



**US Army Corps
of Engineers®**
Portland District



WILLAMETTE VALLEY SYSTEM OPERATIONS AND MAINTENANCE

APPENDIX N: IMPLEMENTATION AND ADAPTIVE MANAGEMENT PLAN

*Willamette Valley System Operations and Maintenance
Environmental Impact Statement*

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Attachment 1. FY2025 Willamette Valley System Research, Monitoring, and Evaluation to Support the Implementation and Adaptive Management Plan



1 - INTRODUCTION

The Final Implementation and Adaptive Management Plan was developed to accompany the Final Environmental Impact Statement (FEIS) for operation and maintenance of the Willamette Valley System (WVS). The WVS is 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 (Figure 1-1).

This Final Implementation and Adaptive Management Plan (referred to as the Implementation Plan or the Adaptive Management 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 FEIS public review in response to comments from NMFS and USFWS during ESA coordination on the Proposed Action. If the plan is further modified through the ESA Section 7 consultation it would be released as an appendix to the final FEIS. Because of this, the term “Preferred Alternative” signifies both the Preferred Alternative from the FEIS as well as the Proposed Action from the WVS final Biological Assessment.

1.1 WILLAMETTE VALLEY SYSTEM BACKGROUND

The Willamette River Basin is an approximately 11,478-square-mile drainage area around the Willamette River that flows north through a fertile valley in (USACE 2019a). The Basin 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 Basin averages 75 miles in width and encompasses approximately 12 percent of the total area of the state (USACE 2019a).

The Willamette River Basin 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).

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The Willamette River Basin encompasses 12 subbasins, or smaller basins within the larger Basin. 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 Rivers. Six of these subbasins (Middle Fork Willamette, Coast Fork Willamette, McKenzie, Long Tom, South Santiam, and North Santiam Rivers) contain dams; these subbasins 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 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 damage to the Willamette Valley.

The 1938 Act authorized the following dam construction projects: Fern Ridge on the Long Tom River, Dorena, and Cottage Grove Dams in the Coast Fork Willamette River Subbasin; Lookout Point Dam on the Middle Fork Willamette River; Detroit Dam on the North Santiam River; and Green Peter Dam on the Middle Santiam River. The 1950 Act reauthorized Green Peter Dam and authorized Big Cliff Dam on the North Santiam River; Cougar and Blue River Dams on the McKenzie River; Hills Creek and Dexter Dams on the Middle Fork Willamette River; and Fall Creek Dam on Fall Creek.

House Document 531 is the overall guiding legislation that provides the basic 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 Willamette River Basin.

Eleven of the 13 dams are multipurpose and 3 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.

Dams with or without hydropower are shown 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 containing 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 Willamette River Basin are in the towns of Goshen, Monroe, Vida, Jasper, Mehama, Jefferson, Waterloo, Albany, Harrisburg, and Salem, Oregon.

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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 FEIS and BA is the Willamette River Basin; that is, the 13 dams and reservoirs on the Willamette River and the 6 subbasins containing dams that comprise the WVS, including the Middle Fork Willamette, Coast Fork Willamette, McKenzie, Long Tom, South Santiam, and North Santiam River riverbank protection projects, fish passage facilities, fish hatcheries, adult fish collection facilities, and communities and populations within the Basin.

1.2 PROPOSED ACTION

As stated in Chapter 1 of the FEIS, 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.

The 2008 National Marine Fisheries Service (NMFS) Biological Opinion 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 FEIS evaluates a range of action alternatives in addition to the No-Action Alternative. The final Implementation Plan and Adaptive Management Plan have been developed based on the Preferred Alternative identified in the FEIS; however, the concepts and framework for long-term implementation and adaptive management described would be applicable to any action alternative if selected in a Record of Decision (ROD). 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 Chute Resurfacing. These three structural measures have been included within the scope of this Final Implementation and Adaptive Management Plan because they would be completed after the ROD.

The Implementation Plan component prioritizes measures for implementation and identifies a timeline for their implementation and implementation criteria that must be met prior to initiating implementation. The Adaptive Management Plan 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.

2 - IMPLEMENTATION PLAN

The Implementation Plan 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 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 Proposed Action, four downstream fish passage structures and one selective withdrawal structure for downstream water temperature management would be constructed. These structures would be complex, costly, and could take multiple years to design and construct. In the meantime, Interim Operations would be implemented to provide immediate benefit to the species while longer-term solutions are developed and/or constructed

(Figure 2-1). In addition, other actions, such as outplanting, propagation via the hatchery program, gravel augmentation, etc., would also be carried out.

Many of the Interim Operations are similar to the operations ordered by the Court as part of the injunctive relief. Therefore, many of the Interim Operations described in this plan have already been implemented and would 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.

In the North Santiam at Detroit, the interim Operations described below will occur until fall 2025. At which time, as required by the NMFS 2024 Biological Opinion Reasonable and Prudent Alternative, the interim fall operations at Detroit (Split RO and turbine use for passage in fall) will be replaced with a late fall/early winter deep drawdown of Detroit reservoir to an elevation of 1395 feet for downstream fish passage.

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 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 would undergo a separate National Environmental Policy Act (NEPA) process that would assess the direct, indirect, and cumulative impacts of their effects on the human environment.

<p>North Santiam</p> <ul style="list-style-type: none"> • 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) <p>South Santiam</p> <ul style="list-style-type: none"> • 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) 	<p>McKenzie</p> <ul style="list-style-type: none"> • Spring and fall drawdown to RO for fish passage (CGR) <p>Middle Fork</p> <ul style="list-style-type: none"> • 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)
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Figure 2-1. Specific Actions as Included under the Interim Operations.

RO = regulating outlet
TDG = total dissolved gas
DET = Detroit Dam
BCL = Big Cliff Dam

GPR = Green Peter Dam
FOS = Foster Dam
CGR = Cougar Dam
HCR = Hills Creek Dam

LOP = Lookout Point Dam
FAL = Fall Creek Dam

2.2 ACTIONS UNDER THE PREFERRED ALTERNATIVE/PROPOSED ACTION

Alternative 5, Integrated Water Management Flexibility and ESA-listed Fish Alternative, was identified as the Proposed Action in the Draft EIS (Figure 2-2) (FEIS, Appendix A, Alternatives Development). This alternative comprises a mix of operational and structural measures to be implemented across the basin. The Implementation Plan and timeline lays out the schedule for

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completing various actions under the Proposed Action at the different USACE projects over the next 30 years.

	Upstream Passage	Downstream Passage	Temperature	Total Dissolved Gas (TDG)	Measures Common to All Alternatives
DEX	Adult Fish Facility (AFF) Improvement	*Structure: Floating Surface Collector (FSC)			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					
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. Primary Measures under the Preferred Alternative.

DEX = Dexter Dam
LOP – Lookout Point Dam
HCR = Hills Creek Dam
FCR = Fall Creek Dam
CGR = Cougar Dam
BLU = Blue Hills Dam
FOS = Foster Dam
GPR = Green Peter Dam
BCL = Big Cliff Dam
DET = Detroit Dam

2.3 PRIORITIZATION OF ACTIONS FOR IMPLEMENTATION

Even though each measure in the Proposed Action 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 necessary time to resolve data gaps and operational research needs.
- Consider impacts to system storage/water management/water supply.

Once the above set of priorities and potential conflicts were considered, the measures were organized into three categories:

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1. Actions that could legally and feasibly start prior to the ROD.
2. Actions that could be implemented immediately after the ROD is signed.
3. Long-term solutions that could take many years to complete either because of 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 Proposed Action. Measures common to all alternatives are not shown in the timeline and include:

- 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 would begin after the ROD is signed and would continue until system operations are re-evaluated. Continued research, monitoring, and evaluation; new research, monitoring, and evaluation; and post-construction evaluations are also not shown in the Implementation Timeline but would 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 or alternatives study phase, the Detailed Design Report phase, Plans and Specifications, Contract Award, and Construction. Potential risks and uncertainties and major check-ins are also noted.

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- = Operations
- = Major Construction
- = Disposition Study
- = AFF Constr.
- = Check-ins

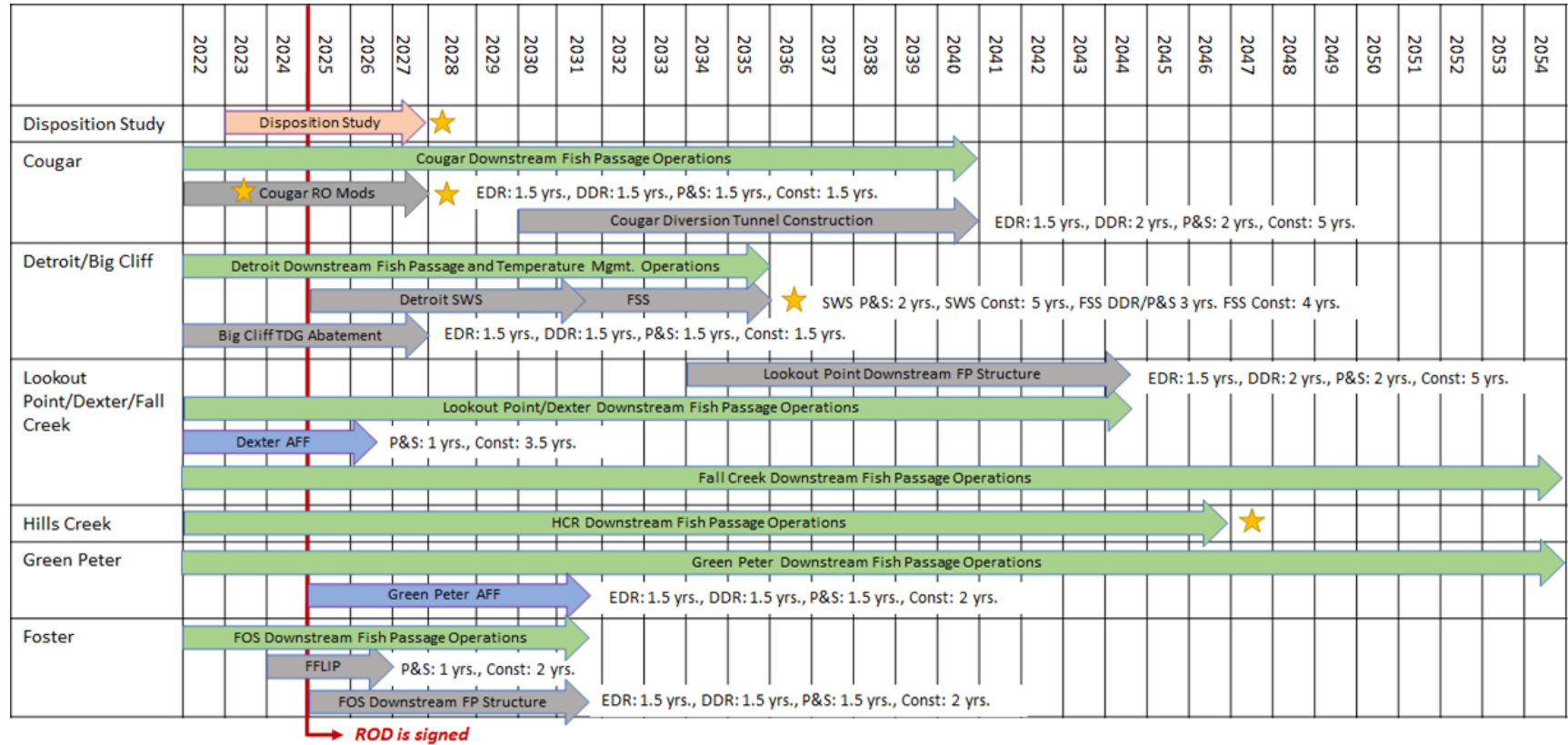


Figure 2-3. Implementation Timeline.

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 Proposed Action have been spread out over time to ensure USACE has adequate staffing and funding to carry out project designs and construction.
- Research and Design Needs/Data Gaps – For some projects, additional information or modeling is required in the initial stages of design. This may extend the Engineering Design Report or DDR process for complex projects such as the design/construction of downstream fish passage structures.
- On-site Construction Constraints – For projects such as operations and maintenance of Detroit Dam, there is limited physical space to allow for the simultaneous construction of large structures (e.g., construction of the selective withdrawal structure and floating screen structure at the same time). One structure must be built before the other, which extends the timeline for completion of the Proposed Action.
- 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 upward of 7 years and requires Congress to act.

2.4.1 Detroit Dam

Operational changes are being carried out prior to the ROD as part of the injunction. Beginning in fall 2025, the interim fall operations at Detroit (Split RO and turbine use for passage in fall) will be replaced with a late fall/early winter deep drawdown of Detroit reservoir to an elevation of 1395 feet for downstream fish passage. These operations focus on improved fall, winter, and spring downstream fish passage and downstream water temperature management. As research, monitoring, and evaluation inform 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 would begin the Plans and Specifications phase of the Detroit Dam selective withdrawal structure and floating screen structure, followed by construction. Due to the limited physical space on the dam, the structures would be constructed in two phases with the selective withdrawal structure constructed first, then the floating screen structure. Anticipated completion of all construction is 2035. The Implementation Timelines do not include post-construction evaluation timelines, but it is anticipated that research, monitoring, and evaluation would continue for at least 3 to 5 years post-construction.

2.4.2 Big Cliff Dam

USACE developed a reasonable timeline for design and construction and has started an Engineering Design Report for constructing a structural solution for mitigating excess TDG levels below Big Cliff Dam during spill operations, as required by court order. Under the

Implementation Plan, it is assumed 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 that 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; therefore, after the ROD the operation would continue, although as research, monitoring, and evaluation is conducted on the operation, potential modifications to the operation may be necessary. Adjustments may require additional legal and environmental compliance.

In addition, an adult fish facility would 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 Adult Fish Facility 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 Adult Fish Facility would be used for outplanting purposes.

2.4.4 Foster Dam

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 the Foster Fish Ladder Improvement Project to provide a warm-water supply pipe to the ladder (Figure 2-3). Once the ROD is signed, USACE would start construction of the Foster improvement project, which is estimated to take 2 years to complete. During this time, USACE would begin the Engineering Design Report phase of a structural downstream fish passage solution at Foster Dam.

Once funded, the Engineering Design Report and Detailed Design Report phase for the downstream fish passage structure is estimated to take a total of 3 years to complete, with Plans and Specifications and construction taking an additional 3.5 years. Completion of a downstream fish passage structure is expected by 2031.

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 Dams; therefore, the timeframe for completion is shorter.

2.4.5 Cougar Dam

Several actions would be taken at Cougar Dam prior to the ROD, as required by a court order. They include the continued implementation of operations that informed the Interim Operations

for improved fall, winter, and spring downstream fish passage and survival, the completion of the Cougar Regulating Outlet Modifications Engineering Design Report.

In 2023 and once the Engineering Design Report is complete, the first major check-in (represented by the yellow star in Figure 2-3) would occur. During this check-in, a decision would be made regarding further modifications to the Cougar Dam regulating outlet to improve downstream fish passage and survival. This implementation schedule assumes that additional improvements would be constructed, with completion of modifications by the end of 2029.

USACE would 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 Dam. At present, the timing, scope, and scale of the disposition study is unknown, so refinements to the implementation timeline, specifically for Cougar Dam, should be anticipated. This study would result in a formal recommendation to Congress on whether to deauthorize power at Cougar Dam, which would allow for the utilization of the diversion tunnel for fish passage, which Congress would also have to fund prior to USACE initiating the Engineering Design Report phase of the project.

Following the ROD and the Cougar Dam regulating outlet modifications, a second major check-in would take place. During this check-in, information from the disposition study, in conjunction with post-construction evaluation data from the regulating outlet modifications and/or the determination by Congress to deauthorize hydropower and fund the diversion tunnel, would be used to inform the next steps at Cougar Dam.

