 2024

NOTE for NMFS, 8/22/2024: This document is an update to the Appendix A of the Biological Assessment submitted to NMFS on the Willamette Valley System Operations and Maintenance. This document also is Appendix N of the draft WVS EIS, and will be finalized as Appendix N for the final WVS EIS.

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CHAPTER 1 - INTRODUCTION

The Draft Implementation and Adaptive Management Plan was developed to accompany the Draft Programmatic Environmental Impact Statement (DPEIS) for operation and maintenance (O&M) of the Willamette Valley System (WVS), a combination of 13 multipurpose dams and reservoirs (impoundments), riverbank protection projects, fish passage facilities, adult fish collection facilities, and hatchery programs in the Willamette River Basin (WRB). This Draft Implementation and Adaptive Management Plan [referred to separately herein as the Implementation Plan (IP) or the Adaptive Management Plan (AMP or AM Plan] is the proposed framework for implementing, monitoring, and evaluating the actions that are included in the proposed action documented in the Biological Assessment used for consultation under Section 7(a)(2) of the Endangered Species Act (ESA). This plan has been modified from the version released as part of the DPEIS public review in response to comments from the Services during ESA coordination on the proposed action. If the plan is further modified through the ESA Section 7 consultation it will be released as an appendix to the final DPEIS. Because of this the term “preferred alternative” signifies both the preferred alternative from the DPEIS as well as the proposed action from the WVS final biological assessment.

1.1 BACKGROUND ON WILLAMETTE VALLEY SYSTEM

The WRB is an approximately 11,478-square-mile drainage area around the Willamette River, which flows north through a fertile valley in the State of Oregon (USACE 2019a). The WRB is located entirely within the State of Oregon, beginning south of Cottage Grove and extending approximately 187 miles to the north where it flows into the Columbia River. The Willamette River is the 13th largest river in the conterminous United States (U.S.) in terms of streamflow and produces more runoff per unit area than any of the 12 larger rivers (EPA 2013). The WRB averages 75 miles in width and encompasses approximately 12 percent of the total area of the state (USACE 2019a).

The WRB is bound by three mountain ranges: the Cascade Range to the east; the Coast Range to the west; and the Calapooya Mountains to the south. Maximum elevations exceed 10,000 feet in the Cascade Range, 4,000 feet in the Coast Range, and 6,000 feet in the Calapooya Mountains. Major Cascade Range tributaries include the Santiam, McKenzie, Middle Fork Willamette, Molalla, and Clackamas rivers. The Willamette River is also fed by major tributaries from the Coast Range, including the Long Tom, Marys, Luckiamute, Yamhill, and Tualatin rivers. At the south end of the basin, the Coast Fork of the Willamette River emerges from the Calapooya Mountains and joins the mainstem Willamette River near the City of Springfield (USACE 2019a).

The WRB encompasses 12 sub-basins, or smaller basins within the larger WRB. These are the Lower Willamette, Tualatin, Molalla-Pudding, Yamhill, Clackamas, South Santiam, North Santiam, Middle Willamette, McKenzie, Coast Fork Willamette, Middle Fork Willamette, and Upper Willamette. Six of these sub-basins – Middle Fork Willamette, Coast Fork Willamette,

McKenzie River, Long Tom, South Santiam, and North Santiam – contain dams; these sub-basins comprise the WVS.

In the 1930s, Congress authorized USACE to construct, operate, and maintain the WVS for flood control purposes. The WVS was originally authorized by three Flood Control Acts (FCAs) passed in 1938, 1950, and 1960. Between 1932 and 1972, USACE constructed 13 dams and extensive bank protection revetments along the Willamette River and its tributaries, creating the WVS. Since their completion, the dams have cumulatively prevented more than $25 billion in flood damages to the Willamette Valley. The 1938 FCA authorized the following dam construction projects: Fern Ridge on the Long Tom River, Dorena and Cottage Grove in the Coast Fork Willamette sub-basin, Lookout Point on the Middle Fork Willamette River, Detroit on the North Santiam River, and Green Peter on the Middle Santiam River. The 1950 FCA reauthorized Green Peter and authorized Big Cliff on the North Santiam, Cougar and Blue River dams on the McKenzie River, Hills Creek and Dexter on the Middle Fork Willamette River and Fall Creek on Fall Creek.

House Document (HD) 531 is the overall guiding legislation that provides the basic the authorized purposes of the WVS. Existing water control manuals provide guidance regarding the regulation of the individual projects in compliance with those purposes. USACE continues to operate and maintain the WVS, which today consists of a combination of 13 multipurpose reservoirs, riverbank protection projects, fish passage facilities, adult fish collection facilities, and hatchery programs within the WRB. Eleven of the 13 dams are multipurpose and three are re-regulating (i.e., used to even out peak discharges of water used for power generation at an upstream dam, thereby controlling downstream river level fluctuations). Eight of the 13 dams are hydropower dams (USACE 2019b). The WVS includes 100 miles of revetments along the mainstem and tributaries of the Willamette River. The WVS also includes five fish hatcheries.

The locations of the 13 dams and reservoirs in the WVS are shown in Figure 1-1. Dams with or without hydropower are indicated, as well as which dams are re-regulating dams. Adult fish collection facilities, hatcheries, and control points of the dams are also shown. Control points are United States Geological Survey (USGS)-gaged locations which contain instrumentation that collects information on water surface elevations. This information helps determine the amount of stored water that can or should be released from upstream reservoirs to meet minimum and maximum flow requirements targeted by dam operators. The downstream control points in the WRB are in the towns of Goshen, Monroe, Vida, Jasper, Mehama, Jefferson, Waterloo, Albany, Harrisburg, and Salem, Oregon.

The WVS is currently operated and maintained to accomplish the various purposes established by Congress when the WVS was initially authorized for construction or in subsequent authorizations. Authorized purposes are purposes assigned to a project by Congress. While the WVS is operated as a whole, each dam and reservoir (or “project”) within the WVS is authorized for a specific set of purposes. For WVS projects, authorized purposes include flood risk management; irrigation; navigation; hydropower; fish and wildlife; water quality; recreation; and water supply.

The geographic scope of the DPEIS and BA is the WRB; that is, the 13 dams and reservoirs on the Willamette River and the six sub-basins containing dams that comprise the WVS, including the Middle Fork Willamette, Coast Fork Willamette, McKenzie River, Long Tom, South Santiam, and North Santiam, riverbank protection projects, fish passage facilities, fish hatcheries, adult fish collection facilities, and communities and populations within the WRB.

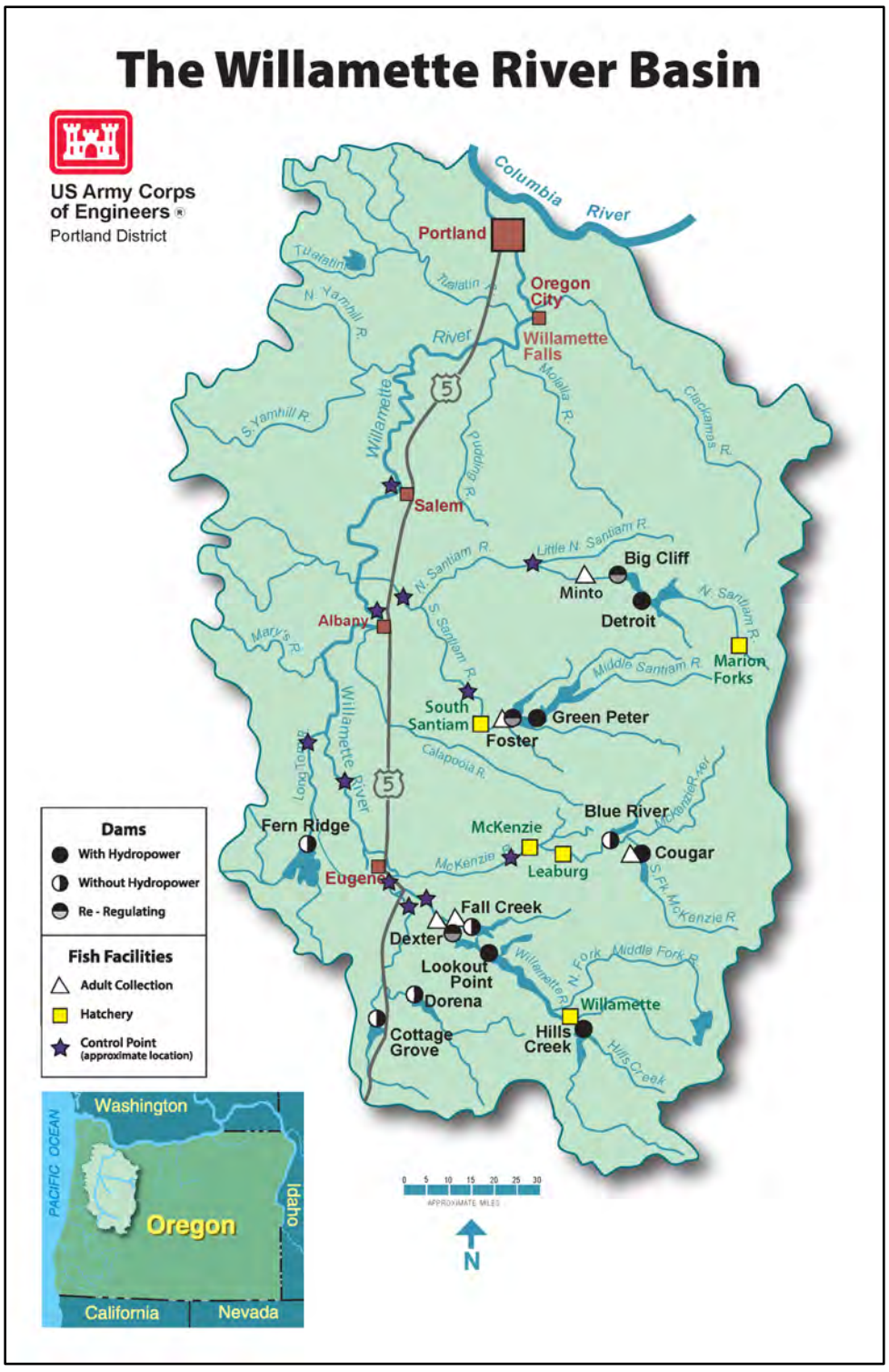

Figure 1-1. The Willamette River Basin

1.2 PROPOSED ACTION

As stated in Chapter 1 of the DPEIS, the proposed action, or the goal of this effort, is to continue to operate and maintain the WVS for the authorized purposes of flood risk management, hydropower generation, irrigation, navigation, recreation, fish and wildlife, water supply, and water quality in compliance with the ESA. The last PEIS that evaluated WVS operations was completed in 1980. Over the four decades following completion of the 1980 PEIS (1980 – 2022), operations have been modified and structural measures for fish passage and temperature management have been implemented to improve conditions for ESA-listed fish species. New information relevant to the environmental effects of operating the WVS has also been acquired, including information related to ESA-listed fish species.

As mentioned previously, the 2008 National Marine Fisheries Service (NMFS) Biological Opinion (BiOp) determined that the proposed continuation of operations of the WVS would jeopardize UWR Chinook salmon and UWR steelhead (NMFS 2008). Therefore, the need for the project, or the need to which USACE is responding, is to continue to operate and maintain the WVS in accordance with its authorized purposes, but to do so without jeopardizing ESA-listed species and/or destroying or adversely modifying their designated critical habitat within the WVS.

1.3 SCOPE OF IMPLEMENTATION AND ADAPTIVE MANAGEMENT PLAN

The DPEIS evaluates a range of action alternatives in addition to the No Action alternative. The Draft IP and AMP have been developed based on the Preferred Alternative identified in the DPEIS; however, the concepts and framework for long-term implementation and adaptive management (AM) described would be applicable to any action alternative if selected in a record of decision. All management measures included in the Preferred Alternative are considered. The Preferred Alternative includes interim operations measures similar to the operations ordered by the Court as part of an interim injunction in NEDC V. USACE. In addition, the Court ordered three structural measures including the construction of the Dexter Adult Fish Facility, Big Cliff Total Dissolved Gas (TDG) Abatement, and Cougar Regulating Outlet (RO) Chute Resurfacing. These three structural measures have been included within the scope of this Draft Implementation and Adaptive Management Plan as they will be completed after the Record of Decision (ROD).

The IP component identifies a prioritization of measures for implementation, a timeline for their implementation, and implementation criteria that must be met prior to initiating implementation. The AMP component outlines the governance structure to be used for adaptive decision-making, the annual adaptive management process for engaging with stakeholders and incorporating new learning into management priorities, and outlines the decision criteria including performance metrics, targets, and decision triggers relevant to monitoring and evaluating the success of management measures at achieving stated objectives.

CHAPTER 2 - IMPLEMENTATION PLAN

The Implementation Plan can be considered a roadmap that lays out a strategy and schedule for implementation of the actions developed through the programmatic EIS process. Considerations such as basin-wide priorities, risk and uncertainty, data gaps and other factors have been used to shape this plan and develop a schedule that is aggressive while being reasonable and implementable, given the presently available information.

This plan links immediate actions (e.g., Interim Operations) to the longer-term actions, such as the upstream and downstream fish passage construction projects and identifies when check-ins, or points along the implementation timeline where course correction (on-ramps/off-ramps) may be necessary. These check-ins are discussed in more detail below.

2.1 INTERIM OPERATIONS

As part of the PA, four downstream fish passage structures and one selective withdrawal structure for downstream water temperature management will be constructed. These structures will be complex, costly, and may take multiple years to design and construct. In the meantime, Interim operations will be implemented to provide immediate benefit to the species while longer-term solutions are developed and/or constructed. In addition, other actions such as outplanting, propagation via the hatchery program, gravel augmentation, etc. will also be carried out.

Many of the Interim operations are similar to the operations ordered by the Court as part of the injunctive relief. So, many of the Interim Operations described in this plan have already been implemented and will continue to be implemented until long-term actions are constructed/finalized. It should be expected that as these Interim operations continue to be implemented, additional refinements may be necessary. Adaptability to changing conditions (e.g., climate change, changes in priorities or changes in operations due to structures coming online) may also be necessary. The Interim operations are listed in Figure 2-1.

In addition to the Interim operations, the Court order required the evaluation of two structural measures including Big Cliff Total Dissolved Gas (TDG) Abatement and Cougar Regulating Outlet (RO) Modifications, as well as the completion of the design/construction of the Dexter Adult Fish Facility. While these actions are tracked in this Implementation Plan, the structural injunction measure will undergo a separate NEPA process that will assess the direct, indirect, and cumulative impacts of their effects on the human environment.

North Santiam
- Use mix of spillway, regulating outlets, and turbines for temperature and passage in spring (DET)
- Split RO and turbine use for passage in fall (DET)
- Spread spill for TDG reduction (BCL)

South Santiam
- Outplant fish above Green Peter
- Use spillway to pass fish in spring (GPR)
- Drawdown to ROs in fall passage (GPR)
- Delay refill and use fish weir in spring (FOS)
- Fall drawdown and spill (FOS)

McKenzie
- Spring and fall drawdown to RO for fish passage (CGR)

Middle Fork
- Prioritize ROs at night in fall and winter for fish passage (HCR)
- Drawdown to ROs in the fall and winter for fish passage (LOP)
- Use spillway to pass fish in spring (LOP)
- Use ROs in the summer and fall for temperature management (LOP)
- Drawdown in fall, winter, and spring for fish passage (FAL)

Figure 2-1. Specific Actions as Included in the Near-Term Operations Measure

2.2 ACTIONS IN THE PREFERRED ALTERNATIVE / PROPOSED ACTION (PA)

Alternative 5, "Integrated Water Management Flexibility and ESA-Listed Fish Alternative" was identified as the PA in the DPEIS (Figure 2-2). This alternative is comprised of a mix of operational and structural measures to be implemented across the basin. The Implementation Plan and timeline lays out the schedule for completing various actions in the PA at the different USACE projects over the next thirty years.

	Upstream Passage	Downstream Passage	Temperature	Total Dissolved Gas (TDG)	Measures Common to All Alternatives
DEX	Adult Fish Facility (AFF) Improvement				Integrated Temperature and Habitat Flow Regime Gravel Augmentation Adapt Hatchery Program Maintain Revetments using Nature-based Engineering Methods Maintain Fish Release Locations above Dams (Outplanting) Interim Operations
LOP		*Structure: Floating Surface Collector (FSC)			
HCR					
FCR	AFF	Operation: Fall Draw Down			
CGR	AFF	*Diversion Tunnel Operation (requires structural improvements)	Temperature Tower	RO modifications to improve DSFP/TDG	
BLU					
FOS	AFF	Combination of Operations & a Small Structure	Pipe Warm Water to AFF		
GPR	Construct AFF w/ Lamprey Passage	Operation: Spring Spill & Fall Draw Down	Operation		
BCL	AFF			Structure to improve TDG	
DET		*Structure: FSS	*Structure: Temperature Tower		

KEY:
- **Proposed Measures in PA**
- Court Ordered Measures
- Previously completed ESA actions including 2008 BiOp Requirements

*2008 BiOp called for Big 4:
- Downstream passage (DSP) at Cougar
- DSP and Temperature Control at Detroit
- DSP at Lookout Point

Figure 2-2. Main Measures in the Preferred Alternative

2.3 PRIORITIZATION OF ACTIONS FOR IMPLEMENTATION

Even though each measure within the PA is considered a priority, it is infeasible to carry out all actions simultaneously. Therefore, careful consideration was given to the timing of implementation considering the following set of priorities:

- Prioritize projects in subbasins with multi-species benefit.
- Prioritize projects that are closest to construction phase.
- Prioritize injunction-related projects.
- Lean out on study design and funding documentation where possible.
- Allow for necessary time to resolve data gaps and operational research needs.
- Consider impacts to system storage/water management/water supply.

Once the above set of prioritizations and potential conflicts were considered, the measures were organized into three categories including: (1) actions that could legally and feasibly start prior to the ROD; (2) actions that could be implemented immediately after the ROD is signed; and (3) long-term solutions that could take many years to complete either due to their high complexity or the need for further study or congressional approval. An Implementation Timeline was developed based on the application of these categories to the measures.

2.4 IMPLEMENTATION TIMELINE

The Implementation Timeline is broken out by project and extends from present (2022) through 2054 (Figure 2-3). This timeline includes the major operational and structural measures selected as part of the PA. What is not shown in this timeline are the measures common to all alternatives:

- Integrated Temperature and Habitat Flow Regime
- Gravel Augmentation
- Adaptive Hatchery Program
- Maintain Revetments using Nature-based Engineering Methods
- Maintain Fish Release Locations above Dams (outplanting)
- Continued Sustainable Rivers Program and Implementation of Environmental Flows
- Water Management Flexibility (i.e., use of power pools)

These measures will begin after the ROD is signed and will continue until system operations are reevaluated. Continued research, monitoring and evaluation (RM&E), new RM&E, and post-construction evaluations are also not shown in the Implementation Timeline but will occur to evaluate and understand how actions are performing in real time.

The following sections describe the Implementation Timeline in greater detail and by project. As shown in Figure 2-3, each phase of each construction project is identified including the Engineering Design Report (EDR) or alternatives study phase, the Detailed Design Report (DDR) phase, Plans and Specifications (P&S), Contract Award and Construction. Potential risks and uncertainties and major check-ins are also noted.

The Implementation Timeline is based on a number of factors that drive the schedule. These factors include:

- Resource Constraints – The large construction projects that are included in the PA have been spread out over time to ensure USACE has adequate staffing and funding to carry out project designs and construction.
- R&D Needs/Data Gaps – For some projects, additional information or modeling is required in the initial stages of design. This may extend the EDR or DDR process for complex projects such as the design/construction of downstream fish passage structures.
- On-Site Construction Constraints – For projects such as Detroit, there is limited physical space to allow for the simultaneous construction of large structures (e.g., construction of the SWS and FSS at the same time). One structure must be built before the other, which extends the timeline for completion of the PA.
- Authority - In some cases, additional authority must be granted prior to the design/construction of facilities or substantial changes to operations. Seeking such authority may take upwards of 7 years and requires Congress to act.

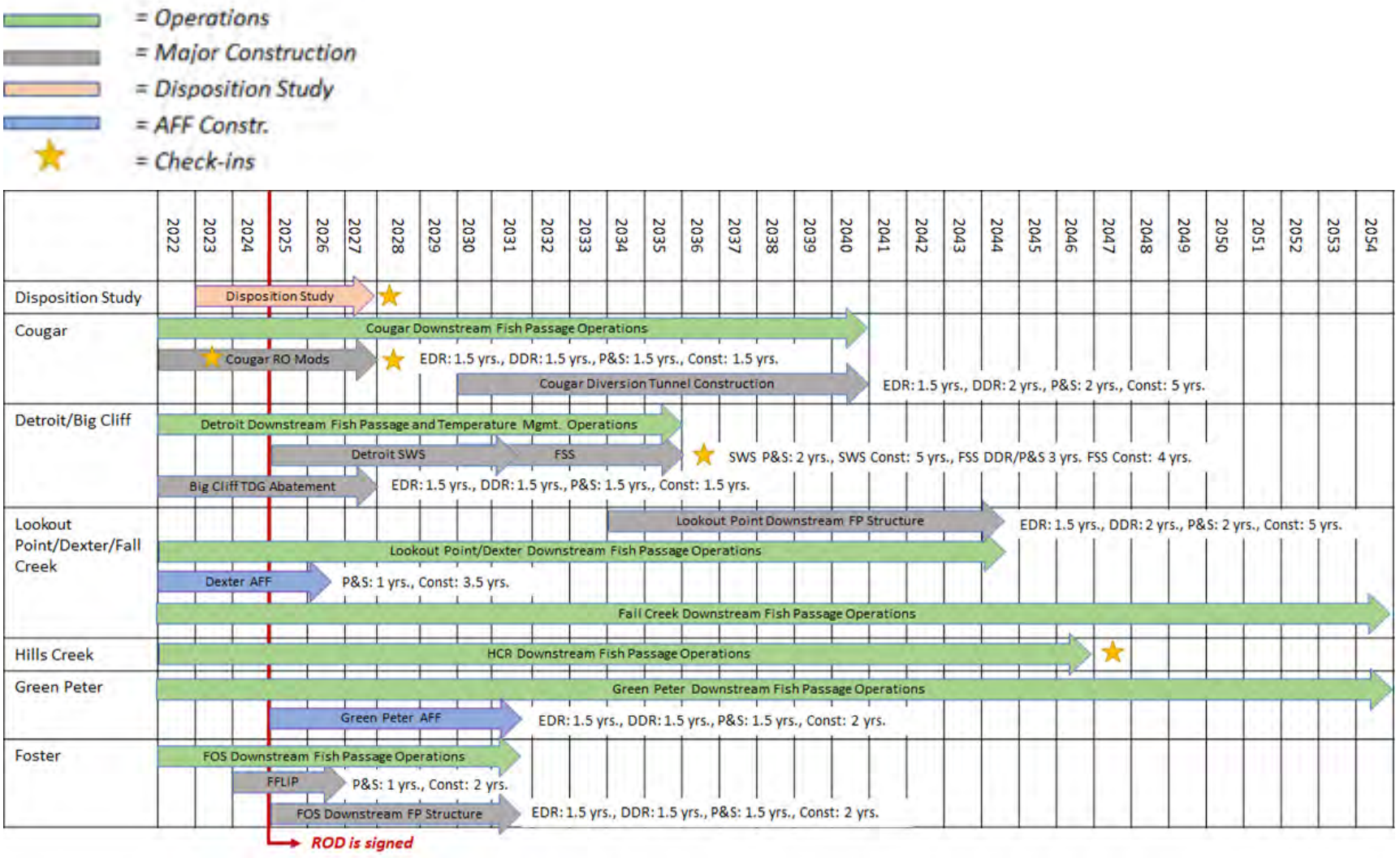

Figure 2-3. Implementation Timeline

2.4.1 Detroit Dam

Operational changes are being carried out prior to the ROD as part of the injunction. These operations will be continued after the ROD as part of the Interim operations. These operations focus on improved fall, winter and spring downstream fish passage and downstream water temperature management. As RM&E informs the success or shortfalls of these operations adjustments may be necessary. Adjustments may result in the need for additional legal and environmental compliance.

Once the ROD is signed, USACE will begin the P&S phase of the Detroit Selective Withdrawal Structure (SWS) and Floating Screen Structure (FSS), followed by construction. Due to the limited physical space on the dam, the structures will be constructed in two phases with the SWS constructed first, then the FSS. Anticipated completion of all construction is 2035. The Implementation Timelines do not include post-construction evaluation timelines, but it is anticipated that RM&E would continue for at least 3-5 years post-construction.

2.4.2 Big Cliff Dam

USACE developed a reasonable timeline for design and construction and has started an EDR for constructing a structural solution for mitigating excess TDG levels below Big Cliff Dam during spill operations, as required by court order. The implementation plan assumes that USACE would continue with the design and construction of a TDG abatement structure at Big Cliff Dam with an in service date of October 2028.

2.4.3 Green Peter Dam

Prior to the ROD, USACE changed operations at Green Peter Dam to improve downstream fish passage in the spring through a surface spill operation and prioritization of the spillway, and a fall operation which includes a deep drawdown and prioritization of the regulating outlets, as required by court order. Continuation of this operation is part of the preferred alternative so after the ROD the operation will continue, though as RM&E is conducted on the operation potential modifications to the operation may be necessary. Adjustments may result in the need for additional legal and environmental compliance.

In addition, an Adult Fish Facility (AFF) will be constructed at the base of Green Peter Dam to support upstream migration and the outplanting of fish in Quartzville Creek and the Middle Santiam River above the dam. The Green Peter AFF project, including the design phase, would start once the ROD is signed, with anticipated completion of a facility by 2031. Until then, fish collected at the Foster AFF will be used for outplanting purposes.

2.4.4 Foster Dam

As shown in Figure 2-3, immediate actions at Foster Dam include the Interim operations for fall and spring downstream fish passage and summer water temperature management operations through use of the Foster fish weir, and the continued design work for Foster Fish Ladder

Improvement Project (FFLIP) to provide a warm water supply pipe to the ladder. Once the ROD is signed, USACE will start construction of the FFLIP, which is estimated to take two years to complete. During this time, USACE would begin the EDR phase of a structural downstream fish passage solution at Foster Dam. Once funded, the EDR and DDR phase for the downstream fish passage structure is estimated to take a total of three years to complete, with P&S and construction taking an additional 3.5 years. Completion of a downstream fish passage structure is expected by 2031. It should be noted that the downstream fish passage structure at Foster Dam is anticipated to be a simpler structure as compared to the structures at Detroit or Lookout Point Dam, therefore the timeframe for completion is shorter.

2.4.5 Cougar Dam

Several actions will be taken at Cougar prior to the ROD, as required by a court order, they include the continued implementation of operations which informed the interim operations for improved fall, winter and spring downstream fish passage and survival, the completion of the Cougar RO Modifications EDR. In 2023 and once the EDR is complete, the first major check-in (represented by the yellow star in Figure 2-3) will occur. During this check-in, a decision will be made regarding further modifications to the Cougar RO to improve downstream fish passage and survival. This implementation schedule assumes that additional improvements will be constructed, with completion of modifications by the end of 2029.

USACE will also lean out in implementation prior to the ROD by beginning the process to initiate a disposition study to evaluate the potential to deauthorize hydropower at Cougar. At present, the timing, scope and scale of the Disposition Study is unknown, so refinements to the Implementation Timeline, specifically for Cougar, should be anticipated. This study will result in a formal recommendation to Congress on whether to deauthorize power at Cougar, which would allow for the utilization of the Diversion Tunnel for fish passage, which Congress will also have to fund prior to USACE initiating the EDR phase of project.

Post the ROD and the Cougar RO modifications, a second major check-in will take place. During this check-in, information from the Disposition Study, in conjunction with post-construction evaluation data from the RO modifications and/or the determination by Congress to deauthorize hydropower and fund the diversion tunnel will be used to inform the next steps at Cougar Dam. By 2028, a determination will be made as to whether USACE will continue with the Diversion Tunnel EDR or if it will use an off ramp. This off ramp would signal a change in direction from the current proposed action and preferred alternative triggering the need for additional legal and environmental compliance including reconsultation.

2.4.6 Lookout Point Dam

Prior to the ROD, USACE will implement operations for improved fall, winter and spring downstream fish passage and downstream water temperature management in the summer through prioritized use of the ROs, as required by the court order. Once the ROD is signed, USACE will continue these operations as part of the Interim operations and will continue them while starting the EDR and alternatives analysis for long-term structural downstream fish passage and until construction of a downstream fish passage structure is operational. During the EDR phase, further review of existing fish passage data and the identification of further RM&E needs will be completed. A major check-in will occur at the conclusion of the EDR, and USACE will decide whether to move forward with the DDR phase of Lookout Point downstream fish passage design or wait for additional RM&E and/or the post-construction evaluation of the Detroit Dam FSS to be completed so that lessons learned from Detroit can be applied to Lookout Point.

The current assumption is that the Lookout Point DDR will start in 2034, allowing for additional RM&E and the post-construction evaluation of the Detroit Dam FSS. Currently, construction of a downstream fish passage structure at Lookout Point Dam is set for completion in 2044. In the interim, immediate improvements to downstream fish passage and survival are expected from the implementation of the deep fall/winter drawdown of Lookout Point Reservoir.

2.4.7 Dexter Dam

Prior to the ROD, USACE will implement operations for spring downstream fish passage at Lookout Point Dam includes spill releases at Dexter Dam and continue to work towards completion of P&S and construction of the Dexter AFF, as required by the court order. Completion of this structure anticipated in 2026.

2.4.8 Fall Creek Dam

As described in the PA, there are no interim operations planned at Fall Creek because the long-term operation which continues the fall deep drawdown would be immediately implemented.

2.4.9 Hills Creek Dam

Prior to the ROD, USACE will continue to operate to provide passage by prioritizing use of the ROs while the reservoir is <El.1460 ft, as required by the court order. This operation would continue immediately after the ROD until all the major construction projects in the preferred alternative are operational or until the decision of whether to pursue alternative operational and/or structural upstream and/or downstream fish passage at Hills Creek Dam is made as denoted in the Implementation Plan as a major check in. Specific criteria for determining whether an additional structure should be constructed will be laid out in the AM plan and the decision will be based on the decision and information gathered as part of RM&E efforts. This major check-in does not preclude the continuation of RM&E and the on-going evaluation of fish passage at Hills Creek Dam at the regional level. Adaptive decision-making is critical to the future success of the Willamette Valley System and the achievement of shared objectives.

2.4.10 Risk and Uncertainty

The Implementation Timeline is based on the information available to USACE at present and modifications or changes to this timeline are possible due to an imperfect understanding of biological condition, performance and outcome, as well as a number of risks and uncertainties.

Discussion of some of these risks and uncertainties follows.

<u>Funding</u>

While the uncertainty in funding was not used to shape or drive the Implementation Timeline, funding constraints could impact schedule and the completion of major construction projects into the future. If funding constraints are identified, adjustments to schedule and a prioritization of future work will be discussed on a regional level as described in the Adaptive Management Plan.

<u>Disposition Study</u>

At present, the scope and scale of the Disposition Study is unknown. For now, a five-year timeline is being assumed as a conservative placeholder for a Disposition Study that will evaluate the deauthorization of hydropower and a rebalancing of the other authorized purposes of all hydropower projects within the WVP. Adjustments to the duration of this study will be made as necessary, which could impact the timing of follow-on actions.

<u>Congressional Authorization – Cougar Diversion Tunnel</u>

USACE will continue to make improvements to Cougar Dam through RO modifications while the Disposition Study is being completed. Information from the Disposition Study, in conjunction with post-construction evaluation data from additional Cougar RO modifications will be used to affirm USACE decision to use the Diversion Tunnel to pass fish as Cougar Dam. If data warrants moving forward with the Cougar Diversion Tunnel Construction Project, Congressional approval and funding will be required prior to the start of the EDR phase of the project. At present, the timing, scope and scale of the Disposition Study is unknown, so refinements to the Implementation Timeline, specifically for Cougar should be anticipated.

Adaptive Management

The RM&E program will continue while the Implementation Plan is carried out. New information gathered through RM&E will likely lead to a new understanding and refinement of models which may warrant adjustments to the Implementation Timeline and current set of assumptions and priorities. Adjustments to the Implementation Timeline are possible, and steps for such adjustments are discussed in greater details in the Adaptive Management Plan.

Water Management

Impacts to USACE's flood risk management mission should be considered during the design and planning phase of each construction project. While construction during the rainy season can be challenging, USACE can mitigate for risks by drawing reservoirs down to gain more reservoir storage, capture more water and reduce the risk of flooding construction sites or downstream areas. Drawing down reservoirs, however, can impact refill and the ability to meet instream and mainstem flow targets during the summer season, so impacts should be carefully weighed. In some cases, constructing "in the wet", meaning constructing structures without a reservoir drawdown may be warranted, but even this option can come with considerable risks not only to schedule but to overall construction costs as well. As each project's design is finalized, some adjustments to construction timelines may be necessary and the Implementation Timeline will be adjusted to reflect these changes.

