US Army Corps of Engineers®
Portland District

WILLAMETTE VALLEY SYSTEM OPERATIONS AND MAINTENANCE

FINAL ENVIRONMENTAL IMPACT STATEMENT

CHAPTER 2 ALTERNATIVES

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CHAPTER 2 - ALTERNATIVES

CHAPTER 2 HAS BEEN REVISED FROM THE DEIS
REPEATED INFORMATION HAS BEEN DELETED
INSERTION OF LARGE TEXT IS IDENTIFIED; MINOR EDITS ARE NOT DENOTED

Summary of changes from the DEIS:

- **DEIS Table 2.2-1, Summary of Key Chapter Terminology, has been revised for clarity.**
- **Objective 6 has been modified to highlight improvements to water quality at the WVS dams rather than specifying a reduction in pollutant levels.**
- **Additional context has been added to FEIS Section 2.4, Purpose of and Need for the Proposed Action.**
- **Information on reservoirs used to provide mainstem flow has been added to the description of Measure 30a and Measure 30b (FEIS Section 2.8.1.1, Integrated Temperature and Habitat Flow Regime (30a) and Section 2.8.1.2, Refined Integrated Temperature and Habitat Flow Regime (30b)).**
- **Use of water from the power pool has been clarified under Measure 304 (FEIS Section 2.8.1.3, Augment Instream Flows by Using the Power Pool).**
- **DEIS Table 2.2-1, Minimum Power Pool Elevations and Storage Volumes, and DEIS Table 2.2-2, Inactive Storage Volume by Project, have been deleted because they are not necessary to understand the measure descriptions. Additionally, this information is now in Appendix A, Alternatives Development.**
- **DEIS Figure 2.3-1, Study Area Subbasins and Control Points, has been deleted because it is not applicable to the Measure 718 description.**
- **Additional information on operating limits of outlets governing minimum flow releases has been added to Measure 723 (FEIS Section 2.8.1.5, Reduce Minimum Flows to Congressionally Authorized Minimum Flow Requirements (723)).**
- **DEIS Table 2.2-3, Tributary Flows from HD531 at Project Locations, and DEIS Table 2.2-4, Mainstem Flows, were deleted to provide consistent information. Similar flow values were not provided for other flow measures within Chapter 2. However, this information is now provided in Appendix A, Alternatives Development.**
- **Measure 105 has been renamed from Construct Water Temperature Control Towers to Construct Selective Withdrawal Structures. Additional information has been provided in Section 2.8.2.1, Construct Selective Withdrawal Structures.**

Summary of changes from the DEIS, continued:

- **DEIS Table 2.2-5 has been revised to specify outlet invert elevations under Measure 166 as FEIS Table 2.8-2.**
- **Clarification has been made that Measure 40 is currently implemented at Fall Creek Dam (FEIS Section 2.8.3.1, Deeper Fall Reservoir Drawdown for Downstream Fish Passage (40)).**
- **DEIS Figure 2.2-9, 1960s Photo of the Cougar Dam Diversion Tunnel, has been deleted because the photo quality was not clear, and the tunnel depiction was not discernable.**
- **Clarification on possible dams where Measure 714 could be implemented has been added to FEIS Section 2.8.3.3, Pass Water over Spillways in Spring for Downstream Fish Passage (714).**
- **The maximum flow that would attract fish through a floating screen structure at Green Peter Dam has been updated in FEIS Table 2.8-6, Minimum and Maximum Flows to Attract Fish through a Floating Screen Structure by Dam.**
- **Additional information has been added to describe structural downstream fish passage at Foster Dam in FEIS Section 2.8.3.2, Construct Structural Downstream Fish Passage (392). DEIS Table 2.2-10, Assumptions used for the Downstream Passage Measure at Foster Dam, has been deleted because the information is preliminary and not germane to the Measure 392 description. Applicable information is provided within the text.**
- **Measure 52, Provide Pacific Lamprey Passage and Infrastructure, has been revised to clarify parameters of this measure (FEIS Section 2.8.4.1). The title of this measure has been changed to "Provide Pacific Lamprey Passage Infrastructure."**
- **DEIS Figure 2.2-13, USACE Existing Adult Fish Collection Facilities, has been deleted because it does not inform an understanding of Measure 722, Construct Adult Fish Facilities.**
- **The term "Near-term Operations Measures" has been changed to "Interim Operations" throughout the EIS. Additional information has been added to FEIS Section 2.8.5, Interim Operations.**
- **The duration for Interim Operations at Green Peter Dam specific to spillway use for downstream fish passage has been updated in FEIS Table 2.8-7, Interim Operations.**
- **Details regarding access platforms; road use; and structural, mechanical, and electrical work to construct structural downstream fish passage have been deleted because details about such construction-specific information are not available for analysis in this programmatic review (FEIS Section 2.8.3.2, Construct Structural Downstream Fish Passage (392)).**