By 2028, a determination would be made as to whether USACE would continue with the diversion tunnel Engineering Design Report or if it would 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 re-consultation.

2.4.6 Lookout Point Dam

Prior to the ROD, USACE would implement operations for improved fall, winter, and spring downstream fish passage and downstream water temperature management in the summer through prioritized use of the regulating outlets, as required by the court order. Once the ROD is signed, USACE would continue these operations as part of the Interim Operations and while starting the Engineering Design Report and alternatives analysis for long-term structural downstream fish passage and until construction of a downstream fish passage structure is operational.

During the Engineering Design Report phase, further review of existing fish passage data and the identification of further research, monitoring, and evaluation needs would be completed. A major check-in would occur at the conclusion of the Engineering Design Report, and USACE would decide whether to move forward with the Detailed Design Report phase of Lookout Point Dam downstream fish passage design or wait for additional research, monitoring, and

evaluation and/or the post-construction evaluation of the Detroit Dam floating screen structure to be completed so that lessons learned from Detroit Dam can be applied to Lookout Point Dam.

The current assumption is that the Lookout Point Detailed Design Report would start in 2034, allowing for additional research, monitoring, and evaluation and the post-construction evaluation of the Detroit Dam floating screen structure. 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 would implement operations for spring downstream fish passage at Lookout Point Dam that include spill releases at Dexter Dam and continue to work toward completion of plans and specifications and construction of the Dexter Adult Fish Facility, as required by the court order. Completion of this structure is anticipated in 2026.

2.4.8 Fall Creek Dam

As described in the Proposed Action, there are no Interim Operations planned at Fall Creek Dam because the long-term operations that continue the fall deep drawdown would be immediately implemented.

2.4.9 Hills Creek Dam

Prior to the ROD, USACE would continue to operate to provide passage by prioritizing use of the regulating outlets while the reservoir elevation is less than 1,460 feet, as required by the court order. This operation would continue immediately after the ROD until all the major construction projects under 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 would be laid out in the Adaptive Management Plan and the decision would be based on the decision and information gathered as part of research, monitoring, and evaluation efforts. This major check-in would not preclude the continuation of research, monitoring, and evaluation 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 WVS 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.

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Discussion of some of these risks and uncertainties follows.

Funding

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 prioritization of future work would be discussed on a regional level as described in the Adaptive Management Plan.

Disposition Study

At present, the scope and scale of the disposition study is unknown. For now, a 5-year timeline is being assumed as a conservative placeholder for a disposition study that would evaluate the deauthorization of hydropower and a rebalancing of the other authorized purposes of all hydropower projects within the WVS. Adjustments to the duration of this study would be made as necessary, which could impact the timing of follow-on actions.

Congressional Authorization – Cougar Dam Diversion Tunnel

USACE would continue to make improvements to Cougar Dam through regulating outlet modifications while the disposition study is being completed. Information from the disposition study, in conjunction with post-construction evaluation data from additional Cougar Dam regulating outlet modifications would be used to affirm a USACE decision to use the diversion tunnel to pass fish at Cougar Dam.

If data warrants moving forward with the Cougar Dam Diversion Tunnel Construction Project, Congressional approval and funding would be required prior to the start of the Engineering Design Report 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 Dam, should be anticipated.

Adaptive Management

The research, monitoring, and evaluation program would continue while the Implementation Plan is carried out. New information gathered through research, monitoring, and evaluation would likely lead to a new understanding and refinement of models that 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 detail in the Adaptive Management Plan.

Water Management

Impacts to the USACE 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; therefore, 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 would 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 USACE to prepare an EIS evaluating the impacts of a proposed Federal action that would 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 analyzed potential effects as 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 programmatic 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 well with adaptive management.

A programmatic EIS facilitates responsiveness when monitoring indicates a change to Federal actions because objectives are not being met or new scientific understanding dictates alternative strategies, therefore strengthening the implementation of the plan. Implementation of specific projects or management measures may require subsequent analysis that can be tiered to the PEIS. Additional NEPA analysis would be required if the adaptive management process provides new information that requires actions not included within the range of impacts and alternatives considered in this EIS.

3 - OVERVIEW OF ADAPTIVE MANAGEMENT

3.1 ADAPTIVE MANAGEMENT DEFINED

The USACE adaptive management technical guide (USACE 2019c) defines adaptive management 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, adaptive management is learning-while-doing in the face of uncertain outcomes.

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The conceptual basis for the USACE definition of adaptive management derives from 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 adaptive management concepts are consistent with those presented in the U.S. Department of Interior's adaptive management technical guide (Williams et al. 2009).

As summarized in USACE (2019c), certain characteristics are common to most definitions of 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 Adaptive Management Plan is being developed during Step 1, Plan/Design, concurrently with the FEIS. Although some Interim Operations measures are currently being implemented as part of the injunction, the long-term adaptive management 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 (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 adaptive management cycle.

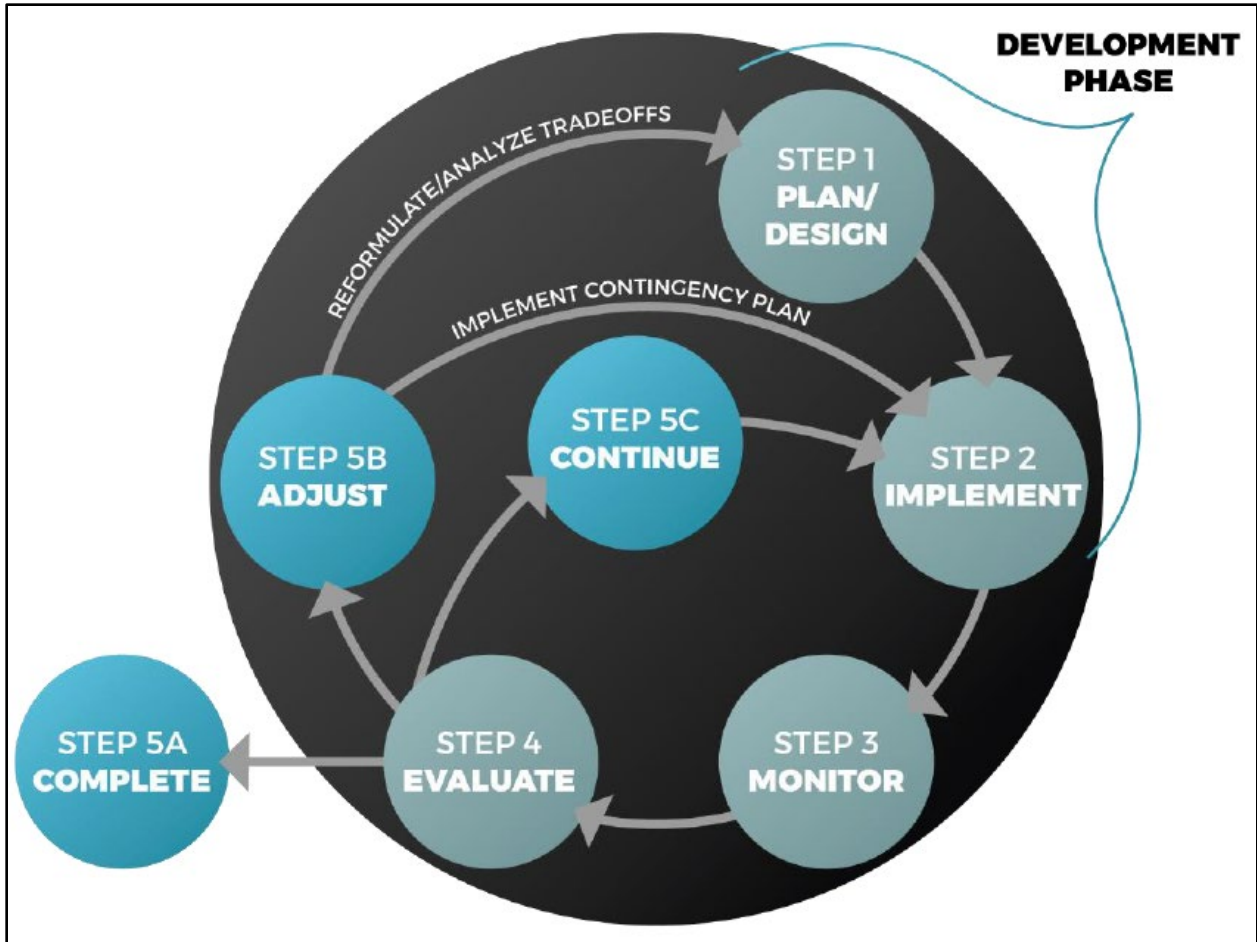


Figure 3-1. Adaptive Management Cycle.

3.2 ADAPTIVE MANAGEMENT TERMS

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

Monitoring

This is Step 3 of the adaptive management 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.

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- 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.
- 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 adaptive management 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 metrics that define 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 adaptive management 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 adaptive management process).

Adaptive Action

A course of action to be implemented as defined in the Adjust step (Step 5b of the adaptive management 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 adaptive management process provides a framework for reducing program uncertainties over time.

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 adaptive management 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
- **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 Adaptive Management Implementation Team (Figure 4-1). This section further describes the responsibilities of each level as it relates to adaptive management decision-making (Table 4-1). The roles and responsibilities of the Willamette Action Team for Ecosystem Restoration (WATER) are described as well.

4.2.1 Oversight Level

Oversight of the Preferred Alternative implementation will be provided by the USACE Portland District Commander (CENWP) and WATER Managers' Forum. The USACE District Commander

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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.

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/U.S. Fish and Wildlife Service (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 USACE regarding program implementation and adaptive management. The roles and responsibilities of WATER are discussed further in Section 4.2.4, Willamette Action Team for Ecosystem Restoration. 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.

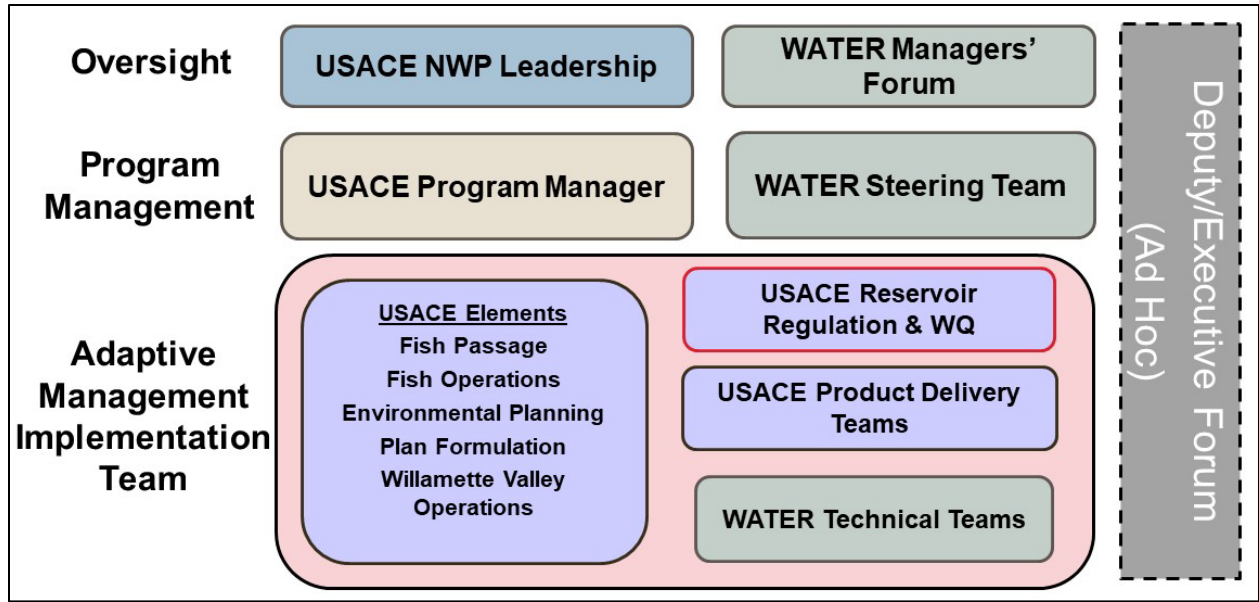


Figure 4-1. Adaptive Management Governance Structure.

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Table 4-1. Governance-level Primary Responsibilities.

Governance Level	USACE Elements	WATER	Primary Responsibilities
Oversight	<ul style="list-style-type: none"> • Portland District Commander • Deputy District Engineer for Programs & Project Management 	Manager’s Forum	<ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • Product Delivery Teams • Reservoir Management and Water Quality • Fish Passage • Environmental Planning • Plan Formulation • Fish Operations Willamette Valley Operations 	Technical Teams	<ul style="list-style-type: none"> • 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.

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 adaptive management workshop, using these engagements for 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 checkpoints during the Federal annual budget cycle, the Management Team would provide input on prioritization of projects based on available funding and identify priority actions based on program needs for Fiscal Year¹ (FY)+2 through FY4, including study proposals, proposed changes to components of the Adaptive Management Plan, 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 Adaptive Management Plan, and Implementation Plan.

4.2.3 Adaptive Management Implementation Team

Implementation of the Preferred Alternative is informed by teams comprising management and technical staff from the USACE, NMFS, USFWS, and others via WATER. The Adaptive Management Implementation Team is responsible for development of and updates to the Adaptive Management Plan; 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. The Team assess the strategic direction of the program through regular interactions associated with the science and implementation planning processes.

The Adaptive Management Implementation Team discusses strategic science and technical and implementation considerations that relate to the program's objectives. Appropriate participation by USACE staff across disciplines would 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 Adaptive Management Implementation Team would 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

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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 would 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 WATER is to provide a forum for coordination and recommendations among the sovereign governments (Federal/state/tribal) working to implement strategies for ESA compliance associated with the WVS. 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 WVS.

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 would 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 three tiers composed of a Manager's Forum, Steering Team, and focused technical teams (Figure 4-2).

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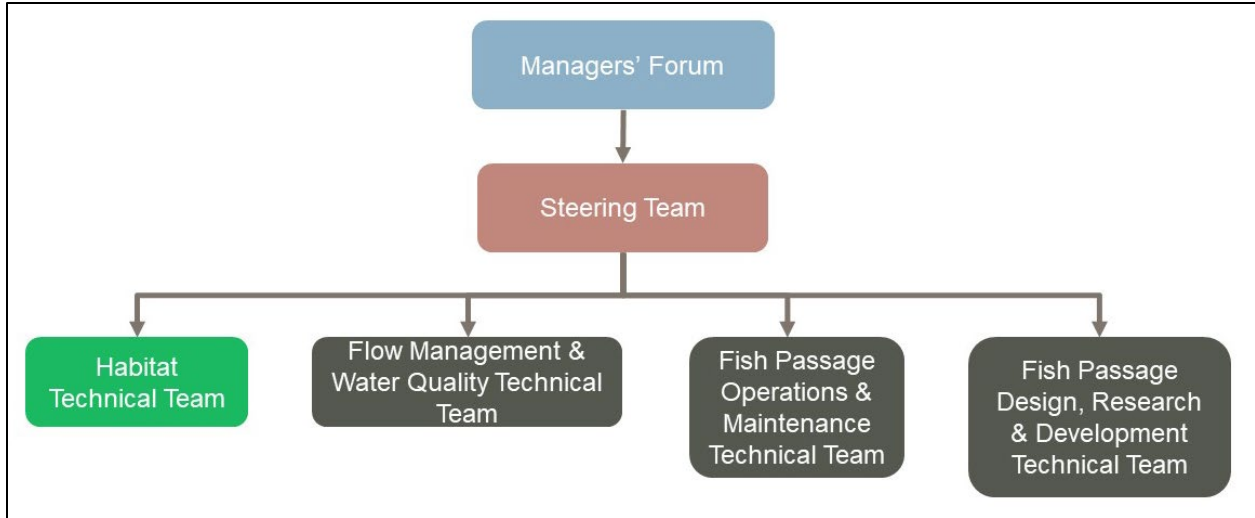


Figure 4-2. Proposed WATER Structure.