2.4.11 NEPA Compliance

NEPA, in combination with the Council on Environmental Quality (CEQ) and USACE regulations, require the USACE to prepare an EIS evaluating the impacts of a proposed Federal action that will significantly affect the human environment so that an informed decision can be made in selecting an alternative for implementation. Due to the complex nature of the interrelated Federal actions in the WVS, USACE employed a programmatic EIS. The benefit of a programmatic EIS is that it allows future site-specific projects to be tiered from the overarching programmatic EIS analysis to help streamline future environmental reviews. CEQ regulations allow this tiering, with the policy or program EIS covering "general matters" and subsequent tiers or separable projects being allowed a narrower environmental analysis that focuses on the project-specific impacts important to the decision maker. This approach is well suited to the WVS, as it integrates very well with AM. A programmatic EIS facilitates responsiveness when monitoring indicates change to Federal actions because objectives are not being met or new

scientific understanding dictates alternative strategies, thus strengthening the implementation of the plan. Implementation of specific projects or management measures may require subsequent analysis that can be tiered to the PEIS. If the AM process provides new and significant information that requires actions not included within the range of impacts and alternatives considered in this EIS, additional NEPA analysis will be required.

CHAPTER 3 - OVERVIEW OF ADAPTIVE MANAGEMENT

3.1 ADAPTIVE MANAGEMENT DEFINED

USACE's adaptive management technical guide (USACE 2019c) defines adaptive management (AM) as a formal, science-based, risk management strategy that permits implementation of actions despite uncertainties. Knowledge gained from monitoring and evaluating results is used to adjust and direct future decisions. Simply stated, AM is learning while doing in the face of uncertain outcomes.

The conceptual basis for the USACE definition of AM derives from the following description provided by the National Research Council in its report Adaptive Management for Water Resources Project Planning (NRC 2004):

> Adaptive management [is a decision process that] promotes flexible decision making that can be adjusted in the face of uncertainties as outcomes from management actions and other events become better understood. Careful monitoring of these outcomes both advances scientific understanding and helps adjust policies or operations as part of an iterative learning process. Adaptive management also recognizes the importance of natural variability in contributing to ecological resilience and productivity. It is not a 'trial and error' process, but rather emphasizes learning while doing. Adaptive management does not represent an end in itself, but rather a means to more effective decisions and enhanced benefits. Its true measure is in how well it helps meet environmental, social, and economic goals, increases scientific knowledge, and reduces tensions among stakeholders.

These AM concepts are consistent with those presented in the U.S. Department of Interior's AM technical guide (Williams et al. 2009).

As summarized in USACE (2019c), certain characteristics are common to most definitions of AM. Adaptive management:

- Involves the accumulation of understanding over time (i.e., learning) and adjustment of management decisions over time (i.e., adaptation) to better achieve goals and objectives.
- It demands the clear statement of objectives, identification of management alternatives, predictions of management consequences, and recognition of uncertainties.
- Includes stakeholder engagement, monitoring of resource response, and modeling.
- It requires a governance process that ensures new knowledge is operationalized through decision making.

To be an adaptive decision process, all these activities must be present in a framework tailored to meet the decision needs. Figure 3-1 illustrates the steps in an adaptive management cycle compatible with USACE projects.

This AMP is being developed during Step 1, Plan/Design, concurrently with the DPEIS. Although some interim operations measures are currently being implemented as part of the injunction, the long-term AM described in this plan would not take effect until a ROD is signed. As described previously, some measures would remain in Step 1 until certain implementation criteria are met as described in Chapter 2 (e.g., completion of tiered NEPA reviews, Disposition Study). Some measures would be implemented immediately (Step 2) following a ROD, which would initiate the long-term AM cycle.

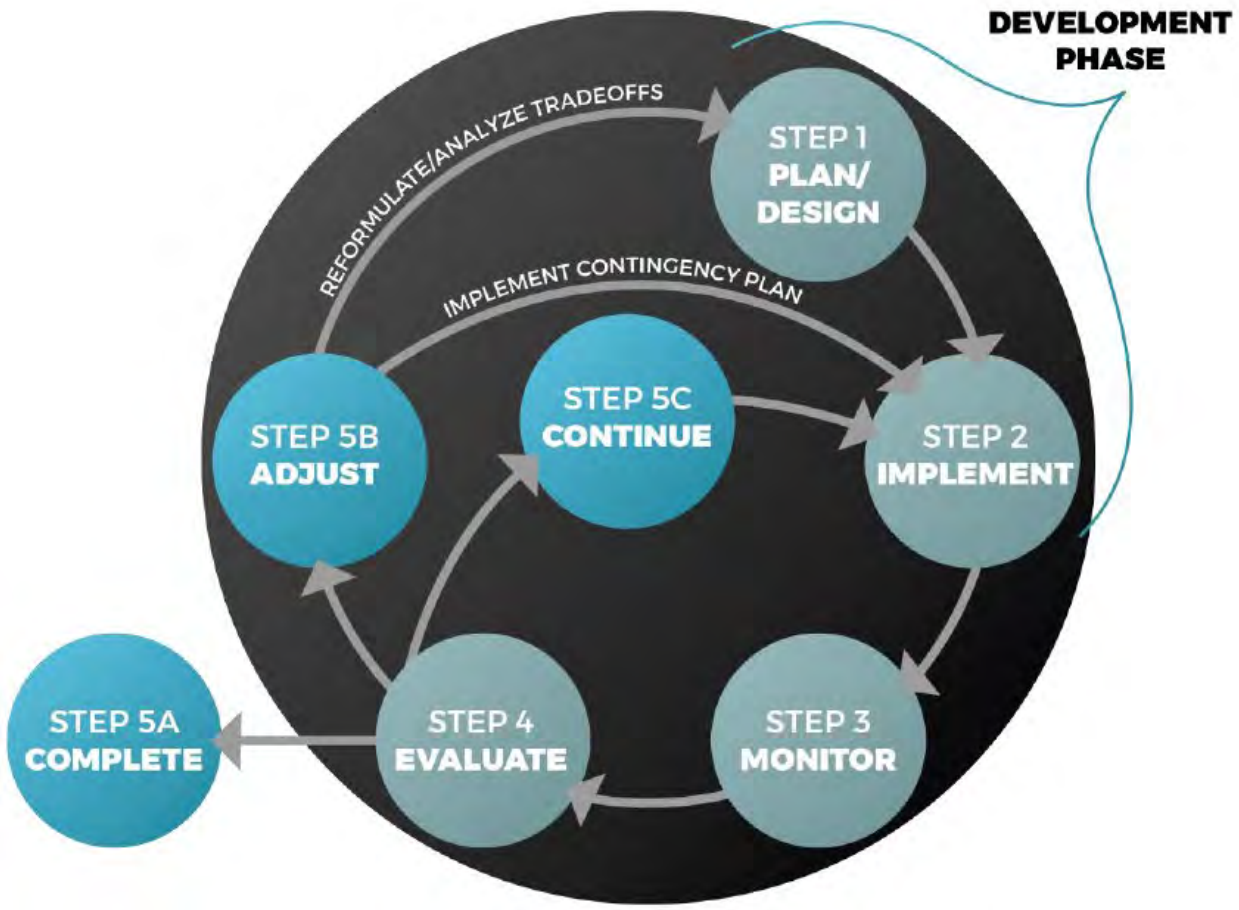

Figure 3-1. Adaptive Management Cycle

3.2 ADAPTIVE MANAGEMENT TERMS

The following terms are used throughout the remainder of this document and are important features of the AMP (definitions taken from USACE 2019c).

- Monitoring – This is Step 3 of the AM cycle and is the process of measuring attributes of the ecological, social, or economic system. Monitoring has many potential purposes, including: to provide a better understanding of spatial and temporal variability, to confirm the status of a system component, to assess trends in a system component, to improve models, to confirm that an action was implemented as planned, to provide the data used to test a

hypothesis or evaluate the effects of a management action, and to provide an understanding of a system attribute that could potentially confound the evaluation of action effectiveness.

- Decision Criteria - A broad reference to the set of pre-determined criteria used to make AM decisions. Performance metrics, targets, and decision triggers are different types of decision criteria. They can be qualitative or quantitative based on the nature of the performance metric and the level of information necessary to decide.
- Performance metric – A specific metric or quantitative indicator that is monitored and can be used to estimate and report consequences of management alternatives with respect to a particular objective.
- Target – A specific value or range of performance metric that defines success. Targets can be quantitative values or overall trends (directional or trajectory).
- Evaluation – Conduct analyses to compare measured results with anticipated outcomes related to decision criteria for specific management actions to determine whether the implementation should be continued, adjusted, or completed.
- Decision Trigger - A pre-defined commitment (population or habitat metric for a specific objective) that triggers a change in a management action. Decision triggers are addressed in the Evaluate step (Step 4 of the AM process) and specify the metrics and actions that will be taken if monitoring indicates performance metrics are or are not reaching target values. In some cases, a decision trigger may be learning a new piece of information that triggers the Continue/Adjust/Complete step (Step 5 of the AM process).
- Adaptive Action - A course of action to be implemented as defined in the Adjust step (Step 5b of the AM process) if the performance of a particular management action is not as anticipated and requires correction. In cases where the action is pre-defined, it is referred to as a "contingency action."
- Contingency Action - A pre-evaluated adaptive action that is implemented when triggered by defined decision criteria without the need for further deliberation or decision.
- Risk – An uncertainty coupled with an adverse consequence, ideally expressed as the product of the two components, with uncertainty represented as a probability.
- Uncertainty – Circumstances in which information is deficient. Learning while doing under the AM process provides a framework for reducing program uncertainties over time.

CHAPTER 4 - ADAPTIVE MANAGEMENT GOVERNANCE

4.1 WHAT IS GOVERNANCE?

Although several definitions of governance are available, a broadly held view is that it includes a consideration of authority, administration, decision-making, and accountability. Governance of an AM program includes the approach for converting knowledge into improved management through decision making, identifying:

- **what** decisions need to be made,
- **who** is involved in the decision process,
- **how** decisions are made, and
- **when** decisions are required.

The role of adaptive governance is to establish and promote frameworks by which decision makers can discuss, identify, and approve decisions to adjust management policies, plans, and actions.

4.2 GOVERNANCE STRUCTURE, ROLES, AND RESPONSIBILITIES

Decisions for the Preferred Alternative would be made at three general levels of authority: Oversight, Program Management, and AM Implementation Team (Figure 4-1). This section further describes the responsibilities of each level as it relates to AM decision-making (Table 4-1). The roles and responsibilities of Willamette Action Team for Ecosystem Restoration (WATER) are described as well.

4.2.1 Oversight Level

Oversight of the Preferred Alternative implementation is provided by the USACE Portland District Commander (CENWP) and WATER Managers' Forum. The USACE District Commander establishes clear boundaries for the program, makes major policy decisions, and resolves disputes that cannot be realized at lower levels. The USACE District Commander is also ultimately responsible for decisions regarding scheduling, staffing, and other resourcing; planning, engineering and design of management measures; management and execution of research, monitoring, and evaluation; and other corresponding activities undertaken at the USACE District office.

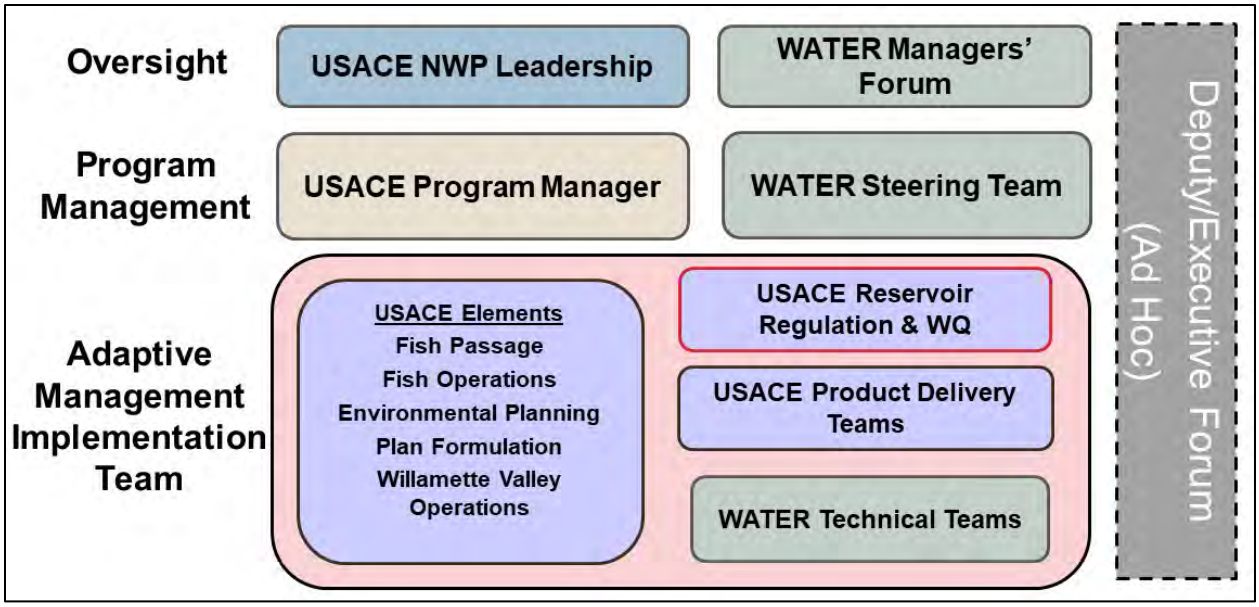

Figure 4-1. Adaptive Management Governance Structure

The USACE Portland District Commander may elect to delegate decisions to senior leaders within the command. Decisions regarding the real-time operations of the reservoirs in the Willamette Valley are typically delegated to the Chief of the Reservoir Regulation and Water Quality Section, for example. The CENWP Deputy District Engineer for Programs & Project Management (DPM) is typically the NWP Commander's delegate for general oversight of the program. The DPM represents USACE in meetings with WATER and/or NMFS/USFWS and may make decisions related to the update of the Implementation Plan, scheduling, resource allocation, and other similar programmatic issues. The DPM may rely upon the Senior Program and Project Managers and/or senior NWP staff to represent the program on day-to-day issues and for interactions with WATER.

WATER provides guidance and recommendations to the USACE regarding program implementation and adaptive management. The roles and responsibilities of the WATER are discussed further in Section 4.2.4. In addition to input from WATER, decisions at the Oversight level are informed by recommendations from the Management Team. Oversight may seek input from independent review on science matters and their decisions are also informed by Tribes and Federal or state agencies as required by applicable laws and regulations, as well as by public input.

4.2.2 Program Management Team

The Program Management Team is responsible for annual updates to the Implementation Plan, development of Strategic Plans to support internal USACE budget processes, development of resource allocation recommendations and oversight of Program implementation. They participate in the annual Science Meeting and the AM Workshop, using these engagements for

Table 4-1. Governance Level Primary Responsibilities

Governance Level	USACE Elements	WATER	Primary Responsibilities
Oversight	Portland District Commander Deputy District Engineer for Programs & Project Management	Manager's Forum	Make decisions or recommendations about priorities Make decisions or recommendations about objectives and decision criteria Make decisions or recommendations about program structure and changes Resolve disputes
Program Management	Program Manager	Steering Team	Make recommendations on action and research prioritization USACE prepares and WATER reviews Draft Near-Term Implementation Plan updates annually Recommend changes to program components and governance
Adaptive Management Implementation Team	Product Delivery Teams Reservoir Management and Water Quality Fish Passage Environmental Planning Plan Formulation Fish Operations Willamette Valley Operations	Technical Teams	Complete planning and design reviews necessary to support implementation of measures Conduct annual assessment of monitoring data, study reports, research results and other relevant information. Evaluate decision criteria and provide information in support of annual science update process Execute and/or review studies, conduct research, develop and apply models to predict habitat, species demographics, etc. Review changing field conditions to identify long-term trends that may necessitate adjustments to implementation Identify decision-relevant studies or analyses that may be necessitated by emerging issues or considerations Identify issues that may warrant targeted independent review

discussions with the Technical and Implementation Team that inform adjustments to the Implementation Plan.

The Program Management Team provides input into the prioritization of implementation actions and reviews the draft Implementation Plan update each year. During various check-points during the federal annual budget cycle, the Management Team will provide input on prioritization of projects based on available funding and identify priority actions based on program needs for FY+2 through 4, including study proposals, proposed changes to components of the AMP, and other recommendations for consideration by WATER and agency leaders.

The Program Management Team makes recommendations to senior leadership on issues requiring Oversight-level decisions, including any issues that merit discussion with WATER. They ensure day-to-day implementation of the program is consistent with direction from senior leadership, the AMP and IP.

4.2.3 Adaptive Management Implementation Team

Implementation of the Preferred Alternative is informed by teams comprised of management and technical staff from the USACE, NMFS, and USFWS, and others via WATER. The Adaptive Management Implementation Team (AMIT) is responsible for development of and updates to the AMP, planning, design, and implementation of management measures, managing data, assessing monitoring results, making recommendations to decision makers, identifying adjustments to actions or the plan, and reporting and communicating results. They assess the strategic direction of the program through regular interactions associated with the science and implementation planning processes. The AMIT discuss strategic science, technical, and implementation considerations that relate to the Program's objectives. Appropriate participation by USACE staff across disciplines will be required to ensure that efficient and effective adjustments and communication occurs both within USACE and to WATER and other affected parties.

USACE representatives to the AMIT will include staff members chairing or participating in the WATER teams or processes, and other technical experts such as reservoir regulators, environmental planners, and fish biologists. Personnel familiar with budgeting, project operations, or other specialized technical topics may participate as needed to advance understanding and knowledge surrounding a particular issue, or for those staff to understand the larger context surrounding decisions and discussions. These representatives and staff would participate in WATER technical team discussions relating to their expertise and position of authority.

Some of the USACE technical experts will by necessity be part of project-specific Product Delivery Teams (PDTs). PDTs are used to organize large projects, specifically design and construction of large or complex structures. Several PDTs would likely be employed for implementation of the Alternative selected. The PDT process follows the guidelines and policies set forth in ER 5-1-11, Management – U.S. Army Corps of Engineers Business Process. The PDT

consists of everyone necessary for successful development and execution of all phases of a project. These PDTs, through one or more PDT representatives, would coordinate their work through the WATER process as appropriate for input on such products as design features, document reviews, and construction times.

4.2.4 Willamette Action Team for Ecosystem Restoration

The purpose of the WATER is to provide a forum for coordination and recommendations among the sovereign governments (federal/state/Tribal) working to implement strategies for Endangered Species Act (ESA) compliance associated with the Willamette Project. Establishment of WATER was a core feature of the adaptive management strategy in the 2008 Reasonable and Prudent Alternative (RPA) developed during consultation on the Willamette Project. Participation in WATER does not alter the duty of these agencies in other interactions. WATER is not intended to make decisions for the participating agencies, it is intended to aid in decision making. All decisions under the authority of the federal government will continue to be made by the appropriate federal agency with the statutory authority to make such decisions.

The tiered system of WATER will clearly define decision authority and provide a vehicle for elevating conflict resolution associated with the efforts to implement the proposed action. WATER is intended to have 3 tiers comprised of a Manager's Forum, Steering Team and focused Technical Teams, as outlined in Figure 4-2. It is USACE's recommendation that each tier of WATER is supported by a different individual from each participating organization to ensure proper oversight and reduce the perception of conflicts of interest at the Steering Team Level and Management Level. A USACE representative will chair each WATER forum or team, with the exception of the HTT which is chaired by BPA.

By its very nature WATER is meant to evolve and adapt based on multiple factors including but not limited to:

- Stage of implementation of the preferred alternative
- Agency resources including funding and personnel
- Advances in understanding the state of available science

The purpose and goals of WATER are to:

- Provide a forum for information sharing and discussion of operation and configuration of the Willamette Project as they relate to compliance with the ESA through implementation of the Willamette BiOps.
- Seek input on actions implemented for the Willamette BiOps, including system configuration and water quality.
- Provide a process for elevating disputes associated with Willamette BiOp implementation to appropriate levels of the involved governmental bodies.

- Promote coordination between implementation of the Willamette BiOps and actions taken under other related regional plans to restore Willamette River Basin fish, such as ESA Recovery Plans or state Conservation Plans.
- Identify opportunities for improved coordination and partnerships to increase efficiencies and avoid unnecessary duplication.
- Increase awareness and include consideration of the implementation of the Willamette BiOps' actions on non-listed species, cultural and other resources, and the multi-purposes of the Willamette Project.
- Facilitate open and transparent communication in making decisions, as well as to track progress and the rationale for decisions.
- Participate and inform long-term adaptive management of the Program through the annual AM cycle established by this AMP.

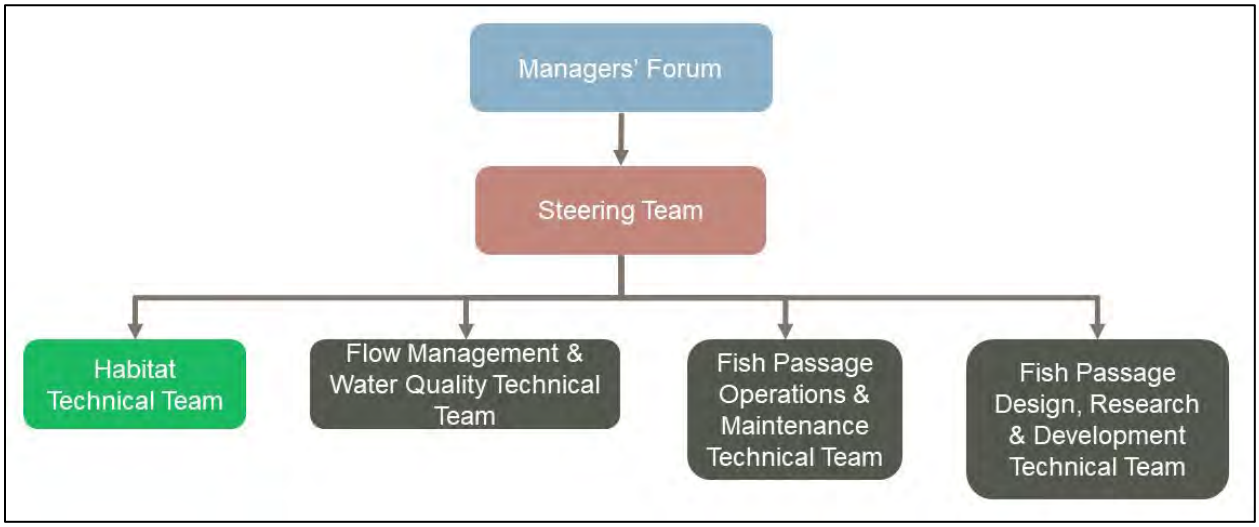

Figure 4-2. Proposed WATER Structure

4.2.4.1 Membership of WATER

Through the precedence of the previous iteration of WATER and in response to the needs of the future iteration of WATER, USACE anticipates the following Agencies will participate at some level. The body of WATER must operate under the constraints of Federal Advisory Committee Act (FACA) which are further outlined in Section 4.5.1 Federal Advisory Committee Act.

Membership includes representatives from the following organizations at various levels of each organization:

- USACE
- Bonneville Power Administration (BPA)
- U.S. Bureau of Reclamation (USBR)

- National Marine Fisheries Service (NMFS)
- U.S. Fish and Wildlife Service (USFWS)
- U.S. Forest Service (USFS)
- Bureau of Land Management (BLM)
- State of Oregon
- Confederated Tribes of the Grand Ronde Community of Oregon (CTGR)

4.2.4.2 Managers' Forum

The Manager's Forum would provide senior management level oversight to the implementation of the Willamette Project Biological Opinions. The Manager's Forum serves as the regional policy and management level body representing the key participating federal agencies with responsibility for operating and maintaining the federal dams in the Willamette Basin (USACE, USBR, BPA).

It is anticipated that the Manager's Forum will continue to consist of senior level management from federal and state agencies and Tribes with fisheries and water resource management responsibilities in the Willamette River Basin. The USACE representative serves as the chair of the forum.

Roles and Responsibilities

The Manager's Forum will provide review, input, and policy guidance related to the development and implementation of actions as they relate to the Willamette BiOps. While most discussions and recommendations will be delegated to lower-level teams, the Manager's Forum serves as the highest body for any disputes or discussions deferred to the management level. Responsibilities include:

- Make final recommendations about priorities
- Make final recommendations about targets and objectives
- Make final recommendations about program structure and changes
- Resolve disputes

WATER managers shall demonstrate leadership and commitment with respect to the outcomes of WATER and Adaptive Management by:

- Taking accountability for the effectiveness of the Steering Team and Technical Teams.
- Ensuring that the policy and implementation strategies are compatible with the requirements of the BiOps.
- Promoting the use of the Adaptive Management approach.

4.2.4.3 Steering Team

The Steering Team is the second tier of WATER comprised of senior managers who have the authority from their respective agencies to provide input on management decisions related to BiOp implementation. The Steering Team is responsible for synthesizing recommendations from the Technical Teams into prioritizations based on budgetary, legal, policy constraints, and other considerations. These prioritizations will get incorporated into the Implementation Plan, which the Steering Team will review. The Steering Team is also the level at which the participating entities will seek to resolve disagreements. The Steering Team is integral to providing recommendations on overall strategy and direction for BiOp implementation, keeping the Managers Forum informed of high-priority issues, and providing direction for the technical teams.

Roles and Responsibilities:

- Make recommendations on action and research prioritization. Recommendations should focus on FY+2 needs and direction for the program (FY+3 and FY+4) but can include suggested adjustments to other years.
- Recommend changes to program components and governance.
- Review the Implementation Plan annually and provide comments.
- Consider any recommendations for independent review from the Technical Teams.

4.2.4.4 Technical Teams

The third tier of WATER is comprised of groups of focused technical teams, each of which represents different elements of the implementation of the Willamette BiOps. Technical teams are charged with implementing the actions listed in the BiOps and in providing the Steering Team technical information and considerations that may aid management discussions. WATER technical teams do not supplant existing federal, state or Tribal decision-making authorities. Technical teams are critical opportunities for other governmental agencies to jointly explore potential solutions and seek agreement on recommendations to the Action Agencies.

Technical teams will be comprised of key function area technical experts from each of the involved federal and state agencies and Tribes, including the Action Agencies. Experts from academia and consulting firms may also attend meetings as needed to provide relevant information.

General responsibilities for the Technical Team are outlined below. Each team will have additional roles and responsibilities based on their respective areas of responsibilities.

- Participate in the Willamette Fisheries Science Review to understand the latest science and its implications on future technical team direction

- Participate in the Adaptive Management Workshop to discuss the latest technical results and its implication for AM plan implementation.
- Establish workgroups as needed on an ad-hoc or permanent basis.
- Review changing field conditions to identify long-term trends that may necessitate adjustments to implementation.
- Identify relevant studies or analyses that may be necessitated by emerging issues or considerations and provide recommendations to the Steering Team on research priorities.

Flow Management and Water Quality Technical Team

The primary responsibilities of the Flow Management and Water Quality Team (FMWQT) would be the development of the Annual Conservation Plan which outlines the annual priorities and real time flow management, operational downstream fish passage priorities, and to ensure integration of water quality improvement requirements undertaken by the Action Agencies to address the needs of ESA-listed species with the requirements undertaken to address CWA requirements. FMWQT will be chaired by a representative of the USACE. The FMWQT will provide recommendations to USACE on operations in real time to better achieve pre-defined ESA-fish related operational objectives for instream flow, water quality and fish passage, and how to balance among those and other operation mission objectives where conflicts or constraints exist amongst those considerations. Recommendations on fish passage prioritization may also be provided to the FMWQT from the WFPOM in real time where in-season constraints exist. In-season changes are intended to be implemented only within that given season. Recommendations from FMWQT and other WATER teams seeking continuing changes (multi-year or permanent) to modify operations will be determined through the annual AM process (Section 4.4).

The FMWQT will be utilized by USACE to communicate the established minimum flow thresholds and provide forecasted model information to the participants given the hydrology and forecasts in any given year. USACE will retain ultimate authority for operating reservoir elevations and downstream flows to meet authorized project purposes. These meetings allow for the agencies to have adequate opportunity for providing input and coordination on flow management operations. WATER participants will use this information in addition to balancing priorities to develop the Conservation Plan, which will account for recommendations on operations to achieve water quality and at-dam fish passage operational measure objectives.

USACE prepares an Implementation Plan to show how it will address the TMDL load allocations for temperature, including compliance and consistency with the pending BiOp for operating the Willamette dams. The ODEQ also recommended that the USACE establish and coordinate TMDL implementation planning through an interagency work group. FMWQT serves as the primary communication and coordination tool for TMDL implementation planning through an interagency work group.

Roles and Responsibilities:

- Contribute technical input necessary to support implementation of flow management, operations for at-dam fish passage, and water quality measures.
- Provide information about storage capacity within the system and annual forecast of general hydrologic conditions; communicate USACE adaptive strategies.
- Provide recommendations and consultat on real-time operations, particularly for, but not limited to, the conservation storage and release season.
- Conduct annual reviews of Willamette Project operations and document issues, concerns and opportunities associated with improving operations to better meet ESA and CWA compliance requirements where possible.
- Provide debriefing materials to other WATER forums regarding flow management, water quality operations, and operational fish passage.
- TMDL implementation planning.
- Assist in development of uniform water quality criteria and standards for CWA and ESA compliance.
- Review and evaluate the latest water quality science.
- Review the annual Conservation Plan and ensure consistency with the most recent Annual Implementation Plan Update.

Willamette Fish Passage Operations and Maintenance Technical Team

The Willamette Fish Passage Operations and Maintenance (WFPOM) forum develops recommendations for ongoing operations and maintenance activities that may affect listed fish species. This forum also includes technical discussions relating to hatchery programs. This forum is responsible for providing input on annual changes to the Willamette Fish Operations Plan, which dictates how facilities must operate to minimize impacts to ESA-listed species. The WFPOM at times may develop in-season recommendations for real-time management operational management for consideration by the FMWQT, consistent with pre-defined operational measure objectives for ESA-fish. Recommendations from the WFPOM and other WATER teams seeking continuing changes (multi-year or permanent) to modify operations will be determined through the annual AM process (Section 4.4).

Roles and Responsibilities

- Coordinate ongoing maintenance and construction activities, both scheduled and unscheduled, as well as any emergency operations that occur.
- Coordinate and review operations required for any future research or construction activities.
- Discuss hatchery program implementation and provide updates on hatchery-related activities

- Provide input to annual revisions of the Willamette Fish Operations Plan (WFOP)
- Provide input for develop and review of the annual Conservation Plan for achieving operational measures for at-dam fish passage
- Provide recommendations on potential research and monitoring needed to inform fish passage operations or maintenance included in the BiOp as well as the AM Plan
- Review the annual Willamette Fish Operations Plan and ensure consistency with the most recent Annual Implementation Plan Update.

Fish Passage Design, Research, and Development Technical Team

The Fish Facility Design, Research, and Development Team is a technical team comprised of engineers, biologists and other fish facility technical experts. The purpose of this workgroup is to provide technical input and review for engineering fish passage improvements (e.g., fish collection facilities, fish passage systems, etc.). USACE PDT representatives will participate in this forum as needed to provide updates and to seek input on PDT efforts relating to design or research of BiOp-related projects.

The Fish Facility Design, Research, and Development Team will also consider what research and monitoring may be needed to inform future fish passage facility design or fish passage operations in support of BiOp implementation and the AM Plan. Research may also be needed to determine the effectiveness of new fish structures or operations, or to evaluate the impact of changing conditions on the continued effectiveness of facilities or operations. Results from this research will be discussed and recommendations made to PDTs or other WATER technical forums to support the AM process, or to the Steering Team to inform management decisions and funding prioritization.

Roles and Responsibilities

- Review and provide input on fish passage design and construction planning efforts tied to BiOp implementation.
- Provide recommendations on potential research and monitoring needed to inform fish passage structures or operations included in the BiOp as well as the AM Plan.
- Provide data and recommendations to the Steering Team and other WATER teams as appropriate to support management discussions on overall strategy and funding prioritization.

Habitat Technical Team

The Habitat Technical Team (HTT) is responsible for identifying and prioritizing any potential habitat restoration activities that support Willamette BiOp requirements, and determining what actions are needed to support these efforts. USACE does not have Congressional authority to fund most habitat restoration actions. BPA is the lead Action Agency and chairs the HTT.

Roles and Responsibilities

- Identify opportunities for habitat restoration and funding.
- Assess progress towards the habitat related BiOp requirements.
- Update the habitat restoration strategy to reflect any new available science and lessons learned.

4.3 DECISION NEEDS FOR WILLAMETTE VALLEY ADAPTIVE MANAGEMENT

Planning, implementing, and adaptively managing the actions the USACE is proposing to take will require hundreds of decisions ranging from relatively mundane issues like what type of net to use for sampling to significant and potentially contentious issues like whether to adjust flow releases from a reservoir. Decisions are required at many points in the process and by multiple entities.