Summary of changes from the DEIS, continued:

- **DEIS Section 2.9, Alternatives Considered but Eliminated from Further Review has been revised.**
- **The definition of the No-action Alternative has been modified in FEIS Section 2.10.3, No-action Alternative, to clarify Council on Environmental Quality regulations through its 40 Most Asked Questions and to delete statements suggesting no action is the same as existing environmental conditions.**
- **DEIS Section 2.10.3.1, Agricultural Irrigation Water Use, has been reframed to address existing U.S. Bureau of Reclamation irrigation contracts under the No-action Alternative.**
- **Additional information has been added to clarify that Measure 719, Adapt Willamette Hatchery Mitigation Program, would only be implemented if passage provides increased access to habitat and that any potential reductions in hatchery production under this measure were not analyzed (FEIS Section 2.10.4.1, Measures Common to All Action Alternatives, Adapt Willamette Hatchery Mitigation Program (719)).**
- **Information on the U.S. Bureau of Reclamation Water Irrigation Marketing Program has been added to FEIS Section 2.10.4.1, Measures and Actions Common to All Action Alternatives.**
- **DEIS Figure 2.4-2, Willamette River Basin Bank Protection Program Revetment Locations, has been deleted. This figure is now located in FEIS Appendix S, USACE-managed Dams, Reservoirs, and Bank Protection Structures.**
- **Environmental flows (FEIS Section 2.10.2.2, Environmental Flow Operations) and maintenance actions have been added (FEIS Section 2.10.2.3, Maintenance, Repair, Replacement, and Rehabilitation Operations) to Section 2.10.2, Existing Operations Common to all Alternatives. Clarifications through formatting and text have been made regarding measures and actions common to all alternatives versus those common to all action alternatives.**
- **Details regarding construction of temperature control towers under Alternative 1 have been deleted because this repeats construction details for all alternatives in FEIS Section 2.10.4.2, General Construction Activities Common to All Action Alternatives.**
- **Clarification that passage under Alternative 1 would be achieved by floating downstream passage structures has been made in FEIS Section 2.10.4.3, Alternative 1, Fish Passage.**
- **A revision to Alternative 2A was made to specify that a selective withdrawal structure at Lookout Point Dam was omitted from this alternative rather than at Hills Creek Dam (FEIS Section 2.10.4.4, Alternative 2A, Water Quality).**

Summary of changes from the DEIS, continued:

- **The introduction to Alternative 2B has been revised to clarify the distinctions with Alternative 2A (FEIS Section 2.10.4.5, Alternative 2B).**
- **Cross-references to other sections and appendices have been added or updated.**
- **Figures have been added (FEIS Figure 2.8-1, Water Temperature Control Tower at Cougar Dam and Reservoir; Figure 2.8-3, Hydropower Dam Outlet Configuration; Figure 2.8-11, Trap and Haul Tanker Truck; Figure 2.8-15, Cougar Dam Adult Fish Facility).**

2.1 Introduction

Federal agencies must evaluate all reasonable alternatives to their Proposed Actions (40 CFR 1502.14). This environmental impact statement (EIS) is a programmatic review of the U.S. Army Corps of Engineers (USACE) Proposed Action (Chapter 1, Introduction, Section 1.3.1.1, Programmatic Reviews and Subsequent Tiering under the National Environmental Policy Act). The range of reasonable alternatives described in this chapter meet the purpose of and need for the programmatic Proposed Action (Appendix A, Alternatives Development).