USACE recommends 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 would chair each WATER forum or team, with the exception of the HTT which is chaired by BPA.

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 WVS as they relate to compliance with the ESA through implementation of the Willamette Valley System Biological Opinions.
- Seek input on actions implemented for the Willamette Valley System Biological Opinions, including system configuration and water quality.
- Provide a process for elevating disputes associated with Willamette Valley System Biological Opinion implementation to appropriate levels of the involved governmental bodies.
- Promote coordination between implementation of the Willamette Valley System Biological Opinions 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.

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- Increase awareness and include consideration of the implementation of the Willamette Valley System Biological Opinions' actions on non-listed species, cultural and other resources, and the multiple purposes of the Willamette Valley System.
- Facilitate open and transparent communication in making decisions as well as track progress and the rationale for decisions.
- Participate and inform long-term adaptive management of the program through the annual adaptive management cycle established by this Adaptive Management Plan.

4.2.4.1 Membership of WATER

Through the precedent of the previous iteration of WATER and in response to the needs of the future iteration of WATER, USACE anticipates the following agencies would 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:

- U.S. Army Corps of Engineers (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 Valley System 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 River Basin (USACE, USBR, BPA).

It is anticipated that the Manager's Forum would 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 would provide review, input, and policy guidance related to the development and implementation of actions as they relate to the Willamette Valley System Biological Opinions. 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 Biological Opinions.
- Promoting the use of the adaptive management approach.

4.2.4.3 Steering Team

The Steering Team is the second tier of WATER composed of senior managers who have the authority from their respective agencies to provide input on management decisions related to Biological Opinion 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 would be incorporated into the Implementation Plan, which the Steering Team would review.

The Steering Team is also the level at which the participating entities would seek to resolve disagreements. The Steering Team is integral to providing recommendations on overall strategy and direction for Biological Opinion 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 composed of groups of focused technical teams, each of which represents different elements of the implementation of the Willamette Valley System Biological Opinions. Technical teams are charged with implementing the actions listed in the Biological Opinions 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 comprise 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 teams 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 Adaptive Management 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 that 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 Clean Water Act (CWA) requirements. FMWQT will be chaired by a representative of 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. Additionally, recommendations will be made on 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 Willamette Fish Passage Operations & Maintenance (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 would be determined through the annual adaptive management process (Section 4.4, Annual Adaptive Management Process).

The FMWQT would 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 would retain ultimate authority for operating reservoir elevations and downstream flows to meet authorized project purposes.

These meetings allow the agencies to have adequate opportunity for providing input and coordination on flow management operations. WATER participants would use this information in addition to balancing priorities to develop the Conservation Plan, which would 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 would address the total maximum daily load (TMDL) allocations for temperature, including compliance and consistency with the pending Biological Opinion for operating the WVS dams. The Oregon Department of Environmental Quality (ODEQ) also recommended that 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 consult on real-time operations, particularly for, but not limited to, the conservation storage and release season.
- Conduct annual reviews of WVS 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.

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- 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 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 FMWQT, consistent with pre-defined operational measure objectives for ESA-listed fish. Recommendations from WFPOM and other WATER teams seeking continuing changes (multi-year or permanent) to modify operations would be determined through the annual adaptive management process (Section 4.4, Annual Adaptive Management Process).

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 development 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 Biological Opinion as well as the Adaptive Management 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 composed 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 would participate in this forum as needed to provide updates and to seek input on PDT efforts relating to design or research of Biological Opinion-related projects.

The Fish Facility Design, Research, and Development Team would also consider what research and monitoring may be needed to inform future fish passage facility design or fish passage operations in support of Biological Opinion implementation and the Adaptive Management 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 would be discussed and recommendations made to PDTs or other WATER technical forums to support the adaptive management 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 Biological Opinion implementation.
- Provide recommendations on potential research and monitoring needed to inform fish passage structures or operations included in the Biological Opinion as well as the Adaptive Management 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 is responsible for identifying and prioritizing any potential habitat restoration activities that support the Willamette Valley System Biological Opinion 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 Habitat Technical Team.

Roles and Responsibilities

- Identify opportunities for habitat restoration and funding.
- Assess progress toward the habitat related Biological Opinion requirements.

- Update the habitat restoration strategy to reflect any new available science and lessons learned.

4.3 DECISION NEEDS FOR WILLAMETTE VALLEY SYSTEM ADAPTIVE MANAGEMENT

Planning, implementing, and adaptively managing the actions USACE is proposing to take would require hundreds of decisions ranging from relatively mundane issues such as what type of net to use for sampling to significant and potentially contentious issues such as 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 senior leadership relies on recommendations from 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, therefore, the positions described herein are subject to change.

NMFS and USFWS are responsible for compliance-related decisions, including policy determinations regarding the application of adaptive management 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 Adaptive Management Plan help frame agency actions. Adaptive management 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 adaptive management program is to facilitate effective and 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 adaptive management. 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 adaptive management 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 (Step 1 and Step 3) of the adaptive management 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 USACE Portland District Reservoir Regulation and Water Quality.

Table 4-2. Example Adaptive Management Decision Needs.

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Decision Need	Step in Adaptive Management Cycle	Recommending Entity	Primary Decision Level
What are the objectives?	Plan/Design	Implementation	Oversight
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 an 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 2-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 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 Adaptive Management Plan. Congress generally authorizes numerous new USACE site-specific activities and provides policy direction in an omnibus USACE authorization

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bill, typically called the Water Resources Development Act (WRDA). The WRDAs do not provide funds to conduct activities, nor are they reauthorization bills.

Calendar Year	2024					2025					2026					2027					2028																														
Month	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D
Fiscal Year	FY24					FY25					FY26					FY27					FY28																														
	FY26 PROGRAM																																																		
	DEVELOP					DEFEND					EXECUTE																																								
											FY27 PROGRAM																																								
						DEVELOP					DEFEND					EXECUTE																																			
											FY28 PROGRAM																																								
						DEVELOP					DEFEND					EXECUTE																																			

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

FY = Fiscal Year

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 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. 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 *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 River control points based on the anticipated total system storage in mid-May, from the April forecast. The Plan 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 they occur in a variety of forms. A study of judicial decisions on adaptive management 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 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, 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 Adaptive Management Plan 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 to 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 adaptive management 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 FEIS, supplemental NEPA analysis would be required. Implementation of actions not contemplated in the FEIS 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 an action that was adequately assessed in the FEIS 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). 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 adaptive management 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 adaptive management process.

4.4 ANNUAL ADAPTIVE MANAGEMENT PROCESS

The annual adaptive management process would revolve around science updates (from monitoring and evaluation activities) and the generation and sharing of information about Preferred Alternative performance and then using that information for adjustments of the Implementation Plan (i.e., next 3 to 5 years) (Figure 4-4, Table 4-3, Table 4-4).

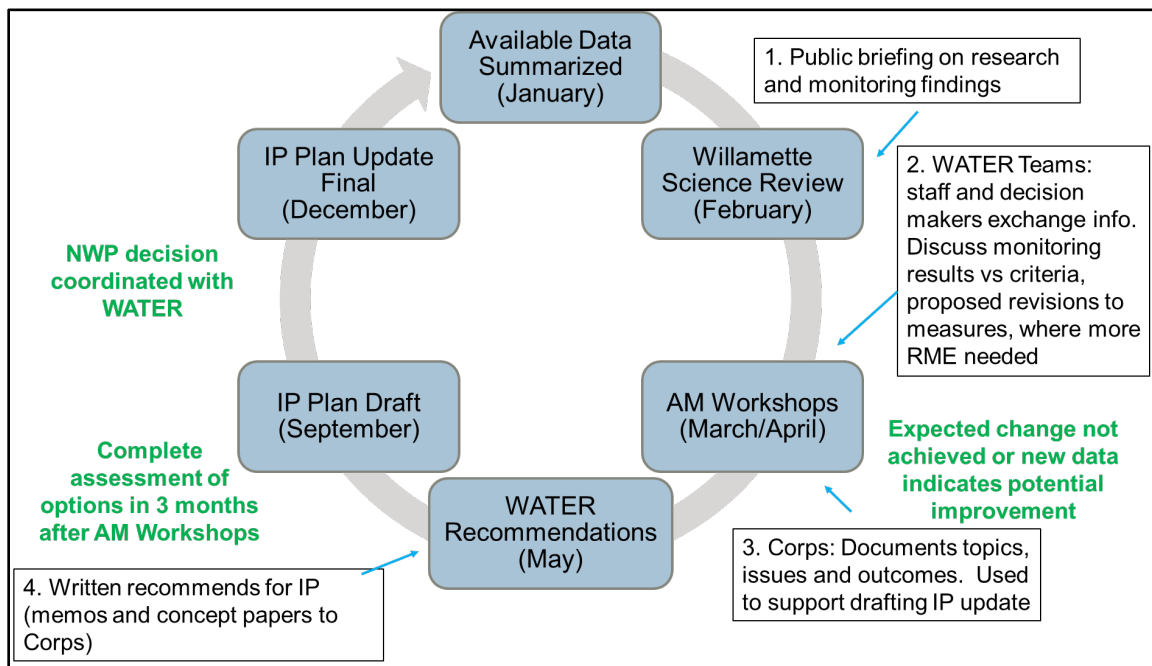


Figure 4-4. Basic Annual Adaptive Management and Implementation Plan Update Process.

Table 4-3. Summary of Annual Adaptive Management 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 Adaptive Management 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
Adaptive Management Workshop Summary	Documents topics, issues, and outcomes discussed during the adaptive management 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 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 and direction for the program (FY+3 and FY+4) but can include suggested adjustments to other years.	June/July
Draft Updates to Annual Implementation Plan	The draft Annual Implementation Plan would be updated to incorporate science updates and associated WATER recommendations and sent out to the Management Team for review.	November/December
Final Annual Implementation Plan Update	The Annual Implementation Plan Update would reflect annual implementation progress and any additional adjustments to outyears.	January

FY = Fiscal 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. 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 operations and maintenance.

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 adaptive management 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 would 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 adaptive management 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 adaptive management 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 adaptive management 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 subbasin/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 under 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 on their discussions, address topics of overlapping interest, and identify next steps.

Adaptive Management Workshop Summary (April/May)

USACE or a facilitation team (if used) would prepare an adaptive management workshop summary that outlines the primary presentations, issues, and outcomes and shares this product with WATER teams after the meeting.

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

The adaptive management process includes reviewing both recent and new information annually to inform activities in subsequent years, including research, monitoring, and evaluation needs. This includes considering which measures require additional research, monitoring, and evaluation; what level of precision is needed when assessing the associated metrics; and what study methods and techniques should be used. However, year 1 research, monitoring, and evaluation activities are not pre-defined in the Adaptive Management Plan. Because implementation of measures will begin on day one, research, monitoring, and evaluation activities are also needed in year 1.

Attachment 1 includes research, monitoring, and evaluation activities developed for 2025 consistent with the Proposed Action measures defined in the Willamette Valley Biological Assessment, Adaptive Management Plan metrics, and the interim (formerly near-term) measures expected benefits and long-term measures performance criteria. These research, monitoring, and evaluation activities are also largely a continuum of activities currently being employed to assess injunction operations. Subsequent year research, monitoring, and

evaluation activities will be refined by following the annual adaptive management process described in this Adaptive Management Plan.

4.4.3 Annual Implementation Plan Update

The Implementation Plan described in Section 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 Implementation Plan. Program management would also need to account for necessary research, monitoring, and evaluation of management measures and research aimed at reducing uncertainty of 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 Implementation Plan. 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

USACE would collaborate annually with WATER to assess if the group has interest in submitting recommendations to USACE regarding any adjustments to prioritization, inclusion of actions in the Implementation Plan, or additions or modification to research, monitoring, and evaluation to provide information supporting Implementation Plan decisions. The format for submission of recommendations from WATER to USACE is anticipated to include memoranda for changes to actions in the Implementation Plan and Concept Papers for recommendations on research, monitoring, and evaluation needs to support Implementation Plan decisions.

Draft Annual Implementation Plan Update

Based on the outcomes of the Adaptive Management Workshop and any WATER recommendations, the annual Implementation Plan would be updated to reflect any necessary changes in program implementation and prioritization. A draft Annual Implementation Plan will be provided to WATER for review.

Final Annual Implementation Plan Update

By January, USACE would finalize updates to the annual Implementation Plan and incorporate this information in its budget planning.

4.5 OTHER ADAPTIVE MANAGEMENT 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 establish and to 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 adaptive management 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, interagency conflicts between USACE and another agency should be resolved using interagency 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, which 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 adaptive management, 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 adaptive management and relate to ESA compliance, therefore, they should be rigorously analyzed and deliberated, including full coordination between USACE, NMFS, and USFWS and with opportunity for input by WATER.

Recommendations for adjustments to these factors 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 Adaptive Management Workshop. Following the Workshop, the Action Agencies along with NMFS and USFWS will discuss the recommended changes and will 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 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 affect 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 would 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 adaptive management 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.

5 - ADAPTIVE MANAGEMENT OF THE PREFERRED ALTERNATIVE

The primary purpose for adaptive management in USACE is to ensure a project or program achieves its goals and objectives (USACE 2019c). The following sections 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 as well as a summary of the metrics and criteria.

5.1 OVERVIEW OF DECISION METRICS AND CRITERIA

5.1.1 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 Operation is described in Section 5, Adaptive Management of the Preferred Alternative. However, there is uncertainty in the extent the effects from WVS operations and maintenance can be reduced by interim actions.

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.

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 (TDG)	TDG levels below dam	

*Metrics monitored and assessed for interim downstream passage will depend on the operation and benefits sought.

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 was 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 Adaptive Management 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 unacceptable 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 the schedule for long-term measure(s).

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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)

5.1.2 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 criteria would be applied to determine if changes have achieved objectives is provided in Figure 5-1.

Once cohort replacement rate criteria are achieved, then cohort replacement rate would continue to be monitored for 10 additional years to help ensure improvements for the maintenance of a sustainable subpopulation above the dam(s) in each subbasin.