The USACE Portland District Commander is ultimately responsible for most of these decisions. However, the sheer volume demands that many decisions be delegated to others within the agency. USACE's senior leadership relies on recommendations from subordinate staff familiar with the issues and from subject-matter experts engaged for that purpose. They also rely on input from WATER, other agencies, Tribes and the public, where appropriate, when making decisions. It is important to understand that personnel structures and programs evolve thus the positions described herein are subject to change.

The NMFS and USFWS are responsible for compliance-related decisions, including policy determinations regarding the application of AM to the ESA. As knowledge about species and their responses to management is gained through implementation, it may be necessary to adjust the targets, decision triggers, and/or required management measures.

WATER provides input and recommendations that may influence agency decisions. WATER may provide recommendations regarding any aspect of the Proposed Action, and discussions that occur through the collaborative engagements outlined in this AMP help frame agency actions. AM demands the commitment of time, resources, and active engagement of stakeholders, as well as their commitment to actively engage in the governance process and provide the necessary input to decision makers.

Agencies are prohibited from delegating decision-making responsibility for their Congressionally delegated programs. . Facilitators promote group participation, trust, mutual understanding, and shared responsibility for collaboration, but are not themselves decision makers, so must maintain a neutral posture.. Similarly, outside technical experts play an important role by helping to link objectives and management decisions to system understanding, but are not themselves stakeholders, so should not be involved in objective/value development or decision making. These entities must be viewed by agencies and stakeholders as neutral third parties and must be capable of performing as such.

4.3.1 Scope of Adaptive Management Decisions

The most evident and essential function of governance for an AM program is to facilitate effective, transparent decision making. The design of the governance structure and processes should anticipate the wide range of decisions needed to incorporate knowledge gained about the outcomes of management measures or new information about the system and species into effective and acceptable management. Governance design should also promote decision making at the lowest practicable level and be sufficiently flexible to allow for efficient, timely decisions, accommodate unanticipated decision needs, and to grow/change over time.

Table 4-2 includes examples of the decisions required for AM. Information presented in Table 4-2 is meant as a general guide; appropriate decision authority will be at the agencies' prerogative except where specifically prescribed by policy or other agreements and may necessarily change over time. Implementation decisions would be made at three general levels of authority by the agency with the requisite authority with input from the other members (defined herein as Oversight, Program Management, and Adaptive Management Implementation Team).

1. The Oversight level includes agency senior leaders, who are responsible for decisions related to Federal policies and protocols and other issues that may significantly affect stakeholder interests or authorized purposes, and therefore involve collaboration with stakeholders and/or the public. These decisions are primarily made during the Plan/Design step (Step 1) of the AM cycle as the Preferred Alternative is developed, but because they are periodically revisited, could occur during the Adjust/Continue step (Step 5).

2. The Program Management level, which includes agency program and project managers, develops updates to the implementation plan and makes decisions regarding resource allocation, reporting and communication, and collaboration. Management-level decisions are primarily made at the Plan/Design and Implementation steps (Steps 1 and 3) of the AM cycle but can include decisions at each step of the process.

3. The Adaptive Management Implementation Team-level decisions include the wide ranging and numerous judgments needed for the day-to-day operation and implementation. These include how monitoring is implemented, how assessments are conducted and reported, how projects are implemented, etc. Note, however, that the real-time dam operational management decisions are made by the USACE Portland District Reservoir Regulation and Water Quality.

Table 4-2. Example Adaptive Management Decision Needs

Decision Need	Step in AM Cycle	Recommending Entity	Primary Decision Level
What are the objectives?	Plan/Design	Implementation	Oversight

Decision Need	Step in AM Cycle	Recommending Entity	Primary Decision Level
What measures/actions are included for implementation?	Plan/Design	Management	Oversight
What is the priority of the measures for implementation?	Plan/Design	Management	Oversight
What are the performance metrics and targets?	Plan/Design	Implementation	Oversight
What monitoring will be conducted?	Plan/Design	Implementation	Management
What research is needed and how should it be prioritized?	Plan/Design	Implementation	Management
How will learning be incorporated into decisions?	Plan/Design	Implementation	Management
How will status and decisions be reported and communicated?	Plan/Design	Implementation	Management
How will conflicts be resolved?	Plan/Design	Management	Oversight
How will resources be allocated to program components?	Adjust/Continue	Implementation	Management
What within year flow adjustments should be made?	Implementation	Implementation	Management
How will science updates be incorporated?	Evaluation	Implementation	Management
When should a interim operations measure be stopped?	Evaluation	AMT	Oversight

4.3.2 Timing

Several outside policies and processes impose important constraints on scheduling and execution. The most significant constraint is the USACE annual budget process for Civil Works, a two-year development process that can be generally summarized as a develop-defend-execute cycle (Figure 4-3). USACE budgets and executes its mission on a Fiscal Year (FY) basis. The FY begins October 1 and ends September 30 the following year. Funding availability affects the ability to execute the Preferred Alternative.

The year-round budget process engaged in by USACE occurs on a timetable that affects other considerations in the AMP. Congress generally authorizes numerous new USACE site-specific activities and provides policy direction in an omnibus USACE authorization bill, typically called the Water Resources Development Act (WRDA). The WRDAs do not provide funds to conduct activities, nor are they reauthorization bills. Federal funding for USACE civil works activities is provided in annual Energy and Water Development appropriations acts or supplemental appropriations acts.In the absence of congressional passage of an agency-specific

appropriation, Civil Works annual funding is generally included in an all-encompassing "omnibus" bill. If a bill has not passed at the start of the FY, Congress typically passes a Continuing Resolution Authority (CRA), which allows the USACE to continue operations until such time as an appropriations bill is passed or the CRA expires. Under a CRA, funding is typically provided on a month-to-month basis (or other similar timeframe) based on the previous year's funding level and no new projects may be started.

Activities within the current FY or the next FY (FY+1) may be subject to minor adjustment only given the budgets are already fixed, actions planned, and mechanisms to shift those actions limited. Emphasis should therefore be placed on establishing needs to set the future direction and budget. Defining needs for FY+2 would be the focus of USACE working with WATER on an ongoing, annual basis.

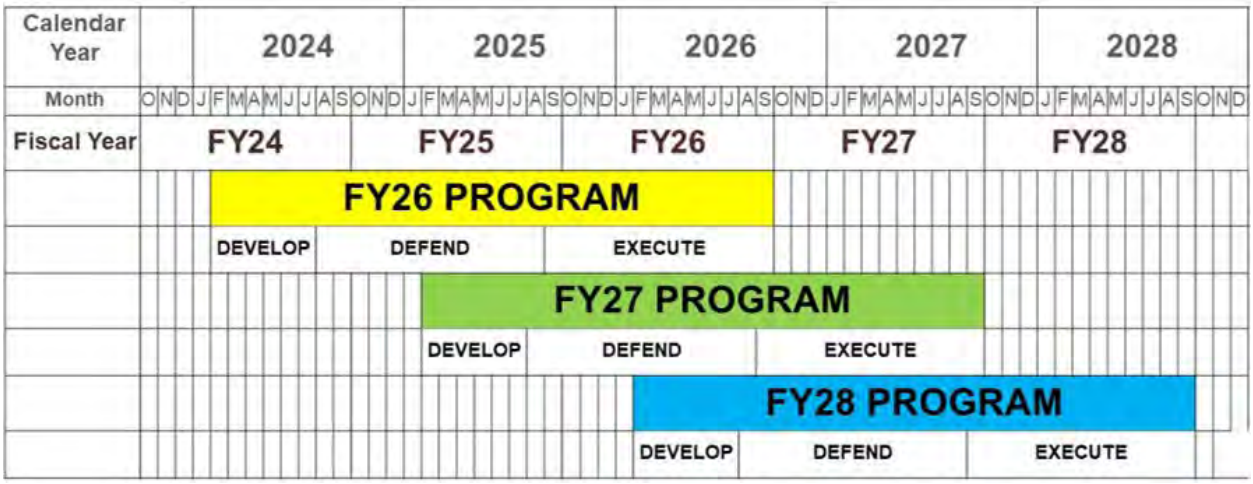

Figure 4-3. Example of USACE Civil Works Budget Development Cycle

Timing of decisions for implementing management measures and/or adjustments is influenced by the operational planning for the conservation release season, which begins with the January water supply forecast and continues through October. The conservation season is approximately from March through October, including the filling season (spring) and the release season (summer). A document titled "Willamette Basin Project Conservation Release Season Operating Plan" (Conservation Plan) is prepared annually to provide flow requirements based on the basin water supply for that year. The Conservation Plan identifies flow and storage needs for each tributary and USACE reservoir in the WVS and mainstem Willamette control points based on the anticipated total system storage in mid-May, from the April forecast, and is developed accounting for operational objectives for water quality and at-dam fish passage operational measure objectives.

4.3.3 Role of Decision Criteria

The term "decision criteria" refers to the set of pre-determined conditions that trigger or guide a decision or the implementation of a contingency plan. They can be qualitative or quantitative based on the nature of the performance metric and the available information to support a

decision and occur in a variety of forms. A recent study of judicial decisions on AM programs cited the lack of decision criteria as one of three key deficiencies leading to possible overturning by the courts of agency practice (Fischman and Ruhl 2016).

Decision criteria would play several roles in implementing the Preferred Alternative; they are designed to:

- define requirements for compliance purposes (e.g., ESA, NEPA, USACE's policies)
- ensure that decisions incorporate best available science
- facilitate complex decisions, or decisions that must be made quickly during implementation
- provide a roadmap for participants (i.e., they define the decision space).

Decision criteria used herein may take various forms, including quantitative triggers, decision trees, planning rubrics, heuristics, and schedules and Gantt charts or flowcharts. Criteria cannot be developed for every decision faced in executing the Preferred Alternative. Some decision criteria may elude development during the initial planning stages; useful criteria cannot be developed until details of actions are known in some cases. As knowledge grows, it will likely become apparent that some criteria need to be changed. To address these realities, the AMP includes a suite of objectives and principles along with a process to guide the development/revision, review, and approval of decision criteria in the future.

4.3.4 NEPA, ESA, and Authority Considerations

Adjusting management actions would necessitate decisions be made on additional NEPA review. The CEQ NEPA Regulations require agencies to prepare supplements to their final EISs under two circumstances: (1) "the agency makes substantial changes to the proposed action that are relevant to environmental concerns", or (2) "if there are significant new circumstances or information relevant to environmental concerns and bearing on the proposed action or its impacts" (40 CFR 1502.9(c)). If AM provides significant new information affecting selection of the Preferred Alternative and the actions and potential impacts are not within the range of impacts and alternatives considered in the DPEIS, supplemental NEPA analysis would be required. Implementation of actions not contemplated in the DPEIS or based on a decision not to supplement the EIS, would require a separate NEPA process. This process would be initiated and conducted according to appropriate CEQ and USACE regulations and policies associated with NEPA. It is possible that USACE may decide to adjust to an action that was adequately assessed in the DPEIS but was not part of the selected alternative. In this case, USACE may issue a new decision document to reflect the change.

4.3.5 Quality Assurance and Independent Science Review

Government-wide standards for the peer-review requirements of scientific information outline the types of peer review that should be considered (OMB 2004). The USACE employs robust, multi-level product review and quality assurance processes (i.e., District Quality Control and Agency Technical Review) and the traditional independent external product review (IEPR)

process. These processes would likely be sufficient to assess products of many AM efforts. However, management may determine that a particular topic or issue could benefit from a targeted independent science review that provides objective input to the AM process.

4.4 ANNUAL ADAPTIVE MANAGEMENT PROCESS

The annual AM process would revolve around science updates (from monitoring and evaluation activities) and the generation and sharing of information about Preferred Alternative performance, then using that information for adjustments of the Implementation Plan (i.e., next 3 to 5 years). Figure 4-4 and Tables 4-3 and 4-4 summarize the process, which would recur each year. The following description outlines the basic process. The process is the same whether the action taken is considered an interim measure or long-term measure. It should be noted that the annual science update and annual Implementation Plan Update processes described below are in addition to, not a replacement of, the regular within year WATER collaboration that USACE engages in as part of real-time flow management and fish passage O&M.

4.4.1 Science Update Process

The Science Update process includes a set of activities that begins when system-wide and action-specific monitoring data becomes available each fall/winter and culminates in the annual AM Workshop, which generates input to the implementation plan update process. The following "typical" events as characterized are intended to guide the process only; deviation in some years will be required for various reasons.

- **Compilation of Information (October through February)** - USACE science and implementation staff compile information on work completed during the prior field season and other information relevant to the management measures in preparation for a Science Meeting.
- **Science Meeting (February)** – This meeting would be hosted annually by USACE to provide a regularly scheduled, focused opportunity for technical personnel engaged in research, studies, or monitoring and assessment to discuss technical aspects of the science and AM implementation efforts. The meeting provides opportunities for field crews to share initial observations regarding system conditions, project performance, and monitoring activities. The Science Meeting may be conducted using webinars and/or in-person meetings as dictated by needs each year, but typically consists of technical presentations with opportunities to discuss implications of the presentations. The Science Meeting would be used to initially identify key issues that could affect the Preferred Alternative's direction, and that serve as a basis for further investigation and discussion at the Adaptive Management Workshop. It is anticipated that the Science Meeting would be attended by members of the USACE Adaptive Management Team, agencies and/or contractors engaged in research or monitoring efforts, and WATER representatives. It is also anticipated that the interested public would be invited. The Science Meeting serves as a critical engagement

point for WATER representatives to learn about scientific findings relevant to the Preferred Alternative implementation. A meeting summary would be prepared as documentation.

- **Adaptive Management Workshop (March)** - A workshop would be held each year for USACE technical staff, program managers, senior leaders, and WATER representatives to discuss results of research and monitoring efforts for the previous year and collaborate on their implications with respect to the Preferred Alternative's direction. The workshop follows the Science Meeting, which serves as a basis for the discussions, and prior to the update of the Implementation Plan, which will incorporate workshop outcomes.

  Objectives of the AM Workshop include the following: (1) Report out on project and program performance, actions, monitoring and research, and projections; (2) Discuss implications of findings and emerging issues relative to strategic direction of the Preferred Alternative; and (3) Facilitate interactions necessary for the technical and implementation teams to develop their respective input and products needed to support the Implementation Plan.

  The AM Workshop is anticipated to be organized around meetings of the WATER Technical Teams, although other meeting organizations can be considered (e.g. topic-based such as flow, water quality, fish passage; or by sub-basin/WVS project). Status updates may be provided on the Implementation Plan, Conservation Plan, and budget in a plenary session, and the key topics identified for the engagement may be reviewed. Teams may then meet individually to deliberate on the performance of measures in the Preferred Alternative, status of the science relative to their technical team's needs, risks and management strategies, new technical developments, and future priorities. Teams may meet in a plenary closing session to report out on their discussions, address topics of overlapping interest, and identify next steps.

- **Adaptive Management Workshop Summary (April/May)** - The USACE or a Facilitation Team (if used) would prepare an AM Workshop Summary that outlines the primary presentations, issues, and outcomes and shares this product with WATER teams after the meeting.

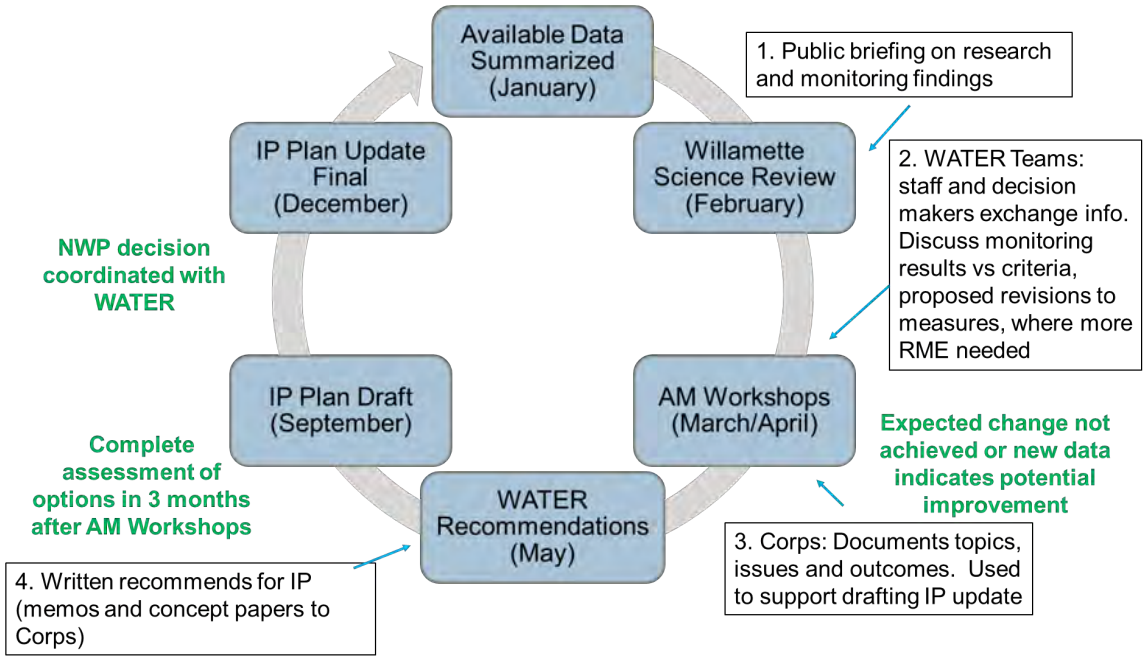

Figure 4-4. Basic annual adaptive management and Implementation Plan Update process.

Table 4-3. Summary of Annual Adaptive Management (AM) Science Update Process

Meeting/Product	Description	Timeframe
Science Meeting	A science meeting would be held for agency technical staff, WATER representatives, and the public to be briefed on research and monitoring findings.	February
Annual AM Workshop	Annual meeting where primary exchange of information between scientists and decision makers occurs. Includes close collaboration with WATER Technical Teams. Focus is on updates to the Implementation Plan given implications of new knowledge and implementation progress.	March
AM Workshop Summary	Documents topics, issues, and outcomes discussed during the AM Workshop. Provides documentation to support any further discussions within WATER teams and drafting of the Implementation Plan update.	April/May

Table 4-4. Summary of Annual Adaptive Management (AM) Annual Implementation Plan Update Process

Meeting/Product	Description	Timeframe
WATER Recommendations	WATER may develop recommendations on the Annual Implementation Plan Update. Recommendations should focus on FY+2 needs	June/July

Meeting/Product	Description	Timeframe
	and direction for the program (FY+3 and FY+4) but can include suggested adjustments to other years.	
Draft Updates to Annual Implementation Plan	The draft Annual Implementation Plan will be updated to incorporate science updates and associated WATER recommendations and sent out to the Management Team for review.	Nov/Dec
Final Annual Implementation Plan Update	The Annual Implementation Plan Update will reflect annual implementation progress and any additional adjustments to outyears.	January

4.4.2 Year 1 (FY25) Research, Monitoring and Evaluation Activities

The annual adaptive management process includes reviewing both recent and new information annually to inform activities in subsequent years, including RM&E needs. This includes considering which measures require additional RM&E, what level of precision is needed when assessing the associated metrics, and what study methods and techniques should be used. However, year one RM&E activities are not pre-defined in the AM plan. Because implementation of measures will begin on day one, RM&E activities are also needed in year one.

Attachment 1 includes RM&E activities developed for 2025 consistent with the Proposed Action measures defined in the WV Biological Assessment, AM Plan metrics, and the interim (formerly near-term) measures expected benefits and long term measures performance criteria. These RM&E activities are also by and large a continuum of activities currently being employed to assess injunction operations. Subsequent year RM&E activities will be refined by following the annual adaptive management process described in this AM Plan.

4.4.3 Annual Implementation Plan Update

The IP described in Chapter 2 provides the long-term strategy for implementation of management measures included in the Preferred Alternative. Following signing of a ROD, USACE would begin implementing measures based on the IP. Program Management would also need to account for necessary research, monitoring, and evaluation (RM&E) of management measures and research aimed at reducing uncertainty into near-term budget requests. However, implementation is highly dependent on the appropriation of funds and variability in budgets from year to year. In addition, new learning or emerging issues identified through the science update process could lead USACE in collaboration with WATER to adjust the prioritization reflected in the IP. To account for these necessary adjustments, USACE would maintain a rolling 3 to 5-year implementation plan that incorporates any updates necessitated by implementation progress and/or science updates. The “typical” events in the annual implementation plan update process would be as follows:

- **WATER Recommendations** – Annually, USACE would collaborate with WATER to assess if the group has interest in submitting recommendations to USACE regarding any adjustments to prioritization, inclusion of actions in the IP, or additions or modification to RM&E to provide information supporting IP decisions. The format for submission of recommendations from WATER to USACE is anticipated to include Memorandums for changes to actions in the IP and Concept Papers for recommendations on RM&E needs to support IP decisions.
- **Draft Annual Implementation Plan Update**– Based on the outcomes of the AM Workshop and any WATER Recommendations, the Annual IP would be updated to reflect any necessary changes in program implementation and prioritization. A draft Annual IP will be provided to WATER for review.
- **Final Annual Implementation Plan Update** – By January, USACE would finalize updates to the Annual IP and incorporate this information in its budget planning.

4.5 OTHER AM CONSIDERATIONS

4.5.1 Federal Advisory Committee Act

USACE (2019c) states that stakeholder engagement is a necessary component of any successful adaptive management process. However, one legal constraint to consider for non-Federal stakeholder involvement is compliance with the Federal Advisory Committee Act (FACA) (5 U.S.C. § 552 [1994]). Under FACA, Federal agencies may not receive advice from a group that the agency has established or that it uses (i.e., manages or controls) unless the agency complies with the provisions of FACA. The FACA is a procedural statute that requires certain actions be taken to set up and operate a committee or similar group that provides group-based (rather than individual) advice to Federal officials. FACA will be a consideration for USACE engagement with WATER throughout the AM process.

4.5.2 Dispute Resolution

Given the large number of considerations and decisions to be addressed in executing the Program, some disputes may arise. Commitment to the rapid and transparent resolution of disputes/conflicts is required from all parties. The approach for resolving conflicts within the Program depends on the nature of the conflict (technical or policy consideration) and the parties involved. USACE would strive to rapidly identify the appropriate path for dispute resolution, while remaining committed to an open, transparent, and collaborative process respective to roles and responsibilities.

If possible, inter-agency conflicts between USACE and another agency should attempt to be resolved using inter-agency engagements; however, any agency has a right to discuss their position within WATER. WATER technical teams may elevate disputes within those teams, with other technical teams, or to the Steering Team for consideration. If deemed appropriate, the Steering Team may elevate a dispute to the Manager's Forum, who is the final authority for WATER dispute resolution. Agencies are legally prevented from delegating decision-making

authority to any other group or individual. Decision making authority is delegated to a specific individual in each organization. Once the appropriate decision maker has been identified the issue should be properly briefed and elevated for resolution by that person.

For disputes of a technical or scientific nature, USACE may consider obtaining input from an independent science review should the Manager's Forum determine this to be a prudent course of action and funds are available.

4.5.3 Adjustments to Objectives and Decision Criteria

As learning progresses under AM, the need to update objectives, performance metrics, targets, decision triggers or other similar Preferred Alternative benchmarks may become necessary. These are factors that fundamentally guide the AM and relate to ESA compliance so they should be rigorously analyzed and deliberated, including full coordination between the USACE, NMFS, and USFWS and with opportunity for input by WATER. Recommendations for adjustments to these items can be initiated by USACE, NMFS, USFWS, or by WATER. Recommendations ideally should be provided in the form of a white paper outlining (a) the specific objective, performance metric, target or criterion to be reconsidered, (b) the basis for the proposed change (studies, reports, monitoring results, data, etc.), and (c) a summary of the rationale and benefits of the change. The merits of recommended changes and feasibility of incorporating said recommendation(s) given the stage of implementation should be discussed as agenda items at the annual AM Workshop. Following the AM Workshop, the Action Agencies along with the Services will discuss the recommended changes and make a decision. .

4.5.4 Addressing New Information

Review of occasional "new information" may be needed for information that originates outside the Program but could significantly influence its direction. The procedure outlined in this section is intended to ensure that the Program is using the high-quality information such as best available and verifiable science information in informing AM decisions and that it is not subject to change driven by incomplete or unsubstantiated data or research.

Any member of WATER may bring to their respective WATER Technical Team new data or other information on the ecology and behavior of the listed species, resources, and habitat attributes that effect those species including environmental stressors, ecosystem processes that are known or suspected to contribute to the survival and recovery of those species, and human factors that may affect the listed species. The member can initiate a review to assess that new information by submitting to either of the WATER Technical Team chairs an issue paper that concisely explains the rationale for introducing new science information. This paper does not need to document all available information; the intent is to illustrate the importance of the issue and motivate a more-detailed analysis and discussion within the group, if appropriate. The paper should include a description of the information and its source, an explanation of its management relevance, and pertinence to purpose of the Program and stated objectives. The WATER Technical Team chair would discuss with the full Technical Team to arrive at an initial determination on whether the new information may have relevance and importance to

decision making. A written evaluation and response may be provided to the submitter. If the initial determination does not support a detailed evaluation of the issue, the submitter will be given an opportunity to provide additional information.

If the initial determination identifies merit in the issue, the WATER Technical Team would discuss what the information means for the program and the actions being taken. The WATER Technical Team chair would then elevate the teams recommendations for consideration by the Steering Team. The Steering Team will deliberate on the initial determination from the Technical Team and determine the appropriate next steps regarding review or research to determine if and how the AM process should accommodate the new information. Anticipated courses of action could include:

- Note the issue but take no further action (based on lack of merit, no clear relationship to management actions, etc.).
- Recommend additional study (including identification of additional data or scientific information/analyses required to clarify the issue).
- Refer the issues for independent review.
- Adjustments to research and monitoring efforts or actions.

In the event further consideration does not resolve the issue, or if the submitting entity disagrees with the outcome, the issue may be elevated to the Manager's Forum.

CHAPTER 5 - ADAPTIVE MANAGEMENT OF THE PREFERRED ALTERNATIVE

The primary purpose for AM in the USACE is to ensure a project or program achieves its goals and objectives (USACE 2019c). The following sections of this chapter describe the proposed performance metrics, targets, and decision triggers for the measures in the Preferred Alternative. Where applicable, the constraints, risks, and uncertainties associated with each measure are described. Measure-specific decision-making considerations and engagements are also described. A summary of the metrics and criteria are provided in the following sub-section.

5.1 OVERVIEW OF DECISION METRICS AND CRITERIA

Interim Operations

Metrics and targets for assessing the performance of interim actions are listed in Table 5-1. The expected direction change resulting from each interim operations are described in the sub-basin sections of Chapter 5 of this plan. However, there is uncertainty in the extent effects from WVS O&M can be reduced by interim actions. By definition the interim actions are not expected to address project effects adequately (i.e. are not the intended long-term solution). The expected directional change criteria for each interim operation, including those as modified in the future per this adaptive management plan, are anticipated to be refined as monitoring and adaptive management progresses. Annually the "expected directional change" criteria listed in Table 5-1 will be reviewed and revised as needed during the Annual Implementation Plan Update process. If monitoring and evaluation determines that an interim operation could potentially meet the long-term criteria for that type of action (e.g. fish passage, flow, water quality), then the criteria associated with the proposed long-term solution for that type of action would be adopted.

Decision Triggers for considering operational changes to interim measures include:

1. Monitoring results indicate the expected directional change not achieved
2. New data shows potential for improvement in one or more interim metrics
3. Negative consequences occur including those for environmental objectives, or other mission areas.

During the Annual AM Workshops, if any of the above decision triggers are indicated then modifications to operations will be discussed and recommended as part of the Annual Implementation Plan Update process. Prior to determining if revisions will be made to the Annual Implementation Plan Update, recommended changes will be assessed, accounting for the feasibility, benefits, impacts, schedule, and cost as follows:

1. Must meet requirements of an RPA under the ESA for authorization, economic feasibility and technical feasibility
2. Does not increase flood risks or reduce dam safety
3. Does not result in un-acceptable tradeoffs for other ESA objectives (e.g. performance criteria cannot be met)

4. Accounts for impacts to other missions
5. Accounts for the timing and duration of benefits when considering schedule for long-term measure(s)
6. Where new funds are required, implementation timing will be subject to funding approval as part of the federal 3-year budget cycle
7. Requirements for and timing to complete additional environmental reviews and authorizations (i.e. NEPA, CWA, etc.)
8. Assessment of proposed changes to operations will be based on available information, which may include estimated changes in:
    a) Reservoir and river hydrology (RES-SIM)
    b) Temperature and TDG (CE-Qual-W2 and TDG models)
    c) Downstream fish passage survival (FBW)
    d) Downstream fish habitat conditions (USGS habitat/flow model)

Table 5-1. Metrics and criteria for assessing interim actions for downstream fish passage, water temperatures and total dissolved gas.

Activity	Annual Monitoring Metric(s)*	Criteria**
Downstream passage	Dam passage survival Dam passage injury Dam passage efficiency Dam passage timing Passage age/size composition	Expected directional change in metric achieved compared to previous operation
Temperatures	7-day Average of the Daily Max (7dADM) at Salem	
Total dissolved gas	Total dissolved gas(TDG) levels below dam	

**Metrics monitored and assessed for interim downstream passage will depend on the operation and benefits sought. **Expected direction change for proposed actions is defined in the sub-basin sections of Chapter 5 under criteria, and will be revised annually as needed when operational changes are implemented per the Annual Implementation Plan Update process.*

Long-Term Measures

Metrics and targets for assessing the performance of long-term actions are listed in Table 5-2. A flow diagram showing how dam passage survival and cohort replacement rate (CRR) criteria would be applied to determine if changes have achieved objectives is provided in Figure 5-1. Once CRR criteria is achieved, then CRR would continue to be monitored for 10 additional years after to help ensure improvements for the maintenance of a sustainable sub-population above the dam(s) in each sub-basin.

Table 5-2. Metrics and criteria for assessing long-term actions for fish passage, flow, water temperatures and total dissolved gas.

Action	Metric	Criteria	Assessment Frequency
Downstream fish passage	Downstream Dam Passage Survival (DPS^)	DPS supporting CRR of 1 or greater above dam	Assess/reassess for 2 yrs within first 5 yrs of improvement or adjustments.
Downstream fish passage	Above-Dam Chinook Cohort Replacement Rate (CRR)	Geometric mean of above-dam CRR for three cohorts ≥ 1.0	Assess/reassess for 3 cohorts within 7 yrs of improvement or adjustments. Continue assessment for 10 additional yrs after criteria met.
Upstream fish passage	Upstream Dam Passage Trap and Transport Timing	Trap and transport timing objectives in WFOP	Annually
Flow	Minimum targets below WVS dams for tributaries, and for mainstem at Albany and Salem	Flows > minimum values for each management reach	Annually
Flow	Reach survival below WVS dams	Increased reach survival over baseline	Every 5 yrs as feasible given data availability and variability.
Temperatures below WVS dams	Targets as specified in Proposed Action	Temperatures within specified ranges	Annually
Total dissolved gas (TDG)	Daily mean TDG	<110%; hatchery receiving waters < 105%	Annually

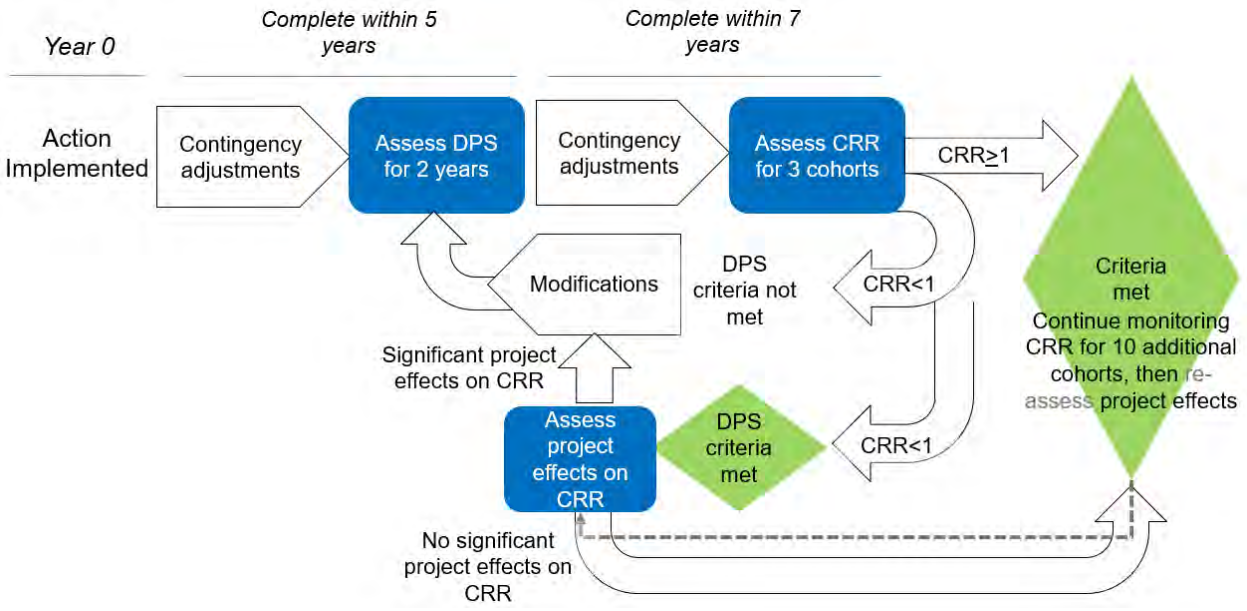

Figure 5-1. Flow diagram showing timing and decision pathways using the metrics Dam Passage Survival (DPS) and Cohort Replacement Rate (CRR) to assess long term downstream fish passage measures.