2.2 Chapter Terminology and Organization

Table 2.2-1. Summary of Key Chapter Terminology.

Term	Definition
Willamette Valley System	The 13 USACE-managed dams, reservoirs, and bank protection structures in the analysis area.
Activities	Activities necessary to implement a measure, program, operations, or maintenance (e.g., construction of a selective withdrawal structure).
Measures	Proposed combination of activities that would be taken under an alternative to meet the purpose and need for the Proposed Action. Alternatives are formulated by suites of measures.
Analysis Area	The area defined as the Affected Environment for each resource in Chapter 3, Affected Environment and Environmental Consequences. Broadly, the analysis area is the Willamette River Basin. An analysis area may differ in Chapter 4, Cumulative Effects, depending on the resource analyzed.
Action Alternatives	In contrast to USACE taking no action, all other alternatives in the range of reasonable alternatives are considered action alternatives.

Table 2.2-2. Chapter 2 Organization.

Section		Content
Section 2.3	Proposed Action	Defines the USACE Proposed Action.
Section 2.4	Purpose of and Need for the Proposed Action	Describes the purpose of and need for the USACE Proposed Action and supporting context.
Section 2.5	Decision-making	Describes the decisions to be made and an overview of the decision process.
Section 2.6	Alternatives Development Overview	Summarizes requirements prior to developing a range of alternatives.
Section 2.7	Range of Reasonable Alternatives Development	Details the six-step process used to create the range of alternatives.
Section 2.8	Final Measures Developed for the Action Alternatives	Describes two sets of measures that are carried forward under the action alternatives and the general construction activities associated with measures requiring construction. ➢ Measures for flow management, water quality management, and fish passage. ➢ Interim Operations measures based on the 2021 Court-ordered Injunction Operations (Chapter 1, Introduction, Section 1.12.3, Court-ordered Injunction Measures).
Section 2.9	Alternatives Considered but Eliminated from Further Review	Reviews the potential alternative considered by USACE for analysis and the rationale for elimination from the range of alternatives.
Section 2.10	Alternatives Considered in Detail and Identification of the Preferred Alternative	Describes the alternatives evaluated in detail, including the No-action Alternative and identifies the Preferred Alternative. Provides a table summarizing each action alternative and corresponding measures that would be implemented during the 30-year implementation timeframe.

2.3 Proposed Action

The Proposed Action is to continue operations and maintenance of the Willamette Valley System (WVS) for specific, authorized purposes. Responsibility for operating each dam and reservoir and the overall system was directed to USACE by Congress in authorizing legislation. Consequently, the Proposed Action is to continue with this authorizing legislation. The Proposed Action would be implemented over a 30-year timeframe.

What is a Lead Agency?

A lead agency is the Federal agency with primary responsibility for preparing an Environmental Impact Statement (40 CFR 1508.16).

The U.S. Army Corps of Engineers, Portland District, is the lead agency for this Proposed Action and development of this Environmental Impact Statement.

2.4 Purpose of and Need for the Proposed Action

The purpose and need for the continued operations and maintenance of the WVS is to operate the system in accordance with the eight Congressionally authorized purposes [as detailed in Chapter 1, Introduction, Section 1.10, Congressionally Authorized Purposes], and in compliance with the ESA and all other applicable treaties, laws, and regulations.

THE DEIS HAS BEEN MODIFIED TO REVISE THE FOLLOWING INFORMATION IN THE FEIS

Potential alternatives inconsistent with the purpose and need for the Proposed Action were not considered in development of the range of alternatives and associated measures. All alternatives analyzed in detail would ensure continued compliance with Congressional authorizations.