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 cohort replacement rate of 1 or greater above dam.	Assess/reassess for 2 years within first 5 years of improvement or adjustments.
Downstream fish passage	Above-dam Chinook Cohort Replacement Rate	Geometric mean of above-dam cohort replacement rate for 3 cohorts ≥ 1.0 .	Assess/reassess for 3 cohorts within 7 years of improvement or adjustments. Continue assessment for 10 additional years after criteria met.
Upstream fish passage	Upstream Dam Passage Trap and Transport Timing	Trap and transport timing objectives in Willamette Fish Operations Plan.	Annually

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Action	Metric	Criteria	Assessment Frequency
Upstream fish passage	Above-dam Chinook Cohort Replacement Rate	Geometric mean of above-dam cohort replacement rate for 3 cohorts ≥ 1.0 .	Assess on schedule commensurate with analysis of this metric for downstream passage improvement
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 years 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

DPS = dam passage survival
 < = less than
 > = greater than

\geq = greater than or equal to
 % = percent

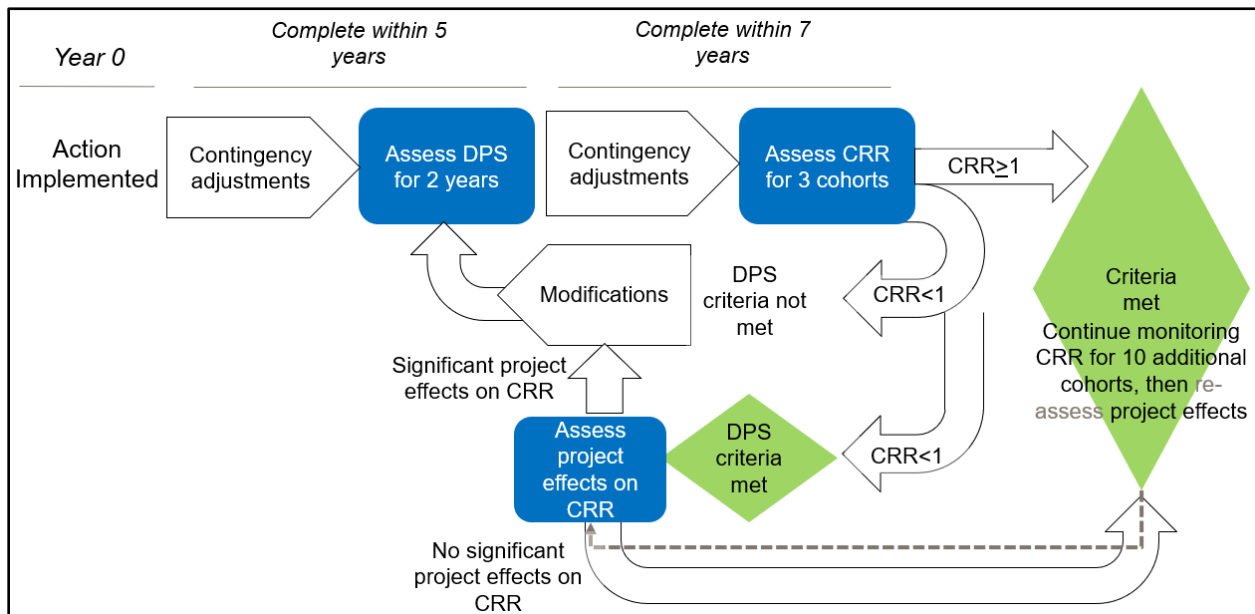


Figure 5-1. Flow Diagram Showing Timing and Decision Pathways using the Metrics Dam Passage Survival (DPS) and Cohort Replacement Rate (CRR) to Assess Long-term Downstream Fish Passage Measures.

5.2 NORTH SANTIAM RIVER SUBBASIN

5.2.1 Detroit Dam Interim Operations

5.2.1.1 Definition and Function

Interim Operations at Detroit Dam include provision for temperature improvement and downstream fish passage by prioritizing flow releases through the upper regulating outlets during the fall/winter once the Detroit Reservoir elevation is less than 100 feet over the turbine intakes (1,419 feet); target elevation 1,450 feet to 1,500 feet. 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 (elevation 1,541 feet) and continue until the reservoir is drafted below the spillway crest. A late fall/early winter deep drawdown of Detroit reservoir will occur to an elevation of 1395 feet for downstream fish passage.

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.

5.2.1.2 Performance Metrics and Targets

Interim Operations at Detroit Dam are anticipated to be implemented until the Detroit Dam selective withdrawal structure and floating screen structure are constructed and operational. USACE selected the selective withdrawal structure/floating screen structure as the long-term solution to downstream fish passage at Detroit Dam. Downstream passage survival through Detroit Dam of juvenile Chinook salmon has been estimated; 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 Dam along with the following:

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

Targets

- Flow releases prioritized through the upper regulating outlets during the fall/winter once the Detroit Reservoir elevation is less than 100 feet over the turbine intakes (1,419 feet); target elevation 1,450 feet to 1,500 feet.
- 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 (elevation 1,541.0 feet) and continue until the reservoir is drafted below the spillway crest. From there, a combination of turbine and regulating outlet discharges would be implemented until water temperature management is no longer possible due to reservoir turnover.
- Seasonal downstream juvenile Chinook salmon passage efficiency through preferred routes (spillway and regulating outlets) at WVS dams increased over pre-injunction operations.
- Downstream juvenile Chinook salmon 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 (7-day average).

Month	Current RA Target Maximum Temp °F	Current RA Target Minimum Temp °F	Prior RA Target Maximum Temp °F	Prior RA Target Minimum Temp °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

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Month	Current RA Target Maximum Temp °F	Current RA Target Minimum Temp °F	Prior RA Target Maximum Temp °F	Prior RA Target Minimum Temp °F	ODEQ 2006 TMDL Target Temperatures °F
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 Oregon Department of Fish and Wildlife (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.

< = less than

5.2.1.3 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. Multiple years of monitoring are anticipated to understand if operations are achieving objectives and targets or if changes are warranted. This is because of the effects of annual hydrologic variability in meeting Interim Operations objectives and resulting variability in water quality and fish passage conditions expected to occur within and across years.

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 adaptive management 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.

5.2.1.4 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 regulating outlets at Detroit Dam is limited and/or passage into the turbine penstocks is not reduced.

5.2.1.5 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 flood risk management operations, then implement adjustments to operations expected to improve achievement of targets that 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 an improved likelihood of achieving targets.

5.2.1.6 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. Fish passage results will be reviewed as part of the annual adaptive management 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. USACE will ensure evaluations are carried out and reports are made available for NMFS and WATER review within timelines necessary to inform adaptive management decisions outlined in this document.

5.2.2 Detroit Dam 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, to achieve CWA 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, 2016, 2017; USACE 2019d, 2019e).

5.2.2.2 Constraints

Constraints associated with the Detroit Dam selective withdrawal structure will be identified as part of the project-specific planning documents developed prior to implementation. However, two known constraints relating to this measure are that 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.

5.2.2.3 Performance Metrics and Targets

Performance Metrics

- 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. Potential conflicts may arise on occasion 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 selective withdrawal structure would be evaluated against the ability to manage flows to meet the downstream water temperature targets. The extent to which operations of the selective withdrawal structure 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 Dam 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 (gravity fed flow that may include pumps for supplementing inflow). A temperature tower is needed to accommodate mooring and receiving the gravity fed outflow from the floating screen structure.

5.2.3.2 Constraints

Constraints associated with the Detroit Dam floating screen structure would be identified as part of the project-specific planning documents developed prior to implementation. However, two known constraints relating to this measure are that 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.

5.2.3.3 Performance Metrics and Targets

Performance Metrics

The following performance metrics, also listed in Table 5-2 and Figure 5-1, would be used to evaluate fish passage at Detroit Dam once the floating screen structure is operational:

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

- Sub-metric: Dam-passage efficiency (DPE)—the proportion of total number of fish passing the dam relative to the total number of 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 total number of fish in the near forebay and available to pass. This sub-metric would be used to calculate DPE.
- Sub-metric: Fish collector efficiency—defined as the proportion of fish passing (collected by) the floating screen structure, relative to the total number of fish passing the dam via any route. This sub-metric would be used to calculate dam-passage efficiency.
- Sub-metric: Concrete Survival (CS)—the proportion of fish surviving passage through each route weighted by the number passing through each route.

- Above-dam Cohort Replacement Rate².

Targets

Dam-passage Survival: Higher Value of the Following Two Estimates:

- Dam-passage survival rate needed to support replacement of spawners above dams as estimated using life cycle models, such as those developed for the Final WVS EIS and ESA consultation. Modeling to define the dam passage survival rate needed to support replacement of spawners would be completed in year 1 of implementation of the Proposed Action and would incorporate any new and relevant scientific information into models.
- Estimate of annual dam-passage survival across water year types.

This estimate would be prepared using the Fish Benefit Workbook (FBW) or other approaches to estimate DPS across a range of water year types. New information would be used to update the estimate prior to assessing performance (field study data; revised models).
- Geometric mean of Above-dam Cohort Replacement Rate for three cohorts is ≥ 1.0 .

5.2.3.4 Research, Monitoring, and Evaluation

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

Dam-passage efficiency would 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 Dam, the near forebay area would 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).

² The success of reintroduction above the Federal dams in the Willamette Valley System 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.

Concrete survival would be measured as the number of fish that survive from Detroit Dam to the downstream concrete survival measurement boundary divided by the total number of fish that pass downstream. The concrete survival downstream measurement boundary would 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 would be reconsidered to produce comparable survival estimates. Bennett dams are an additional option for placing a marked fish detection array for assessing concrete survival.

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

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Above-dam Cohort Replacement Rate serves as a basis for evaluating performance of the above-dam population performance. Above-dam Cohort Replacement Rate would be estimated as:

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

Above-dam Cohort Replacement Rate 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 fish used to supplement the number of spawners is considered part of the cohort parentage.

The Hatchery Genetic Management Plan (HGMP) thresholds define the minimum abundance levels for assessing Cohort Replacement Rate above each dam because outplanted adults would 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

- Floating screen structure entrance rejection by juvenile Chinook salmon 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 fish passage given scale of reservoir fluctuation at Detroit Dam.
- Large forebay area impacting guidance and attraction to the floating screen structure 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 the entrance point.
- Climate change – see discussion under Basin Flow Measures (Section 5.8, Basin-wide Flow Measures).

5.2.3.6 Decision Triggers and Adaptive Actions

Successful fish passage would be defined by achieving either the dam-passage survival or the cohort replacement rate target (Figure 5-1). Additional assessments would be completed to determine if the cohort replacement rate is not being met due to project effects or non-project effects. This would occur if the dam-passage survival target has been met, but not the cohort replacement rate target.

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If the issue is due to project effects, additional measures taken under the Preferred Alternative would be identified, designed, and implemented, and then the cohort replacement rate (and dam-passage survival if warranted, depending on the type of additional improvements made) would be re-evaluated or re-consultation would occur.

Contingency actions to operation of the floating screen structure are expected to be made in real time during the first few years as part of the commissioning and initial operations. No in-season changes would be made to support evaluation once field studies to assess performance metrics begins. However, operational treatments for study may be considered at this time to simultaneously evaluate different conditions.

Additional contingency actions would be implemented that are within the design capacity of the floating screen structure once two representative study years of floating screen structure operation are completed and the DPS target is not achieved. If actions require additional funding or engineering, these would be implemented if the above-dam cohort replacement rate 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, dam-passage survival and cohort replacement rate would be re-assessed following the same approach and timeframes as the initial assessments, as described above.

Examples of contingency actions for the floating screen structure 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: floating screen structure—longer or shorter operational periods of floating screen structure, 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 regulating outlet 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 floating screen structure 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 dam-passage survival and above-dam cohort replacement rate is achieved, above-dam cohort replacement rate would then continue to be monitored for the subsequent decade to

ensure performance is maintained. If the geometric mean of the cohort replacement rate is less than 1 for this period and it is determined the floating screen structure remains a significant factor affecting the cohort replacement rate, then additional measures taken under the Preferred Alternative would be identified, designed, and implemented, and the cohort replacement rate (and dam-passage survival if warranted, depending on the type of additional improvements made) would be re-evaluated or reconsultation would occur.

5.2.3.7 Decision-making and Collaboration

The Action Agencies would fund post-construction evaluations of dam-passage survival and fish survival through the floating screen structure. The WATER Fish Passage Design, Research, and Development Technical Team and other WATER technical teams, either jointly or separately, would 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 would address the comments to improve the study design for assessing the performance metrics. If NMFS and the Action Agency technical staff do not concur on final study designs, the dispute would be elevated for resolution following Federal Family and WATER procedures and protocols. The Action Agencies would 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 for transport of adult spring Chinook salmon 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.
- violate USACE dam safety requirements.

5.2.4.3 Performance Metrics and Targets

Performance Metrics:

The following performance metrics would be used to evaluate operation of the Minto Adult Fish Facility:

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- 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 would 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 adult fish facility or during truck transport.
 - Health condition of outplanted fish.
 - Health condition of fish taken for brood.
 - Number and locations of outplanted fish.
 - Sex ratio of outplanted fish.
 - Fish densities when in holding at adult fish facility and in transport trucks.
 - Water temperatures and oxygen levels in the adult fish facility and transport trucks.
 - Cumulative temperature exposure when in the adult fish facility 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 (Section 5.6, Ongoing Hatchery Mitigation Program Monitoring).

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 would be summarized annually and reports provided to WATER for review. Information on most metrics listed above would be collected commensurate with operation of the adult fish facility. Discharge and water temperatures below Detroit Dam would also be continuously monitored.

As part of ongoing hatchery mitigation monitoring activities, available information on the following metrics would be included as part of annual summaries to support monitoring of upstream passage actions in the subbasin:

- Counting salmon at diversion dams (Bennett).
- Counting of salmon at WVS adult fish facility.
- 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, flood risk management, hydropower, etc.) on upstream migration of adult fish to Detroit Dam tailrace and adult collection in the adult fish facility.
- Effects of water temperatures discharged from Detroit Dam or from the adult fish facility on adult attraction and collection in the adult fish facility.

5.2.4.6 Decision Triggers and Adaptive Actions

Minor changes to operation of the adult fish facility (i.e., operationally feasible and within USACE authority, and not requiring additional funding) are expected to be made in real time to maintain compliance with the Willamette Fish Operations Plan protocols. Reports of operations would be reviewed annually to determine areas where minor changes may be needed.

Adjustments or modifications would be assessed if compliance cannot be maintained with minor changes. Depending on the potential solutions, engineering studies or biological studies may be planned as funding is available. The timeframe for implementation of adjustments or modifications to the adult fish facility would depend on the specific actions identified for implementation.

5.2.5 Big Cliff Dam Spread Spill for Total Dissolved Gas 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 Metrics:

- 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 Dam Total Dissolved Gas Abatement Structure (Injunction Measure 10b)

5.2.6.1 Definition and Function

USACE has established a Project Development Team to evaluate alternative concepts for a TDG abatement structural solution at Big Cliff Dam. Although the function of any structural solution would be to reduce TDG downstream of Big Cliff Dam, the specific structural solution that would 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 Metrics:

- 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 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 subbasin 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 subbasin 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 scenario would necessitate an adjustment, which would potentially be to resume the Big Cliff Dam spill spread measure. Timing of the decision to adjust would also need to account for when the Detroit Dam selective withdrawal structure/floating screen structure was constructed and operational.

5.3 SOUTH SANTIAM RIVER SUBBASIN

5.3.1 Green Peter Dam 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 the fall to 25 feet over the regulating outlets.

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 regulating outlets in fall would increase the number and survival rate of fish passing.

5.3.1.2 Constraints

Constraints relating to this measure are that 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.

5.3.1.3 Performance Metrics and Targets

The following performance metrics, also listed in Table 5-2 and Figure 5-1, would be used to evaluate fish passage at Detroit Dam once the floating screen structure is operational:

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

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

Targets:

Dam-passage Survival: Higher Value Developed from the Following Two Approaches:

- Dam-passage survival rate needed to support replacement of spawners above dams as estimated using life cycle models, such as those developed for the FEIS and ESA consultation. Modeling to define the dam-passage survival rate needed to support replacement of spawners would be completed in year 1 of implementation of the Proposed Action and would incorporate any new and relevant scientific information into models.
- Estimate of annual dam-passage survival across water year types.

This estimate would be prepared using the Fish Benefit Workbook or other approaches to estimate dam-passage survival across a range of water year types. New information would be used to update the estimate prior to assessing performance (field study data; revised models).
- Cohort Replacement Rate = ≥ 1.0

5.3.1.4 Research, Monitoring, and Evaluation

Annual dam passage survival (calculated as $DPS = DPE * CS$) will be measured in two separate years that 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 dam-passage structure estimates would be determined at the time of the assessment to evaluate passage to provide reasonable certainty bounds acceptable to decision makers.

Dam-passage efficiency would 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 Dam, the near forebay zone would 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).