5.2 NORTH SANTIAM

5.2.1 Detroit Interim Operations

5.2.1.1 Definition and Function

Interim operations at Detroit include provision for temperature improvement and downstream fish passage by prioritizing flow releases through the upper regulating outlets (UROs) during the fall/winter once the Detroit Reservoir elevation is less than 100 feet over the turbine intakes (1419 ft); target el. 1450 -1500 ft. The timing of the operation results in approximately 60% of the daily flow going through the upper regulating outlet and approximately 40% through the penstock and turbines. Provision of downstream fish passage in the spring and water temperature management throughout late spring and summer at Detroit and Big Cliff Dams would occur through strategic use of the spillway, turbines and regulating outlets. Spillway operations would start when the reservoir reaches spillway crest elevation (El. 1541.0 ft) and continue until the reservoir is drafted below the spillway crest. From there, a combination of turbine and regulating outlet (RO) discharges would be implemented until water temperature management is no longer possible due to reservoir turnover.

5.2.1.2 Constraints

Implementation should not:

- Result in a reduction of USACE ability to operate the dam for flood risk management authorized purpose

- Violate USACE dam safety requirements.

5.2.1.3 Performance Metrics and Targets

Interim operations at Detroit are anticipated to be implemented until the Detroit Selective Withdrawal Structure (SWS) and Floating Screen Structure (FSS) are constructed and operational. USACE selected the SWS/FSS as the long-term solution to downstream fish passage at Detroit. Downstream passage survival of juvenile Chinook has been estimated through Detroit Dam, and therefore metrics for fish passage focus on monitoring of passage efficiency and timing.

Performance Metrics:

The performance metrics listed in Table 5-1 will be used to evaluate the interim operations at Detroit, along with the following:

- Dam outlets operated during the defined interim operational period
- Pool elevations during the defined interim operational period
- Gate openings and discharge from each outlet operated
- Juvenile Chinook passage efficiency through preferred routes at Detroit Dam
- Juvenile Chinook passage timing at Detroit Dam

Targets:

- Flow releases prioritized through the upper regulating outlets (UROs) during the fall/winter once the Detroit Reservoir elevation is less than 100 feet over the turbine intakes (1419 ft); target elevation 1450 -1500 ft.
- Strategic use of the spillway, turbines and regulating outlets at Detroit and Big Cliff Dams, with spillway operations starting when the reservoir reaches spillway crest elevation (El. 1541.0 ft) and continue until the reservoir is drafted below the spillway crest. From there, a combination of turbine and RO discharges would be implemented until water temperature management is no longer possible due to reservoir turnover.
- Seasonal downstream juvenile Chinook passage efficiency through preferred routes (spillway and ROs) at WVS dams increased over pre-injunction operations.
- Downstream juvenile Chinook passage timing at WVS dams more consistent with natural emigration patterns in comparison to pre-injunction operations.
- Daily water temperatures as defined in Table 5-3.

Table 5-3. Detroit / Big Cliff Dams downstream water temperature 2020 resource agency (RA) targets (daily average)* and ODEQ's 2006 TMDL targets (seven-day average).

Month	Current RA Target Temperature Range Maximum / Minimum °F *		Prior RA Target Temperature Range Maximum / Minimum °F		ODEQ 2006 TMDL Target Temperatures °F
January	42	38	40.1	40.1	No Allocation Needed
February	42	38	42.1	41.0	No Allocation Needed
March	44	42	42.1	41.0	No Allocation Needed
April	46	42	45.1	43.2	41.7
May	50	46	49.1	46.0	45.1
June	54	48	56.1	51.1	49.5
July	55	52	61.2	54.1	55.0
August	55	52	60.3	54.1	55.0
September	54	48	56.1	52.3	51.6
October	52	46	<50.0	<50.0	45.9
November	46	42	<50.0	<50.0	45.9
December	46	41	41.0	41.0	No Allocation Needed

*Daily average 2020 RA target temperatures proposed by ODFW (2017) and approved in 2017 and 2018 by the North Santiam temperature task group (USACE, BPA, ODFW, NMFS, USFWS and ODEQ) for downstream of the Detroit and Big Cliff Dams. On July 20, 2018, the maximum 2018 RA targets were revised to 60 °F through August.

5.2.1.4 Research, Monitoring, and Evaluation

Interim actions were designed in collaboration with NMFS and other parties to operate the dams as best as feasible using existing facilities until long-term actions are implemented. Due to the effects of annual hydrologic variability in meeting interim operational objectives and resulting variability in water quality and fish passage conditions expected to occur within and across years, multiple years of monitoring are anticipated to be needed to understand if operations are achieving objectives and targets or if changes are warranted. Monitoring results will be reported and reviewed annually. If targets are not met, decision makers will determine each year if any adjustments should be made to meet the operational objectives or water quality targets, or if additional monitoring or uncertainty research should be conducted.

Study designs and methodology to assess the defined metrics will be reviewed and updated annually so that the best available scientific approaches and methods can be applied. The AM process will be followed to annually prioritize research and monitoring activities, and to complete technical review of proposed monitoring plans for assessing the metrics against the defined targets.

5.2.1.5 Risks and Uncertainties

Potential risks to successful implementation include:

- Interim operations for fish passage and water quality may influence the ability to meet tributary flow targets in some years.

- Meeting tributary flow targets may influence the ability to achieve interim operations for fish passage and water quality in some years.
- During the fall drawdown, use of the ROs at Detroit is limited and/or passage into the turbine penstocks is not reduced.

5.2.1.6 Decision Triggers and Adaptive Actions

Decision Criteria:

- If operational objectives or targets are met, continue with interim operation.
- If operational objectives or targets are not achieved for reasons other than hydrologic limitations or FRM operations, then implement adjustments to operations expected to improve achievement of targets which are feasible and authorized.
- If there are potential feasible and authorized adjustments, but uncertainty if those adjustments can improve the ability to achieve targets, then conduct uncertainty research and implement if results indicate improvement in likelihood of achieving targets.

5.2.1.7 Decision-Making and Collaboration

The USACE will prepare annual reports documenting operations and summarizing the results in comparison to the defined targets. Annual check-ins will occur to assess how well targets have been achieved for water quality. Annually fish passage results will be reviewed as part of the annual AM process to assess how well targets have been achieved. Where targets are not achieved, the Action Agencies will propose changes to improve achievement of the operation where feasible and authorized. If changes that could improve achieving targets are not apparent, Action Agencies or WATER may instead propose uncertainty research to inform what changes may lead to achievement of the targets. The WATER Technical Teams will review the reported results from the operation, and any proposed changes to achieve the operational targets. The USACE will ensure evaluations are carried out and reports are made available for NMFS and WATER review within timelines necessary to inform AM decisions outlined in this document.

5.2.2 Detroit Selective Withdrawal Structure (105)

5.2.2.1 Definition and Function

This measure would use a temperature control structure, assumed to be a selective withdrawal structure (SWS), to achieve Clean Water Act (CWA) total maximum daily load (TMDL) temperatures, and ESA water temperature requirements below Detroit Dam, as appropriate. Temperature control structures include outlet works that allow for selective withdrawal of water at various temperatures that could be blended to improve downstream water temperature. Structural fixes could allow releases from various elevations in the reservoir, send this water through the powerhouse, and continue to generate power while meeting downstream water quality targets. Water temperature simulations assume outlet details and

temperature targets align with those used in previous studies (Buccola et.al 2012, Buccola et.al 2016, Buccola 2017, USACE 2019d, USACE 2019e).

5.2.2.2 Constraints

Constraints associated with the Detroit SWS will be identified as part of the project-specific planning documents developed prior to implementation. However, two known constraints relating to this measure is that implementation should not:

- Result in a reduction of USACE ability to operate the dam for flood risk management authorized purpose, and
- Violate USACE dam safety requirements.

5.2.2.3 Performance Metrics and Targets

Performance Metric:

- Water temperature: 7-day running average of downstream water temperature

Targets:

Table 5-3 identifies the existing water temperature targets for the North Santiam. Evaluation and/or refinement of these targets may be necessary in the future, which would be coordinated through the WATER Flow Management and Water Quality Technical Team.

5.2.2.4 Research, Monitoring, and Evaluation

North Santiam water temperature is measured upstream and downstream of Detroit and Big Cliff Reservoirs throughout each year. USACE continues to fund the USGS to measure and report continuous flow, temperature and TDG. The downstream gage that would be used to evaluate this measure is located 0.75 mile below Big Cliff Reservoir near Niagara (BCLO). Flow, stage, temperature, and TDG data are published real-time by the USGS on publicly accessible websites. The USGS station number, which corresponds to the USACE identification, i.e., BCLO, is 14181500.

5.2.2.5 Risks and Uncertainties

Risks and uncertainties associated with this measure would be described during the site-specific planning and design process. There are occasions when potential conflicts may arise between operating to meet the downstream fish temperature targets and the TMDLs. When this occurs, there is a trade-off decision that must be made in real-time prioritizing the needs of the species.

5.2.2.6 Decision Triggers and Adaptive Actions

The success of the SWS would be evaluated against the ability to manage flows to meet the downstream water temperature targets. The extent to which operations of the SWS could be adjusted to ensure performance would be described in future planning and design documentation. Specifically, the Design Documentation Report or associated Engineering Documentation Report would describe the operation, maintenance, repair, replacement, and rehabilitation requirements for the structure.

5.2.3 Detroit Floating Screen Structure (392)

5.2.3.1 Definition and Function

The measure provides a structural solution to improve downstream fish passage in the form of a Floating Screen Structure (FSS; gravity fed flow which may include pumps for supplementing inflow). A temperature tower is needed to accommodate mooring of the FSS and receiving the gravity fed outflow from the FSS.

5.2.3.2 Constraints

Constraints associated with the Detroit FSS will be identified as part of the project-specific planning documents developed prior to implementation. However, two known constraints relating to this measure is that implementation should not:

- Result in a reduction of USACE ability to operate the dam for flood risk management authorized purpose, and
- Violate USACE dam safety requirements.

5.2.3.3 Performance Metrics and Targets

Performance Metrics:

The following performance metrics, also listed in Table 5-2 and Figure 5-1, will be used to evaluate the passage at Detroit once the FSS is operational:

- Juvenile Fish Dam Passage Survival (DPS = DPE * CS)
    - Sub-metric: Dam-passage efficiency (DPE), the proportion of total fish passing the dam relative to the number of total fish detected in the near forebay of the dam and therefore available to pass.
    - Sub-metric: Fish passage efficiency (FPE), the proportion of fish passing via a non-turbine route, relative to the number of total fish in the near forebay and available to pass. This sub-metric will be used to calculate DPE.

  - Sub-metric: Fish collector efficiency (FCE), defined as the proportion of fish passing (collected by) the FSS, relative to the number of total fish passing the dam via any route. This sub-metric will be used to calculate DPE.
  - Sub-metric: Concrete Survival (CS), the proportion surviving passage through each route weighted by the number passing through each route
- Above-Dam Cohort Replacement Rate (CRR)[1]

Targets:

- DPS: Higher value of the following two estimates
  - DPS rate needed to support replacement of spawners above dams as estimated using life cycle models, such as those developed for the Draft WVS PEIS and ESA consultation. Modeling to define the DPS rate needed to support replacement of spawners will be completed in year one of implementation of the proposed action and will incorporate any new and relevant scientific information into models.
  - Estimate of annual DPS across water year types
    - This estimate will be prepared using the Fish Benefit Workbook (FBW) or other approaches to estimate DPS across a range of water year types. New information will be used to update the estimate prior to assessing performance (field study data; revised models).
- Geometric mean of Above-dam Cohort Replacement Rate (CRR) for three cohorts ≥ 1.0

[1] The success of reintroduction above the federal dams in the Willamette is being evaluated principally through genetic pedigree analyses (NMFS 2019).

Figure 5-2. Detroit Dam tailrace, forebay, and near forebay zone (gray) showing approximate area to be used for measuring fish passage metrics.

5.2.3.4 Research, Monitoring, and Evaluation

Dam passage survival (calculated as DPS = DPE * CS) will be measured in two separate years which are representative of typical operating conditions (i.e., water years within 95% of normal hydrological conditions in the period of record). The precision needed about annual DPS estimates will be determined at the time of the assessment to evaluate passage to provide reasonable certainty bounds acceptable to decision makers.

DPE will be measured as the proportion of fish that exit the reservoir downstream (or are transported downstream) divided by the total number of fish in the near forebay area (i.e., fish approaching the dam). For Detroit the near forebay area will be defined as from the dam upstream to approximately the log boom in the upstream boundary of the dam forebay (Array 6 as defined by Beeman et al. 2015) (Figure 5-2).

CS will be measured as the number of fish that survive from Detroit Dam to the downstream CS measurement boundary divided by the total number of fish that pass downstream. The CS downstream measurement boundary will be located near the river confluence with the mainstem Willamette River (or nearest feasible location upstream of the confluence for

assessing survival). In the North Santiam River below Detroit Dam, previous survival estimates used detection arrays at Minto Dam and Portland Oregon (Beeman et al. 2015), and these locations will be reconsidered to produce comparable survival estimates. Bennett dams are an additional option for placing a marked fish detection array for assessing CS.

The priority seasonal period(s) for assessing DPS, DPE and CS are the times of the year representative of when most juvenile salmon migrants are actively moving downstream. These test periods likely will cover portions of spring and fall/winter and could be one longer test period or two separate seasonal periods within a year.

Above-dam CRR serves as a basis for evaluating performance of the above-dam population performance. Above-dam CRR will be estimated as:

$$CRR = \frac{\text{Number of } \mathbf{unmarked} \text{ 3, 4 and 5 year old returns produced by outplants (males and females) in Year X}}{\text{Number of spawners (}\mathbf{marked\ and\ unmarked}\text{) in Year X}}$$

Above-dam CRR is calculated using the above equation, and uses the entirety of the spawning population in the reach above the dam regardless of the origin of the parents. In other words, adults of hatchery origin used to supplement the number of spawners is considered part of the cohort parentage. The HGMP thresholds define the minimum abundance levels for assessing CRR above each dam because outplanted adults will continue to be supplemented with hatchery fish until natural origin fish meet or exceed the HGMP thresholds (Table 5-7).

5.2.3.5 Risks and Uncertainties

- FSS Entrance rejection by juvenile Chinook and steelhead
- Reservoir influence on steelhead passage rates and residualism (i.e., juveniles choose not to emigrate downstream but mature in the reservoir or upstream.
- Seasonal variation in flow rates (from hydrology or dam operations) influencing fish attraction and collection
- Uncertainty in survival rate associated with copepod infection
- Difference in survival between volitional passage and truck transport downstream.
- Effectiveness of structural passage given scale of reservoir fluctuation at Detroit Dam
- Large forebay area impacting guidance and attraction to the FSS entrance. Design has used the dam as a guidance structure. Entrance oriented along longitudinal face of the dam. Could influence the number of fish attracted to entrance point.
- Climate change – see discussion under Basin Flow Measures (Section 5.1.1.5).

5.2.3.6 Decision Triggers and Adaptive Actions

Successful fish passage would be defined by achieving either the DPS or the CRR target, as depicted in Figure 5-1. If the DPS target has been met, but not the CRR target, additional assessment will be completed to determine if CRR is not being met due to project effects or

non-project effects. If the issue is due to project effects, additional measures taken under the preferred alternative will be identified, designed and implemented, and then CRR (and DPS if warranted, depending on the type of additional improvements made) will be re-evaluated, or reconsultation will occur.

Contingency actions to operation of the FSS are expected to be made in real-time during the first few years as part of the commissioning and initial operations. Once studies to assess the performance metrics begins, no in-season changes will be made to support evaluation. However, operational treatments for study may be considered at this time to simultaneously evaluate different conditions. Once two representative study years of FSS operation are completed, and the DPS target is not achieved, additional contingency actions will be implemented that are within the design capacity of the FSS. If actions require additional funding or engineering, these will be implemented if the above-dam CRR criteria (after years 5,6 and 7) is also subsequently not met. After contingency actions or follow-on actions requiring additional funding or engineering are taken, DPS and CRR will be re-assessed following the same approach and timeframes as the initial assessments, as described above.

Examples of contingency actions for the FSS include:

- Structural: adjusting baffles, and other tuning of the existing facility; changing debris management practices, changing fish handling/holding/transport using existing facilities, guide nets or lead nets.
- Operational: FSS: longer or shorter operational periods of FSS, increasing or decreasing entrance flows, operating screens above criteria, bypass flows, etc.
- Operational dam and reservoir: changes to operating intake gates of temperature tower, increasing or decreasing total or proportional through RO or turbine, changes in refill pattern, operating dam with pulses, operating at lower pool level during conservation season, changing rate of reservoir drawdown through summer and fall.

The extent to which operations of the FSS could be adjusted to ensure performance would be described in future planning and design documentation. This would include both contingency actions as well as adjustments that may require additional environmental compliance or planning/design activities prior to implementation. Specifically, the Design Documentation Report or associated Engineering Documentation Report would describe the operation, maintenance, repair, replacement, and rehabilitation requirements for the structure.

After DPS and above-dam CRR is achieved, above-dam CRR will then continue to be monitored for the subsequent decade to ensure performance is going to maintain. If the geometric mean of CRR is less than 1 for this period, and it is determined the FSS remains a significant factor effecting CRR, then additional measures taken under the preferred alternative will be identified, designed and implemented, and then CRR (and DPS if warranted, depending on the type of additional improvements made) will be re-evaluated, or reconsultation will occur.

5.2.3.7 Decision-Making and Collaboration

The Action Agencies will fund post-construction evaluations of DPS and fish survival through the FSS. The WATER Fish Passage Design, Research, and Development Technical Team and other WATER Technical Teams, either jointly or separately will review study designs for assessing the performance metrics. It is also anticipated that study designs may benefit from a targeted independent scientific review. The Action Agencies will address the comments to improve the study design for assessing the performance metrics. If NMFS and the Action Agencies' technical staff do not concur on final study designs, the dispute will be elevated for resolution following Federal Family and WATER procedures and protocols. The Action Agencies will ensure evaluations are carried out and reports are made available for NMFS and WATER team review within timelines necessary to inform adaptive management decisions outlined in this document.

5.2.4 Minto Adult Fish Facility

5.2.4.1 Definition and Function

Continued operation of the Minto adult fish facility (AFF) for transport of adult spring Chinook and steelhead above Detroit Dam.

5.2.4.2 Constraints

Implementation should not:

- Result in a reduction of USACE ability to operate the dam for flood risk management authorized purpose, and
- Violate USACE dam safety requirements.

5.2.4.3 Performance Metrics and Targets

Performance Metrics:

The following performance metrics will be used to evaluate operation of the Minto AFF:

Adult fish collection and handling, and adult fish transport and outplanting protocols defined in the current Willamette Fish Operations Plan. At a minimum, the following protocols will be evaluated:

- Timing of fish collection and outplanting relative to natural run timing
- Injury rates from handling and sorting
- Mortality rates for fish while in the AFF or during truck transport
- Health condition of fish outplanted
- Health condition of fish taken for brood

- Number and locations of outplanted fish
- Sex ratio of outplanted fish
- Fish densities when in holding at AFF and in transport trucks
- Water temperatures and oxygen levels in the AFF and transport trucks
- Cumulative temperature exposure when in the AFF and transport trucks
- Temperature exposure when water temperatures need to be tempered prior to release of outplanted fish

Additional monitoring activities are also included for ongoing hatchery mitigation relevant to assessing the trapping and transport of adult Chinook salmon (see Section 5.6 of this Plan).

Targets:

Compliance with the adult fish collection and handling, and adult fish transport and outplanting protocols defined in the 2022 Willamette Fish Operations Plan.

5.2.4.4 Research, Monitoring, and Evaluation

Upstream passage metrics will be summarized annually, and reports provided to WATER for review. Information on most metrics listed above will be collected commensurate with operation of the AFF. Discharge and water temperatures below Detroit Dam will also be continuously monitored. As part of ongoing hatchery mitigation monitoring activities, available information on the following metrics will be included as part of annual summaries to support monitoring of upstream passage actions in the sub-basin:

- Counting salmon at diversion dams (Bennett).
- Counting of salmon at WVS AFF.
- Number, sex ratio and timing of adult salmon released above WVS dams.
- Assess genetic pedigree of Chinook Salmon.
- Assess salmon spawning above federal dams.

5.2.4.5 Risks and Uncertainties

- Effects of variation in Detroit Dam discharges (from hydrologic conditions, FRM, hydropower, etc.) on upstream migration of adult fish to Detroit Dam tailrace and adult collection in the AFF.
- Effects of water temperatures discharged from Detroit Dam or from the AFF on adult attraction and collection in the AFF.

5.2.4.6 Decision Triggers and Adaptive Actions

Minor changes to operation of the AFF (i.e., operational feasible, and within USACE authority, and not requiring additional funding) are expected to be made in real-time to maintain compliance with the WFOP protocols. Reports of operations will be reviewed annually to determine areas where minor changes may be needed. If compliance cannot be maintained with minor changes, then adjustments or modifications will be assessed. Depending on the potential solutions, engineering studies or biological studies may be planned as funding is available. The timeframe for implementation of adjustments of modifications to the AFF will depend on the specific actions identified for implementation.

5.2.5 Big Cliff Spread Spill for TDG Abatement (Injunction Measure 10b)

5.2.5.1 Definition and Function

Spread spill across multiple spill bays at Big Cliff Dam, when operating the spillway, to reduce TDG levels. When spill is necessary at Big Cliff Dam, some benefit can be realized from spreading spill across the spillway, using multiple spill bays.

5.2.5.2 Constraints

Minimum gate opening constraints preclude USACE from spreading spill under many flow regimes. Additionally, TDG is generated by Detroit Dam operations, particularly when a non-turbine unit is used to discharge water. In this case, spreading spill at Big Cliff Dam does not prevent/abate TDG levels that are generated by Detroit Dam.

5.2.5.3 Performance Metrics and Targets

Performance Metric:

- Daily average TDG

Target:

- TDG <110%; hatchery receiving waters < 105%

5.2.5.4 Research, Monitoring, and Evaluation

USACE continues to fund the USGS to measure and report continuous flow, temperature and TDG. The downstream gage that would be used to evaluate this measure is located 0.8 miles below Big Cliff Reservoir near Niagara (BCLO). Flow, stage, temperature, and TDG data are published real-time by the USGS on publicly accessible websites. The USGS station number, which corresponds to the USACE identification, i.e., BCLO, is 14181500.

5.2.5.5 Risks and Uncertainties

Potential conflict between downstream water temperature management, downstream fish passage operations, downstream fish hatchery TDG target, and meeting a target of 110% TDG.

5.2.5.6 Decision Triggers and Adaptive Actions

It is anticipated that this measure would be implemented until the Big Cliff TDG Abatement Structure is operational. As a result, decision triggers and adaptive actions are not applicable to this measure.

5.2.6 Big Cliff TDG Abatement Structure (Injunction Measure 10b)

5.2.6.1 Definition and Function

USACE has established a PDT to evaluate alternative concepts for a TDG abatement structural solution at Big Cliff. Although the function of any structural solution would be to reduce TDG downstream of Big Cliff, the specific structural solution that will be selected for implementation has not yet been determined.

5.2.6.2 Constraints

Constraints would be documented as part of the planning and design reports.

5.2.6.3 Performance Metrics and Targets

Performance Metric:

- Daily average TDG.

Target:

- TDG <110%; hatchery receiving waters < 105%

5.2.6.4 Research, Monitoring, and Evaluation

USACE continues to fund the USGS to measure and report continuous flow, temperature and TDG. The downstream gage that would be used to evaluate this measure is located 0.8 miles below Big Cliff Reservoir near Niagara (BCLO). Flow, stage, temperature, and TDG data are published real-time by the USGS on publicly accessible websites. The USGS station number, which corresponds to the USACE identification, i.e., BCLO, is 14181500. USACE also provides depth information to population dynamics models to measure TDG dissipation relative channel configuration to quantify the realized mortality impacts.

5.2.6.5 Risks and Uncertainties

To be determined as part of project-specific planning and design. Modeling efforts are ongoing to compare the basin wide TDG standard to specific sub-basin river configuration to quantify depth compensation and mortality risks. Preliminary analysis indicates that in cases where TDG standards are exceeded, mortality risk is dependent on channel configuration. Gas-bubble trauma is not closely correlated to mortality and outcomes are sub-basin specific.

5.2.6.6 Decision Triggers and Adaptive Actions

Decision triggers would be defined following selection of the structural solution for TDG abatement at Big Cliff. However, it is likely that if TDG exceedances occurred following implementation of the structural project that would necessitate the need to adjust. A potential adjustment given that scenario would be to resume the Big Cliff spill spread measure. Timing of the decision to adjust would also need to account for when the Detroit SWS/FSS was constructed and operational.

5.3 SOUTH SANTIAM

5.3.1 Green Peter Pass Water Over Spillway in Spring (714) and Deep Fall Reservoir Drawdown to Regulating Outlets (40)

5.3.1.1 Definition and Function

Discharge water via the surface spillway in spring and early summer to increase the number and survival of juvenile salmon and steelhead passing downstream of Green Peter Dam. Drawdown Green Peter Reservoir in fall to 25 feet over the ROs. Juvenile salmonids are known to pass if a surface route is available, particularly in spring and fall. Providing surface spill in spring and then decreasing reservoir elevations to near ROs in fall would increase the number of fish passing and their survival rate.

5.3.1.2 Constraints

Constraints relating to this measure is that implementation should not:

- Result in a reduction of USACE ability to operate the dam for flood risk management authorized purpose, and
- Violate USACE dam safety requirements.

5.3.1.3 Performance Metrics and Targets

The following performance metrics, also listed in Table 5-2 and Figure 5-1, will be used to evaluate the passage at Detroit once the FSS is operational:

- Juvenile Fish Dam Passage Survival (DPS = DPE * CS)

  - Sub-metric: Dam-passage efficiency (DPE), the proportion of total fish passing the dam relative to the number of total fish detected in the near forebay of the dam and therefore available to pass.
  - Sub-metric: Fish passage efficiency (FPE), the proportion of fish passing via a non-turbine route, relative to the number of total fish in the near forebay and available to pass.
  - Sub-metric: Concrete Survival (CS), the proportion surviving passage through each route weighted by the number passing through each route
- Above-Dam Cohort Replacement Rate (CRR)

Targets:

- DPS: Higher value developed from the following two approaches:
  - DPS rate needed to support replacement of spawners above dams as estimated using life cycle models, such as those developed for the DPEIS and ESA consultation. Modeling to define the DPS rate needed to support replacement of spawners will be completed in year one of implementation of the proposed action, and will incorporate any new and relevant scientific information into models.
  - Estimate of annual DPS across water year types
    - This estimate will be prepared using the Fish Benefit Workbook (FBW) or other approaches to estimate DPS across a range of water year types. New information will be used to update the estimate prior to assessing performance (field study data; revised models).
- Cohort Replacement Rate = ≥1.0

Figure 5-3. Green Peter Dam tailrace, forebay, and near forebay zone (gray) showing approximate area to be used for measuring fish passage metrics.

5.3.1.4 Research, Monitoring, and Evaluation

Annual dam passage survival (calculated as DPS = DPE * CS) will be measured in two separate years which are representative of typical operating conditions (i.e., water years within 95% of normal hydrological conditions in the period of record). The precision needed about annual DPS estimates will be determined at the time of the assessment to evaluate passage to provide reasonable certainty bounds acceptable to decision makers.

DPE will be measured as the proportion of fish that exit the reservoir from the near forebay zone downstream, divided by the total number of fish in the near forebay zone (i.e., fish approaching the dam). For Green Peter the near forebay zone will be defined as from the dam upstream to approximately the log boom, comparable with the upstream boundary used by Beeman et al. (2015) for assessment of downstream passage metrics at Detroit Dam (Figure 5-3).

Test period(s): Times of the year representative of when most juvenile salmon migrants are actively moving downstream. These test periods likely will cover portions of spring and fall/winter and could be one longer test period or two separate seasonal periods within a year.

CS will be measured as the number of fish that survive from Green Peter Dam to the downstream to one of two CS measurement boundaries, each divided by the total number of fish that pass downstream. Two CS measurement boundaries are necessary to assess passage survival at Green Peter Dam separately from the combine passage survival for both Green Peter and Foster dams. The first CS measure boundary will be upstream of Foster Dam, either at the head of Foster Reservoir, or in the forebay of Foster Dam (or potentially both locations). The second CS downstream measurement boundary will be located near the river confluence with the mainstem Willamette River (or nearest feasible location upstream of the confluence for assessing survival). In the South Santiam River, previous survival estimates utilized detection arrays at Lebanon Dam (Liss et al. 2020), and these locations will be reconsidered to produce comparable survival estimates.

5.3.1.5 Risks and Uncertainties

- Annual hydrologic variability limiting or effecting timing of surface spill, resulting in low fish passage efficiency in spring
- Reservoir influence on steelhead passage rates and residualism (i.e., juveniles choose not to emigrate downstream but mature in the reservoir or upstream.
- Uncertainty in survival rate associated with spillway or RO passage
- Uncertainty in survival rate associated with copepod infection
- Climate change – see discussion under Basin Flow Measures (Section 5.1.1.5).

5.3.1.6 Decision Triggers and Adaptive Actions

Once two representative study years of fish passage operations are completed, contingency actions or adjustments will be implemented if results warrant, which are within the operational capacity of Green Peter Dam. Actions requiring additional funding or engineering will not be considered until after three CRR estimates are available (after year 7).

Successful fish passage would be defined by achieving either the DPS or the CRR target, as depicted in Figure 5-1. If the DPS target has been met, but not the CRR target, additional assessment will be completed to determine if CRR is not being met due to project effects or non-project effects. If the issue is due to project effects, additional measures taken under the preferred alternative will be identified, designed and implemented, and then CRR (and DPS if warranted, depending on the type of additional improvements made) will be re-evaluated, or reconsultation will occur.

5.3.2 Green Peter Surface Spill when available in the spring and summer to improve downstream water temperatures (721), and Use regulating outlets to discharge

colder water during drawdown operations in fall and winter to reduce water temperatures below dams (166)

5.3.2.1 Definition and Function

Use the spillway when available in the spring and summer to improve downstream water temperatures from spring through autumn. By extending the use of the spillway, a larger volume of warm surface water from the reservoir can be released and cold deep water can be reserved for later in the fall/early winter when necessary for fish incubation. In the fall, the deeper regulating outlets (ROs) can release a limited amount of cooler water at Green Peter. At Green Peter, this measure would consist of using up to 60% of total release through spillway as soon as available in May to provide attraction temperatures for upstream migrant adult Chinook. Use up to 60% of total release through ROs in the fall to reduce temperatures for egg incubation downstream of Foster. This operation maybe refined to address ongoing water quality concerns relating to temperature and sedimentation.

5.3.2.2 Constraints

Constraints relating to this measure is that implementation should not:

- Result in a reduction of USACE ability to operate the dam for flood risk management authorized purpose, and
- Violate USACE dam safety requirements.

5.3.2.3 Performance Metrics and Targets

Performance Metric:

- Water temperature: 7-day running average of downstream water temperature

Targets:

Table 5-4 identifies the existing water temperature targets for the South Santiam. Evaluation and/or refinement of these targets may be necessary in the future, which would be coordinated through the WATER Flow Management and Water Quality Technical Team.

Table 5-4. Green Peter and Foster Dams downstream water temperature targets from resource agencies (daily average)* and ODEQ's 2006 TMDL targets (seven-day average).

Month	RA Target Temperature Range Maximum / Minimum °F*		ODEQ 2006 TMDL Target Temperatures °F
January	40.1	40.1	No Allocation Needed
February	42.1	41.0	No Allocation Needed
March	42.1	41.0	No Allocation Needed
April	45.1	43.2	43.0
May	49.1	46.0	46.8
June	56.1	51.1	54.3
July	61.2	54.1	65.1
August	60.3	54.1	64.4
September	56.1	52.3	59.9
October	<50.0	<50.0	54.7
November	<50.0	<50.0	54.7
December	41.0	41.0	No Allocation Needed

*Daily average target temperatures originally developed by the resource agencies (NMFS, USFWS, ODFW) for the McKenzie River below Cougar Dam (October and November slightly modified for the North / South Santiam River).