END REVISED TEXT

2.4.1 Summary of ESA Requirements Specific to the Need for the Proposed Action

USACE must operate and maintain the WVS for specific purposes but cannot jeopardize the continued existence of a species listed as threatened or endangered or result in the destruction or adverse modification of designated critical habitat by the Services (Chapter 1, Introduction, Section 1.3.2, Endangered Species Act).

Listed species affected by the WVS operations and maintenance in the analysis area are bull trout (listed as threatened in 1998), Upper Willamette River (UWR) spring Chinook salmon (listed as threatened in 1999), and UWR winter steelhead (also listed as threatened in 1999) (Chapter 1, Introduction, Section 1.3.2, Endangered Species Act).

Dams along the Willamette River and its tributaries block access to substantial portions of spawning and rearing habitat for these listed species and degrade remaining downstream riverine habitats (NMFS 2008; USFWS 2008). Fish passage is believed to be a limiting factor affecting the prospects of recovery for ESA-listed and other native migratory fish and include

(NMFS 2008[1]) both the passage of adults migrating upstream to spawn and juveniles (smolts) migrating downstream toward the ocean. Altered water temperatures and flows also contribute to adverse impacts on bull trout, UWR spring Chinook salmon, and UWR winter steelhead and their habitats (NMFS 2008[2]; USFWS 2008[3]).

Several ESUs of UWR spring Chinook salmon and UWR winter steelhead are listed as Federally threatened or endangered (NWFSC 2015) (Chapter 1, Introduction, Section 1.3.2, Endangered Species Act). Improvements to fish passage and water quality are necessary to comply with the ESA for listed fish and listed salmonid ESUs.

2.5 Decision-making

The intent in preparing this EIS is to assist the USACE decision-maker in making an informed decision regarding future operations and maintenance of the WVS. This decision will be applied at the program level and made through review of the detailed analyses of various alternative operations and maintenance options within the EIS.

These analyses will be used to balance interests among various natural resource and human environment impacts and regulatory requirements. The alternatives incorporate combinations of operations and maintenance activities to address this balance.

What is "Scoping?"

Scoping is an early and open process to identify the scope and significance of issues to be addressed in an EIS (40 CFR 1501.7). Scoping requirements include:

- Inviting participation by other affected Federal, state, and local agencies, tribes, and interested parties.
- Determining the scope of significant issues to be analyzed.
- Identifying and eliminating issues that would not be significant or were covered by a prior environmental review.
- Allocating EIS assignments among the lead and Cooperating Agencies.
- Identifying related NEPA reviews and other reviews and consultation requirements.
- Indicating the relationship between the decision timing and EIS development.
- Conducting an early scoping meeting.

2.6 Alternatives Development Overview

Before a lead agency can establish the range of alternatives to be analyzed in an EIS, it must engage in public scoping and development of an interdisciplinary analysis process (Appendix A, Alternatives Development).

2.6.1 The Scoping Process

Relative to scoping, key purposes and policies of NEPA ensure that environmental information is available to citizens before decisions are made

[1] In NMFS 2008, Subsection 3.2.1.4.3, Multipurpose Dams

[2] In NMFS 2008, Subsection 3.2.2.4.1, Tributary and Willamette Mainstem Habitat

[3] In USFWS 2008, Section 5.5, Water Quality

(40 CFR 1500.1(b)) and to "encourage and facilitate public involvement in decisions that affect the quality of the human environment" (40 CFR 1500.2(d)). Decisions can include determinations on the range of reasonable alternatives and the scope of those alternatives (i.e., the alternative descriptions and content). As such, agencies involve the public through the scoping process to fulfill these NEPA requirements.