Figure 5-3. Green Peter Dam Tailrace, Forebay, and Near Forebay Zone (gray) Showing Approximate Area to be Used for Measuring Fish Passage Metrics.

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 would 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 concrete survival measurement boundaries are necessary to assess passage survival at Green Peter Dam separately from the combined passage survival for both Green Peter and Foster Dams. The first concrete survival measure boundary would 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 concrete structure downstream measurement boundary would 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 would be reconsidered to produce comparable survival estimates.

5.3.1.5 Risks and Uncertainties

- Annual hydrologic variability limiting or affecting 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 regulating outlet passage.
- Uncertainty in survival rate associated with copepod infection.
- Climate change – see discussion under Basin Flow Measures (Section 5.8, Basin-wide Flow Measures).

5.3.1.6 Decision Triggers and Adaptive Actions

Contingency actions or adjustments within the operational capacity of Green Peter Dam would be implemented if results warrant. This would occur once two representative study years of fish passage operations are completed. Actions requiring additional funding or engineering would not be considered until after three cohort replacement rate estimates are available (after year 7).

Successful fish passage would be defined by achieving either the dam-passage survival or the cohort replacement rate target (Figure 5-1). Additional assessments would be completed to determine if the cohort replacement rate is not being met due to project effects or non-project effects. This would occur if the dam-passage survival target has been met but not the cohort replacement rate target.

If the issue is due to project effects, additional measures taken under the Preferred Alternative would be identified, designed, and implemented, and then the cohort replacement rate (and dam-passage survival if warranted, depending on the type of additional improvements made) would be re-evaluated or consultation would 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 can release a limited amount of cooler water at Green Peter Dam.
- At Green Peter Dam, this measure would consist of using up to 60% of total release through the spillway as soon as available in May to provide attraction temperatures for upstream migrant adult Chinook salmon.
- Use up to 60% of total release through regulating outlets in the fall to reduce temperatures for egg incubation downstream of Foster Dam. This operation may be 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.
- violate USACE dam safety requirements.

5.3.2.3 Performance Metrics and Targets

Performance Metrics

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

Targets

Table 5-4 identifies the existing water temperature targets for the South Santiam River. 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	Current RA Target Maximum Temp °F	Current RA Target Minimum Temp °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, Oregon Department of Fish and Wildlife (ODFW)) for the McKenzie River below Cougar Dam (October and November slightly modified for the North/South Santiam River).

< = less than

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 River 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 Dam through the use of the regulating outlets 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 regulating outlets 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 an adult fish facility at Green Peter Dam for transport of adult spring Chinook salmon and steelhead above Green Peter Dam. Provide adult upstream passage above Green Peter Dam for adult fish, including spring Chinook salmon and steelhead.

5.3.3.2 Constraints

Constraints associated with the Green Peter Dam Adult Fish Facility would be identified as part of the project-specific planning documents developed prior to implementation. However, two known constraints relating to this measure are that 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.

5.3.3.3 Performance Metrics and Targets

Performance Metrics

The following performance metrics would be used to evaluate operation of the adult fish facility 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 would be evaluated:
 - Timing of fish collection and outplanting relative to natural run timing.

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- Injury rates from handling and sorting.
- Mortality rates for fish while in the adult fish facility or during truck transport.
- Health condition of outplanted fish.
- Health condition of fish taken for brood.
- Number and locations of outplanted fish.
- Sex ratio of outplanted fish.
- Fish densities when in holding at the adult fish facility and in transport trucks.
- Water temperatures and oxygen levels in the adult fish facility and transport trucks.
- Cumulative temperature exposure when in the adult fish facility 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 (Section 5.6, Ongoing Hatchery Mitigation Program Monitoring).

Targets

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

5.3.3.4 Research, Monitoring, and Evaluation

Upstream passage metrics would be summarized annually and reports provided to WATER for review. Information on most metrics listed above would be collected commensurate with operation of the adult fish facility. Discharge and water temperatures below Green Peter Dam would also be continuously monitored.

As part of ongoing hatchery mitigation monitoring activities, available information on the following metrics would be included as part of annual summaries to support monitoring of upstream passage actions in the subbasin:

- Counting salmon at downstream diversion dams (Lebannon).
- Counting of salmon at the WVS adult fish facility.
- 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, flood risk management, hydropower, etc.) on upstream migration of adult fish to Green Peter Dam tailrace and adult collection in the adult fish facility.
- Effects of water temperatures discharged from Green Peter Dam or from the adult fish facility on adult attraction and collection in the adult fish facility.

5.3.3.6 Decision Triggers and Adaptive Actions

Minor changes to operation of the adult fish facility (i.e., operationally feasible and within USACE authority, and not requiring additional funding) are expected to be made in real time to maintain compliance with the Willamette Fish Operations Plan protocols. Reports of operations would be reviewed annually to determine areas where minor changes may be needed.

Adjustments or modifications would be assessed if compliance cannot be maintained with minor changes. Depending on the potential solutions, engineering studies or biological studies may be planned as funding is available. The timeframe for implementation of adjustments or modifications to the adult fish facility would depend on the specific actions identified for implementation.

5.3.4 Foster Dam Interim Operations

5.3.4.1 Definition and Function

The Interim Operations at Foster Dam 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 salmon at the Foster Dam Adult Fish Facility.

- From February 1 through May 15, delay the refill of Foster Reservoir and hold at minimum conservation pool (elevation 613 feet to 615 feet). The spillway would be operated at night from 1 hour before sunset to 0.5 hour after sunrise; one turbine unit would be operated for station service (approximately 300 cubic feet/second [cfs]) to reduce/balance TDG levels created by the spill operation.
- From May 16 through 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 Dam Adult Fish Facility 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 salmon collected at the adult fish facility).

- Starting just after Labor Day weekend, gradually draw down Foster Reservoir to target a forebay elevation of 620 feet to 625 feet 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 would be used to evaluate the Interim Operations at Foster Dam, along with the following:

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

Targets

- Reservoir elevations and flow releases prioritized as defined under the Interim Operations.
- Seasonal downstream juvenile Chinook salmon passage efficiency through preferred routes (spillway and fish weir) at Foster Dam increased over pre-injunction operations.
- Downstream juvenile Chinook salmon 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 triggering entrance and collection of adult Chinook salmon in the adult fish facility.

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. Multiple years of monitoring are anticipated to understand if operations are achieving

objectives and targets or if changes are warranted. This is because of the effects of annual hydrologic variability in meeting Interim Operations objectives and resulting variability in water quality and fish passage conditions expected to occur within and across years.

Monitoring results would be reported and reviewed annually. If targets are not met, decision makers would 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.

A 5-year check-in would be conducted to review if fish passage targets were achieved. This is due to the seasonal and annual variability that occurs and the 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 to fish passage before multiple years of data are collected.

Study designs and methodology to assess the defined metrics would be determined during implementation so that the best available scientific approaches and methods can be applied. The adaptive management process would 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.

5.3.4.5 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

USACE would prepare annual reports documenting operations and summarizing the results in comparison to the defined targets. Annual check-ins would occur to assess how well targets have been achieved for water quality. A 5-year check-in would 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 would 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 would review the reported results from the operation and any proposed changes to achieve the operational targets. USACE would ensure evaluations are carried out and reports are made available for NMFS and WATER review within timelines necessary to inform adaptive management 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 would provide fish downstream passage through a surface route with a flow rate of 500 cfs to 800 cfs.

5.3.5.2 Constraints

Constraints associated with the Foster Dam Downstream fish passage structure would be identified as part of the project-specific planning documents developed prior to implementation. However, two known constraints relating to this measure are that 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.

5.3.5.3 Performance Metrics and Targets

Performance Metrics

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

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

- Sub-metric: Dam-passage efficiency—the proportion of total number of fish passing the dam relative to the total number of fish detected in the near forebay of the dam and therefore available to pass.
- Sub-metric: Fish passage efficiency—the proportion of fish passing via a non-turbine route relative to the total number of fish in the near forebay and available to pass.
- Sub-metric: Fish collector efficiency—defined as the proportion of fish passing (collected by) the floating screen structure relative to the total number of fish passing the dam via any route.
- Sub-metric: Concrete Survival—the proportion of fish surviving passage through each route weighted by the number passing through each route.

- Above-dam Cohort Replacement Rate.

Targets

Dam-passage Survival: Higher Value Developed from the Following Two Approaches:

- Dam-passage survival rate needed to support replacement of spawners above dams as estimated using life-cycle models, such as those developed for the Final WVS EIS and ESA consultation. Modeling to define the dam-passage survival rate needed to support replacement of spawners would be completed in year 1 of implementation of the Proposed Action and would incorporate any new and relevant scientific information into models.
- Estimate of annual dam-passage survival across water year types.

This estimate would be prepared using the Fish Benefit Workbook or other approaches to estimate dam-passage survival across a range of water year types. New information would be used to update the estimate prior to assessing performance (field study data; revised models).
- Cohort Replacement Rate = ≥ 1.0

5.3.5.4 Research, Monitoring, and Evaluation

Annual dam passage survival (calculated as $DPS = DPE * CS$) would be measured in two separate years that 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 would be determined at the time of the assessment to evaluate passage to provide reasonable certainty bounds acceptable to decision-makers.

Dam-passage efficiency would 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 Dam, the near forebay area would 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).



Figure 5-4. Foster Dam Tailrace, Forebay, and Near Forebay Zone (gray) Showing Approximate Area to be Used for Measuring Fish Passage Metrics.

Test Period(s):

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

Concrete survival would be measured as the number of fish that survive from Foster Dam to the downstream concrete survival measurement boundary divided by the total number of fish that pass downstream. The concrete survival downstream measurement boundary would 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 (see Liss et al., 2020). These locations would be reconsidered to produce comparable survival estimates.

5.3.5.5 Risks and Uncertainties

- Low fish collector efficiency of juvenile Chinook salmon 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 Dam downstream fish passage structure are expected to be made in real time during the first few years. No in-season changes would be made to support evaluation once field studies to assess performance metrics begins. However, operational treatments for study may be considered at this time to simultaneously evaluate different conditions where information supports such treatments.

Additional minor changes or adjustments within the design capacity of Foster Dam facilities, flood risk management operations, and USACE authority would be implemented if results warrant. This would occur once two representative study years of operation are completed. However, actions requiring additional funding or engineering would not be considered until after three cohort replacement rate estimates are available (after year 7).

Successful fish passage would be defined by achieving either the dam-passage survival or the cohort replacement rate target (Figure 5-1). Additional assessment would be completed to determine if the cohort replacement rate is not being met due to project effects or non-project effects. This would occur if the dam-passage survival target is met but not the cohort replacement rate target.

If the issue is due to project effects, additional measures taken under the Preferred Alternative would be identified, designed, and implemented, and then cohort replacement rate (and dam-passage survival if warranted, depending on the type of additional improvements made) would be re-evaluated, or re-consultation will occur.

5.3.5.7 Decision-Making and Collaboration

The Action Agencies would fund post-construction evaluations of dam-passage survival at Foster Dam. WATER would review study designs for assessing the performance metrics. Study designs may also benefit from a targeted independent scientific review.

The Action Agencies would address the comments to improve the study design for assessing the performance metrics. If NMFS and the Action Agency technical staff do not concur on final study designs, the dispute would be elevated for resolution following Federal family and WATER procedures and protocols. The Action Agencies would 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 the Foster Dam forebay and used in the Foster Dam Adult Fish Facility 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 Dam forebay is stratified in terms of temperature. The existing water supply for the fish ladder is located at the powerhouse intakes and 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 adult fish facility fish ladder from the Foster Dam tailrace.

The major feature of this measure is construction of a new forebay warm water supply pipe that would draw warm water from above the thermocline in the Foster Dam 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 the 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 forebay warm water supply intake to keep juvenile fish from entering the pipe.

The purpose of the forebay warm water supply is to reduce delay of upstream-migrating spring Chinook salmon at Foster Dam or Reservoir. Successful adult passage includes: (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 Foster Fish Ladder Improvement Project.

The goal of the forebay warm water supply design is to address the second aspect of successful fish passage—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 salmon into adult fish facilities.

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The USACE Forebay Warm Water Supply PDT developed water temperature targets for the Foster Dam fish ladder in consultation with NMFS and Oregon Department of Fish and Wildlife (ODFW) (Table 5-5). Targets are based on water temperatures in the South Santiam River above Foster Dam, which were determined to be appropriate for encouraging upstream migration of Chinook salmon. Temperature targets were established based on the 75 percent, 50 percent, or 25 percent quartiles by 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 July 1 to August 30 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 Foster Dam Fish Ladder.

DD-MM	Foster Dam Fish Ladder Target	Explanation (based on 2008 to 2019 data from USGS 14185000 South Santiam below Cascadia) (%)
May 1	51°F (10.6 °C)	75th
May 15	53 °F (11.7 °C)	75th
Jun 1	55 °F (12.8 °C)	Average of 15 May 75th and 15 Jun 75th
Jun 15	57 °F (13.9 °C)	50th
Jul 1 to Aug 30	60 °F (15.6 °C)	Summer maximum
Sep 1	58 °F (14.4 °C)	25th
Sep 15	55 °F (12.8 °C)	25th

5.3.6.2 Constraints

Constraints associated with the Foster Dam Downstream fish passage structure would be identified as part of the project-specific planning documents developed prior to implementation. However, two known constraints relating to this measure are that 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.

5.3.6.3 Performance Metrics and Targets

Performance Metrics

- 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 would be coordinated through the WATER technical teams.

5.3.6.4 Research, Monitoring, and Evaluation

Temperature data loggers would be operated in the Foster Dam Adult Fish Facility fish ladder near the points of discharge into the Foster Dam tailrace and would record at least hourly water temperatures. Daily average water temperatures would be summarized annually.

5.3.6.5 Risks and Uncertainties

Risks and uncertainties associated with the Foster Dam fish ladder would 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 Dam Adult Fish Facility to achieve the water temperature targets in the fish ladder.
- If targets are not achieved for reasons other than hydrologic limitations or flood risk management operations, then implement adjustments or modifications expected to improve achievement of targets that are feasible and authorized.
- If there are potential feasible and authorized adjustments but uncertainty of those adjustments can improve the ability to achieve targets, then conduct uncertainty research and implement if results indicate an improved likelihood of achieving targets.

5.3.7 Foster Dam Adult Fish Facility

5.3.7.1 Definition and Function

Continued operation of the Foster Dam Adult Fish Facility for transport of adult spring Chinook salmon and steelhead above Foster Dam. Provide adult upstream passage above Foster Dam for adult fish, including spring Chinook salmon 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.
- violate USACE dam safety requirements.

5.3.7.3 Performance Metrics and Targets

Performance Metrics

The following performance metrics would be used to evaluate operation of the Foster Dam Adult Fish Facility:

- 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 would 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 adult fish facility or during truck transport.
 - Health condition of outplanted fish.
 - Health condition of fish taken for brood.
 - Number and locations of outplanted fish.
 - Sex ratio of outplanted fish.
 - Fish densities when in holding at the adult fish facility and in transport trucks.
 - Water temperatures and oxygen levels in the adult fish facility and transport trucks.
 - Cumulative temperature exposure when in the adult fish facility 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 (Section 5.6, Ongoing Hatchery Mitigation Program Monitoring).

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 would be summarized annually and reports provided to WATER for review. Information on most metrics listed above would be collected commensurate with operation of the adult fish facility. Discharge and water temperatures below Foster Dam would also be continuously monitored.