5.3.2.4 Research, Monitoring, and Evaluation

Water temperature data would be measured upstream and downstream of Green Peter and Foster Dams by the USACE funded USGS gages including:

- Middle Santiam River upstream of Green Peter Reservoir (MSCO)
- Quartzville Creek upstream of Green Peter Reservoir (QCCO)
- Middle Santiam downstream of Green Peter Reservoir (GPRO)
- South Santiam River near the town of Cascadia (SSCO)
- South Santiam River downstream of Foster Reservoir (SSFO)

5.3.2.5 Risks and Uncertainties

The risks and uncertainties associated with this measure relate to the variability in precipitation, snowpack and water supply conditions. In dry years, spillway releases for downstream water temperature management may be limited, particularly if Green Peter Reservoir does not refill to above spillway crest. Furthermore, uncertainty exists in the success of operational downstream water temperature management at Green Peter through the use of the ROs in the fall. There is limited cold water storage in Green Peter Reservoir, it should be reserved for the most critical time periods (incubation). The sooner cold water is used, the sooner it is depleted.

5.3.2.6 Decision Triggers and Adaptive Actions

The success of operational downstream temperature management would be evaluated against the ability to manage flows to meet the downstream water temperature targets. The extent to which operations could be adjusted to ensure performance would be described in future planning documentation. In some years, releases greater than 60% of total release through the spillway and/or ROs may be necessary to meet downstream water temperature objectives.

5.3.3 Green Peter Adult Fish Facility (722)

5.3.3.1 Definition and Function

Construct adult fish facility (AFF) at Green Peter Dam for transport of adult spring Chinook and steelhead above Green Peter Dam. Provide adult upstream passage above Green Peter Dam for adult fish, including spring Chinook and steelhead.

5.3.3.2 Constraints

Constraints associated with the Green Peter Dam AFF will be identified as part of the project-specific planning documents developed prior to implementation. However, two known constraints relating to this measure is that implementation should not:

- Result in a reduction of USACE ability to operate the dam for flood risk management authorized purpose, and
- Violate USACE dam safety requirements.

5.3.3.3 Performance Metrics and Targets

Performance Metrics:

The following performance metrics will be used to evaluate operation of the AFF at Green Peter Dam:

Adult fish collection and handling, and adult fish transport and outplanting protocols defined in the current Willamette Fish Operations Plan. At a minimum, the following protocols will be evaluated:

- Timing of fish collection and outplanting relative to natural run timing
- Injury rates from handling and sorting
- Mortality rates for fish while in the AFF or during truck transport
- Health condition of fish outplanted
- Health condition of fish taken for brood

- Number and locations of outplanted fish
- Sex ratio of outplanted fish
- Fish densities when in holding at AFF and in transport trucks
- Water temperatures and oxygen levels in the AFF and transport trucks
- Cumulative temperature exposure when in the AFF and transport trucks
- Temperature exposure when water temperatures need to be tempered prior to release of outplanted fish

Additional monitoring activities are also included for ongoing hatchery mitigation relevant to assessing the trapping and transport of adult Chinook salmon (see Section 5.6 of this Plan).

Targets:

Compliance with the adult fish collection and handling, and adult fish transport and outplanting protocols defined in the 2022 Willamette Fish Operations Plan.

5.3.3.4 Research, Monitoring, and Evaluation

Upstream passage metrics will be summarized annually, and reports provided to WATER for review. Information on most metrics listed above will be collected commensurate with operation of the AFF. Discharge and water temperatures below Green Peter Dam will also be continuously monitored. As part of ongoing hatchery mitigation monitoring activities, available information on the following metrics will be included as part of annual summaries to support monitoring of upstream passage actions in the sub-basin:

- Counting salmon at downstream diversion dams (Lebannon).
- Counting of salmon at WVS AFF.
- Number, sex ratio and timing of adult salmon released above WVS dams.
- Assess genetic pedigree of Chinook Salmon.
- Assess salmon spawning above federal dams.

5.3.3.5 Risks and Uncertainties

- Effects of variation in Green Peter Dam discharges (from hydrologic conditions, FRM, hydropower, etc.) on upstream migration of adult fish to Green Peter Dam tailrace and adult collection in the AFF.
- Effects of water temperatures discharged from Green Peter Dam or from the AFF on adult attraction and collection in the AFF.

5.3.3.6 Decision Triggers and Adaptive Actions

Minor changes to operation of the AFF (i.e., operational feasible, and within USACE authority, and not requiring additional funding) are expected to be made in real-time to maintain compliance with the WFOP protocols. Reports of operations will be reviewed annually to determine areas where minor changes may be needed. If compliance cannot be maintained with minor changes, then adjustments or modifications will be assessed. Depending on the potential solutions, engineering studies or biological studies may be planned as funding is available. The timeframe for implementation of adjustments of modifications to the AFF will depend on the specific actions identified for implementation.

5.3.4 Foster Interim Operations

5.3.4.1 Definition and Function

The interim operations at Foster are intended to improve fish passage by increasing passage of fish over spillways, reducing passage through penstocks and improving water temperatures in the tailrace to support collection of adult Chinook at the Foster AFF. From February 1 – May 15, delay the refill of Foster Reservoir and hold at minimum conservation pool (El. 613-615 ft.). The spillway would be operated at night from one hour before sunset to one-half hour after sunrise; one turbine unit would be operated for station service (~300 cfs) to reduce/balance TDG levels created by the spill operation. From May 16 – June 15, Foster Reservoir would refill. The night spillway-only operations would continue with flows from one turbine as described above.

Starting on June 16, the fish weir would be installed and operated. The fish weir provides warmer surface water from the reservoir to raise river temperatures and aid in attracting adult salmon to the Foster AFF for collection, from June 16 to mid/late July. The fish weir would be operated at a 300 cfs flow with the duration of operation depending on storage in both Green Peter and Foster Reservoirs, and biological need (i.e., numbers of adult Chinook collected at the AFF). Starting just after Labor Day weekend, gradually draw down Foster reservoir to target a forebay elevation of 620-625 ft by October 1. Beginning on October 1, use the spillway to pass fish at night, while generation occurs during the day. Carry out through December 15.

5.3.4.2 Constraints

Implementation should not:

- Result in a reduction of USACE ability to operate the dam for flood risk management authorized purpose
- Violate USACE dam safety requirements.

5.3.4.3 Performance Metrics and Targets

Performance Metrics:

Downstream passage survival through Foster Dam has been previously estimated. The performance metrics listed in Table 5-1 will be used to evaluate the interim operations at Foster, along with the following:

- Dam outlets operated during the defined interim operational period
- Pool elevations during the defined interim operational period
- Gate openings and discharge from each outlet operated
- Juvenile Chinook and steelhead passage efficiency through preferred routes at Foster Dam
- Juvenile Chinook and steelhead passage timing at Foster Dam

Targets:

- Reservoir elevations and flow releases prioritized as defined under the interim operation.
- Seasonal downstream juvenile Chinook passage efficiency through preferred routes (spillway and fish weir) at Foster Dam increased over pre-injunction operations.
- Downstream juvenile Chinook passage timing at Foster Dam more consistent with natural emigration patterns in comparison to pre-injunction operations.
- Daily water temperatures in the tailrace resulting from prioritized releases using the fish trigging entrance and collection of adult Chinook in the AFF.

5.3.4.4 Research, Monitoring, and Evaluation

Interim actions were designed in collaboration with NMFS and other parties to operate the dams as best as feasible using existing facilities until long-term actions are implemented. Due to the effects of annual hydrologic variability in meeting interim operational objectives and resulting variability in water quality and fish passage conditions expected to occur within and across years, multiple years of monitoring are anticipated to be needed to understand if operations are achieving objectives and targets or if changes are warranted. Monitoring results will be reported and reviewed annually. If targets are not met, decision makers will determine each year if any adjustments should be made to meet the operational objectives or water quality targets, or if additional monitoring or uncertainty research should be conducted. For fish passage, a 5-year check-in will be conducted to review if targets were achieved. This is due to the seasonal and annual variability that occurs and resulting need for multiple years of data to evaluate if targets were achieved. Check-ins can also occur more often if information warrants, however caution should be taken before implementing operational changes fish passage before multiple years of data are collected.

Study designs and methodology to assess the defined metrics will be determined during implementation so that the best available scientific approaches and methods can be applied. The AM process will be followed to annually prioritize research and monitoring activities, and to complete technical review proposed monitoring plans for assessing the metrics against the defined targets.

5.3.4.5 Risks and Uncertainties

Potential risks to successful implementation include:

- Interim operations for fish passage and water quality may influence the ability to meet tributary flow targets in some years.
- Meeting tributary flow targets may influence the ability to achieve interim operations for fish passage and water quality in some years.

5.3.4.6 Decision Triggers and Adaptive Actions

The USACE will prepare annual reports documenting operations and summarizing the results in comparison to the defined targets. Annual check-ins will occur to assess how well targets have been achieved for water quality. A 5-year check-in will be conducted to review fish passage results to assess how well targets have been achieved. Check-ins on fish passage performance can also occur more often if adequate information is available and warrants review. Where targets are not achieved, the Action Agencies will propose changes to improve achievement of the operation where feasible and authorized. If changes that could improve achieving targets are not apparent, Action Agencies may instead propose uncertainty research to inform what changes may lead to achievement of the targets. The WATER Technical Teams will review the reported results from the operation, and any proposed changes to achieve the operational targets. The USACE will ensure evaluations are carried out and reports are made available for NMFS and WATER review within timelines necessary to inform AM decisions outlined in this document.

5.3.5 Foster Downstream Fish Passage (392)

5.3.5.1 Definition and Function

The measure provides a structural solution to improve downstream fish passage in the form of a modified fish weir or dedicated surface outlet. The design will provide fish downstream passage through a surface route with a flow rate of 500-800 cfs.

5.3.5.2 Constraints

Constraints associated with the Foster Downstream Fish Passage Structure will be identified as part of the project-specific planning documents developed prior to implementation. However, two known constraints relating to this measure is that implementation should not:

- Result in a reduction of USACE ability to operate the dam for flood risk management authorized purpose, and
- Violate USACE dam safety requirements.

5.3.5.3 Performance Metrics and Targets

Performance Metrics:

The following performance metrics, also listed in Table 5-2 and Figure 5-1, will be used to evaluate the passage at Foster once the structure is operational:

- Juvenile Fish Dam Passage Survival (DPS = DPE * CS)
    - Sub-metric: Dam-passage efficiency (DPE), the proportion of total fish passing the dam relative to the number of total fish detected in the near forebay of the dam and therefore available to pass.
    - Sub-metric: Fish passage efficiency (FPE), the proportion of fish passing via a non-turbine route, relative to the number of total fish in the near forebay and available to pass.
    - Sub-metric: Fish collector efficiency (FCE), defined as the proportion of fish passing (collected by) the FSS, relative to the number of total fish passing the dam via any route.
    - Sub-metric: Concrete Survival (CS), the proportion surviving passage through each route weighted by the number passing through each route
- Above-Dam Cohort Replacement Rate (CRR)

Targets:

- DPS: Higher value developed from the following two approaches:
    - DPS rate needed to support replacement of spawners above dams as estimated using life cycle models, such as those developed for the Draft WVS PEIS and ESA consultation. Modeling to define the DPS rate needed to support replacement of spawners will be completed in year one of implementation of the proposed action, and will incorporate any new and relevant scientific information into models.
    - Estimate of annual DPS across water year types
        - This estimate will be prepared using the Fish Benefit Workbook (FBW) or other approaches to estimate DPS across a range of water year types. New information will be used to update the estimate prior to assessing performance (field study data; revised models).
- Cohort Replacement Rate = ≥1.0

Figure 5-4. Foster Dam tailrace, forebay, and near forebay zone (gray) showing approximate area to be used for measuring fish passage metrics.

5.3.5.4 Research, Monitoring, and Evaluation

Annual dam passage survival (calculated as DPS = DPE * CS) will be measured in two separate years which are representative of typical operating conditions (i.e., water years within 95% of normal hydrological conditions in the period of record). The precision needed about annual DPS estimates will be determined at the time of the assessment to evaluate passage to provide reasonable certainty bounds acceptable to decision makers.

DPE will be measured as the proportion of fish that exit the reservoir downstream divided by the total number of fish in the near forebay area (i.e., fish approaching the dam). For Foster, the near forebay area will be defined as from the dam upstream approximately a quarter mile to the log boom, consistent with previous survival studies completed by Liss et al. (2020) (Figure 5-4).

Test period(s): Times of the year representative of when most juvenile salmon migrants are actively moving downstream. These test periods likely will cover portions of spring and fall/winter and could be one longer test period or two separate seasonal periods within a year.

CS will be measured as the number of fish that survive from Foster Dam to the downstream CS measurement boundary divided by the total number of fish that pass downstream. The CS downstream measurement boundary will be located near the river confluence with the mainstem Willamette River (or nearest feasible location upstream of the confluence for assessing survival). In the South Santiam River, previous survival estimates utilized detection arrays at Lebannon Dam (see Liss et al., 2020), and these locations will be reconsidered in order to produced comparable survival estimates.

5.3.5.5 Risks and Uncertainties

- Low FCE of juvenile Chinook and steelhead (i.e., fish passage facility rejection)
- Reservoir influence on steelhead passage rates and residualism (i.e., juveniles choose not to emigrate downstream but mature in the reservoir or upstream).
- Seasonal variation in flow rates (from hydrology or dam operations) influencing fish attraction and collection
- Uncertainty in survival rate associated with copepod infection
- Uncertainty in injury or mortality from structural fish passage
- Climate change – change in hydrology that would influence flow rates through the structure and downstream water temperatures

5.3.5.6 Decision Triggers and Adaptive Actions

Minor changes to operation of the Foster Downstream Fish Passage Structure are expected to be made in real-time during the first few years. Once field study to assess performance metrics begins, no in-season changes will be made in order to support evaluation. However, operational treatments for study may be considered at this time to simultaneously evaluate different conditions where information supports such treatments. Once two representative study years of operation are completed, additional minor changes or adjustments will be implemented if results warrant, which are within the design capacity of Foster Dam facilities, FRM operations, and USACE authority. However, actions requiring additional funding or engineering will not be considered until after three CRR estimates are available (after year 7).

Successful fish passage would be defined by achieving either the DPS or the CRR target, as depicted in Figure 5-1. If the DPS target has been met, but not the CRR target, additional assessment will be completed to determine if CRR is not being met due to project effects or non-project effects. If the issue is due to project effects, additional measures taken under the preferred alternative will be identified, designed and implemented, and then CRR (and DPS if warranted, depending on the type of additional improvements made) will be re-evaluated, or reconsultation will occur.

5.3.5.7 Decision-Making and Collaboration

The Action Agencies will fund post-construction evaluations of DPS at Foster Dam. The WATER will review study designs for assessing the performance metrics. Study designs may also benefit from a targeted independent scientific review. The Action Agencies will address the comments to improve the study design for assessing the performance metrics. If NMFS and the Action Agencies' technical staff do not concur on final study designs, the dispute will be elevated for resolution following Federal Family and WATER procedures and protocols. The Action Agencies will ensure evaluations are carried out and reports are made available for NMFS and WATER team review within timelines necessary to inform adaptive management decisions outlined in this document.

5.3.6 Foster Fish Ladder Temperature Improvement (479)

5.3.6.1 Definition and Function

This measure would provide improved water temperature control for water discharged from Foster Dam forebay and used in the Foster AFF fish ladder. Under this measure, a structural modification to Foster Dam would be implemented to reduce delay of upstream-migrating spring Chinook salmon and winter steelhead by increasing the water temperature in the fish ladder. During the later spring and summer months, the Foster forebay is stratified in terms of temperature. The existing water supply for the fish ladder is located at the powerhouse intakes, below the thermocline, and as a result, the temperature of the flow issuing from the pre-sort pool at the top of the fish ladder and from the ladder entrances is too cold to attract adult Chinook salmon to enter the AFF fish ladder from the Foster Dam tailrace.

The major feature of this measure is construction of a new Forebay Warm Water Supply (FWWS) pipe that would draw warm water from above the thermocline in the Foster forebay. The existing water supply pipe would remain in use and a network of pipes and valves would allow the two water sources to be mixed to achieve desired temperatures at adult fish facility. The temperature targets were developed as a function of the upstream South Santiam River, with maximum target temperatures constrained by needs for fish health. A juvenile fish exclusion screen would be provided upstream of the FWWS intake to keep juvenile fish from entering the pipe.

The purpose of the FWWS is to reduce delay of upstream-migrating spring Chinook salmon at FOS. Successful adult passage needs: 1) warm water in the lower river to move fish into the tailrace; and 2) warmer ladder temperatures to move fish from the tailrace into the ladder. The first item is beyond the scope of the FFLIP project. The goal of the FWWS design is to address the second aspect of successful fish passage, namely warming up the water in the fish ladder and discharging from its entrances during the later spring and summer so that any fish in the tailrace can be collected with minimal delay. Water temperatures less than 52°F/11.1°C are too cold to attract upstream movement of adult Chinook into adult fish facilities.

The USACE FWWS PDT developed water temperature targets for the FOS fish ladder in consultation with NMFS and ODFW (Table 5-5). The targets are based on water temperatures in the South Santiam River above Foster, which were determined to be appropriate for encouraging upstream migration of Chinook salmon. The temperature targets were established based on the 75 percent, 50 percent, or 25 percent quartiles based on the time of year. In spring, when the South Santiam River is cooler, the 75 percent quartile was used as a target to attract fish into the fish ladder. In the late summer, when the South Santiam River is warmer, the 25 percent quartile was used. The quartile selection was based on knowledge that salmon migrate when water temperatures are at or above 52 °F (11.1 °C) and that temperatures above 60 °F (15.6 °C) may become stressful. Although the South Santiam River temperature rises above 60 °F (15.6 °C) every year, a summer maximum target temperature of 60 °F (15.6 °C) was established for the period of 01 July to 30 August to minimize temperature stress on fish. The selection was approved by ODFW and NMFS (May 7, 2019 and June 4, 2019 WFFDWG meetings).

Table 5-5. Water Temperature Targets for the FOS Fish Ladder

DD-MM	FOS Fish Ladder Target	Explanation (based on 2008 to 2019 data from USGS 14185000 South Santiam below Cascadia)
01-May	51°F (10.6 °C)	75th %
15-May	53 °F (11.7 °C)	75th %
01-Jun	55 °F (12.8 °C)	Average of 15 May 75th % and 15 Jun 75th %
15-Jun	57 °F (13.9 °C)	50th %
01-Jul to 30-Aug	60 °F (15.6 °C)	Summer maximum
01-Sep	58 °F (14.4 °C)	25th %
15-Sep	55 °F (12.8 °C)	25th %

5.3.6.2 Constraints

Constraints associated with the Foster Downstream Fish Passage Structure will be identified as part of the project-specific planning documents developed prior to implementation. However, two known constraints relating to this measure is that implementation should not:

- Result in a reduction of USACE ability to operate the dam for flood risk management authorized purpose, and
- Violate USACE dam safety requirements.

5.3.6.3 Performance Metrics and Targets

Performance Metric:

- Daily average water temperature as measured at the fish ladder points of discharge to the Foster Dam tailrace.

Targets:

- Water temperature targets listed in Table 5-5, +/- 2°F.

Any refinement of these targets will be coordinated through the WATER Technical Teams.

5.3.6.4 Research, Monitoring, and Evaluation

Temperature data loggers will be operated in the Foster AFF fish ladder near the points of discharge into the Foster Dam tailrace and recording at least hourly water temperatures. Daily average water temperature will be summarized annually.

5.3.6.5 Risks and Uncertainties

Risks and uncertainties associated with the Foster Fish Ladder will be documented as part of the site-specific engineering design process. These may include hatchery and natural origin attraction and collection rates after the fish ladder modifications are implemented.

5.3.6.6 Decision Triggers and Adaptive Actions

Decision Criteria:

- If fish ladder water temperature targets are met, continue with operation of the Foster AFF to achieve the water temperature targets in the fish ladder.
- If targets are not achieved for reasons other than hydrologic limitations or FRM operations, then implement adjustments or modifications expected to improve achievement of targets which are feasible and authorized.
- If there are potential feasible and authorized adjustments, but uncertainty if those adjustments can improve the ability to achieve targets, then conduct uncertainty research and implement if results indicate that improvement is likelihood of achieving targets.

5.3.7 Foster Adult Fish Facility

5.3.7.1 Definition and Function

Continued operation of the Foster AFF for transport of adult spring Chinook and steelhead above Foster Dam. Provide adult upstream passage above Foster Dam for adult fish, including spring Chinook and steelhead.

5.3.7.2 Constraints

Implementation should not:

- Result in a reduction of USACE ability to operate the dam for flood risk management authorized purpose, and
- Violate USACE dam safety requirements.

5.3.7.3 Performance Metrics and Targets

Performance Metrics:

The following performance metrics will be used to evaluate operation of the Foster AFF:

Adult fish collection and handling, and adult fish transport and outplanting protocols defined in the current Willamette Fish Operations Plan. At a minimum, the following protocols will be evaluated:

- Timing of fish collection and outplanting relative to natural run timing
- Injury rates from handling and sorting
- Mortality rates for fish while in the AFF or during truck transport
- Health condition of fish outplanted
- Health condition of fish taken for brood
- Number and locations of outplanted fish
- Sex ratio of outplanted fish
- Fish densities when in holding at AFF and in transport trucks
- Water temperatures and oxygen levels in the AFF and transport trucks
- Cumulative temperature exposure when in the AFF and transport trucks
- Temperature exposure when water temperatures need to be tempered prior to release of outplanted fish

Additional monitoring activities are also included for ongoing hatchery mitigation relevant to assessing the trapping and transport of adult Chinook salmon (see Section 5.6 of this Plan).

Targets:

Compliance with the adult fish collection and handling, and adult fish transport and outplanting protocols defined in the 2022 Willamette Fish Operations Plan.

5.3.7.4 Research, Monitoring, and Evaluation

Upstream passage metrics will be summarized annually, and reports provided to WATER for review. Information on most metrics listed above will be collected commensurate with operation of the AFF. Discharge and water temperatures below Foster Dam will also be

continuously monitored. As part of ongoing hatchery mitigation monitoring activities, available information on the following metrics will be included as part of annual summaries to support monitoring of upstream passage actions in the sub-basin:

- Counting salmon at diversion dams (Lebannon).
- Counting of salmon at AFF.
- Number, sex ratio and timing of adult salmon released above WVS dams.
- Assess genetic pedigree of Chinook Salmon.
- Assess salmon spawning above federal dams.

5.3.7.5 Risks and Uncertainties

- Effects of variation in Foster Dam discharges (from hydrologic conditions, FRM, hydropower, etc.) on upstream migration of adult fish to Foster Dam tailrace and adult collection in the AFF.
- Effects of water temperatures discharged from Foster Dam or from the AFF on adult attraction and collection in the AFF.

5.3.7.6 Decision Triggers and Adaptive Actions

Minor changes to operation of the AFF (i.e., operational feasible, and within USACE authority, and not requiring additional funding) are expected to be made in real-time to maintain compliance with the WFOP protocols. Reports of operations will be reviewed annually to determine areas where minor changes may be needed. If compliance cannot be maintained with minor changes, then adjustments or modifications will be assessed. Depending on the potential solutions, engineering studies or biological studies may be planned as funding is available. The timeframe for implementation of adjustments of modifications to the AFF will depend on the specific actions identified for implementation.

5.4 MCKENZIE

5.4.1 Cougar Interim Operations

5.4.1.1 Definition and Function

The Cougar interim operation is intended to improve fish passage. In the fall, Cougar Reservoir would be drawn down below minimum conservation pool to provide a surface-oriented flow through the ROs. The RO would be prioritized throughout the implementation of this operation. However, some station service (a 150 cfs release through the turbine unit) may be required early on to ensure no loss of remote flood risk management capability due to issues with the operability of the emergency diesel generator, which is the only automatic back-up power source for the facility in the event of an unanticipated loss of line power. Refill begins in December and operations would transition to nighttime RO releases and daytime generation.

During storms and flood risk reduction events, USACE, may decide to allow the reservoir to fill rather than use the turbines to increase outflows out of Cougar Dam workign with WATER to develop a strategy to manage water releases following this and future storm events. Once the storm passes, RO discharges will be increased to draw the reservoir back to the targeted elevation of 1505 ft. as quickly as possible.

The RO at Cougar Dam is known to produce elevated downstream TDG when releases are more than 800 cfs. Modest increases in downstream TDG are expected to be less detrimental to the life history stages in the reach downstream of Cougar at that time of year than passing juvenile fish through the turbine units.

Cougar will be allowed to refill back to elevation 1532 ft. starting on December 15, along with nighttime RO usage and daytime generation.

On February 1, the refill of Cougar Reservoir will be delayed until May or June depending on water conditions (i.e., wet, average, dry). In dry years, Cougar Reservoir may be refilled as early as May 1, while in wet years, refill may not begin until June 1. The goal is to start refill early enough that the reservoir can reach elevation 1571 ft. by summer so that the Cougar Water Temperature Control Tower (WTCT) weirs can be used for downstream water temperature management. On June 2, switch to all powerhouse. Cougar Reservoir should not be drawn down below the elevation of the saddle dam during fish passage operations.

5.4.1.2 Constraints

Implementation should not:

- Result in a reduction of USACE ability to operate the dam for flood risk management authorized purpose
- Violate USACE dam safety requirements.

5.4.1.3 Performance Metrics and Targets

Performance Metrics:

The performance metrics listed in Table 5-1 will be used to evaluate the interim operations at Cougar, along with the following:

- Dam outlets operated during the defined interim operational period
- Pool elevations during the defined interim operational period
- Gate openings and discharge from each outlet operated Juvenile Chinook passage efficiency through preferred routes at Cougar Dam
- Juvenile Chinook passage efficiency through preferred routes at Cougar Dam
- Juvenile Chinook passage timing at Cougar Dam

Targets:

- Reservoir elevations and flow releases prioritized as defined under the interim operation.
- Seasonal downstream juvenile Chinook passage efficiency through preferred routes (spillway and ROs) at Cougar Dam increased over pre-injunction operations.
- Downstream juvenile Chinook passage timing at Cougar Dam more consistent with natural emigration patterns in comparison to pre-injunction operations.

5.4.1.4 Research, Monitoring, and Evaluation

Interim actions were designed in collaboration with NMFS and other parties to operate the dams as best as feasible using existing facilities until long-term actions are implemented. Due to the effects of annual hydrologic variability in meeting interim operational objectives and resulting variability in water quality and fish passage conditions expected to occur within and across years, multiple years of monitoring are anticipated to be needed to understand if operations are achieving objectives and targets or if changes are warranted. Monitoring results will be reported and reviewed annually. If targets are not met, decision makers will determine each year if any adjustments should be made to meet the operational objectives or water quality targets, or if additional monitoring or uncertainty research should be conducted.

Study designs and methodology to assess the defined metrics will be determined during implementation so that the best available scientific approaches and methods can be applied. The AM process will be followed to annually prioritize research and monitoring activities, and to complete technical review proposed monitoring plans for assessing the metrics against the defined targets.

5.4.1.5 Risks and Uncertainties

- Risk: There is a trade-off in some water years between achieving the operational targets of these flow measures vs meeting other objectives (e.g. downstream minimum flow values)
- Risk: Hydrologic variability limiting the ability to achieve the interim operation in a given year

5.4.1.6 Decision Triggers and Adaptive Actions

Decision Criteria:

- If operational objectives or targets are met, continue with interim operation.
- If operational objectives or targets are not achieved for reasons other than hydrologic limitations or FRM operations, then implement adjustments to operations expected to improve achievement of targets which are feasible and authorized.

- If there are potential feasible and authorized adjustments, but uncertainty if those adjustments can improve the ability to achieve targets, then conduct uncertainty research and implement if results indicate that improvement is likelihood of achieving targets.

5.4.1.7 Decision-Making and Collaboration

USACE will prepare annual reports documenting operations and summarizing the results in comparison to the defined targets. Annual check-ins will occur to assess how well targets have been achieved for water quality. A 5-year check-in will be conducted to review fish passage results to assess how well targets have been achieved. Check-ins on fish passage performance can also occur more often if adequate information is available and warrants review. Where targets are not achieved, the Action Agencies will propose changes to improve achievement of the operation where feasible and authorized. If changes that could improve achieving targets are not apparent, Action Agencies may instead propose uncertainty research to inform what changes may lead to achievement of the targets. The WATER Technical Teams will review the reported results from the operation, and any proposed changes to achieve the operational targets. The USACE will ensure evaluations are carried out and reports are made available for NMFS and WATER review within timelines necessary to inform AM decisions outlined in this document.

5.4.2 Cougar Regulating Outlet Chute Resurfacing and Modifications

5.4.2.1 Definition and Function

Recoating the Cougar Regulating Outlet (RO) chute was completed in 2023. The coating has been peeling off. Plans are proceeding for structural modifications to the regulating outlet An Engineering Documentation Report (EDR), completed August 2023, identified a preferred alternative referred to as the Long Chute + Low-Flow Channel + Flow Deflector alternative, also known as Alternative 6B. The EDR found this alternative would provide the greatest improvements to both fish passage and total dissolved gas downstream of Cougar Dam. This alternative would require rockfill be placed in the existing RO outlet channel and stilling basin. A near-horizontal RO chute extension would be built on top of the rockfill to contain and direct the flow downstream. A new stilling basin would be constructed just upstream of the confluence with the powerhouse outlet channel to facilitate energy dissipation. The low-flow channel concept would provide increased water column depth even at low flows for fish to maneuver within. The flow deflector at the downstream end of the RO chute extension would promote skimming flow in the stilling basin and reduce TDG generation. A Design Documentation Report (DDR) is scheduled for completion in spring 2025, Plans and Specifications Report in spring 2026, and construction over two years beginning in 2027.

5.4.2.2 Constraints

Constraints associated with the Cougar RO Modifications will be identified as part of the project-specific planning documents developed prior to implementation.

5.4.2.3 Performance Metrics and Targets

Performance Metrics:

The performance metrics listed in Table 5-1 will be used to evaluate the modified RO at Cougar, along with the following:

- Dam outlets operated during the defined operational period
- Pool elevations during the defined operational period
- Gate openings and discharge from each outlet operated

Targets:

- Reservoir elevations and flow releases prioritized as defined under the interim operation.
- Seasonal downstream juvenile Chinook passage rates through preferred routes (RO) at WVS dams increased over pre-injunction operations.
- Downstream juvenile Chinook passage timing at WVS dams more consistent with natural emigration patterns in comparison to pre-injunction operations.
- Downstream juvenile Chinook passage survival through the RO increased compared to pre-RO improvement survival.

5.4.2.4 Research, Monitoring, and Evaluation

Interim actions were designed in collaboration with NMFS and other parties to operate the dams as best as feasible using existing facilities until long-term actions are implemented. One-year of study is expected to be adequate unless unique or extreme operational conditions occur during the testing period. In which case additional study may be needed. Monitoring results will be reported and reviewed once available. If targets are not met, decision makers will determine if any adjustments should be made to meet the targets, or if additional monitoring or uncertainty research should be conducted.

Study designs and methodology to assess the defined metrics will be determined during implementation so that the best available scientific approaches and methods can be applied. The AM process will be followed to annually prioritize research and monitoring activities, and to complete technical review proposed monitoring plans for assessing the metrics against the defined targets.

5.4.2.5 Risks and Uncertainties

Injury and survival of juvenile passing downstream through the Cougar RO relates to multiple factors, including hydraulic head, gate opening, surface conditions of the RO, and conditions in the stilling basin. The extent to which injury rates can be reduced or survival rates can be increased is uncertain.

5.4.2.6 Decision Triggers and Adaptive Actions

Decision Criteria:

- If operational objectives or targets are met, continue with interim operation.
- If operational objectives or targets are not achieved for reasons other than hydrologic limitations or FRM operations, then implement adjustments to operations expected to improve achievement of targets which are feasible and authorized.
- If there are potential feasible and authorized adjustments, but uncertainty if those adjustments can improve the ability to achieve targets, then conduct uncertainty research and implement if results indicate that improvement in likelihood of achieving targets.

5.4.3 Cougar Deep Reservoir Drawdown to Diversion Tunnel (720) in Spring and Fall

5.4.3.1 Definition and Function

The measure involves drafting Cougar Reservoir elevation to 25 ft over the top of the Cougar Diversion Tunnel and hold at this elevation to increase the number and the survival of juvenile Chinook salmon passing downstream of Cougar dam in fall and spring.

5.4.3.2 Constraints

Implementation should not:

- Result in a reduction of USACE ability to operate the dam for flood risk management authorized purpose,
- Violate USACE dam safety requirements.