Public involvement for development of this EIS began with publication in the Federal Register of a 2019 Notice of Intent to prepare an EIS, which invited participation in the EIS process by the public and other entities (Chapter 6, Public Involvement). Through the scoping process, USACE solicited input from stakeholders such as tribes, the public (both private citizens and non-governmental organizations [NGOs]), and other agencies. A Scoping Report was prepared at the conclusion of the public scoping process that summarizes the process and comments received (Appendix P, Public Scoping Report).

2.6.1.1 Interdisciplinary Preparation and Cooperating Agency Involvement

To comply with the requirement to engage and consult with other agencies, USACE formed an interdisciplinary team (composed of various technical experts from USACE) that collaborated with Willamette River Basin stakeholders and tribes. Potential Federal and state Cooperating Agencies were also identified and invited to participate in the EIS development process. Combined input from the interdisciplinary team, Cooperating Agencies, tribes, and the public helped to inform the scope of the EIS, including the alternatives development process.

2.7 Range of Reasonable Alternatives Development

Alternatives were developed in accordance with the 1978 Council on Environmental Quality (CEQ) NEPA implementing regulations (40 CFR 1502.14) (Chapter 1, Introduction, Section 1.3.1, National Environmental Policy Act). The USACE process involved six development steps:

1. Identify primary constraints that would apply to any measure under any alternative.
2. Identify primary management and environmental objectives that would also meet the purpose and need for the Proposed Action.
3. Combine results from the first two steps into formation of a preliminary range of reasonable alternatives that meet conditions from Step 1 and Step 2.
4. Refine the preliminary range of alternatives as new information became available.
5. Finalize the range of alternatives for the Draft EIS with identification of measures under each alternative.
6. Evaluate and compare each alternative to be analyzed in the EIS to inform identification of the Preferred Alternative.

The following is a summary of how these steps were applied. Appendix A, Alternatives Development, provides detail on the alternative development process and information on distinctions among the alternatives.

Step 1: Identify Constraints

Constraints based on the purpose of and need for the Proposed Action and life safety were identified. Potential alternative measures were eliminated from consideration for the following reasons:

Flood Risk Management

Results of the preliminary modeling were used to screen for any measures with potential adverse flood risk effects. Specifically, measures that would result in flood risk management changes from current protection levels were eliminated as an alternative measure.

Dam Safety

USACE performed a preliminary evaluation of measures for dam safety considerations. Measures that would compromise dam safety and that could not be mitigated were eliminated as an alternative measure. A more detailed dam safety evaluation of components will be conducted during site-specific planning and design (Appendix H, Dam Safety).

Step 2: Identify Management and Environmental Objectives

Objectives that would meet the purpose of and need for the Proposed Action were identified. The objectives below were identified from the public scoping comments and by USACE interdisciplinary team, Cooperating Agency, and tribal input:

1. Allow greater flexibility in water management (related to refill, drawdown timing, and other water management measures) as compared to current operational requirements in water control diagrams and manuals. This objective supported development of measures that would meet authorized purposes and ESA obligations without current system management constraints.
2. Increase opportunities for the creation of nature-based structures during maintenance of USACE-managed revetments (structures that help prevent bank erosion) as compared to opportunities under current operations (Chapter 1, Introduction, Section 1.7.2, Revetments and Other Structures for Bank Protection). This objective supported development of a measure to manage revetments to provide engineering functions relevant to flood risk management while providing economic, environmental, or social benefits.
3. Allow greater flexibility in hydropower production as compared to current operational requirements in water control manuals. This objective supported development of measures that would provide opportunities in hydropower pool management to meet Congressionally authorized purposes and ESA obligations.

4. Increase anadromous[4] ESA-listed fish passage survival at WVS dams as compared to conditions under current operations. This objective supported development of fish passage measures in compliance with ESA obligations.
5. Improve water management during the conservation season[5] (related to refill, drawdown timing, and other water management measures), as compared to current operational requirements in water control diagrams and manuals, to benefit anadromous ESA-listed fish and other Congressionally authorized purposes.
6. Improve water quality associated with the WVS dams to benefit anadromous ESA-listed species.
7. Reduce spawning and rearing habitat competition caused by hatchery fish.