As part of ongoing hatchery mitigation monitoring activities, available information on the following metrics would be included as part of annual summaries to support monitoring of upstream passage actions in the subbasin:

- Counting salmon at diversion dams (Lebannon).
- Counting of salmon at the adult fish facility.
- 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, flood risk management, hydropower, etc.) on upstream migration of adult fish to the Foster Dam tailrace and adult collection in the adult fish facility.
- Effects of water temperatures discharged from Foster Dam or from the adult fish facility on adult attraction and collection in the adult fish facility.

5.3.7.6 Decision Triggers and Adaptive Actions

Minor changes to operation of the adult fish facility (i.e., operationally feasible and within USACE authority, and not requiring additional funding) are expected to be made in real time to maintain compliance with the Willamette Fish Operations Plan protocols. Reports of operations would be reviewed annually to determine areas where minor changes may be needed.

Adjustments or modifications would be assessed if compliance cannot be maintained with minor changes. Depending on the potential solutions, engineering studies or biological studies may be planned as funding is available. The timeframe for implementation of adjustments or modifications to the adult fish facility would depend on the specific actions identified for implementation.

5.4 MCKENZIE RIVER SUBBASIN

5.4.1 Cougar Dam Interim Operations

5.4.1.1 Definition and Function

The Cougar Dam Interim Operations are 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 regulating outlets. The regulating outlets 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. The generators are 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 regulating outlet 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 working with WATER to develop a strategy to manage water releases following this and future storm events. Once the storm passes, regulating outlet discharges would be increased to draw the reservoir back to the targeted elevation of 1,505 feet as quickly as possible.

The regulating outlet 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 Dam at that time of year than passing juvenile fish through the turbine units.

Cougar Dam would be allowed to refill back to elevation 1,532 feet starting on December 15 along with nighttime regulating outlet usage and daytime generation.

On February 1, the refill of Cougar Reservoir would 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 1,571 feet by summer so that the Cougar water temperature control tower 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 would be used to evaluate the Interim Operations at Cougar Dam along with the following:

- Dam outlets operated during the defined Interim Operation period.
- Pool elevations during the defined Interim Operations period.
- Gate openings and discharge from each outlet operated for juvenile Chinook salmon passage efficiency through preferred routes at Cougar Dam.
- Juvenile Chinook salmon passage efficiency through preferred routes at Cougar Dam.
- Juvenile Chinook salmon passage timing at Cougar Dam.

Targets

- Reservoir elevations and flow releases prioritized as defined under the Interim Operations.
- Seasonal downstream juvenile Chinook salmon passage efficiency through preferred routes (spillway and regulating outlets) at Cougar Dam increased over pre-injunction operations.
- Downstream juvenile Chinook salmon passage timing at Cougar Dam is 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. Multiple years of monitoring are anticipated to understand if operations are achieving objectives and targets or if changes are warranted. This is because of the effects of annual hydrologic variability in meeting Interim Operations objectives and resulting variability in water quality and fish passage conditions expected to occur within and across years.

Monitoring results would be reported and reviewed annually. If targets are not met, decision makers would 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 would be determined during implementation so that the best available scientific approaches and methods can be applied. The adaptive management process would 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.

5.4.1.5 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 flood risk management operations, then implement adjustments to operations expected to improve achievement of targets that 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 an improved likelihood of achieving targets.

5.4.1.7 Decision-making and Collaboration

USACE would prepare annual reports documenting operations and summarizing the results in comparison to the defined targets. Annual check-ins would occur to assess how well targets have been achieved for water quality.

A 5-year check-in would 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 would 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 would review the reported results from the operation and any proposed changes to achieve the operational targets. USACE would ensure evaluations are carried out and reports are made available for NMFS and WATER review within timelines necessary to inform adaptive management 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 Dam regulating outlet 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, 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 Engineering Documentation Report found this alternative would provide the greatest improvements to both fish passage and TDG downstream of Cougar Dam.

This alternative would require rockfill be placed in the existing regulating outlet channel and stilling basin. A near-horizontal regulating outlet 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 regulating outlet chute extension would promote skimming flow in the stilling basin and reduce TDG generation. A Design Documentation Report is scheduled for completion in spring 2025, Plans and Specifications Report in spring 2026, and construction over 2 years beginning in 2027.

5.4.2.2 Constraints

Constraints associated with the Cougar Dam regulating outlet modifications would 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 would be used to evaluate the modified regulating outlet at Cougar Dam 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 salmon passage rates through preferred routes (regulating outlets) at WVS dams increased over pre-injunction operations.

- Downstream juvenile Chinook salmon passage timing at WVS dams is more consistent with natural emigration patterns in comparison to pre-injunction operations.
- Downstream juvenile Chinook salmon passage survival through the regulating outlet is increased compared to pre-regulating outlet 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 would be reported and reviewed once available. If targets are not met, decision-makers would 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 would be determined during implementation so that the best available scientific approaches and methods can be applied. The adaptive management process would 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.

5.4.2.5 Risks and Uncertainties

Injury and survival of juvenile fish passing downstream through the Cougar Dam regulating outlet relates to multiple factors, including hydraulic head, gate opening, surface conditions of the regulating outlet, 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 flood risk management operations, then implement adjustments to operations expected to improve achievement of targets that 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 an improved likelihood of achieving targets.

5.4.3 Cougar Dam 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 feet over the top of the Cougar Dam diversion tunnel and hold at this elevation to increase the number and 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, would be used to evaluate the passage of fish at Cougar Dam once the diversion tunnel is operational:

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

- Sub-metric: Dam-passage efficiency—the proportion of total number of fish passing the dam relative to the total number of fish detected near the diversion tunnel upstream and therefore available to pass downstream.
- Sub-metric: Fish passage efficiency— the proportion of fish passing via a non-turbine route relative to the total number of fish near the diversion tunnel upstream and available to pass downstream.
- Sub-metric: Concrete Survival—the proportion of fish surviving passage through each route weighted by the number passing through each route.
- Above-dam Cohort Replacement Rate.

Targets

Dam-passage Survival: Higher Value Developed from the Following Two Approaches:

- Dam-passage survival rate needed to support replacement of spawners above dams as estimated using life cycle models, such as those developed for the Final WVS EIS and ESA consultation. Modeling to define the dam-passage survival rate needed to support replacement of spawners would be completed in year 1 of implementation of the Proposed Action and would incorporate any new and relevant scientific information into models.

- Estimate of annual dam-passage survival across water year types.

This estimate would be prepared using the Fish Benefit Workbook or other approaches to estimate dam-passage survival across a range of water year types. New information would be used to update the estimate prior to assessing performance (field study data; revised models).

- Cohort Replacement Rate = ≥ 1.0

5.4.3.4 Research, Monitoring, and Evaluation

Annual dam passage survival (calculated as $DPS = DPE * CS$) would be measured in two separate years that 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 would be determined at the time of the assessment to evaluate passage to provide reasonable certainty bounds acceptable to decision-makers.

Dam-passage efficiency would 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 Dam would 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).

Dam-passage survival would be measured in two separate years that 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 dam-passage survival 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 would cover portions of spring and fall/winter and could be one longer test period or two separate seasonal periods within a year.

Concrete survival would be measured as the number of fish that survive from Cougar Dam to the downstream concrete survival measurement boundary divided by the total number of fish that pass downstream. The concrete survival downstream measurement boundary would 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 would be reconsidered to produce comparable survival estimates.

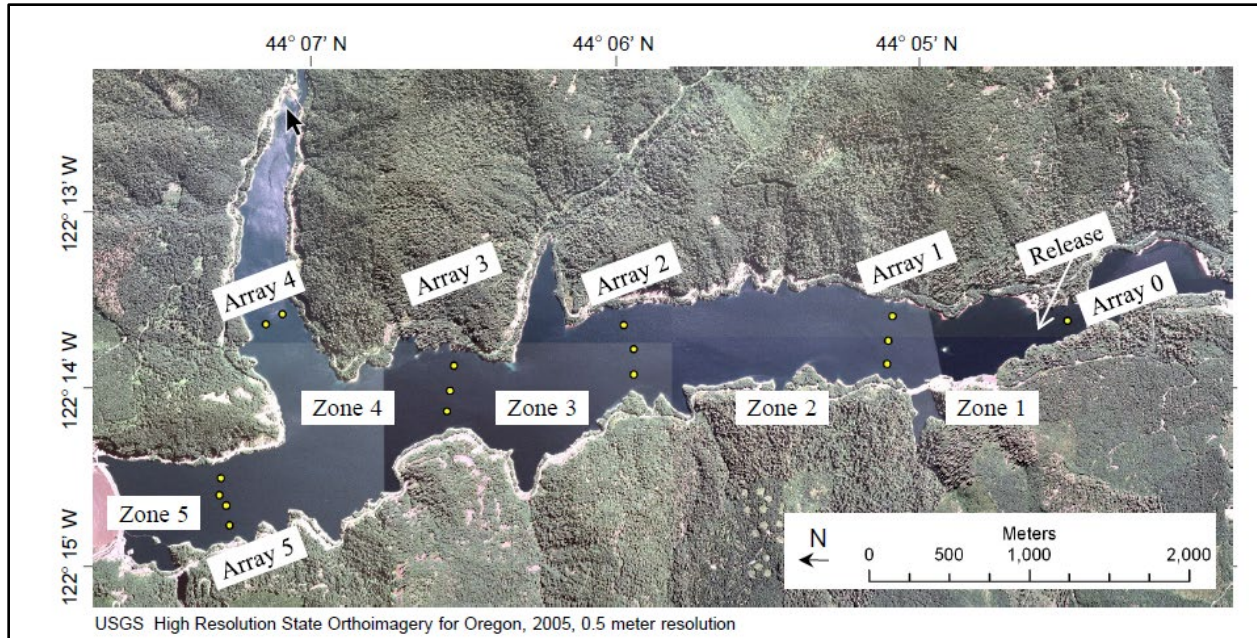


Figure 5-5. Cougar Dam Tailrace, Forebay, and Near Forebay Zone (gray) Showing Approximate Area to be Used for Measuring Fish Passage Metrics.

Image copied from Figure 3, Beeman et al. 2014.

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 floating screen structure 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. No in-season changes would be made to support evaluation once field studies to assess performance metrics begins. However, operational treatments for study may be considered at this time to simultaneously evaluate different conditions where information supports such treatments.

Additional minor changes or adjustments within the design capacity of the dam and outlet works, flood risk management, and USACE authority would be implemented if results warrant. This would occur once two representative study years of operations are completed. However, actions requiring additional funding or engineering would not be considered until after three cohort replacement rate estimates are available (after year 7).

Successful fish passage would be defined by achieving either the dam-passage survival or the cohort replacement rate target (Figure 5-1). Additional assessments would be completed to

determine if the cohort replacement rate is not being met due to project effects or non-project effects if the dam-passage survival target has been met but not the cohort replacement rate target.

If the issue is due to project effects, additional measures taken under the Preferred Alternative would be identified, designed, and implemented, and then the cohort replacement rate (and dam-passage survival if warranted, depending on the type of additional improvements made) would be re-evaluated or re-consultation would occur.

5.4.3.7 Decision-making and Collaboration

The Action Agencies would fund post-construction evaluations. WATER would review study designs for assessing the performance metrics. Study designs may also benefit from a targeted independent scientific review.

The Action Agencies would address the comments to improve the study design for assessing the performance metrics. If NMFS and the Action Agency technical staff do not concur on final study designs, the dispute would be elevated for resolution following Federal Family and WATER procedures and protocols. The Action Agencies would 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 Dam Adult Fish Facility

5.4.4.1 Definition and Function

Continued operation of the Cougar Dam Adult Fish Facility for transport of adult spring Chinook salmon 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.
- violate USACE dam safety requirements.

5.4.4.3 Performance Metrics and Targets

Performance Metrics

The following performance metrics would be used to evaluate operation of the Cougar Dam Adult Fish Facility:

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- 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 would 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 adult fish facility or during truck transport.
 - Health condition of outplanted fish.
 - Health condition of fish taken for brood.
 - Number and locations of outplanted fish.
 - Sex ratio of outplanted fish.
 - Fish densities when in holding at the adult fish facility and in transport trucks.
 - Water temperatures and oxygen levels in the adult fish facility and transport trucks.
 - Cumulative temperature exposure when in the adult fish facility 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 (Section 5.6, Ongoing Hatchery Mitigation Program Monitoring).

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 would be summarized annually and reports provided to WATER for review. Information on most metrics listed above would be collected commensurate with operation of the adult fish facility. Discharge and water temperatures below Cougar Dam would also be continuously monitored.

As part of ongoing hatchery mitigation monitoring activities, available information on the following metrics would be included as part of annual summaries to support monitoring of upstream passage actions in the subbasin:

- Counting salmon at diversion dams (Leaburg).
- Counting of salmon at the adult fish facility.
- 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, flood risk management, hydropower, etc.) on upstream migration of adult fish to Cougar Dam tailrace and adult collection in the adult fish facility.
- Effects of water temperatures discharged from Cougar Dam or from the adult fish facility on adult attraction and collection in the adult fish facility.

5.4.4.6 Decision Triggers and Adaptive Actions

Minor changes to operation of the adult fish facility (i.e., operationally feasible and within USACE authority and not requiring additional funding) are expected to be made in real time to maintain compliance with the Willamette Fish Operations Plan protocols. Reports of operations would be reviewed annually to determine areas where minor changes may be needed.

Adjustments or modifications would be assessed if compliance cannot be maintained with minor changes. 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 adult fish facility would depend on the specific actions identified for implementation.

5.5 MIDDLE FORK WILLAMETTE RIVER SUBBASIN

5.5.1 Dexter Dam Adult Fish Facility

5.5.1.1 Definition and Function

Design and construct upgrades to the Dexter Dam Adult Fish Facility.

5.5.1.2 Constraints

Constraints associated with the Dexter Dam Adult Fish Facility upgrade would be identified as part of the project-specific planning documents developed prior to implementation. However, two known constraints relating to this measure are that 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.

5.5.1.3 Performance Metrics and Targets

Performance Metrics

The following performance metrics would be used to evaluate operation of the adult fish facility at Dexter Dam:

- Upstream Passage Metrics: Adult fish collection and handling and adult fish transport and outplanting protocols as defined in the current Willamette Fish Operations Plan. At a minimum, the following protocols would 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 adult fish facility or during truck transport.
 - Health condition of outplanted fish.
 - Health condition of fish taken for brood.
 - Number and locations of outplanted fish.
 - Sex ratio of outplanted fish.
 - Fish densities when in holding at the adult fish facility and in transport trucks.
 - Water temperatures and oxygen levels in the adult fish facility and transport trucks.
 - Cumulative temperature exposure when in the adult fish facility 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 (Section 5.6, Ongoing Hatchery Mitigation Program Monitoring).

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 would be summarized annually and reports provided to WATER for review. Information on most metrics listed above would be collected commensurate with operation of the adult fish facility. Discharge and water temperatures below Dexter Dam would also be continuously monitored.

As part of ongoing hatchery mitigation monitoring activities, available information on the following metrics would be included as part of annual summaries to support monitoring of upstream passage actions in the subbasin:

- Counting of salmon at the adult fish facility.
- 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, flood risk management, hydropower, etc.) on upstream migration of adult fish to Dexter Dam tailrace and adult collection in the adult fish facility.
- Effects of water temperatures discharged from Dexter Dam or from the adult fish facility on adult attraction and collection in the adult fish facility.
- Effects of water temperatures discharged from Dexter Reservoir into the Dexter Dam Adult Fish Facility on the health of adults collected at Dexter Dam Adult Fish Facility.

5.5.1.6 Decision Triggers and Adaptive Actions

Minor changes to operation of the adult fish facility (i.e., operationally feasible and within USACE authority, and not requiring additional funding) are expected to be made in real time to maintain compliance with the Willamette Fish Operations Plan protocols. Reports of operations would be reviewed annually to determine areas where minor changes may be needed.