5.4.3.3 Performance Metrics and Targets

Performance Metrics:

The following performance metrics, also listed in Table 5-2 and Figure 5-1, will be used to evaluate the passage at Cougar once the diversion tunnel is operational:

- Juvenile Fish Dam Passage Survival (DPS = DPE * CS)
    - Sub-metric: Dam-passage efficiency (DPE), the proportion of total fish passing the dam relative to the number of total fish detected near the diversion tunnel upstream, and therefore available to pass downstream
    - Sub-metric: Fish passage efficiency (FPE), the proportion of fish passing via a non-turbine route, relative to the number of total fish near the diversion tunnel upstream and available to pass downstream

- Sub-metric: Concrete Survival (CS), the proportion surviving passage through each route weighted by the number passing through each route

- Above-Dam Cohort Replacement Rate (CRR)

Targets:

- DPS: Higher value developed from the following two approaches:
  - DPS rate needed to support replacement of spawners above dams as estimated using life cycle models, such as those developed for the Draft WVS PEIS and ESA consultation. Modeling to define the DPS rate needed to support replacement of spawners will be completed in year one of implementation of the proposed action, and will incorporate any new and relevant scientific information into models.
  - Estimate of annual DPS across water year types
    - This estimate will be prepared using the Fish Benefit Workbook (FBW) or other approaches to estimate DPS across a range of water year types. New information will be used to update the estimate prior to assessing performance (field study data; revised models).
- Cohort Replacement Rate = ≥1.0

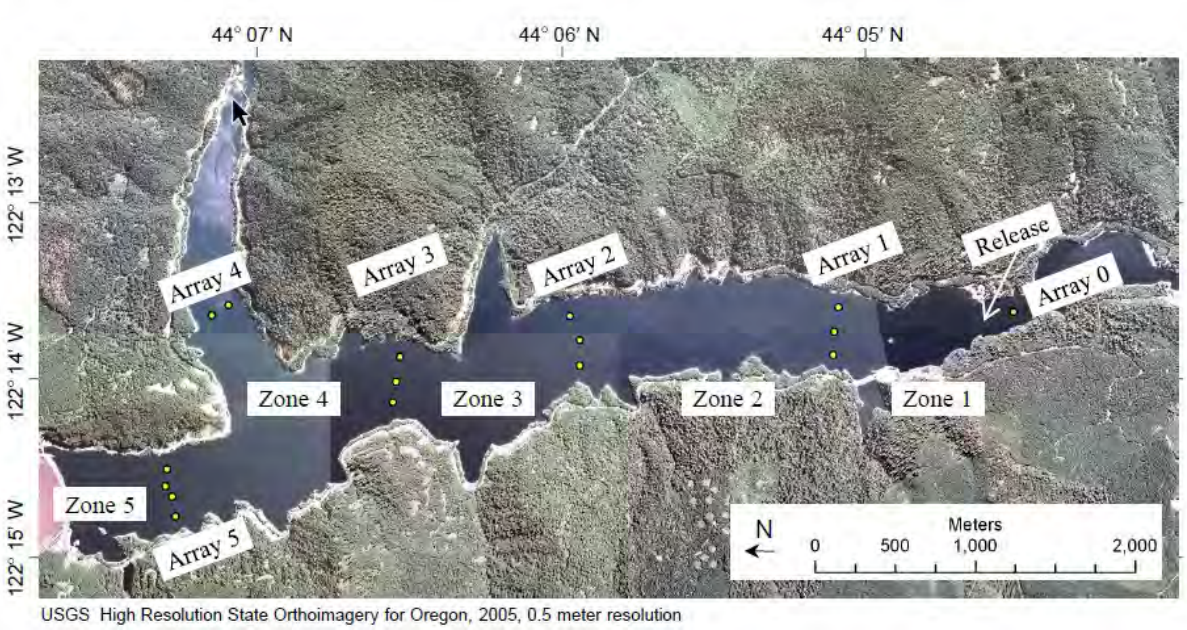

Figure 5-5. Cougar Dam tailrace, forebay, and near forebay zone (gray) showing approximate area to be used for measuring fish passage metrics. Image copied from Figure 3 from Beeman et al. (2014).

5.4.3.4 Research, Monitoring, and Evaluation

Annual dam passage survival (calculated as DPS = DPE * CS) will be measured in two separate years which are representative of typical operating conditions (i.e., water years within 95% of normal hydrological conditions in the period of record). The precision needed about annual DPS estimates will be determined at the time of the assessment to evaluate passage to provide reasonable certainty bounds acceptable to decision makers.

DPE will be measured as the proportion of fish that exit the reservoir downstream (or are transported downstream) divided by the total number of fish in the near forebay area (i.e., fish approaching the dam). The near forebay area at Cougar will be defined as from the dam and diversion tunnel outlet upstream to Array 3 as defined by Beeman et al. (2014a). The specific location may need adjustment from Array 3 as defined by Beeman et al. (2014a) due to the deep reservoir draft, however the intent is to define an area within a similar proximity to the diversion tunnel as was used by Beeman et al. (2014a) for assessing passage at the dam using Array 5 (Figure 5-5).

DPS will be measured in two separate years which are representative of typical operating conditions (i.e., water years within 95% of normal hydrological conditions in the period of record) to evaluate fish passage efficiency and survival. The precision needed about annual DPS would be determined at the time of the assessment to evaluate passage. Observed performance would be compared to downstream passage survival rates estimated to support replacement.

Test period(s): Times of the year representative of when most juvenile salmon migrants are actively moving downstream. These test periods likely will cover portions of spring and fall/winter and could be one longer test period or two separate seasonal periods within a year.

CS will be measured as the number of fish that survive from Cougar Dam to the downstream CS measurement boundary divided by the total number of fish that pass downstream. The CS downstream measurement boundary will be located near the river confluence with the mainstem Willamette River (or nearest feasible location upstream of the confluence for assessing survival). In the McKenzie River below Cougar Dam, previous survival estimates utilized detection arrays at Leaburg Dam (Beeman et al. 2014b), and these locations will be reconsidered to produced comparable survival estimates.

5.4.3.5 Risks and Uncertainties

- Seasonal variation in flow rates and pool elevations (from hydrology or dam operations) influencing fish attraction and passage rates
- Uncertainty in survival rate passing through the diversion tunnel
- Uncertainty in survival rate associated with copepod infection
- Climate change – change in hydrology that would influence flow rates through the FSS and downstream water temperatures

5.4.3.6 Decision Triggers and Adaptive Actions

Minor changes to operations expected to be made in real-time during the first few years. Once field study to assess performance metrics begins, no in-season changes will be made to support evaluation. However, operational treatments for study may be considered at this time to simultaneously evaluate different conditions where information supports such treatments. Once two representative study years of operations are completed, additional minor changes or adjustments will be implemented if results warrant, which are within the design capacity of the dam and outlet works, FRM, and USACE authority. However, actions requiring additional funding or engineering will not be considered until after three CRR estimates are available (after year 7).

Successful fish passage would be defined by achieving either the DPS or the CRR target, as depicted in Figure 5-1. If the DPS target has been met, but not the CRR target, additional assessment will be completed to determine if CRR is not being met due to project effects or non-project effects. If the issue is due to project effects, additional measures taken under the preferred alternative will be identified, designed and implemented, and then CRR (and DPS if warranted, depending on the type of additional improvements made) will be re-evaluated, or reconsultation will occur.

5.4.3.7 Decision-Making and Collaboration

The Action Agencies will fund post-construction evaluations. The WATER will review study designs for assessing the performance metrics. Study designs may also benefit from a targeted independent scientific review. The Action Agencies will address the comments to improve the study design for assessing the performance metrics. If NMFS and the Action Agencies' technical staff do not concur on final study designs, the dispute will be elevated for resolution following Federal Family and WATER procedures and protocols. The Action Agencies will ensure evaluations are carried out and reports are made available for NMFS and WATER team review within timelines necessary to inform adaptive management decisions outlined in this document.

5.4.4 Cougar Adult Fish Facility

5.4.4.1 Definition and Function

Continued operation of the Cougar AFF for transport of adult spring Chinook above Cougar Dam.

5.4.4.2 Constraints

Implementation should not:

- Result in a reduction of USACE ability to operate the dam for flood risk management authorized purpose, and

- Violate USACE dam safety requirements.

5.4.4.3 Performance Metrics and Targets

Performance Metrics:

The following performance metrics will be used to evaluate operation of the Cougar AFF:

Adult fish collection and handling, and adult fish transport and outplanting protocols defined in the current Willamette Fish Operations Plan. At a minimum, the following protocols will be evaluated:

- Timing of fish collection and outplanting relative to natural run timing
- Injury rates from handling and sorting
- Mortality rates for fish while in the AFF or during truck transport
- Health condition of fish outplanted
- Health condition of fish taken for brood
- Number and locations of outplanted fish
- Sex ratio of outplanted fish
- Fish densities when in holding at AFF and in transport trucks
- Water temperatures and oxygen levels in the AFF and transport trucks
- Cumulative temperature exposure when in the AFF and transport trucks
- Temperature exposure when water temperatures need to be tempered prior to release of outplanted fish

Additional monitoring activities are also included for ongoing hatchery mitigation relevant to assessing the trapping and transport of adult Chinook salmon (see Section 5.6 of this Plan).

Targets:

Compliance with the adult fish collection and handling, and adult fish transport and outplanting protocols defined in the 2022 Willamette Fish Operations Plan.

5.4.4.4 Research, Monitoring, and Evaluation

Upstream passage metrics will be summarized annually, and reports provided to WATER for review. Information on most metrics listed above will be collected commensurate with operation of the AFF. Discharge and water temperatures below Cougar Dam will also be continuously monitored. As part of ongoing hatchery mitigation monitoring activities, available information on the following metrics will be included as part of annual summaries to support monitoring of upstream passage actions in the sub-basin:

- Counting salmon at diversion dams (Leaburg).
- Counting of salmon at AFF.
- Number, sex ratio and timing of adult salmon released above WVS dams.
- Assess genetic pedigree of Chinook Salmon.
- Assess salmon spawning above federal dams.

5.4.4.5 Risks and Uncertainties

- Effects of variation in Cougar Dam discharges (from hydrologic conditions, FRM, hydropower, etc.) on upstream migration of adult fish to Cougar Dam tailrace and adult collection in the AFF.
- Effects of water temperatures discharged from Cougar Dam or from the AFF on adult attraction and collection in the AFF.

5.4.4.6 Decision Triggers and Adaptive Actions

Minor changes to operation of the AFF (i.e., operational feasible, and within USACE authority, and not requiring additional funding) are expected to be made in real-time to maintain compliance with the WFOP protocols. Reports of operations will be reviewed annually to determine areas where minor changes may be needed. If compliance cannot be maintained with minor changes, then adjustments or modifications will be assessed. Depending on the potential solutions, engineering studies or biological studies may be planned as funding is available. The timeframe for implementation of adjustments of modifications to the AFF will depend on the specific actions identified for implementation.

5.5 MIDDLE FORK WILLAMETTE

5.5.1 Dexter Adult Fish Facility

5.5.1.1 Definition and Function

Design and construct upgrades to the Dexter adult fish facility.

5.5.1.2 Constraints

Constraints associated with the Dexter AFF upgrade will be identified as part of the project-specific planning documents developed prior to implementation. However, two known constraints relating to this measure is that implementation should not:

- Result in a reduction of USACE ability to operate the dam for flood risk management authorized purpose, and
- Violate USACE dam safety requirements.

5.5.1.3 Performance Metrics and Targets

Performance Metrics:

The following performance metrics will be used to evaluate operation of the AFF at Dexter:

Upstream Passage Metrics: Adult fish collection and handling, and adult fish transport and outplanting protocols defined in the current Willamette Fish Operations Plan. At a minimum, the following protocols will be evaluated:

- Timing of fish collection and outplanting relative to natural run timing
- Injury rates from handling and sorting
- Mortality rates for fish while in the AFF or during truck transport
- Health condition of fish outplanted
- Health condition of fish taken for brood
- Number and locations of outplanted fish
- Sex ratio of outplanted fish
- Fish densities when in holding at AFF and in transport trucks
- Water temperatures and oxygen levels in the AFF and transport trucks
- Cumulative temperature exposure when in the AFF and transport trucks
- Temperature exposure when water temperatures need to be tempered prior to release of outplanted fish

Additional monitoring activities are also included for ongoing hatchery mitigation relevant to assessing the trapping and transport of adult Chinook salmon (see Section 5.6 of this Plan).

Targets:

Compliance with the adult fish collection and handling, and adult fish transport and outplanting protocols defined in the current Willamette Fish Operations Plan

5.5.1.4 Research, Monitoring, and Evaluation

Upstream passage metrics will be summarized annually, and reports provided to WATER for review. Information on most metrics listed above will be collected commensurate with operation of the AFF. Discharge and water temperatures below Dexter Dam will also be continuously monitored. As part of ongoing hatchery mitigation monitoring activities, available information on the following metrics will be included as part of annual summaries to support monitoring of upstream passage actions in the sub-basin:

- Counting of salmon at AFF.

- Number, sex ratio and timing of adult salmon released above WVS dams.
- Assess genetic pedigree of Chinook Salmon.
- Assess salmon spawning above federal dams.

5.5.1.5 Risks and Uncertainties

- Effects of variation in Dexter Dam discharges (from hydrologic conditions, FRM, hydropower, etc.) on upstream migration of adult fish to Dexter Dam tailrace and adult collection in the AFF.
- Effects of water temperatures discharged from Dexter Dam or from the AFF on adult attraction and collection in the AFF.
- Effects of water temperatures discharged from Dexter Reservoir into the Dexter AFF on the health of adults collected at Dexter AFF.

5.5.1.6 Decision Triggers and Adaptive Actions

Minor changes to operation of the AFF (i.e., operational feasible, and within USACE authority, and not requiring additional funding) are expected to be made in real-time to maintain compliance with the WFOP protocols. Reports of operations will be reviewed annual to determine areas where minor changes may be needed. If compliance cannot be maintained with minor changes, then adjustments or modifications will be assessed. Depending on the potential solutions, engineering studies or biological studies may be planned as funding is available. The timeframe for implementation of adjustments of modifications to the AFF will depend on the specific actions identified for implementation.

5.5.2 Lookout Point Interim Operations

5.5.2.1 Definition and Function

Use storage from Hills Creek Reservoir to begin refilling Lookout Point Reservoir in early March. Once Lookout Point Reservoir elevation is 2.5 feet over spillway crest (El. 890 ft.), start continuous, ungated spill using as many gates (5 are available) as needed to approximate the rate of inflow to maintain the reservoir level between El. 890-893 ft. for as long as water conditions allow, for at least 30 days at both Lookout Point and Dexter dams. Operate the Lookout Point powerhouse only as needed to remain within the desired reservoir elevation limits, or to control downstream TDG. After that initial 30-day period, refill pool as hydrology allows and spill (gated) at night at both projects, with generation during the day, for as long as water is available and downstream conditions allow. Then manage Lookout Point Reservoir to achieve elevation 887.5 ft by July 15 and operate the regulating outlets as needed to reduce downstream water temperatures when water temperatures downstream of Dexter Dam near 60 degrees. The interim operations at Lookout Point include a drawdown of the reservoir, starting in July, to reach a target elevation of 761 feet in mid-November.

The interim operations are intended to improve downstream passage conditions for juvenile Upper Willamette River Chinook salmon by encouraging juvenile fish passage through the ROs instead of the turbines during periods when juvenile fish are most likely to be migrating downstream.

5.5.2.2 Constraints

Implementation should not:

- Result in a reduction of USACE ability to operate the dam for flood risk management authorized purpose
- Violate USACE dam safety requirements.

5.5.2.3 Performance Metrics and Targets

Performance Metrics:

The performance metrics listed in Table 5-1 will be used to evaluate the interim operations at Lookout Point, along with the following:

- Dam outlets operated during the defined interim operational period
- Pool elevations during the defined interim operational period
- Gate openings and discharge from each outlet operated
- Juvenile Chinook passage efficiency through preferred routes at Lookout Point Dam
- Juvenile Chinook passage timing at Lookout Point Dam

Targets:

- Reservoir elevations and flow releases prioritized as defined under the interim operation.
- Seasonal downstream juvenile Chinook passage efficiency through preferred routes (spillway and ROs) at Lookout Point Dam increased over pre-injunction operations.
- Downstream juvenile Chinook passage timing at Lookout Point Dam more consistent with natural emigration patterns in comparison to pre-injunction operations.
-

5.5.2.4 Research, Monitoring, and Evaluation

Interim actions were designed in collaboration with NMFS and other parties to operate the dams as best as feasible using existing facilities until long-term actions are implemented. Due to the effects of annual hydrologic variability in meeting interim operational objectives and resulting variability in water quality and fish passage conditions expected to occur within and across years, multiple years of monitoring are anticipated to be needed to understand if

operations are achieving objectives and targets or if changes are warranted. Monitoring results will be reported and reviewed annually. If targets are not met, decision makers will determine each year if any adjustments should be made to meet the operational objectives or if additional monitoring or uncertainty research should be conducted.

Study designs and methodology to assess the defined metrics will be determined during implementation so that the best available scientific approaches and methods can be applied. The AM process will be followed to annually prioritize research and monitoring activities, and to complete technical review proposed monitoring plans for assessing the metrics against the defined targets.

5.5.2.5 Risks and Uncertainties

- Risk: There is a trade-off in some water years between achieving the operational targets of these measures vs meeting other objectives (e.g. downstream minimum flow values)
- Risk: Hydrologic variability limiting the ability to achieve the interim operation in a given year

5.5.2.6 Decision Triggers and Adaptive Actions

Decision Criteria:

- If operational objectives or targets are met, continue with interim operation.
- If operational objectives or targets are not achieved for reasons other than hydrologic limitations or FRM operations, then implement adjustments to operations expected to improve achievement of targets which are feasible and authorized.
- If there are potential feasible and authorized adjustments, but uncertainty if those adjustments can improve the ability to achieve targets, then conduct uncertainty research and implement if results indicate that improvement is likelihood of achieving targets.

5.5.2.7 Decision-Making and Collaboration

The USACE will prepare annual reports documenting operations and summarizing the results in comparison to the defined targets. Annual check-ins will occur to assess how well targets have been achieved for water quality. A 5-year check-in will be conducted to review fish passage results to assess how well targets have been achieved. Check-ins on fish passage performance can also occur more often if adequate information is available and warrants review. Where targets are not achieved, the Action Agencies will propose changes to improve achievement of the operation where feasible and authorized. If changes that could improve achieving targets are not apparent, Action Agencies may instead propose uncertainty research to inform what changes may lead to achievement of the targets. The WATER Technical Teams will review the reported results from the operation, and any proposed changes to achieve the operational targets. USACE will ensure evaluations are carried out and reports are made available for NMFS

and WATER review within timelines necessary to inform AM decisions outlined in this document.

5.5.3 Lookout Point Downstream Fish Passage Structure (392)

5.5.3.1 Definition and Function

The measure provides a structural solution to improve downstream fish passage in the form of a Floating Surface Collector (FSC; pumped inflow operated independent of dam outlets).

5.5.3.2 Constraints

Constraints associated with the Lookout Point FSC will be identified as part of the project-specific planning documents developed prior to implementation. However, two known constraints relating to this measure is that implementation should not:

- Result in a reduction of USACE ability to operate the dam for flood risk management authorized purpose, and
- Violate USACE dam safety requirements.

5.5.3.3 Performance Metrics and Targets

Performance Metrics:

The following performance metrics, also listed in Table 5-2 and Figure 5-1, will be used to evaluate the passage at Lookout Point once the FSC is operational:

- Juvenile Fish Dam Passage Survival (DPS = DPE * CS)
    - Sub-metric: Dam-passage efficiency (DPE), the proportion of total fish passing the dam relative to the number of total fish detected in the near forebay of the dam and therefore available to pass.
    - Sub-metric: Fish passage efficiency (FPE), the proportion of fish passing via a non-turbine route, relative to the number of total fish in the near forebay and available to pass.
    - Sub-metric: Fish collector efficiency (FCE), defined as the proportion of fish passing (collected by) the FSS, relative to the number of total fish passing the dam via any route.
    - Sub-metric: Concrete Survival (CS), the proportion surviving passage through each route weighted by the number passing through each route
- Above-Dam Cohort Replacement Rate (CRR)

Targets:

- DPS: Higher value developed from the following two approaches:

- DPS rate needed to support replacement of spawners above dams as estimated using life cycle models, such as those developed for the Draft WVS PEIS and ESA consultation. Modeling to define the DPS rate needed to support replacement of spawners will be completed in year one of implementation of the proposed action, and will incorporate any new and relevant scientific information into models.
- Estimate of annual DPS across water year types
    - This estimate will be prepared using the Fish Benefit Workbook (FBW) or other approaches to estimate DPS across a range of water year types. New information will be used to update the estimate prior to assessing performance (field study data; revised models).

- Cohort Replacement Rate = ≥1.0

Figure 5-6. Lookout Point Dam tailrace, forebay, and near forebay zone (gray) showing approximate area to be used for measuring fish passage metrics.

5.5.3.4 Research, Monitoring, and Evaluation

Dam passage survival (calculated as DPS = DPE * CS) will be measured in two separate years which are representative of typical operating conditions (i.e., water years within 95% of normal hydrological conditions in the period of record). The precision needed about annual DPS estimates will be determined at the time of the assessment to evaluate passage to provide reasonable certainty bounds acceptable to decision makers.

DPE will be measured as the proportion of fish that exit the reservoir downstream (or are transported downstream) divided by the total number of fish in the near forebay area (i.e., fish approaching the dam). For Lookout Point the near forebay area will be defined as from the dam upstream to approximately the log boom in the upstream boundary of the dam forebay (Array 6 as defined by Beeman et al. 2015) (Figure 5-6).

Test period(s): Times of the year representative of when most juvenile salmon migrants are actively moving downstream. These test periods likely will cover portions of spring and fall/winter and could be one longer test period or two separate seasonal periods within a year.

CS will be measured as the number of fish that survive from Lookout Point Dam to the downstream CS measurement boundary divided by the total number of fish that pass downstream. The CS downstream measurement boundary will be located near the river confluence with the mainstem Willamette River (or nearest feasible location upstream of the confluence for assessing survival).

5.5.3.5 Risks and Uncertainties

- FSC Entrance rejection by juvenile Chinook and steelhead
- Reservoir influence on steelhead passage rates and residualism (i.e., juveniles choose not to emigrate downstream but mature in the reservoir or upstream.
- Seasonal variation in flow rates (from hydrology or dam operations) influencing fish attraction and collection
- Uncertainty in survival rate associated with copepod infection
- Difference in survival between volitional passage and truck transport downstream.
- Effectiveness of structural passage given scale of reservoir fluctuation at Lookout Point Dam
- Large forebay area impacting guidance and attraction to the FSC entrance. Design has used the dam as a guidance structure. Entrance oriented along longitudinal face of the dam. Could influence the number of fish attracted to entrance point.
- Climate change – see discussion under Basin Flow Measures (Section 5.1.1.5).

5.5.3.6 Decision Triggers and Adaptive Actions

Contingency actions to operation of the FSC are expected to be made in real-time during the first few years. Once field study to assess performance metrics begins, no in-season changes will be made to support evaluation. However, operational treatments for study may be considered at this time to simultaneously evaluate different conditions where information supports such treatments. Once two representative study years of FSC operation are completed, additional contingency actions will be implemented if results warrant, which are within the design capacity of the FSC. However, actions requiring additional funding or engineering will not be considered until after three CRR estimates are available (after year 7).

Successful fish passage would be defined by achieving either the DPS or the CRR target.

Examples of contingency actions for the FSC include:

- Structural: adjusting baffles, and other tuning of the existing facility; changing debris management practices, changing fish handling/holding/transport using existing facilities, guide nets or lead nets.
- Operational FSC: longer or shorter operational periods of FSC, increasing or decreasing entrance flows, operating barrels above criteria, bypass flows, etc.
- Operational dam and reservoir: increasing or decreasing flow through dam outlets, changes in refill pattern, operating dam with pulses, operating at lower pool level during conservation season, changing rate of reservoir drawdown through summer and fall.

The extent to which operations of the FSC could be adjusted to ensure performance would be described in future planning and design documentation. This would include both contingency actions as well as adjustments that may require additional environmental compliance or planning/design activities prior to implementation. Specifically, the Design Documentation Report or associated Engineering Documentation Report would describe the operation, maintenance, repair, replacement, and rehabilitation requirements for the structure.

5.5.3.7 Decision-Making and Collaboration

The Action Agencies will fund post-construction evaluations of DPS and fish survival through the FSS. The WATER Fish Passage Design, Research, and Development Technical Team will review study designs for assessing the performance metrics. It is also anticipated that study designs may benefit from a targeted independent science review. The Action Agencies will address the comments to improve the study design for assessing the performance metrics. If NMFS and the Action Agencies' technical staff do not concur on final study designs, the dispute will be elevated for resolution following Federal Family and WATER procedures and protocols. The Action Agencies will ensure evaluations are carried out and reports are made available for NMFS and WATER team review within timelines necessary to inform adaptive management decisions outlined in this document.

5.5.4 Fall Creek Interim Operations and Long-Term Operations

5.5.4.1 Definition and Function

Operate Fall Creek AFF to collect and transport adult spring Chinook upstream of Fall Creek Reservoir. For downstream fish passage in fall and winter, drawdown Fall Creek reservoir in the late fall, to elevation 690 ft; refill slightly to 700 ft; starting in mid-December and hold until March 15. Operate dam intake gates in a manner that maximizes fish passage survival at all times. Maintain sufficient discharge to operate the adult trap while refilling the reservoir to the extent possible. Blend releases through the various horns to control downstream water temperatures. Manage stored water to ensure a high probability of being able to operate the adult trap through September 30. USACE may need to provide flushing flows to clear the tailrace.

5.5.4.2 Constraints

Implementation should not:

- Result in a reduction of USACE ability to operate the dam for flood risk management authorized purpose
- Violate USACE dam safety requirements.

5.5.4.3 Performance Metrics and Targets

Fall Creek Reservoir Deep Drawdown in fall - This measure has been implemented and evaluated (e.g., Nesbit et al. 2012). Numbers of adult Chinook collected at the Fall Creek AFF and outplanted above Fall Creek Reservoir will annually be summarized and reported.

5.5.4.4 Research, Monitoring, and Evaluation

Fall Creek Reservoir Deep Drawdown in fall - This measure has been implemented and evaluated (e.g., Nesbit et al. 2012). Numbers of adult Chinook collected at the Fall Creek AFF and outplanted above Fall Creek Reservoir will annually be summarized and reported.

Fall Creek Reservoir Delayed Refill in spring – Interim actions were designed in collaboration with NMFS and other parties to operate the dams as best as feasible using existing facilities until long-term actions are implemented. Due to the effects of annual hydrologic variability in meeting interim operational objectives and resulting variability in water quality and fish passage conditions expected to occur within and across years, multiple years of monitoring are anticipated to be needed to understand if operations are achieving objectives and targets or if changes are warranted. Monitoring results will be reported and reviewed annually. If targets are not met, decision makers will determine each year if any adjustments should be made to meet the operational objectives or water quality targets, or if additional monitoring or uncertainty research should be conducted. For fish passage, a 5-year check-in will be conducted to review if targets were achieved. This is due to the seasonal and annual variability that occurs and resulting need for multiple years of data to evaluate if targets were achieved. Check-ins can also occur more often if information warrants, however caution should be taken before implementing operational changes fish passage before multiple years of data are collected.

Adult returns will be tissue sample and used to assess cohort replacement rates. CRR will be calculated to determine if targets are being achieved and used to help assess if spring delayed refill operations are positively or negatively affecting CRR.

5.5.4.5 Risks and Uncertainties

- Risk: There is a trade-off in some water years between achieving the operational targets of these measures vs meeting other objectives (e.g. downstream minimum flow values)
- Risk: Hydrologic variability limiting the ability to achieve the interim operation in a given year

5.5.4.6 Decision Triggers and Adaptive Actions

Fall Creek Reservoir Deep Drawdown in fall - This measure has been implemented and evaluated (e.g., Nesbit et al. 2012). Therefore, no decision criteria are included for this measure.

5.5.5 Fall Creek Adult Fish Facility

5.5.5.1 Definition and Function

Continued operation of the Fall Creek AFF for transport of adult spring Chinook above Fall Creek Dam.

5.5.5.2 Constraints

Implementation should not:

- Result in a reduction of USACE ability to operate the dam for flood risk management authorized purpose, and
- Violate USACE dam safety requirements.

5.5.5.3 Performance Metrics and Targets

Performance Metrics:

The following performance metrics will be used to evaluate operation of the Fall Creek AFF:

Adult fish collection and handling, and adult fish transport and outplanting protocols defined in the current Willamette Fish Operations Plan. At a minimum, the following protocols will be evaluated:

- Timing of fish collection and outplanting relative to natural run timing
- Injury rates from handling and sorting
- Mortality rates for fish while in the AFF or during truck transport
- Health condition of fish outplanted
- Health condition of fish taken for brood
- Number and locations of outplanted fish
- Sex ratio of outplanted fish
- Fish densities when in holding at AFF and in transport trucks
- Water temperatures and oxygen levels in the AFF and transport trucks
- Cumulative temperature exposure when in the AFF and transport trucks

- Temperature exposure when water temperatures need to be tempered prior to release of outplanted fish

Additional monitoring activities are also included for ongoing hatchery mitigation relevant to assessing the trapping and transport of adult Chinook salmon (see Section 5.6 of this Plan).

Targets:

Compliance with the adult fish collection and handling, and adult fish transport and outplanting protocols defined in the 2022 Willamette Fish Operations Plan.

5.5.5.4 Research, Monitoring, and Evaluation

Upstream passage metrics will be summarized annually, and reports provided to WATER for review. Information on most metrics listed above will be collected commensurate with operation of the AFF. Discharge and water temperatures below Fall Creek Dam will also be continuously monitored. As part of ongoing hatchery mitigation monitoring activities, available information on the following metrics will be included as part of annual summaries to support monitoring of upstream passage actions in the sub-basin:

- Counting of salmon at AFF.
- Number, sex ratio and timing of adult salmon released above WVS dams.
- Assess genetic pedigree of Chinook Salmon.

5.5.5.5 Risks and Uncertainties

- Effects of variation in Fall Creek Dam discharges (from hydrologic conditions, FRM, hydropower, etc.) on upstream migration of adult fish to Fall Creek Dam tailrace and adult collection in the AFF.
- Effects of water temperatures discharged from Fall Creek Dam or from the AFF on adult attraction and collection in the AFF.

5.5.5.6 Decision Triggers and Adaptive Actions

Minor changes to operation of the AFF (i.e., operational feasible, and within USACE authority, and not requiring additional funding) are expected to be made in real-time to maintain compliance with the WFOP protocols. Reports of operations will be reviewed annually to determine areas where minor changes may be needed. If compliance cannot be maintained with minor changes, then adjustments or modifications will be assessed. Depending on the potential solutions, engineering studies or biological studies may be planned as funding is available. The timeframe for implementation of adjustments of modifications to the AFF will depend on the specific actions identified for implementation.

5.5.6 Hills Creek Interim Operations

5.5.6.1 Definition and Function

Interim operations at Hills Creek Dam prioritize discharges through the regulating outlets at night rather than through the turbines. This interim operation is to improve downstream passage conditions for juvenile Upper Willamette River Chinook salmon by encouraging juvenile fish passage through the ROs instead of the turbines during periods when juvenile fish are most likely to be migrating downstream. USACE will implement regulating outlet spill operations daily from 6:00 PM to 10:00 PM at Hills Creek Dam once the reservoir elevation is 50 feet or less above the regulating outlets in the fall through March 1.

5.5.6.2 Constraints

Implementation should not:

- Result in a reduction of USACE ability to operate the dam for flood risk management authorized purpose
- Violate USACE dam safety requirements.

5.5.6.3 Performance Metrics and Targets

Performance Metrics:

The performance metrics listed in Table 5-1 will be used to evaluate the interim operations at Hills Creek Dam, along with the following:

- Dam outlets operated during the defined interim operational period
- Pool elevations during the defined interim operational period
- Gate openings and discharge from each outlet operated
- Juvenile Chinook passage efficiency through preferred routes at Hills Creek Dam
- Juvenile Chinook passage timing at Hills Creek Dam

Targets:

- Reservoir elevations and flow releases prioritized as defined under the interim operation.
- Seasonal downstream juvenile Chinook passage efficiency through preferred routes (spillway and ROs) at Hills Creek Dam increased over pre-injunction operations.
- Downstream juvenile Chinook passage timing at Hills Creek Dam more consistent with natural emigration patterns in comparison to pre-injunction operations.

5.5.6.4 Research, Monitoring, and Evaluation

Interim actions were designed in collaboration with NMFS and other parties to operate the dams as best as feasible using existing facilities until long-term actions are implemented. Due to the effects of annual hydrologic variability in meeting interim operational objectives and resulting variability in water quality and fish passage conditions expected to occur within and across years, multiple years of monitoring are anticipated to be needed to understand if operations are achieving objectives and targets or if changes are warranted. Monitoring results will be reported and reviewed annually. If targets are not met, decision makers will determine each year if any adjustments should be made to meet the operational objectives or water quality targets, or if additional monitoring or uncertainty research should be conducted.

Study designs and methodology to assess the defined metrics will be determined during implementation so that the best available scientific approaches and methods can be applied. The AM process will be followed to annually prioritize research and monitoring activities, and to complete technical review proposed monitoring plans for assessing the metrics against the defined targets.