Step 3: Develop a Preliminary Range of Reasonable Alternatives

Measures, or actions, that would meet at least one of the objectives were developed. These measures were formulated based on input from the public scoping comments and Cooperating Agencies.

Potential measures were then screened. Each measure had to meet the purpose and need for the Proposed Action, life safety constraints, and achieve at least one of the seven objectives. Each measure also had to be technically feasible and not result in unacceptable adverse environmental effects. Appendix A, Alternatives Development, provides detail on how measures were developed, screened, and incorporated into an alternative.

Those measures retained after applying screening criteria were then incorporated into alternative options. Measures were incorporated in combinations or around unifying management strategies. An alternative is, therefore, a combination of one or more measures that, together, would address one or more of the USACE objectives described above.

Step 4: Refine the Preliminary Range of Reasonable Alternatives

The alternatives described in this EIS were developed through an iterative process. As information was revealed during the development process, the level of understanding and detail increased, which allowed a hard look at any given potential alternative. This iterative development process fostered informed decisions about the range and refinement of alternatives.

[4] USACE assumed that formulating improvements for UWR spring Chinook salmon and UWR winter steelhead would also meet needs for other fish species and their life stages, such as bull trout.

[5] The term 'conservation season' encompasses spring, summer, and fall seasons and is composed of 'conservation storage season' and 'conservation use season'. The conservation season is in contrast to the flood season, which is primarily in the winter months.

Following initial modeling and evaluation of preliminary alternatives, new refined alternatives were developed to assess slightly different combinations of measures and to provide clarity on the tradeoffs associated with key measures.

The alternatives development process focused on creating management approaches, or strategies, to meet at least one objective under individual alternatives (Table 2.7-1). Each alternative strategy placed a different emphasis on the management and environmental objectives described in Step 2.

Table 2.7-1. Alternative Strategies and Associated Objectives[1].

Alternative	Strategy	Obj. 1	Obj. 2	Obj. 3	Obj. 4	Obj. 5	Obj. 6	Obj. 7
No-action	Current operations and maintenance practices, as of April 2019.	–	–	–	–	–	–	–
1	Improve fish passage through storage-focused measures. Increase the probability of refilling WVS reservoirs and water delivery for authorized purposes.	X	X	X	X	X	X	X
2A, 2B, 5	Integrate water management flexibility with operations and structures for ESA-listed fish.	X	X	–	X	X	X	X
3A, 3B	Improve passage of ESA-listed fish through existing structures by modifying water control operations.	–	X	–	X	X	X	X
4	Improve passage of ESA-listed fish by constructing fish passage and temperature control structures.	X	X	X	X	X	X	X

[1] Objectives: See Step 2, Identify Management and Environmental Objectives, above.

Step 5. Finalize the Range of Alternatives for Incorporation into the Draft EIS

The alternatives development process was finalized following the refinement process described in Step 4. The final development process included identification of measures to be incorporated into alternative descriptions as described below (Section 2.8, Final Measures Developed for the Action Alternatives).

The final alternatives analyzed in this EIS are described in Section 2.10, Alternatives Considered in Detail.

Step 6. Evaluate and Compare the Alternatives for Identification of the Preferred Alternative

The final step was to evaluate and compare each alternative to be analyzed in the EIS to inform identification of the Preferred Alternative. Environmental consequences, described in Chapter 3, Affected Environment and Environmental Consequences, were analyzed under each alternative. These consequences were then compared among the alternatives in Chapter 5, Preferred Alternative Identification and Implementation, provided in the Draft EIS. USACE considered multiple criteria to assess how well each alternative met the objectives. The criteria were also used to assess tradeoffs between alternatives.