Adjustments or modifications would be assessed if compliance cannot be maintained with minor changes. Depending on the potential solutions, engineering studies or biological studies may be planned as funding is available. The timeframe for implementation of adjustments or modifications to the adult fish facility would depend on the specific actions identified for implementation.

5.5.2 Lookout Point Dam 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 (elevation 890 feet), 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 elevation 890 feet to 893 feet for as long as water conditions allow and for at least 30 days at both Lookout Point and Dexter Dams.

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- Operate the Lookout Point Dam 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 feet by July 15, and operate the regulating outlets as needed to reduce downstream water temperatures when water temperatures downstream of Dexter Dam near 60°. The Interim Operations at Lookout Point Dam 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 regulating outlets 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 would be used to evaluate the Interim Operations at Lookout Point Dam along with the following:

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

Targets

- Reservoir elevations and flow releases prioritized as defined under the Interim Operation.
- Seasonal downstream juvenile Chinook salmon passage efficiency through preferred routes (spillway and regulating outlets) at Lookout Point Dam increased over pre-injunction operations.
- Downstream juvenile Chinook salmon passage timing at Lookout Point Dam is 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. Multiple years of monitoring are anticipated to understand if operations are achieving objectives and targets or if changes are warranted. This is because of the effects of annual hydrologic variability in meeting Interim Operations objectives and resulting variability in water quality and fish passage conditions expected to occur within and across years.

Monitoring results would be reported and reviewed annually. If targets are not met, decision-makers would 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 would be determined during implementation so that the best available scientific approaches and methods can be applied. The adaptive management process would 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.

5.5.2.5 Risks and Uncertainties

- Risk: The 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 flood risk management operations, then implement adjustments to operations expected to improve achievement of targets that 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 an improved likelihood of achieving targets.

5.5.2.7 Decision-making and Collaboration

USACE would prepare annual reports documenting operations and summarizing the results in comparison to the defined targets. Annual check-ins would occur to assess how well targets have been achieved for water quality.

A 5-year check-in would 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 would 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 would review the reported results from the operation and any proposed changes to achieve the operational targets. USACE would ensure evaluations are carried out and reports are made available for NMFS and WATER review within timelines necessary to inform adaptive management decisions outlined in this document.

5.5.3 Lookout Point Dam 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 (i.e., pumped inflow operated independent of dam outlets).

5.5.3.2 Constraints

Constraints associated with the Lookout Point Dam floating surface collector would be identified as part of the project-specific planning documents developed prior to implementation. However, two known constraints relating to this measure are that 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.

5.5.3.3 Performance Metrics and Targets

Performance Metrics

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

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

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

Targets

Dam-passage Survival: Higher Value Developed from the Following Two Approaches:

- Dam-passage survival rate needed to support replacement of spawners above dams as estimated using life-cycle models, such as those developed for the Final WVS EIS and ESA consultation. Modeling to define the dam-passage survival rate needed to support replacement of spawners would be completed in year 1 of implementation of the Proposed Action and would incorporate any new and relevant scientific information into models.

- Estimate of annual dam-passage survival across water year types.

This estimate would be prepared using the Fish Benefit Workbook or other approaches to estimate dam-passage survival across a range of water year types. New information would be used to update the estimate prior to assessing performance (field study data; revised models).

- Cohort Replacement Rate = ≥ 1.0

5.5.3.4 Research, Monitoring, and Evaluation

Dam passage survival (calculated as $DPS = DPE * CS$) would be measured in two separate years that 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 dam-passage survival estimates would be determined at the time of the assessment to evaluate passage to provide reasonable certainty bounds acceptable to decision-makers.

Dam-passage efficiency would 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 Dam, the near forebay area would 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).



Figure 5-6. Lookout Point Dam Tailrace, Forebay, and Near Forebay Zone (gray) Showing Approximate Area to be Used for Measuring Fish Passage Metrics.

Test period(s):

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

Concrete survival would be measured as the number of fish that survive from Lookout Point Dam to the downstream concrete survival measurement boundary divided by the total number of fish that pass downstream. The concrete survival downstream measurement boundary would 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

- Floating surface collector entrance rejection by juvenile Chinook salmon 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 the scale of reservoir fluctuation at Lookout Point Dam.
- Large forebay area impacting guidance and attraction to the floating surface collector 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 the entrance point.
- Climate change—see discussion under Basin Flow Measures (Section 5.8, Basin-wide Flow Measures).

5.5.3.6 Decision Triggers and Adaptive Actions

Contingency actions to operation of the floating surface collector are expected to be made in real time during the first few years. No in-season changes would be made to support evaluation once field studies to assess performance metrics begins. However, operational treatments for study may be considered at this time to simultaneously evaluate different conditions where information supports such treatments.

Additional contingency actions within the design capacity of the floating surface collector would be implemented if results warrant. This would occur once two representative study years of floating surface collector operation are completed. However, actions requiring additional funding or engineering would not be considered until after three cohort replacement rate estimates are available (after year 7).

Successful fish passage would be defined by achieving either the dam-passage survival or the cohort replacement rate target.

Examples of contingency actions for the floating surface collector 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 Floating Surface Structure:

Longer or shorter operational periods of floating surface collector, 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 floating surface collector 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 would fund post-construction evaluations of dam-passage survival and fish survival through the FSS. The WATER Fish Passage Design, Research, and Development Technical Team would 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 would address the comments to improve the study design for assessing the performance metrics. If NMFS and the Action Agency technical staff do not concur on final study designs, the dispute would be elevated for resolution following Federal Family and WATER procedures and protocols. The Action Agencies would 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 Dam Interim Operations and Long-term Operations

5.5.4.1 Definition and Function

- Operate Fall Creek Adult Fish Facility to collect and transport adult spring Chinook salmon upstream of Fall Creek Reservoir.
- For downstream fish passage in fall and winter, drawdown of Fall Creek Reservoir in the late fall to elevation 690 feet; refill slightly to 700 feet 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 salmon collected at the Fall Creek Dam Adult Fish Facility and outplanted above Fall Creek Reservoir would 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 salmon collected at the Fall Creek Dam Adult Fish Facility and outplanted above Fall Creek Reservoir would 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. Multiple years of monitoring are anticipated to understand if operations are achieving objectives and targets or if changes are warranted. This is because of the effects of annual hydrologic variability in meeting Interim Operations objectives and resulting variability in water quality and fish passage conditions expected to occur within and across years.

Monitoring results would be reported and reviewed annually. If targets are not met, decision makers would 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.

A 5-year check-in would be conducted to review if fish passage 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 for fish passage before multiple years of data are collected.

Adult returns would be tissue sampled and used to assess cohort replacement rates. Cohort replacement rates would be calculated to determine if targets are being achieved and used to

help assess if spring delayed refill operations are positively or negatively affecting cohort replacement rates.

5.5.4.5 Risks and Uncertainties

- Risk: The 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 Dam Adult Fish Facility

5.5.5.1 Definition and Function

Continued operation of the Fall Creek Dam Adult Fish Facility for transport of adult spring Chinook salmon 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.
- violate USACE dam safety requirements.

5.5.5.3 Performance Metrics and Targets

Performance Metrics

The following performance metrics would be used to evaluate operation of the Fall Creek Dam Adult Fish Facility:

- 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 would 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 adult fish facility or during truck transport.

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- Health condition of outplanted fish.
- Health condition of fish taken for brood.
- Number and locations of outplanted fish.
- Sex ratio of outplanted fish.
- Fish densities when in holding at the adult fish facility and in transport trucks.
- Water temperatures and oxygen levels in the adult fish facility and transport trucks.
- Cumulative temperature exposure when in the adult fish facility 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 (Section 5.6, Ongoing Hatchery Mitigation Program Monitoring).

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 would be summarized annually and reports provided to WATER for review. Information on most metrics listed above would be collected commensurate with operation of the adult fish facility. Discharge and water temperatures below Fall Creek Dam would also be continuously monitored.

As part of ongoing hatchery mitigation monitoring activities, available information on the following metrics would be included as part of annual summaries to support monitoring of upstream passage actions in the subbasin:

- Counting of salmon at the adult fish facility.
- 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, flood risk management, hydropower, etc.) on upstream migration of adult fish to Fall Creek Dam tailrace and adult collection in the adult fish facility.
- Effects of water temperatures discharged from Fall Creek Dam or from the adult fish facility on adult attraction and collection in the adult fish facility.

5.5.5.6 Decision Triggers and Adaptive Actions

Minor changes to operation of the adult fish facility (i.e., operationally feasible and within USACE authority, and not requiring additional funding) are expected to be made in real time to maintain compliance with the Willamette Fish Operations Plan protocols. Reports of operations would be reviewed annually to determine areas where minor changes may be needed.

Adjustments or modifications would be assessed if compliance cannot be maintained with minor changes. Depending on the potential solutions, engineering studies or biological studies may be planned as funding is available. The timeframe for implementation of adjustments or modifications to the adult fish facility would depend on the specific actions identified for implementation.

5.5.6 Hills Creek Dam 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 regulating outlets instead of the turbines during periods when juvenile fish are most likely to be migrating downstream.

USACE would 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 would be used to evaluate the Interim Operations at Hills Creek Dam along with the following:

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

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- Juvenile Chinook salmon passage efficiency through preferred routes at Hills Creek Dam.
- Juvenile Chinook salmon passage timing at Hills Creek Dam.

Targets

- Reservoir elevations and flow releases prioritized as defined under the Interim Operation.
- Seasonal downstream juvenile Chinook salmon passage efficiency through preferred routes (spillway and regulating outlets) at Hills Creek Dam increased over pre-injunction operations.
- Downstream juvenile Chinook salmon passage timing at Hills Creek Dam is 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. Multiple years of monitoring are anticipated to understand if operations are achieving objectives and targets or if changes are warranted. This is because of the effects of annual hydrologic variability in meeting Interim Operations objectives and resulting variability in water quality and fish passage conditions expected to occur within and across years.

Monitoring results would be reported and reviewed annually. If targets are not met, decision makers would 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 would be determined during implementation so that the best available scientific approaches and methods can be applied. The adaptive management process would 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.

5.5.6.5 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 would prepare annual reports documenting operations and summarizing the results in comparison to the defined targets. Annual check-ins would occur to assess how well targets have been achieved for water quality.

A 5-year check-in would 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 would 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 would review the reported results from the operation and any proposed changes to achieve the operational targets. USACE would ensure evaluations are carried out and reports are made available for NMFS and WATER review within timelines necessary to inform adaptive management decisions outlined in this document.

5.5.7 Hills Creek Dam 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 final Preferred Alternative estimates Chinook salmon population performance is expected to result in natural sustainable populations of Chinook salmon above dams in the four subbasins affected by the WVS in this evolutionarily significant unit (ESU). These analyses also indicated that the performance of the Middle Fork Chinook salmon 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 Willamette River 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 Dam for Chinook salmon. Assessment of the interim action for downstream fish passage would be included as described in Section 5.5.6, Hills Creek Dam Interim Operations.

The need for long-term fish passage at Hills Creek Dam would be determined as part of the Adaptive Management Plan and process. A check-in point with NMFS and USFWS is included to determine an appropriate downstream passage solution at Hills Creek Dam if UWR Chinook salmon downstream passage is not successful in at least 3 out of 4 of the proposed locations where passage is proposed (Section 2.4, Implementation Timeline).

Some bull trout are known to move below Hills Creek 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 Willamette River are those above Hills Creek Reservoir and, therefore, access back upstream would be needed for individuals moving below the dam 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 would 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 would include consideration of water temperatures released from Hills Creek Dam. The review is expected to take 1 year and would begin in 2026. If found feasible, the timing for completion of this trap would be 6.5 years, with 1.5 years each for engineering design report, detailed design report, plans and specifications, 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 salmon 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 Dam 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 be considered. These additional measures could be adjustments or modifications to the measures already taken in any of the four Chinook salmon populations affected by the WVS or as new measures such as adding passage at Hills Creek Dam. It would be important to consider population(s) that should be targeted 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 salmon above Dexter, Lookout Point, and Hills Creek Dams, particularly measures that singularly focus on passage at Hills Creek Dam. First, longer transport times affect adult translocation success. Likewise, juveniles would face greater mortality risk passing through

multiple reservoirs, particularly Lookout Point Reservoir where linear distance is substantially greater than reservoir transport in other subbasins.

Other issues include uncertainty in using genetics to sort adult Chinook salmon at Dexter Dam Adult Fish Facility for transport above Lookout Point Reservoir from those to be transported above Hills Creek Reservoir, pre-spawn mortality in adult Chinook salmon transported above Lookout Point and Hills Creek Dams, and the dam-passage survival of juvenile Chinook salmon at WVS after operational and structural measures are implemented. These include longer sorting requirements from Dexter to Hills Creek Dams and longer transport times from Dexter Dam to the Hills Creek Dam release site.

Results of the passage measures included in the Proposed Action after they are implemented would help determine the potential for achieving adequate improvements for the UWR Chinook salmon ESU. These would include:

- Upstream passage measures in the South Santiam River where Chinook salmon would be collected and transported both above Foster Dam and above Green Peter Dam
- Downstream passage measures using surface collectors at Detroit and Lookout Point Dams and operational measures and Green Peter Dam (spring surface spill and fall deep reservoir drawdown).

5.5.7.2 Constraints

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

- result in a reduction of USACE ability to operate the dam for the flood risk management authorized purpose.
- violate USACE dam safety requirements.
- violate WFPOM fish safety requirements.

5.5.7.3 Performance Metrics and Targets

- A decision to proceed with a new bull trout adult trap below Hills Creek Dam would 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 salmon 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 adult fish facility or during truck transport.
- Health condition of fish transported above dam.

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- Health condition of fish taken for brood.
- Number and locations of transported fish.
- Sex ratio of transported fish.
- Fish densities when in holding at the adult fish facility and in transport trucks.
- Water temperatures and oxygen levels in the adult fish facility and transport trucks.
- Cumulative temperature exposure when in the adult fish facility 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 would be used to evaluate the performance of UWR Chinook salmon 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 Salmon Populations.

Primary Attributes	Description	Primary Data Sources Sought	Units of Measure
Productivity	Population growth rate	Recruits/spawner, smolt-to-adult-return rates, counts or indices of abundance for adults and juveniles.	Estimated change in the geometric mean R/S, smolt-to-adult-return rates, and A/P.
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 would depend on data available to support a given expected uncertainty of prospective analyses).
Extinction Risk	Quasi-extinction risk	Empirical counts and prospective analysis of adult return counts and redds.	Probability that abundance is less than threshold over several salmon generations (forecasted period would depend on data available to support a given expected

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Primary Attributes	Description	Primary Data Sources Sought	Units of Measure
			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 to 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 to 100 years).
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 to 10 years).

5.5.7.4 Risks and Uncertainties

- The effect of bull trout passage at Hills Creek Dam 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 salmon 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 salmon transported above WVS dams in the Middle Fork Willamette River.
- The ability to achieve an adequate downstream passage survival rate supporting the establishment of sustainable natural populations of Chinook salmon 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 would 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 years each for Engineering Design

Report, Detailed Design Report, plans and specifications, and 1 year for construction. The chosen design concept would influence the final timing of completion of the design and construction process.