5.5.6.5 Risks and Uncertainties

Potential risks to successful implementation include:

- Interim operations for fish passage and water quality may influence the ability to meet tributary flow targets in some years.
- Meeting tributary flow targets may influence the ability to achieve interim operations for fish passage and water quality in some years.

5.5.6.6 Decision Triggers and Adaptive Actions

USACE will prepare annual reports documenting operations and summarizing the results in comparison to the defined targets. Annual check-ins will occur to assess how well targets have been achieved for water quality. A 5-year check-in will be conducted to review fish passage results to assess how well targets have been achieved. Check-ins on fish passage performance can also occur more often if adequate information is available and warrants review. Where targets are not achieved, the Action Agencies will propose changes to improve achievement of the operation where feasible and authorized. If changes that could improve achieving targets are not apparent, Action Agencies may instead propose uncertainty research to inform what changes may lead to achievement of the targets. The WATER Technical Teams will review the reported results from the operation, and any proposed changes to achieve the operational targets. The USACE will ensure evaluations are carried out and reports are made available for NMFS and WATER review within timelines necessary to inform AM decisions outlined in this document.

5.5.7 Hills Creek Adaptive Management Approach for Long Term Fish Passage

5.5.7.1 Definition and Function

Two ESA-listed fish are affected by Hills Creek Dam – UWR Chinook salmon and bull trout. Analysis of the proposed action (in the Biological Assessment) and draft preferred alternative (in the Draft WVS EIS) estimates Chinook population performance is expected to result in natural sustainable populations of Chinook above dams in the four sub-basins affected by the WVS in this ESU. These analyses also indicated that the performance of the Middle Fork Chinook population may be lower if passage is included at Hills Creek Dam, in comparison to only at Lookout Point Dam. The only spawning areas used by bull trout in the Middle Fork are those above Hills Creek Reservoir, and the population has been growing under existing conditions at Hills Creek dam and reservoir. Therefore only the interim operation is proposed at Hills Creek for Chinook salmon. Assessment of the interim action for downstream fish passage will be included as described in Section 5.5.6 for Hills Creek interim Operations.

The need for long-term fish passage at Hills Creek Dam will be determined as part of the Adaptive Management Plan and process. A check-in point with the Services is included to determine an appropriate downstream passage solution at Hills Creek Dam if UWR Chinook downstream passage is not successful in at least 3 out of 4 of the proposed locations where passage is proposed (see Section 2.4 Implementation Timeline). Some bull trout are known to move below HCR Dam, however there is no means for those individuals to move back upstream of the dam. The only spawning areas used by bull trout in the Middle Fork are those above HCR Reservoir, and therefore access back upstream would be needed for individuals moving below the dam in order to access spawning habitat above the dam and reservoir.

Bull Trout

Although the bull trout population above Hills Creek Dam has been growing, individuals going below Hills Creek Dam are a loss for the population unless they migrate back up to Hills Creek Dam and can be collected and transported back upstream of the dam. Permanent trapping facilities designed primarily for bull trout are not common. A review will be completed to assess the feasibility and likelihood that a safe and effective trap can be operated in the tailrace of Hills Creek Dam to support the trap and transport of bull trout above the dam, and to review effective designs and features. The assessment will include consideration of water temperatures released from Hills Creek Dam. The review is expected to take one year and will begin in 2026. If found feasible the timing for completion of this trap would be 6.5 years, with 1.5 years each for EDR, DDR, P&S, and 1 year for construction. Trap completion is therefore scheduled for 2033.

Chinook Salmon

There are at least two uncertain technical issues to assess to support a decision on Hills Creek Dam passage for Chinook Salmon:

1. The level of performance achieved by the UWR Chinook Salmon populations affected by the WVS after implementation of measures included in the Proposed Action;

2. The ability to provide safe and effective passage for Chinook around the Dexter/Lookout Point/Hills Creek Dam complex.

If the level of improvement for the UWR Chinook Salmon ESU is high enough from the collective actions taken under the Proposed Action/Preferred Alternative, then all four populations affected by the WVS would achieve sustainable natural populations, and additional actions at Hills Creek may not be necessary. On the other hand, if the level of performance for the UWR Chinook Salmon populations affected by the WVS is lower than expected, then additional measures may need to be considered. These additional measures could take the form of adjustments or modifications to the measures already taken in any of the four Chinook populations affected by the WVS, or as new measures such as adding passage at Hills Creek Dam. It will be important to consider population(s) should be targeted in order to most effectively address the needs of the UWR Chinook Salmon ESU.

There is greater uncertainty in the biological feasibility of establishing a sustainable population of Chinook above Dexter, Lookout and Hills Creek dams, particularly measures that singularly focus on passage at Hills Creek. First, longer transport times affect adult translocation success. Likewise, juveniles would face greater mortality risk passing through multiple reservoirs, particularly Lookout where linear distance is substantially greater than reservoir transport in other sub-basins. Other issues include uncertainty in using genetics to sort adult Chinook at Dexter AFF for transport above Lookout Point Reservoir from those to be transported above Hills Creek Reservoir, pre-spawn mortality in adult Chinook transported above Lookout Point and Hills Creek dams, and the dam passage survival of juvenile Chinook at WVS after operational and structural measures are implemented. These include longer sorting requirements from Dexter to Hills Creek and longer transport times from Dexter to the Hill Creek release site. Results of the passage measures included in the Proposed Action after they are implemented will help determine the potential for achieving adequate improvements for the UWR Chinook Salmon ESU. These would include upstream passage measures in the South Santiam where Chinook will be collected and transported both above Foster Dam and above a second dam, Green Peter, and downstream passage measures using surface collectors at Detroit and Lookout Point, and operational measures and Green Peter (spring surface spill and fall deep reservoir drawdown).

5.5.7.2 Constraints

Consistent with other measures, the Hills Creek passage measures should not:

- Result in a reduction of USACE ability to operate the dam for the flood risk management authorized purpose, and
- Violate USACE dam safety requirements.
- Violate WFPOM fish safety requirements.

5.5.7.3 Performance Metrics and Targets

For bull trout, a decision for proceeding with a new bull trout adult trap below Hills Creek Dam will be based on the assessment described above to determine the feasibility and likelihood that a safe and effective trap can be operated in the tailrace of Hills Creek Dam to support the trap and transport of bull trout above the dam. If this trap is constructed, operations would be evaluated by assessing similar attributes to those listed for adult chinook and steelhead adult fish facilities:

- Timing of fish collection and transport relative to natural run timing
- Injury rates from handling and sorting
- Mortality rates for fish while in the AFF or during truck transport
- Health condition of fish transported above dam
- Health condition of fish taken for brood
- Number and locations of transported fish
- Sex ratio of transported fish
- Fish densities when in holding at AFF and in transport trucks
- Water temperatures and oxygen levels in the AFF and transport trucks
- Cumulative temperature exposure when in the AFF and transport trucks
- Temperature exposure when water temperatures need to be tempered prior to release of outplanted fish
- Tagging and/or marking of individuals collected
- Recording of previously marked or tagged individuals

Population level metrics will be used to evaluate the performance of UWR Chinook performance using life cycle models, with life cycle models updated with the latest downstream passage survival information, smolt to adult return rates and other biological attributes of these populations where new information is available (Table 5-6).

Table 5-6. Summary effects analysis metrics for ESA-listed UWR spring Chinook populations

Primary attributes	Description	Primary data sources sought	Units of measure
Productivity	Population Growth Rate	Recruits/Spawner (R/S), Smolt-to-adult-return rates (SAR), counts or indices of	Estimated change in the geometric mean R/S, SAR, and A/P

Primary attributes	Description	Primary data sources sought	Units of measure
		abundance for adults and juveniles	
Abundance	Geomean of naturally producing adults	Empirical counts, retrospective analysis, and simulations of adult return counts and redds	Estimated trends in geomean abundance of natural origin spawners over several salmon generations (forecasted period will depend on data available to support given expected uncertainty of prospective analyses)
Extinction Risk	Quasi extinction risk (QET)	Empirical counts and prospective analysis of adult return counts and redds	Probability that abundance is less than threshold over several salmon generations (forecasted period will depend on data available to support given expected uncertainty of prospective analyses)
Diversity	Number of surviving trajectories	Life history strategies that survived under a management alternative	Proportion of surviving life history strategies

The primary performance metrics for the population models are: 1. Equilibrium abundance which describes the adult abundance predictions once the population stabilizes at some point in the future (30-100 years), 2. Productivity describes the number of successful juveniles that are produced per adult spawner either in the first 10 years or as an average over 100 years, 3. Extinction Risk is the probability that a population will fall below a given number of adults at some point into the future (30-100 years), and 4. Diversity is the percentage of life history strategies that succeed (i.e., demonstrate a productivity greater than 1 once the population reaches equilibrium (5-10 years).

5.5.7.4 Risks and Uncertainties

- The effect of bull trout passage at Hills Creek on the abundance of bull trout spawners above Hills Creek Dam

- The ability to provide safe and effective collection, holding and sorting facilities and protocols for adult Chinook to be transported above Lookout Point and Hills Creek dams

- The ability to adequately control pre-spawn mortality rates and illegal harvest in adult Chinook transported above WVS dams in the Middle Fork

- The ability to achieve an adequate downstream passage survival rate supporting the establishment of sustainable natural populations of Chinook above Lookout Point and Hills Creek dams

5.5.7.5 Decision Triggers and Adaptive Actions

Bull Trout

If the review of traps finds that it is feasible to construct and operate an effective trap for bull trout in the tailrace of Hills Creek Dam, then the design and construction process will proceed pending funding authorization. The approximate timing for completion of this trap would be 6.5 years, if funding is available and assuming 1.5 each for EDR, DDR, P&S, and 1 year for construction. The chosen design concept will influence the final timing of completion of the design and construction process.

Chinook

1. In 2038, using life-cycle modeling updated with any new fish passage estimates and other relevant information, assess the performance potential of the UWR Chinook populations affected by the WVS.

    a. Information should include field results from at least 2 years of downstream passage testing completed at the DET FSS, up to 6 years of operations of the updated FOS downstream passage facilities, up to 6 years of operating two AFFs in the South Santiam (Green Peter and FOS AFF), and up to 13 years of Green Peter downstream passage spill and deep drawdown operations.

    b. If ESU performance potential too low, proceed with HCR passage planning (EDR, DDR, P&S; 2041-2046.5) and re-assess in 2046 (see item 2).

        i. Potential downstream passage options: RO improvement, spillway improvement, both, FSS, or FSC

        ii. Potential upstream passage options: AFF at DEX w/ sort using genetic pedigree; AFF at DEX and HCR with temperature control improvements at HCR Dam

    c. If ESU performance potential is expected to be adequate upon review by the Action Agencies and NMFS, then continue with implementation of the proposed action; with re-assessment in 2046 (see item 2).

2. In 2046, using life-cycle modeling updated with fish passage estimates and other information, re-assess the performance potential of the UWR Chinook populations affected by the WVS

    a. Information should include field results from at least 2 years of downstream passage testing completed at the LOP FSC, up to 10 years of DET FSS operations, up to 6 years of operations of the updated FOS downstream passage facilities, up to 6 years of operating two AFFs in the South Santiam (Green Peter and FOS AFF), and up to 13 years of Green Peter downstream passage spill and deep drawdown operations.

If ESU performance potential is estimated to be too low, determine what actions will most effectively address UWR Chinook Salmon ESU performance (HCR passage actions, adjustments or modifications to other measures affecting any of the four UWR Chinook populations affected by the WVS), and complete planning design and construction by 2053, then repeat step 2.

5.6 ONGOING HATCHERY MITIGATION PROGRAM MONITORING

In 2019, NMFS completed a biological opinion on new Hatchery and Genetic Management Plans (HGMPs) developed by ODFW and USACE for hatchery programs for spring Chinook salmon, summer steelhead, and rainbow trout in the Upper Willamette River Basin. The proposed action is to continue implementation of the HGMPs and recommendations included in NMFS 2019 biological opinion, including monitoring activities. For context, monitoring activities listed in the NMFS 2019 biological opinion terms and conditions are incorporated here by reference, and include:

- Collection of biometrics of hatchery salmon returning to collection facilities.
- Counting salmon at diversion dams (Bennett, Lebannon, and Leaburg).
- Analyzing steelhead genetics (ODFW).
- Assess future effects of hatchery summer steelhead in the North and South Santiam Rivers.
- Assess genetic pedigree of Chinook Salmon.
- Assess salmon spawning above federal dams.
- Use ODFW's existing database to input data associated with these terms and conditions.
- Prepare a report to NMFS every three years address specified requirements.

5.7 HATCHERY MEASURE (719)

Existing HGMPs describe how hatchery Chinook are currently being used to support reintroduction of spring Chinook above WVS dams, as well as a framework for reducing or ending hatchery supplementation above WVS dams as effective fish passage is achieved and unmarked adults increase. The HGMPs recognize that Federal hatchery mitigation obligations will be reduced based upon a crediting system once fish passage is improved, but do not include a crediting system or process for establishment of that system.

The number of hatchery origin Chinook outplanted above dams annually to supplement natural origin returns will be adjusted consistent with the existing HGMPs and NMFS 2019 BiOp. The overall goal of Measure 719 is to adjust production of WVS hatcheries for mitigation obligations and conservation needs after demonstrated improvements to fish access to habitat above dams. However brood take and juvenile production/release levels for all programs (spring Chinook, summer steelhead, rainbow trout) will not be reduced in association with fish passage improvements until future negotiations between the Corps, NMFS and ODFW occur. A proposed process for reductions in hatchery fish production is included as part of Measure 719, as summarized below, but would not be implemented until after detailed discussions with NMFS and ODFW.

5.7.1 Spring Chinook Salmon Crediting After Dam Passage is Improved

Before passage is improved, hatchery juvenile spring Chinook releases (Table 5-7) and outplanting (Table 5-8) of adult spring Chinook hatchery fish above dams will occur according to the HGMPs and NMFS associated 2019 Biological Opinion.

After passage improvement at a dam (years 0-5), hatchery-origin returns (HORs) would continue to supplement natural-origin returns (NORs) outplanted in order to meet but not exceed the abundance thresholds as defined in the HGMPs (Table 5-6). For projects at which only natural origin fish are currently outplanted above a project (i.e., Foster Dam), this plan would remain consistent with strategies to maintain hatchery production below the dam.

Table 5-6provides the adult Chinook outplanting thresholds from the associated HGMPs and NMFS' 2019 BiOp except for the South Santiam. When the number of natural origin (unmarked) Chinook spawner returns are below these levels, hatchery origin returns will be used to supplement to achieve the thresholds. The South Santiam HGMP indicates 600 total, if needed, however up to 800 hatchery adult Chinook will begin being outplanted above Green Peter Dam in 2022. Currently, no hatchery origin (marked) fish are outplanted above Foster so the outplant number for South Santiam in Table 5-7 is for fish intended for reintroduction above Green Peter.

PHASE 1 - Years 1-7 following improved fish passage conditions:

Following the implementation of downstream fish passage improvements, hatchery spring Chinook production will remain at production levels as defined in the HGMPs. Annual dam passage survival (DPS, i.e., dam passage efficiency * dam passage survival) will be measured in two separate years which are representative of typical operating conditions (i.e., water years within 95% of normal hydrological conditions in the period of record) to evaluate fish passage efficiency and survival at the dam. The precision needed about annual DPS will be determined at the time of the assessment to evaluate passage. Observed performance will be compared to downstream passage survival rates estimated to support the replacement criteria.

PHASE 2 - After Year 7 following a fish passage improvement – production crediting based on adult return rates:

Recognizing several factors can affect adult Chinook returns, cohort replacement rate (CRR) serves as a basis for evaluating overall population performance. CRR will be estimated as:

$$CRR = \frac{\text{Number of } \mathbf{unmarked} \text{ 3, 4 and 5 year old returns produced by outplants (males and females) in Year X}}{\text{Number of spawners (}\mathbf{marked\ and\ unmarked}\text{) in Year X}}$$

CRR is calculated using the above equation; and uses the entirety of the spawning population in the reach above the dam regardless of the origin of the parents. In other words, adults of hatchery origin used to supplement the number of spawners is considered part of the cohort parentage. The HGMP thresholds define the minimum abundance levels for assessing CRR above each dam because outplanted adults will continue to be supplemented with hatchery fish until natural origin fish meet or exceed the HGMP thresholds (Table 5-7).

After 7 years CRR will be calculated for three separate cohorts accounting for adult returns in years 3-5, 4-6 and 5-7. If the CRR for Chinook is >1 based on a geometric mean of replacement rates for the three cohorts returning in years 3-5, 4-6 and 5-7, then the full credit for fish passage improvements will be applied to the spring Chinook hatchery production for the sub-basin in which returns are being assessed. In this case, Chinook production will be reduced over a period of five years to a Reduced Level of Production (see below). This gradual reduction strategy allows economic interests to adjust and provides the State of Oregon additional time to seek funding for additional hatchery production if desired. The basin-specific NOR thresholds will be the same as the outplanting thresholds indicated in the Table 5-7.

If CRR < 1, and DSP criteria not met, then mitigation credit reductions will not occur at this time and instead be re-assessed again after year 14. After re-assessment, if the geometric mean of CRR is >1.0 for cohorts returning in years 12, 13 and 14, then reductions to Chinook release will be reduced over a period of five years to the Reduced Level of Production.

If the geometric mean of CRR is still <1.0 for cohorts returning in years 12, 13 and 14, and the DSP target is met, non-project effects will be evaluated. There have been several methods proposed in similar programs for quantifying non-project effects for the purpose of demonstrating reduced impact to ESA-listed salmonids. For example, the Lewis River Hydroelectric Projects M&E Plan (2010) describes the number of ocean recruits (i.e., Total Adult Production; TAP), and adult escapement to traps accounting for harvest removals. Another possible metric may include examining the ratio of adults observed at Willamette Falls to those observed at traps when enroute mortality is accounted for (e.g., Keefer et al. 2017). Extensive modeling of hydrologic conditions relative to available habitat are ongoing as part of the SWIFT project (Peterson et al. 2022), passage modeling by the University of British Columbia, among other efforts may be applied to assess the effect of project management on juvenile out-migration and adult returns compared to off-project effects (e.g., ocean conditions, poor hydrologic conditions, harvest, etc.). UBC has shown that marine survival alone can impact the effects of perfect passage in poor marine years. If these available methods indicate substantial non-project effects on replacement, credit for dam fish passage improvements will be determined through further review and discussion among the State of Oregon, USACE and NMFS following the same process as outlined in the Reduced Hatchery Production section and

take into consideration the effectiveness of the dam passage conditions, other project effects, and other non-project effects. Based on this assessment, outcomes could include:

- No changes to mitigation production, with further actions to address project effects. CRR would then be reassessed after 7 years following implementation of additional action.
- Changes to mitigation production due to recognized impacts from the hatchery program constraining natural production, with alternative mitigation implemented.
- Mitigation credit due to recognition of improved passage conditions and non-project effects constraining CRR. In this scenario mitigation production for passage could be fully reduced, while maintaining some Reduced Level of Spring Chinook Salmon Production (see below) to mitigate for any remaining, non-passage, project effects identified.

Reduced Level of Spring Chinook Salmon Production

The purpose of the Reduced Level of Production is to maintain some mitigation production, to be developed with the State of Oregon and NMFS, recognizing 1) some project effects may remain that require mitigation after successful fish passage is implemented and assessed, 2) hatchery production may need to be maintained for conservation/safety net purposes recognizing uncertainty in reintroduction success, and 3) increases in natural origin returns when still below the CRR of 1 may warrant reductions in hatchery production and releases to help increase natural productivity. The Reduced Hatchery Production levels will be based on the passage assessment leading to habitat access as referenced in HD 531. Alternative mitigation may also need to be considered where there are effects on ESA-listed species from the production and release of hatchery mitigation fish. If CRR is improved by passage, yet remains below a CRR of 1, brood take needed to support conservation outplanting should be assessed as part of determining reduced levels of production. The deficit in replacement value (in number of consensus spawners) will be used to calculate a potential new production level (Ppost) intended for meeting conservation (outplanting) needs in years 9-142:

$$P_{Post} = \frac{\#\ of\ outplants_y - \#\ of\ returns_{y5}}{SAR_{harv}}$$

Where SARharv is the estimated smolt to adult return rate assuming harvest and y is the brood year and y5 is all of the progeny that can reasonably be assigned to brood year y. For purposes of calculating a new conservation production level, changes in the SAR from increased levels of natural origin brood should be considered.

5.7.2 Rainbow Trout Crediting

As for spring Chinook and summer steelhead, trout hatchery mitigation needs after fish passage improvements at WVS dams will be developed with the State of Oregon. The initial authorization for game fish mitigation related to construction and operation of the WVS was based on concerns about the productivity of resident fish given impoundment and inundation by authorized projects. Trout mitigation changes as it relates to passage improvements at WVS

may be important to consider given these assumptions about productivity of resident trout in reservoirs, addressing effects of ongoing hatchery trout stocking on ESA-listed fish reintroduction and natural production (including local fisheries for hatchery stocked trout), and/or to account for other mitigation credits that have or are continuing to occur (e.g. BPA is directly addressing the mitigation for inundation through the Wildlife Enhancement Memorandum of Agreement; BPA & ODFW 2010). Impacts to ESA-listed fish from rainbow trout is recognized and the current HGMPs describe approaches to limit overlap of rainbow trout and ESA-listed fish. USACE anticipates that further changes may need to be made once passage is implemented to limit impacts on reintroduced populations.

5.7.3 Summer Steelhead Crediting

In association with improved fish passage conditions at WVS dams, any changes to the mitigation hatchery production of summer steelhead as funded by USACE will also be developed with the State of Oregon. Non-native hatchery summer steelhead are produced to mitigate for the effects of the WVS on native ESA-listed winter steelhead. Plans for any reintroduction of winter steelhead above WVS dams (including within the Winter Steelhead Distinct Population Segment; DPS) have not been developed. Summer steelhead provide no conservation value to support winter steelhead reintroduction above WVS dams and are known to have negative impacts on winter steelhead in the Willamette Basin (e.g., fitness effects associated with introgression). It also may not be feasible to assess winter steelhead CRR. Oncorhynchus Mykiss progeny can become either resident (rainbow trout) or anadromous (steelhead). Recent work indicates that non-anadromy may be an adaptive strategy in response to reservoir inundation with lack of adequate passage and that these strategies are plastic, i.e., anadromous females can breed with non-anadromous males with documented success of anadromous progeny as summarized in McAllister et al. (2022 in draft). Estimates of CRR for steelhead are uncertain given some offspring will remain in freshwater and mature as rainbow trout, and some adult steelhead returns will be progeny of rainbow trout.

Table 5-7. Willamette Hatchery Mitigation Program production goals for UWR spring Chinook salmon in each sub-basin according to the Hatchery Genetics Management Plans.

Sub-basin	ESA Conservation Purpose (per HGMP)	USACE-funded Non-Conservation Release (per HGMP)	ODFW-funded Release per HGMP	Total Hatchery Release
North Santiam	630,000	74,000	0	704,000
South Santiam	350,000	289,000	382,000	1,021,000
McKenzie	604,750	0	0	604,750
Middle Fork Willamette	NA	2,039,000	0	2,039,000

Table 5-8. Willamette Spring Chinook Salmon Natural Origin Thresholds Required Prior to Crediting (Outplant Numbers Taken from HGMPs).

Sub-basin	Natural-origin fish threshold*	Natural-origin female fish threshold*	Natural-origin male fish threshold*
McKenzie	600	400	200
Middle Fork	2,450	–	–
South Santiam	800	–	–
North Santiam	1,500	750	750

5.7.4 Decision-Making and Collaboration

USACE will prepare reports documenting results from assessment of Chinook DPS and CRR following passage improvements as described in previously within Section 5.6. The WATER Technical Teams will review the reported results, and any proposed changes to hatchery production developed consistent with targets and the decision framework described in Section 5.6. USACE will ensure evaluations are carried out and reports are made available for NMFS and WATER review within timelines necessary to inform AM decisions outlined in this document.

5.8 BASIN-WIDE FLOW MEASURES

5.8.1 Definition and Function

This section combines adaptive management considerations for three flow measures: integrated temperature and habitat flow regime (Measure 30b), flow augmentation by tapping the power pool (Measure 304), and flow augmentation by using the inactive pool (Measure 718). These measures are addressed collectively for adaptive management purposes because they function together to facilitate meeting downstream minimum flow and mainstem temperature requirements (additional measures address tributary water temperature management and are discussed in their respective sub-basin sections of this chapter). Measure 30b proposed operations would include all Willamette basin projects. Measure 304 is proposed at Lookout Point, Hills Creek, Cougar, Green Peter, and Detroit. Measure 718 is proposed at Fall Creek and Blue River.

Physical habitat provided by streamflow must also include water quality and water temperature conditions within thermal biologic tolerances for native and sensitive species. A primary function of the fish flow management regime is to help avoid exceeding high water temperature thresholds to improve available habitat. The proposed flow measure is based on two components: 1) minimum flow thresholds that incorporate magnitude, seasonal variation and are responsive to annual hydrologic conditions and 2) water releases for real-time water temperature management.

5.8.2 Constraints

- The measure should not result in a reduction of USACE ability to operate the WVS for the flood risk management authorized purpose.
- Annual hydrologic variability has the potential to constrain any flow and water temperature management measure.

5.8.3 Performance Metrics and Targets

Operations for river flow management measures include minimum and maximum flow values as well as 7-day average maximum water temperature values (Table 5-9). These operational targets or thresholds direct how flow would be managed in any given year and are described in Chapter 2 and Appendix A of the DPEIS. Monitoring the flow measures will consist of measuring flow and water temperature daily in each management reach. Observed daily flow and water temperatures will be summarized and reported annually, along with the percentage of days flows are below minimum threshold values, the percentage contribution to the observed flows from conservation storage, and the percentage of time water temperatures are outside target ranges.

Table 5-9. Performance Metrics and Targets for Proposed Flow Measures.

Monitoring Metrics	Targets	Assessment
Flow (cfs)	Flows > minimum values for each management reach	Annually summarize below dam flows at points of discharge and downstream control points: % days below reach target % conservation storage contribution to river flow
Temperature (C)	7-day Average of the Daily Max (7dADM) at Salem	Annually summarize below dam water temperatures at Salem: % days below reach target range % change in water temperatures at Salem when pulses released

5.8.4 Research, Monitoring, and Evaluation

An assessment of the frequency minimum flow and temperature targets were met will be completed annually. Uncontrolled environmental variability complicates the ability to assess and identify effects of WVS dam and reservoir operations on downstream flow conditions separately from those caused by natural or other factors occurring downstream. Fish response to flow management will be assessed every five to ten years, and results used to determine if adjustments or modifications are needed in flow management measures or criteria (see Decision Triggers and Adaptive Management Section below).

As a part of assessing fish response to the effects of WVS dam and reservoir operations on downstream river conditions, modeling of fish survival will be completed. Minimum flow thresholds values included in the DPEIS were developed with application of integrated decision support models which were used to evaluate the effect of flows on two life history stages of Chinook salmon and winter steelhead (Deweber and Peterson 2020, Peterson et al. 2022). These models are regionally referred to as the Science of Willamette Instream Flows Team (SWIFT) models. The four fundamental objectives associated with the SWIFT models are shown on Figure 5-7. Fish habitat time series input into the SWIFT models were estimated using habitat sub-models prepared by USGS (e.g. White et al. 2022). These models rely on relationships between biological responses and physical aquatic conditions (flow and water temperatures) to estimate fish survival. Research and analysis may be necessary to reduce uncertainty and unacceptable levels of risks for decision makers. Sensitivity analysis of the current SWIFT models indicated models were most sensitive to water temperature. The SWIFT models include an assumption that when juvenile habitat units fill to capacity, then additional juveniles will move downstream to the next available habitat unit. This assumption is based on published literature from outside the Willamette Basin, and therefore additional research may be warranted. As this process proceeds, additional critical information needs may be identified. Consideration of additional research will be raised through the WATER Technical and Steering teams. Prioritization of any new research needs proposed should consider information needs which reduce uncertainty for those attributes which are likely to have significant influence on the fundamental biological objectives targeted by the management actions.

USGS gage control points through the basin provide continuous flow (cfs) and water temperature data that would support evaluation of the flow measures.

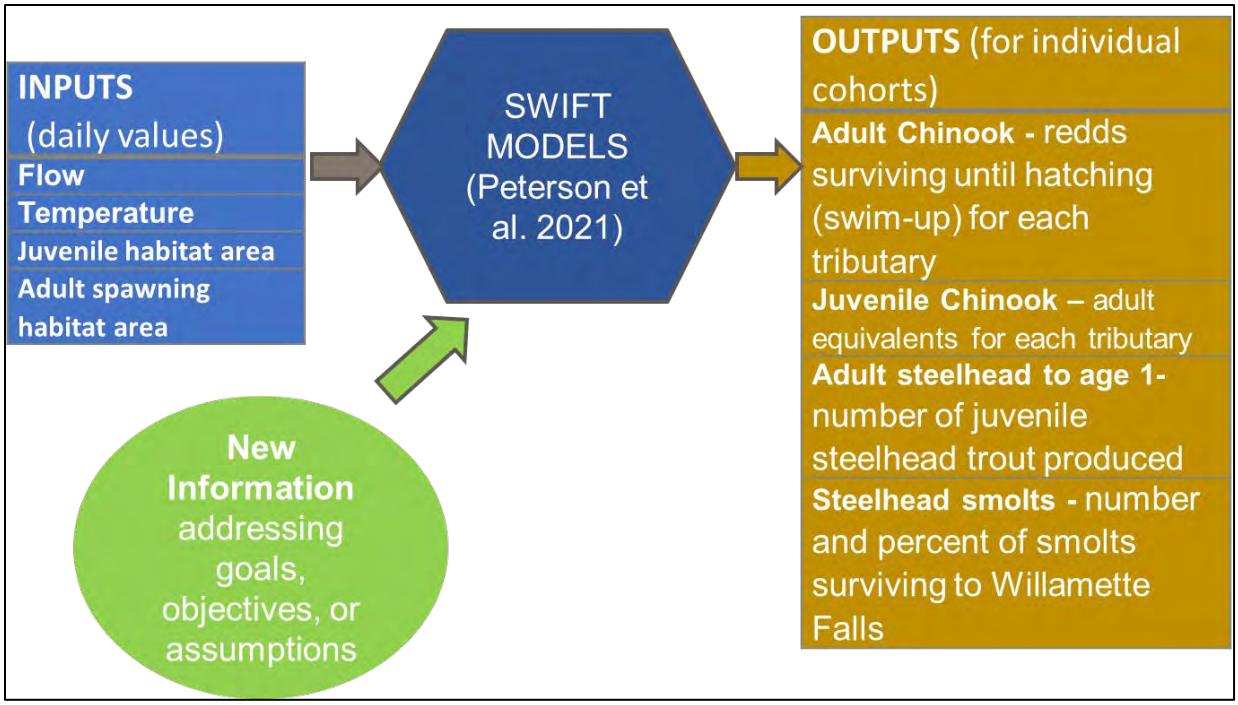

Figure 5-7. Conceptual diagram showing application of SWIFT models for adaptive management of WVS flows to address WVS effects to spring Chinook and winter steelhead

5.8.5 Risks and Uncertainties

Potential risks to successful implementation of the flow measures include:

- Natural water inflows directly affect annual conservation storage volumes in each reservoir and therefore the ability to supplement stream flows downstream of dams to meet tributary flow minimum values.
- Interim operations may affect conservation storage volumes in reservoirs and therefore the ability to supplement stream flows downstream of dams to meet tributary flow minimum values at particular times in some years.
- It may not be possible to implement downstream fish passage operations and other measures while simultaneously meeting objectives for downstream flow measures in drier water years. A trade-off may be necessary in these years between operations for fish passage or operations for downstream instream flow objectives for fish.
- Diversion of water downstream of WVS dams reducing instream flows below targets. The USACE does not have the authority to ensure water released downstream from WVS reservoirs is not diverted for other uses downstream.

As described previously, there are known areas of scientific uncertainty that are relevant to the variables and relationships in the SWIFT models. The following would be priority research topics to reduce uncertainty for assessing response of spring Chinook and winter steelhead to flow management:

1. Habitat availability: Do new flow/habitat relationships show significant differences from flow/habitat relationships applied in the WVS PEIS?

2. Juvenile Chinook and winter steelhead movements and distribution at high density. Does fish density result in movement to other habitat units?

Climate change represents both a risk to successful implementation of measures included in the Preferred Alternative and is an area of high uncertainty. USACE completed a climate change assessment that documents the qualitative effects of climate change on hydrology in the region (Appendix F to the DPEIS). Qualitative assessment of climate change impacts is required by USACE Engineering and Construction Bulletin (ECB) 2018-14 (revision 1, expires 10-Sep 2022), Guidance for Incorporating Climate Change Impacts to Inland Hydrology in Civil Works Studies, Designs, and Projects.