2.8 Final Measures Developed for the Action Alternatives

This section describes the measures, after screening, that have been incorporated under the action alternatives, as applicable. Measures are characterized into general categories, including flow, water quality, downstream fish passage, upstream fish passage, and measures common to all action alternatives (Appendix A, Alternatives Development).

Measures addressing flow were developed to meet Objectives 1 and 3 or Objectives 5 and 6 (Section 2.7, Reasonable Range of Alternatives Development). Water quality measures were developed to address temperature and total dissolved gas (TDG) parameters to meet Objectives 4, 5, and 6. Passage measures were developed to meet Objective 4.

Some measures are location-specific, meaning the measure was developed to address a problem associated with a specific USACE facility. These locations are identified in the following measure descriptions. Other measures more broadly apply to a subbasin, all facilities, or the system. These were associated with either aquatic habitat downstream of dams or with general operations and maintenance required to run the WVS facilities. One measure associated with both downstream habitat and operations and maintenance was specifically developed to address Objective 2. Finally, a single measure was developed to address Objective 7.

Measure Identification Numbering

Each measure was assigned a unique identification number at the start of the measure development process. This identification number was carried through the measure screening process and is provided in parentheses in the measure titles. For example: Provide Pacific Lamprey Passage Infrastructure (52) – this is Measure Number 52. This section provides summary measure descriptions.

2.8.1 Flow Measures

The amount of water flowing in a river is important to support all life stages of fish species and affects the water quality of the water body. Physical habitat and water quality associated with streamflow are central for meeting the habitat needs of aquatic biota in riverine ecosystems. Thermal conditions can annually exceed biological thresholds in the Willamette River Basin regardless of streamflow conditions.

This section describes operational measures that would manage streamflow on tributaries and on the mainstem Willamette River through releases from USACE dams.

2.8.1.1 Integrated Temperature and Habitat Flow Regime (30a)

Under this measure, dynamic dam outflows would be implemented to increase fish survival and passage. Dynamic dam outflows are also known as adaptive streamflows, or adaptive fish flows. These terms refer to dam flow management techniques that vary based on the amount and temperature of water required by fish below the dam. This flow regime is described in Appendix A, Alternatives Development, and the associated modeling parameters and results are provided in Appendix B, Hydrologic Processes Technical Information.

The proposed integrated temperature and habitat flow regime is based on three components:

- Alternative flow targets that incorporate magnitude, seasonal variation, and annual hydrologic conditions.
- Opportunistic/adaptable water releases for real-time water temperature management.
- Fall maximum outflows from Detroit/Big Cliff, Green Peter/Foster, Cougar, and Lookout Point/Dexter Dams.

In developing the integrated temperature and habitat flow regime, USACE assumed that prioritizing adult UWR spring Chinook salmon would also meet critical habitat needs for other fish species and their life stages, such as bull trout. Under this priority, USACE could also address pre-spawn mortality, which is the rate at which targeted fish species die before they are able to spawn (reproduce) and thus contribute to the population.

Pre-spawn mortality substantially constrains productivity of UWR spring Chinook salmon; therefore, by directly addressing pre-spawn mortality, these adaptive fish flows are addressing a critical factor to avoid jeopardizing this listed species. USACE developed these adaptive fish flows by considering the timing of their freshwater migration, holding, and spawning, all three of which extend from early spring to the fall months.

Flow targets for wet and dry years for the major tributaries regulated by WVS dams on the North Santiam, South Santiam, McKenzie, and Middle Fork Willamette Rivers were developed based on hydrologic conditions in any given year. These flow targets depend on how full the

reservoirs are during the refill season. The flow targets from the National Marine Fisheries Service (NMFS) 2008 Biological Opinion were carried forward for other dams and subbasins.

Fish flows under this regime also incorporate temperature pulse flows during the period from May through June. Temperature pulse flows reduce and stabilize water temperature during important timeframes for UWR spring Chinook salmon and UWR winter steelhead, mitigating warmer air temperatures to the extent possible. These adaptive flows are in addition to base flow releases. Reservoirs used to provide mainstem flow would be decided on a real-time basis depending on realized hydrologic conditions throughout the Willamette River Basin.