Chinook Salmon

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 salmon populations affected by the WVS.
 - a. Information should include field results from at least 2 years of downstream passage testing completed at the Detroit Dam floating screen structure, up to 6 years of operations of the updated Foster Dam downstream passage facilities, up to 6 years of operating two adult fish facilities in the South Santiam River (Green Peter Dam and Foster Dam Adult Fish Facilities), and up to 13 years of Green Peter Dam downstream passage spill and deep drawdown operations.
 - b. If ESU performance potential is too low, proceed with Hills Creek Dam passage planning (Engineering Design Report, Detailed Design Report, plans and specifications; 2041 to 2046.5) and re-assess in 2046 (see item 2 below).
 - i. Potential downstream passage options: regulating outlet improvement, spillway improvement, both, floating screen structure, or floating surface collector.
 - ii. Potential upstream passage options: adult fish facility at Dexter Dam with sort using genetic pedigree; adult fish facility at Dexter Dam and Hills Creek Dam with temperature control improvements at Hills Creek 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 below).
2. In 2046, using life-cycle modeling updated with fish passage estimates and other information, re-assess the performance potential of the UWR Chinook salmon populations affected by the WVS.
 - a. Information should include field results from at least 2 years of downstream passage testing completed at the Lookout Point Dam floating surface collector, up to 10 years of Detroit Dam floating screen structure operations, up to 6 years of operations of the updated Foster Dam downstream passage facilities, up to 6 years of operating two adult fish facilities in the South Santiam River (Green Peter Dam and Foster Dam Adult Fish Facilities), and up to 13 years of Green Peter Dam downstream passage spill and deep drawdown operations.

If ESU performance potential is estimated to be too low, determine what actions would most effectively address UWR Chinook salmon ESU performance (Hills Creek Dam passage actions, adjustments or modifications to other measures affecting any of the four UWR Chinook salmon

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 by reference and include:

- Collection of biometrics of hatchery salmon returning to collection facilities.
- Counting salmon at diversion dams (Bennett, Lebanon, 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 3 years that addresses specified requirements.

5.7 HATCHERY MEASURE (719)

Existing HGMPs describe how hatchery Chinook salmon are currently being used to support reintroduction of spring Chinook salmon 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 would 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 salmon outplanted above dams annually to supplement natural-origin returns would be adjusted consistent with the existing HGMPs and NMFS 2019 Biological Opinion. 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 salmon, summer steelhead, rainbow trout) would not be reduced in association with fish passage improvements until future negotiations between USACE, 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 salmon releases (Table 5-7) and outplanting (Table 5-8) of adult spring Chinook salmon hatchery fish above dams would occur according to the HGMPs and NMFS-associated 2019 Biological Opinion.

Table 5-7. Willamette Hatchery Mitigation Program Production Goals for UWR Spring Chinook Salmon in Each Subbasin According to the Hatchery Genetics Management Plans.

Subbasin	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	N/A	2,039,000	0	2,039,000

N/A = Not Applicable

Table 5-8. Willamette Spring Chinook Salmon Natural-origin Thresholds Required Prior to Crediting (outplant numbers taken from HGMPs).

Subbasin	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

After passage improvement at a dam (years 0 through 5), hatchery-origin returns would continue to supplement natural-origin returns outplanted 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 5-6 provides the adult Chinook salmon outplanting thresholds from the associated HGMPs and NMFS’ 2019 Biological Opinion except for the South Santiam River. When the

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number of natural-origin (unmarked) Chinook salmon spawner returns are below these levels, hatchery-origin returns would be used to supplement to achieve the thresholds.

The South Santiam River HGMP indicates 600 total, if needed; however, up to 800 hatchery adult Chinook salmon would begin being outplanted above Green Peter Dam in 2022. Currently, no hatchery-origin (marked) fish are outplanted above Foster Dam so the outplant number for the South Santiam River in Table 5-7 is for fish intended for reintroduction above Green Peter Dam.

PHASE 1 - Years 1 through 7 Following Improved Fish Passage Conditions:

Following the implementation of downstream fish passage improvements, hatchery spring Chinook salmon production would remain at production levels as defined in the HGMPs. Annual dam passage survival (DPS, i.e., dam-passage efficiency * dam-passage survival) would be measured in two separate years that 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 dam-passage survival 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 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 salmon returns, cohort replacement rate (CRR) serves as a basis for evaluating overall population performance. Cohort replacement rate would be estimated as:

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

Cohort replacement rate 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 the cohort replacement rate above each dam because outplanted adults would continue to be supplemented with hatchery fish until natural-origin fish meet or exceed the HGMP thresholds (Table 5-7).

After 7 years, the cohort replacement rate would be calculated for three separate cohorts, accounting for adult returns in years 3 through 5, 4 through 6 and 5 through 7. If the cohort

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replacement rate for Chinook salmon is >1 based on a geometric mean of replacement rates for the three cohorts returning in years 3 through 5, 4 through 6, and 5 through 7, then the full credit for fish passage improvements would be applied to the spring Chinook salmon hatchery production for the subbasin in which returns are being assessed. In this case, Chinook salmon production would be reduced over a period of 5 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 natural-origin return thresholds would be the same as the outplanting thresholds indicated in the Table 5-7.

If the cohort replacement rate < 1 , and DSP criteria are not met, then mitigation credit reductions would not occur at this time and instead be re-assessed again after year 14. After re-assessment, if the geometric mean of the cohort replacement rate is >1.0 for cohorts returning in years 12, 13, and 14, then reductions to Chinook salmon releases would be reduced over a period of 5 years to the Reduced Level of Production.

If the geometric mean of the cohort replacement rate is still <1.0 for cohorts returning in years 12, 13, and 14, and the dam-passage survival target is met, non-project effects would be evaluated. Several methods have been 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) 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.). University of British Columbia 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 would 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. Cohort replacement rate 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 the cohort replacement rate. 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 cohort replacement rate of 1 may warrant reductions in hatchery production and releases to help increase natural productivity.

The reduced hatchery production levels would be based on the passage assessment leading to habitat access as referenced in House Document 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 the cohort replacement rate is improved by passage yet remains below a cohort replacement rate 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) would be used to calculate a potential new production level (P_{Post}) intended for meeting conservation (outplanting) needs in years 9 through 142:

$$P_{Post} = \frac{\# \text{ of outplants}_y - \# \text{ of returns}_{y5}}{SAR_{harv}}$$

Where SAR_{harv} is the estimated smolt-to-adult return rate assuming harvest, 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 smolt-to-adult-return rates from increased levels of natural-origin brood should be considered.

5.7.2 Rainbow Trout Crediting

As for spring Chinook salmon and summer steelhead, trout hatchery mitigation needs after fish passage improvements at WVS dams would 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 dams.

Trout mitigation changes, as they relate 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 and ODFW 2010).

Impacts to ESA-listed fish from rainbow trout are recognized; 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 would 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) 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 River Basin (e.g., fitness effects associated with introgression). It also may not be feasible to assess winter steelhead cohort replacement rate. *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 the cohort replacement rate for steelhead are uncertain given some offspring will remain in fresh water and mature as rainbow trout and some adult steelhead returns will be progeny of rainbow trout.

5.7.4 Decision-making and Collaboration

USACE would prepare reports documenting results from assessment of Chinook dam-passage survival and cohort replacement rate following passage improvements (Section 5.6, Ongoing Hatchery Mitigation Program Monitoring). WATER technical teams would review the reported results, and any proposed changes to hatchery production developed consistent with targets

and the decision framework described in Section 5.6 (Ongoing Hatchery Mitigation Program Monitoring). USACE would ensure evaluations are carried out and reports are made available for NMFS and WATER review within timelines necessary to inform adaptive management 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: (1) the 2008 Biological Opinion flow targets (until new flow management plan can be developed per NMFS 2024 Biological Opinion RPA), (2) flow augmentation by tapping the power pool (Measure 304), and (3) 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 subbasin sections below).

Proposed operations for the 2008 Biological Opinion flow targets would include all Willamette River Basin projects. Measure 304 is proposed at Lookout Point, Hills Creek, Cougar, Green Peter, and Detroit Dams. Measure 718 is proposed at Fall Creek and Blue River Dams.

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 FEIS Chapter 2, Alternatives, and Appendix A, Alternatives Development.

Monitoring the flow measures would consist of measuring flow and water temperature daily in each management reach. Observed daily flow and water temperatures would 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

> = greater than

% = percent

5.8.4 Research, Monitoring, and Evaluation

An assessment of the frequency that minimum flow and temperature targets were met would 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 would be assessed every 5 to 10 years and results used to determine if adjustments or modifications are needed in flow management measures or criteria (Section 5.8.6, Decision Triggers and Adaptive Actions).

As a part of assessing fish response to the effects of WVS dam and reservoir operations on downstream river conditions, modeling of fish survival would be completed. Minimum flow thresholds values included in the FEIS were developed with application of integrated decision support models that 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

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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 risk 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 River Basin and, therefore, additional research may be warranted. As this process proceeds, additional critical information needs may be identified.

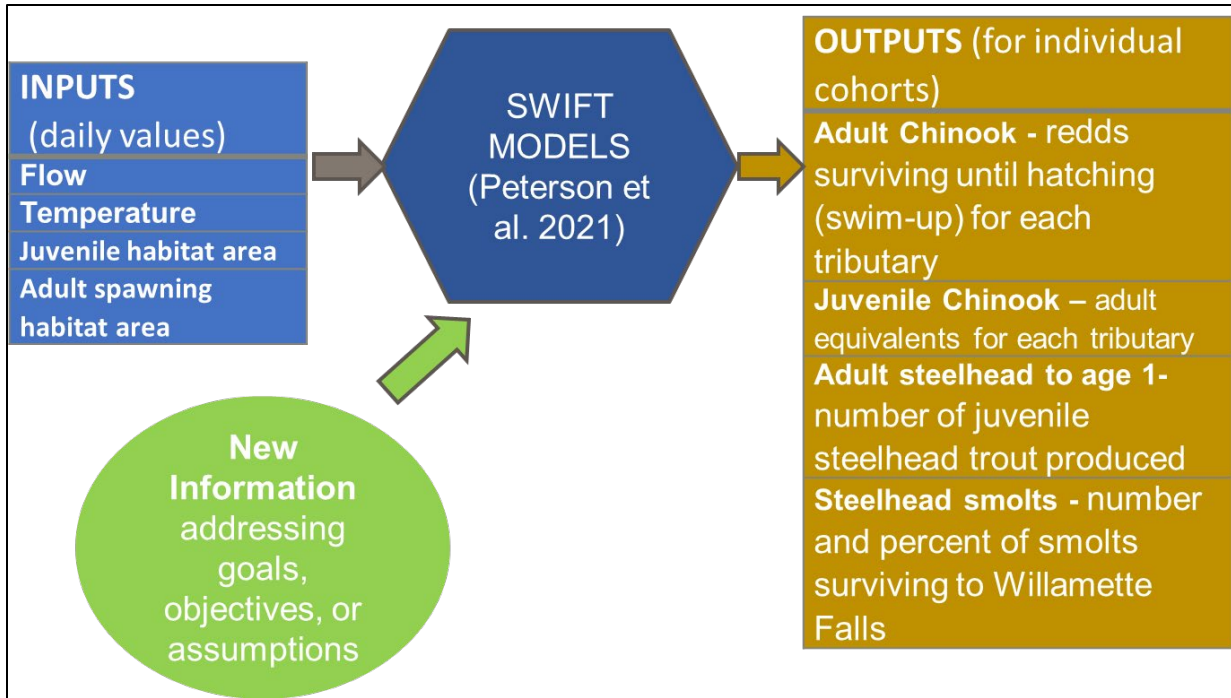


Figure 5-7. Application of SWIFT Models for Adaptive Management of Willamette Valley System Flows to Address System Effects to Spring Chinook Salmon and Winter Steelhead.

Consideration of additional research would be raised through the WATER Technical and Steering teams. Prioritization of any new research needs proposed should consider information needs that reduce uncertainty for those attributes 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.

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.

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- Diversion of water downstream of WVS dams reducing instream flows below targets. 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 salmon 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 salmon 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 F1, Qualitative Assessment of Climate Change Impacts; Appendix F2, Supplemental Climate Change Information). 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.

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 (Appendix F1, Qualitative Assessment of Climate Change Impacts). 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.) of 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 would 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 would prepare a water management plan each year describing how water would 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 and vulnerabilities is recommended as identified in Appendix F1, Qualitative Assessment of Climate Change Impacts; Appendix F2, Supplemental Climate Change Information. Evaluation of adaptive management 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 (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 Adaptive Management Workshop process described in Section 4.4, Annual Adaptive Management Process. 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 would occur annually. Assessing the fish response to flow management would occur every 5 to 10 years, and the frequency of analysis would 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 would occur every 5 years, and assessment of performance metrics would occur at this time if

statistically reliable estimates could 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, would 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 adaptive management 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.

Decision makers would consider continuing, adjusting, or reformulating flow management thresholds based on summarization of flow and temperature metrics and modeled biological response. Critical information needs to reduce uncertainties and risks of making changes would be identified. If there is a consideration of adjusting or reformulating, hypotheses for improving flow management would 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 would 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.

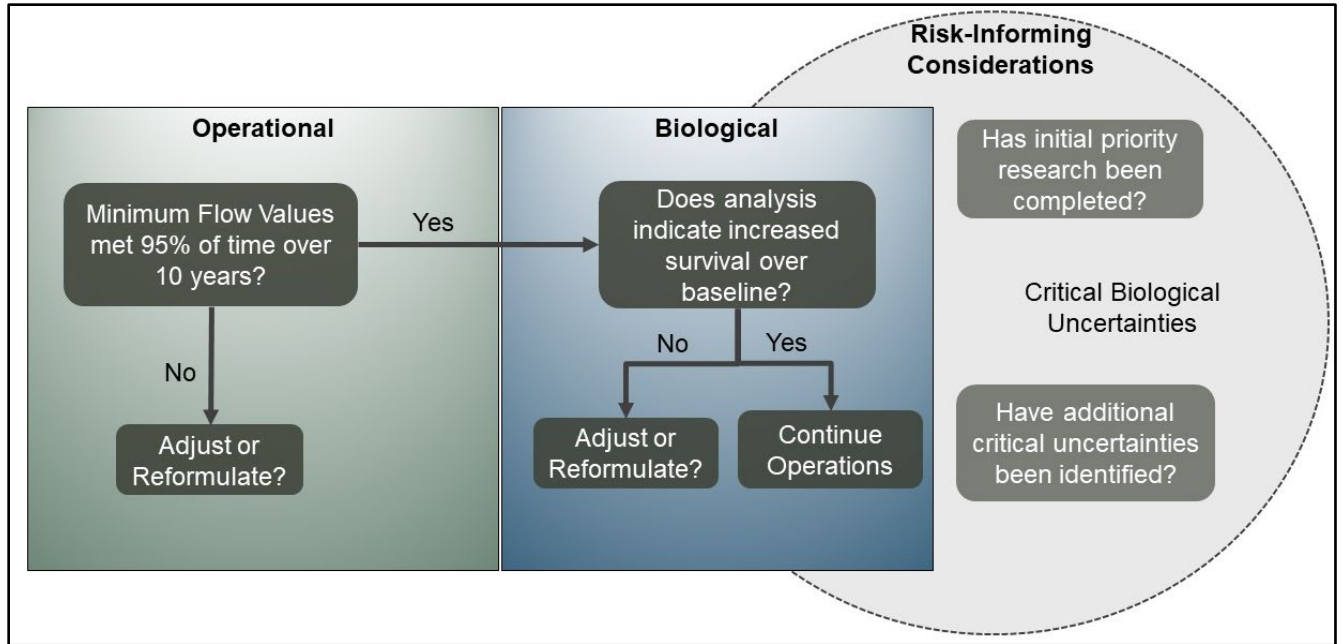


Figure 5-8. Conceptual Decision Tree for Evaluating Flow Measures.

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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*Willamette Valley System Operations and Maintenance
Environmental Impact Statement*

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Attachment 1

FY2025 Willamette Valley System Research, Monitoring, and Evaluation to Support the Implementation and Adaptive Management Plan



Painting by Lee Johnson (USACE Portland Media Images Database)