USACE response to climate change is adaptation centric and a guiding tenet is to incorporate climate change information and considerations early into the formulation process, with the goal of increasing resilience in its measures and alternatives. A more resilient feature is one that is conceptually more resistant to likely future conditions, and/or possesses inherent flexibility to adapt successfully to projected changes. As described in Appendix F to the DPEIS, while the climate change assessment did not indicate a statistically significant influence effect from changing climate on historical observed streamflows, future projections estimate that the WVS will experience generally wetter winter flood seasons with less snow and more rain, as well as warmer and drier summer/conservation seasons. The uncertainty associated with a given future projection of hydrologic conditions is large. To address very high uncertainty of a single climate change scenario, USACE policy is to leverage ensembles of the best available and accepted GCM scenario hydroclimate and hydrologic datasets. Determinations can then be made by inferring trends in terms of the statistical distribution metrics (e.g., median shifts, standard deviation etc.) the climate change scenario ensemble.

Measure 30b was designed to be flexible and responsive in real-time to hydrologic conditions. The measure includes two minimum flow schedules and releases to help manage Willamette River water temperatures. Conservation storage conditions are to be reviewed every two weeks between February and June to determine which minimum flow schedule will be applied. Measures 304 and 718 are also employed if reservoirs are drafted to the conservation pool levels and releases are needed to supplement downstream flows.

Real-time water management also has the flexibility to accommodate historical annual hydrologic variation. Reservoirs must be drawn down to minimum conservation pool elevations each fall to meet flood risk reduction objectives. To accomplish draw down, the timing and magnitude of discharges can be adjusted in real-time between spring and fall. Managers each year will prepare a water management plan describing how water will be released from reservoirs to meet instream flow objectives serving fish and wildlife needs and other authorized purposes, and drawdown reservoirs to minimum conservation pool elevations by December 1 annually.

Incorporating updates to future climate change assessments and monitoring variables focused on the relevant climate change factors (see section 3.1.5 and Appendix F) and vulnerabilities identified in Appendix F, is recommended. Evaluation of AM steps is also recommended and important to determine how projected trends manifest themselves in future observations. Such monitoring would allow for a proactive response from USACE, should the risk to successful implementation of measures increase substantially over the long-term. Resilience principles espoused in Engineering and Construction Bulletin, ECB-2020-6 (revision 1, May 2022, expires May 2024), Implementation of Resilience Principles in the Engineering & Construction Community of Practice, should be adhered to and implemented in future adaptive management and monitoring activities.

Updates to the climate change assessments could coincide and follow the Intergovernmental Panel on Climate Change's (IPCC) latest General Circulation Model (GCM) result releases, on average every 6 to 7 years. This frequency of update would align with informing the 10-year evaluation periods outlined for the flow measures. It is also recommended that the update cycle consider the lag time between detection of trends and time to act. More frequent updates may be warranted and should be considered as part of the annual Science Update and AM Workshop process described in Chapter 4. More frequent updates may be precipitated by the availability of new climate change data or improved spatial resolution and statistical analyses that would better outline expected trends.

5.8.6 Decision Triggers and Adaptive Actions

Assessing the performance of flow management for achievement of flow and temperature targets will occur annually. Assessing the fish response to flow management will occur every 5 to 10 years, and the frequency of analysis will depend on the data adequacy for completing this assessment and the variability of flows. A check-in to assess data adequacy and variability for estimating performance metrics will occur every 5 years, and assessment of performance metrics will occur at this time if statistically reliable estimates can be prepared representative of the typical range of inter-annual and seasonally variable conditions. Monitoring metrics will be summarized as described previously to assess target achievement. SWIFT models, or other appropriate tools for assessing biological response to WVS flow management, will be applied with relevant new information to assess the biological response to the implemented flow management. Figure 5-8 summarizes a conceptual decision tree for long-term AM of the flow measures, illustrating a progression from demonstrating operational effectiveness, to adequately reducing uncertainty in models used for evaluation, to ultimately making decisions based on biological response.

Based on summarization of flow and temperature metrics, and modeled biological response, decision makers will consider continuing, adjusting or reformulating flow management thresholds. Critical information needs to reduce uncertainties and risks of making changes will be identified. If there is a consideration of adjusting or reformulating, hypotheses for improving flow management will be developed. To support hypothesis development, candidate flow and water temperature regimes may be input into models to predict the potential outcomes.

Where biologically significant benefits changes are predicted and are within the management flexibility and authority of USACE to implement, then changes will be implemented and then re-assessed during the next management cycle (e.g., subsequent 10 years), subject to existing laws.

No contingency actions are identified for the flow measures. By the nature of these measures being a flow operation, there are not pre-determined contingency actions that could be employed outside of the defined operations in the measures. Potential adjustments or major adjustments include:

Adjustments

- Modifying timing, magnitude and/or duration of water releases to ensure minimum flow target values are achieved or exceeded
- Modifying timing, magnitude and/or duration of water releases for achieving mainstem temperature targets

Major Adjustments

- Modifying minimum flow values to address critical biological effects of the WVS
- Modify flow releases for management of mainstem temperatures to address critical biological effects of the WVS

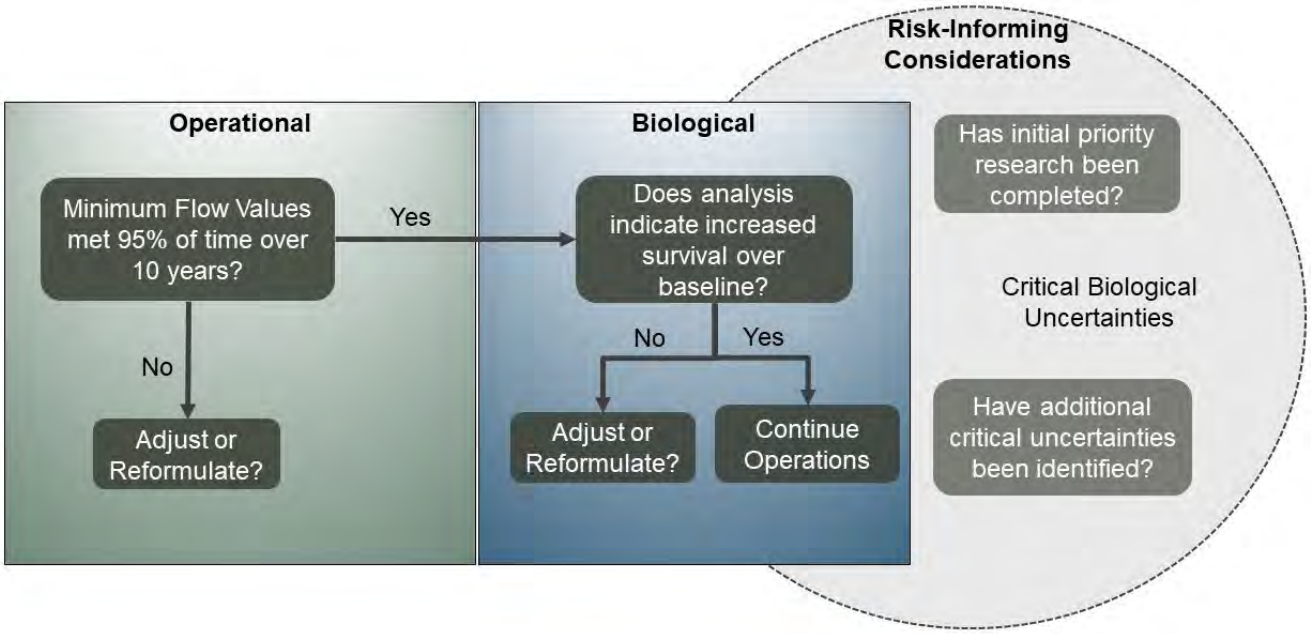

Figure 5-8. Conceptual Decision Tree for Evaluating Flow Measures.

5.8.7 Decision-Making and Collaboration

The primary means of collaboration on real-time water management associated with the proposed flow measures would be through the WATER Flow Management and Water Quality Technical Team, consistent with existing practice. The frequency of those engagements is driven by conditions in any given conservation season. It is expected that results of annual operations would be reported on at the annual Science Meeting.

5.9 GRAVEL AUGMENTATION

5.9.1 Definition and Function

Improving downstream streambeds with gravel would occur in the North Santiam, South Santiam, and McKenzie River Basins below Big Cliff, Foster, Cougar, and Blue River dams. The WVS is restricting sediment transport and subsequently degrading habitat for ESA-listed and other native fish below its dams. Clean round river gravel would be added to the areas of wetted streambeds to improve river substrate conditions for spawning and rearing of native fish species downstream of WVS dams. Gravel would be sized appropriately for use by spawning UWR Chinook salmon and UWR steelhead, and to the maximum extent feasible, locally sourced. Placed gravel would be expected to transport, abrade to smaller material, and deposit for longer term storage in bars and backwaters over time. An ongoing program of annual or semiannual sediment placement is proposed to maintain long term spawning gravel bars and beds downstream of the dams.

5.9.2 Constraints

Site-specific design and environmental compliance documentation would be prepared for each location prior to implementation of gravel augmentation. Constraints of gravel augmentation at each location would be specified in this site-specific documentation.

5.9.3 Performance Metrics and Targets

It is anticipated that performance metrics for gravel augmentation would consist of a combination of metrics associated with successful design/operations of the gravel augmentation process and habitat-based/biological response metrics. This assumption is based on USACE experience with gravel augmentation at other locations including the Green River below Howard Hanson Dam and the Trinity River below Lewiston Dam. Performance metrics related to the successful design/operations of the placed gravel augmentation would likely focus on the mobilization of placed material relative to different flow events. Habitat-based/biological response metrics would likely be based on achieving an increase in spawning habitat quality or quantity for Chinook salmon and steelhead. Performance metrics and targets would be location-specific and therefore would be developed during the completion of site-specific design and environmental compliance documentation.

5.9.4 Research, Monitoring, and Evaluation

It is anticipated that baseline surveys below the dams would be necessary to determine where gravel placement could increase usable spawning areas while considering channel bathymetry, water temperature, hydrology, and hydraulics. Anticipated monitoring activities may likely include channel surveys, geomorphic and habitat inventories, sediment transport and channel stability monitoring. Specifics of research, monitoring, and evaluation would be developed as part of site-specific design and environmental compliance documentation.

5.9.5 Risks and Uncertainties

Location-specific risks and uncertainties would be identified during the development of site-specific design and environmental compliance documentation. However, the following general questions relative to gravel augmentation are likely to be of focus:

- Is gravel augmentation effectively providing spawning gravels to the river each year?
- What is the rate of gravel transport through the reach?
- How does gravel size affect transport?
- How is substrate composition changing downstream?
- What is the effect of gravel nourishment on Chinook salmon and steelhead trout spawning?
- How should the risk of undesirable bank erosion or increased flood risk be considered in implementation and decision criteria?

5.9.6 Decision Triggers and Adaptive Actions

Based on previous experience with USACE gravel augmentation programs, it is anticipated that adaptive actions would typically include:

- Adjustments to the location and manner of gravel placement
- Adjustments to the timing of when gravel is placed
- Adjustments to the amount of gravel placed
- Adjustments to the grain size of gravel placed

Decision triggers that would result in specific adjustments would be developed as part of site-specific design and environmental compliance documentation.

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IMPLEMENTATION AND ADAPTIVE MANAGEMENT PLAN

ATTACHMENT 1:

FY2025 Willamette Valley System RM&E to Support the Implementation and Adaptive Management Plan included in the 2023 Proposed Action

USACE's adaptive management technical guide (USACE 2019a) defines adaptive management (AM) as a formal, science-based, risk management strategy that permits implementation of actions despite uncertainties. Knowledge gained from monitoring and evaluation studies are used to adjust and direct future decisions. Simply stated, AM is learning while acting in the face of uncertain outcomes.

The Implementation and Adaptive Management (AM) Plan included as part of the WVS Proposed Action defines the timeline for implementation of the measures included in the Proposed Action, the governance structure to be used for adaptive decision-making, the annual adaptive management process for inter-agency collaboration, engaging with stakeholders, and incorporating new learning into management priorities. The AM Plan also outlines the decision criteria relevant to monitoring and evaluating the success of management measures at achieving stated objectives. For interim (previously near-term (NT)) measures, the decision criteria will be based on the directions of trends in the realized values of performance metrics or indicators (termed *Expected Benefits*). For Long-term (LT) measures, quantified performance criteria are defined.

The annual adaptive management process includes reviewing both recent and new information annually to inform activities in subsequent years, including research, monitoring and evaluation (RM&E) needs. This includes considering which measures require additional RM&E, what level of precision is needed when assessing the associated metrics, and what study methods and techniques should be used. However, year one RM&E activities are not pre-defined in the AM plan. Because implementation of measures will begin on day one, RM&E activities are also needed in year one.

The following RME activities were developed for 2025 consistent with the Proposed Action measures defined in the WV Biological Assessment, AM Plan metrics, and the NT expected benefits or LT performance criteria. These RME activities are also by and large a continuum of activities currently being employed to assess injunction operations. Subsequent year RM&E activities will be refined by following the annual adaptive management process described in the AM Plan.

Measures included in the Proposed Action to improve upstream fish passage (U/S), downstream fish passage (D/S), ecological flow conditions (Q), water temperatures (T) and total dissolved gas (TDG) levels are described in Table 1. RM&E activities for FY25 to assess Near-Term (NT) expected benefits and Long-Term (LT) performance criteria, based on the specified monitoring metrics, are listed in Table 2.

Table 1. Summary of Near-Term (NT) and Long-Term (LT) Measures Implemented in FY 2025. Downstream passage = D/S; Upstream passage = U/S; Q = flow; Temperature = T.

North Santiam

Location	Description of Measure by Location	Phase	Type	Duration of Operation	Priority Outlet	Target Elevation
Detroit	Spring downstream fish passage and operational downstream temperature management	NT	D/S, T	Mid-Mar to Fall	Spillway/ Turbines/ Upper ROs/Lower ROs	n/a
	Nighttime (dusk to dawn) RO prioritization for improved downstream fish passage	NT	D/S	Winter	Upper ROs	Less than 1,500 feet and once downstream temperature management operations have concluded for the year
Big Cliff	Spread spill across as many spillbays as safety protocols allow to reduce downstream TDG exceedances	NT	TDG	Year-round	Spillway	Discharges greater than powerhouse capacity
	Ecological flows (M30)	LT	Q	Feb 1 - Nov 1	na	Na
Minto	Adult Fish Facility Operation	LT	U/S	Apr to Nov	na	na

South Santiam

Location	Description of Measure by Location	Phase	Type	Duration of Operation	Priority Outlet	Target Elevation
Green Peter	Outplanting plan for reintroduction of adult Chinook salmon above Green Peter Dam	LT	U/S	Summer	n/a	n/a
	Spring downstream fish passage and operational downstream temperature management	LT	D/S, T	Mid-Apr to Fall	Spillway/ Turbines/ ROs	n/a
	Deep drawdown and RO prioritization for improved downstream fish passage	LT	D/S	Nov 15 to Dec 15	RO	780 feet

Location	Description of Measure by Location		Phase	Type	Duration of Operation	Priority Outlet	Target Elevation
Foster	Delay refill and utilize spillway in the spring for improved downstream fish passage; use the fish weir in the summer for improved downstream temperature management and upstream fish migration/passage	NT	D/S, T	Feb 1 to Jun 15; Jun 16 to approximately late-Jul (similar to NAA)	Spillway (spring) Fish Weir (summer)	613 feet (Feb - May) 637 feet (May - Jun)	
	Utilize the spillway for improved downstream fish passage in the fall	NT	D/S	Oct 1 to Dec 15	Spillway	613 feet	
	Adult Fish Facility Operation	LT	U/S	Apr to Nov	na	na	
	Ecological flows (M30)	LT	Q	Feb 1 - Nov 1	na	na	

McKenzie

Location	Description of Measure by Location	Phase	Type	Duration of Operation	Priority Outlet	Target Elevation
Cougar	Deep drawdown and RO prioritization for improved downstream fish passage	NT	D/S	Early Nov to Dec 15	RO	1,505 feet
	Delayed reservoir refill and RO prioritization for improved downstream fish passage	NT	D/S	Feb to May/Jun	RO	1,520-1,532 feet
	Ecological flows (M30)	LT	Q	Feb 1 - Nov 1	na	na
	Adult Fish Facility Operation	LT	U/S	Apr to Nov	na	na

Middle Fork

Location	Description of Measure by Location	Phase	Type	Duration of Operation	Priority Outlet	Target Elevation
Hills Creek	Nighttime (dusk to dawn) RO prioritization for improved downstream fish passage when elevation less than 1,460 feet.	NT	D/S	Approximately Nov to Mar	RO	Less than 1,460 feet
Lookout Point	Utilize spillway for improved downstream fish passage in the spring; RO use in the fall for downstream temperature management	NT	D/S	Mid-Mar to May/Jun (spring); Jul to Oct 15 (RO)	Spillway/RO	890 to 893 feet spring spill Less than 887.5 feet late summer/ fall RO
Lookout Point	Deep drawdown and RO prioritization for improved downstream fish passage in fall	NT	D/S	Nov 15 to Dec 15	RO	750 feet
	Ecological flows (M30)	LT	Q	Feb 1 - Nov 1	na	na
	Adult Fish Facility Operation	LT	U/S	Apr to Nov	na	na
Fall Creek	Deep drawdown for improved downstream fish passage in fall	LT	D/S	Nov 15 to Dec 1	RO	690 feet

Mainstem

Location	Description of Measure by Location	Phase	Type	Duration of Operation	Priority Outlet	Target Elevation
Mainstem	Ecological flows and temperature pulses (M30)	LT	Q	Feb 1 – Nov 1	na	na

Table 2. Primary RM&E activities in FY 2025 to assess Near-Term (NT) expected benefits and Long-Term (LT) performance criteria, based on the specified monitoring metrics.

North Santiam

Location	Description of Measure by Location	NT Expected Benefits OR LT Criteria	Primary Monitoring Metrics[1]	FY23-24 ongoing RM&E	2025 RM&E Activities
Detroit	Spring downstream fish passage and operational downstream temperature management	Higher DPE via surface spill resulting in higher survival	DPE index in spring and summer (note: spillway DPE and survival previously estimated)	RST below BCL & above DET	Same as FY 23-24 ongoing RM&E – indirectly evaluate DPE with multi-yrs. RST ops and increased TE testing
		Temperature mixing operations in summer reduces warm water releases in fall	Daily mean and max temperatures in Detroit Reservoir and below in the N. Santiam R. downstream of Big Cliff	Temperature gaging	Same as FY 23-24 ongoing RM&E
	Nighttime (dusk to dawn) RO prioritization for improved downstream fish passage	Higher percent passing ROs compared to baseline operations resulting in higher survival	DPE index in fall and FBW modeling to refine field study needs (Note: assume survival higher through RO then turbines based on previous studies)	RST below BCL & above DET	Same as FY 23-24 ongoing RM&E. RST ops and increased TE testing
Big Cliff	Spread spill across as many spillbays as safety protocols allow to reduce downstream TDG exceedances	Reduced TDG levels below Big Cliff (Note: assume reduced effects for fish downstream)	Daily mean and max TDG levels below Big Cliff	TDG gaging below Big Cliff	Same as FY 23-24 ongoing RM&E

Location	Description of Measure by Location	NT Expected Benefits OR LT Criteria	Primary Monitoring Metrics[1]	FY23-24 ongoing RM&E	2025 RM&E Activities
	TDG dissipation boulders	Reduced TDG levels below Big Cliff (Note: assume reduced effects for fish downstream)	Daily mean and max TDG levels below Big Cliff	TDG monitoring above/below Big Cliff	TDG gaging upstream and downstream of Big Cliff – pilot project (full design construction in FY28
	Ecological flows (M30)	Meet or exceed min. flows	Daily average cfs	Flow gaging below Big Cliff	Same as FY 23-24 ongoing RM&E
		Mainstem pulse temp criteria	Daily mean and max water temperature	Temperature gaging	Same as FY 23-24 ongoing RM&E
Minto	Adult Fish Facility Operation	WFOP objectives for safe and timely collection and transport of adult Chinook and steelhead	See WFOP	Summary stats on collection and transport of adult fish	Same as FY 23-24 ongoing RM&E. Includes tissue sampling for pedigree analysis every 5 yrs

1. *Hourly dam operations are assumed to be available to support evaluation of monitoring metric data collected.*

South Santiam

Location	Description of Measure by Location	NT Expected Benefits OR LT Criteria	Primary Monitoring Metrics	FY23-24 ongoing RM&E	2025 RM&E Activities
Green Peter	Outplanting plan for reintroduction of adult Chinook salmon above Green Peter Dam	Chinook spawning in Quartzville Cr and Middle Santiam River, above Green Peter Res.	Redd and carcass counts, redd distribution, PSM	Redd and carcass surveys, Quartzville Cr.	Redd and carcass surveys, Quartzville & Middle Santiam River. Adult tissue sampling for pedigree analysis every 5 yrs
			Relative fry abundance and reservoir entry timing	*RST above GPR in Middle Santiam Feb-Nov; RST	Same as FY 23-24 ongoing RM&E, and adding RST in Quartzville if

Location	Description of Measure by Location	NT Expected Benefits OR LT Criteria	Primary Monitoring Metrics	FY23-24 ongoing RM&E	2025 RM&E Activities
				below GPR year-round	possible, with increased TE testing
	Spring downstream fish passage and operational downstream temperature management	DPS at level modeled to support a CRR average of 1 with acceptable TDG-related effects downstream	DPS	*RST sampling below GPR; Active tag assessment of juvenile Chinook passage	Same as FY 23-24 ongoing RM&E with increased RST TE testing
			Daily mean and max TDG levels below Green Peter	TDG gaging below Green Peter and Foster	Same as FY 23-24 ongoing RM&E
	Deep drawdown and RO prioritization for improved downstream fish passage	DPS at level modeled to support a CRR average of 1 with acceptable turbidity-related effects downstream	DPS	*RST sampling below GPR; Active tag assessment of juvenile Chinook passage	Same as FY 23-24 ongoing RM&E with increased RST TE testing
			Turbidity	Turbidity levels upstream and downstream of Green Peter and Foster Dam and in the South Santiam R. near Waterloo	Same as FY 23-24, with the addition of a turbidity gage(s) upstream of Green Peter

Location	Description of Measure by Location	NT Expected Benefits OR LT Criteria	Primary Monitoring Metrics	FY23-24 ongoing RM&E	2025 RM&E Activities
Foster	Delay refill and utilize spillway in the spring for improved downstream fish passage. Utilize the spillway for improved downstream fish passage in the fall	Higher DPE when surface spill present resulting in higher survival	Relative DPE via turbines and spillway (note: spillway and turbine survival previously estimated)	RST sampling above Foster on South Santiam Feb-Nov; See GPR for Middle Santiam arm Active tag assessment of juvenile Chinook and steelhead passage	Same as FY 23-24 ongoing RM&E with increased RST TE testing. (note steelhead not available for FY25 studies due to no egg take in 2023)
	Use the fish weir in the summer for improved downstream temperature management and upstream fish migration/passage	Temperature mixing operations in summer will improve adult Chinook collection in AFF, with acceptable turbidity-related effects downstream. ~~Monitor TDG levels below Foster Dam (Note: assume reduced effects for fish downstream)~~	Daily adult Chinook count in AFF. Daily mean and max temperatures in Foster AFF and tailrace.	Temperature gaging, in Foster and Green Peter Reservoirs and downstream of Foster Dam	Same as FY 23-24 ongoing RM&E
			Daily mean and max TDG levels below Foster	TDG gaging below Foster	Same as FY 23-24 ongoing RM&E
	Ecological flows (M30)	Meet or exceed min. flows	Daily mean cfs	Flow gaging	Same as FY 23-24 ongoing RM&E

Location	Description of Measure by Location	NT Expected Benefits OR LT Criteria	Primary Monitoring Metrics	FY23-24 ongoing RM&E	2025 RM&E Activities
	Adult Fish Facility Operation	WFOP objectives for safe and timely collection and transport of adult Chinook and steelhead	See WFOP	Summary stats on collection and transport of adult fish	Same as FY 23-24 ongoing RM&E. Includes tissue sampling for pedigree analysis every 5 yrs

McKenzie

Location	Description of Measure by Location	NT Expected Benefits OR LT Criteria	Primary Monitoring Metrics	FY23-24 ongoing RM&E	2025 RM&E Activities
Cougar	Spring Delayed reservoir refill and RO prioritization for improved downstream fish passage	Higher percentage passing ROs compared to baseline operations resulting in higher survival	Turbine and RO specific DPE index (Note: RO and turbine survival previously estimated)	RSTs below PH & RO – year-round RST above CGR Feb-Nov	RST below Cougar Dam 2x 8ft RSTs in PH 1x 5ft RST in RO with increased RST TE testing
	Fall deep drawdown and RO prioritization for improved downstream fish passage	Higher percent passing ROs compared to baseline operations resulting in higher survival, with acceptable TDG-related effects downstream.	Turbine and RO specific DPE index (note RO and turbine survival previously estimated)	RSTs below PH & RO – year-round RST above CGR Feb-Nov	RST below Cougar Dam 2x 8ft RSTs in PH 1x 5ft RST in RO with increased RST TE testing
			Daily mean and max TDG levels below Cougar	TDG gaging below Cougar	Same as FY 23-24 ongoing RM&E
	Ecological flows (M30)	Meet or exceed min. flows	Daily mean cfs	Flow gaging	Same as FY 23-24 ongoing RM&E

Location	Description of Measure by Location	NT Expected Benefits OR LT Criteria	Primary Monitoring Metrics	FY23-24 ongoing RM&E	2025 RM&E Activities
		Mainstem pulse temp criteria	Daily mean and max water temperature	Temperature gaging in Cougar Reservoir and downstream	Same as FY 23-24 ongoing RM&E
Cougar	Adult Fish Facility Operation	WFOP objectives for safe and timely collection and transport of adult Chinook and steelhead	See WFOP	Summary stats on collection and transport of adult fish	Same as FY 23-24 ongoing RM&E. Includes tissue sampling for pedigree analysis every 5 yrs

Middle Fork

Location	Description of Measure by Location	NT Expected Benefits OR LT Criteria	Primary Monitoring Metrics	FY23-24 ongoing RM&E	2025 RM&E Activities
Hills Creek	During fall/winter, nighttime (dusk to dawn) RO prioritization for improved downstream fish passage when elevation less than 1,460 feet.	Higher percent passing ROs compared to baseline operations resulting in higher survival with acceptable TDG-related effects downstream.	Turbine and RO specific DPE index (note assume RO survival higher than turbines)	RSTs operate in RO & PH during fall/winter RO operations RST above reservoir operates ~Feb-June	Same as FY 23-24 ongoing RM&E for RST below Hills Creek Dam with increased RST TE testing
			Daily mean and max TDG levels below Hills Creek Dam	TDG gaging below Hills Creek	Same as FY 23-24 ongoing RM&E
Lookout Point	Utilize spillway for improved downstream fish passage in the spring; RO use in the fall for downstream temperature management	Higher DPE via surface spill resulting in higher survival with acceptable TDG-related effects downstream.	DPE index in spring and summer; FBW modeling to refine field study needs (note: spillway DPE and survival previously estimated)	(1) RSTs below Lookout Point Dam (3x 8ft RSTs) (2) RST above LOP reservoir (below NFMF) (3) RST below DEX	Same as FY 23-24 ongoing RM&E with increased RST TE testing
			Daily mean and max TDG levels below Lookout Point Dam	TDG gaging below Lookout Point	Same as FY 23-24 ongoing RM&E
		Temperature mixing operations in summer reduces	Daily mean and max temperatures in Lookout Point and Dexter	Temperature gaging	Same as FY 23-24 ongoing RM&E

Location	Description of Measure by Location	NT Expected Benefits OR LT Criteria	Primary Monitoring Metrics	FY23-24 ongoing RM&E	2025 RM&E Activities
		warm water releases in fall	Reservoirs and downstream of Dexter		
	Deep drawdown and RO prioritization for improved downstream fish passage	Higher percent passing ROs compared to baseline operations resulting in higher survival with acceptable TDG and turbidity-related effects downstream.	DPE index in fall and FBW modeling to refine field study needs (Note: assume survival higher through RO then turbines based on previous studies)	RST below Lookout Point Dam 3x 8ft RSTs Period of ??; below DEX Active tag study of DPS	Same as FY 23-24 ongoing RM&E with increased RST TE testing
			Daily mean and max TDG levels; Turbidity	Monitoring upstream/downstream of Lookout Point and Dexter Dams and in the MF Willamette R. at Jasper	Same as FY 23-24
Dexter	Ecological flows (M30)	Meet or exceed min. flows	Daily mean cfs	Flow gaging	Same as FY 23-24 ongoing RM&E

Location	Description of Measure by Location	NT Expected Benefits OR LT Criteria	Primary Monitoring Metrics	FY23-24 ongoing RM&E	2025 RM&E Activities
		Mainstem pulse temp criteria	Daily mean and max water temperature	Temperature gaging	Same as FY 23-24 ongoing RM&E
	Adult Fish Facility Operation	WFOP objectives for safe and timely collection and transport of adult Chinook and steelhead	See WFOP	Summary stats on collection and transport of adult fish	Same as FY 23-24 ongoing RM&E. Includes tissue sampling for pedigree analysis every 5 yrs
Fall Creek	Fall deep drawdown for juvenile passage	High DPE and survival		RST below Fall Creek Dam	Same as FY 23-24 ongoing RM&E with increased RST TE testing
		Higher percent passing ROs compared to baseline operations resulting in higher survival with acceptable TDG, temperature and turbidity-related effects downstream.	Daily mean and max TDG levels; Turbidity	Monitoring upstream/downstream of Fall Creek Dam and in the MF Willamette R. at Jasper	Same as FY 23-24

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Fall Creek	Adult Fish Facility Operation	WFOP objectives for safe and timely collection and transport of adult Chinook and steelhead	See WFOP	Summary stats on collection and transport of adult fish	Same as FY 23-24 ongoing RM&E. Includes tissue sampling for pedigree analysis every 5 yrs

Mainstem

Location	Description of Near-term Operations by Location	NT Expected Benefits OR LT Criteria	Primary Monitoring Metrics	FY23-24 ongoing RM&E	2025 RM&E Activities
Mainstem	Ecological flows (M30)	Meet or exceed min. flows	Daily mean cfs	Flow gaging	Same as FY 23-24 ongoing RM&E
		Mainstem pulse temp criteria	Daily mean and max water temperature	Temperature gaging	Same as FY 23-24 ongoing RM&E

Modeling needs for RM&E

Adaptive management requires structured modeling efforts. Adaptive management often proposes scenarios that have not been observed prior to the action. Due to data limitations in the Willamette, there is uncertainty about key parameters that affect the outcome of an action. This is where simulation modeling can be most useful. In initial stages, the goal of simulation modeling is not to converge on an "answer" but to identify where monitoring needs to be improved to reduce uncertainty and improve the quality of the answer. Often, model estimation is subject to sensitivity. Where data are lacking to inform precision about this sensitivity, precision bounds can be wide and uninformative. To accommodate this, simulation modeling tracks what data best inform the answer. It is less important to obtain a "correct" estimate than it is to understand which monitoring programs are most informative to showing a difference from baseline actions. If all parameters were "certain" then modeling would be wholly unnecessary. However, given the range of uncertain outcomes, the number of potential monitoring programs would become unwieldy and prohibitively expensive.

Instead, we propose a framework for adaptive-learning simulation modeling, whereby initial modeling efforts may be more frequent initially, but as key monitoring parameters become more certain, modeling needs become less urgent. We propose integrating simulation modeling early in the adaptive management process since it is not logistically possible to monitor all parameters every year, year-round. When new scenarios are proposed, the simulation modeling process should be iterative (ie, there may be additional modeling needs if new scenarios are proposed late in the process that are not informed by observed data). Under this strategy, modeling needs may be required frequently initially, but only periodically as the system becomes more informed by targeted monitoring information.

We propose the following objectives for adaptive management planning:

1. Estimate benefits of specific measures and refine hypotheses;
2. Inform RM&E needs by assessing the sensitivity of responses to different variables;
3. Develop and assess expected benefits of proposed alternative measures where goals are not being achieved.

The primary models proposed to be used are:

Model
RES-SIM - hydrology
CE-QUAL-W2 - temperature
Excel-based TDG regressions
FBW - Chinook and steelhead downstream dam passage survival
LCMs - Chinook and steelhead population (and lifestage) responses
SWIFT - Chinook and steelhead survival response to combined flow and temperature conditions
USGS 2D habitat - Chinook and steelhead habitat availability relative to flow conditions

Actual modeling needs may be more or less dependent on the results of adaptive simulation modeling results, monitoring programs identified, and future scenarios proposed within the management period.

Additional 2025 Activities

- FBW model refinement and application: workshop with experts to determine changes and refine input values; update model structure and inputs; apply model to estimate passage survival for operations currently being implemented to support assessment and refinement of field RM&E needs.