Specific flow targets for adaptive flow releases were based on the observed relationship between flow, air temperature, and water temperature between 2001 and 2018. If air temperature were forecasted to be above the threshold, additional flow from the WVS dams would occur according to limits defined for each period. Source of flow augmentation would be determined based on current reservoir conditions and adaptively managed to meet the specific need. These proposed fish flow targets are intended to reduce thermal stress on ESA-listed fish and to reduce mortality during extreme heat.

Redds are instream nests created by female salmonids to lay eggs and are also crucial to early-stage juveniles, or fry. Some redd areas can become dewatered after reservoirs are drafted for flood risk management, reducing egg and fry survival. Ensuring higher flows in these areas can encourage spawning and reduce egg and fry mortality. Therefore, as a part of Measure 30a, maximum outflows from Detroit/Big Cliff, Green Peter/Foster, Cougar, and Lookout Point/Dexter Dams would be applied to protect against redd dewatering from September 1 to October 15. The spawning flow level was chosen to help balance the need to encourage spawning in areas that would remain wetted after reservoir drafting and the need to increase flows to draft reservoirs for flood management.

2.8.1.2 Refined Integrated Temperature and Habitat Flow Regime (30b)

This measure is a modification of Measure 30a with changes to the mainstem and tributary flow targets. Flows are subject to change throughout the season based on realized hydrology and annual water management decisions. Additional water may be released from the dams and reservoirs to achieve temperature targets in the mainstem as measured at Salem, as noted under Measure 30a.

Under this measure, mainstem flow targets at Salem and minimum flow thresholds at Detroit/Big Cliff, Lookout Point/Dexter, and Foster Dams would be modified from those under Measure 30a according to the flow targets provided in Appendix A, Alternatives Development. The reservoirs used to provide the mainstem flow would be decided on a real-time basis depending on realized hydrologic conditions throughout the basin. Associated modeling parameters and results for each alternative that includes this measure are provided in Appendix B, Hydrologic Processes Technical Information.

2.8.1.3 Augment Instream Flows by Using the Power Pool (304)

Under this measure, water stored within power pools would be used to supplement downstream flows to assist in meeting minimum tributary flows during the summer and late fall. Using water from the power pool would only occur when there is not enough water in the conservation pool to provide the biologically justified flows. Measure 304 would only be implemented to meet ESA flow obligations and not to provide water to meet consumptive needs of downstream municipal and industrial irrigation users.

Due to annual variability in hydrologic conditions throughout the Willamette River Basin, a set priority for use of the power pools is not possible and would be determined on an as-needed basis according to flow conditions in the tributaries. An annual coordination process would be defined.

The re-regulating reservoirs at Dexter and Big Cliff Dams do not have power pool storage. Foster Dam has the smallest amount of power pool storage in the WVS (3.6 acre-feet); the available amount is negligible in comparison to the other reservoirs with power pool storage in the WVS. Therefore, Measure 304 does not apply to Dexter, Big Cliff, and Foster Dams.

2.8.1.4 Augment Instream Flows by Using the Inactive Pool (718)

Under this measure, instream flows would be augmented using the inactive pool in a combination of two or four reservoirs depending on the alternative (Cottage Grove, Dorena, Fall Creek, or Blue River Reservoirs). The inactive pool is designed to trap sediment and is the lowest storage area in a reservoir.

Because the inactive pool is the last available storage in a reservoir, inactive pool water is traditionally reserved for extreme droughts, emergencies, and used only after the conservation pool has been emptied. Drafting into inactive storage increases the risk of not refilling the reservoirs depending on the water year.

Using the inactive pools would assist in meeting minimum tributary and mainstem flows during the late summer and fall. The reservoirs are generally not drafted below their minimum conservation pools unless hydrologic conditions result in reservoir inflows less than what is needed to provide downstream minimum flows.

Water stored in the designated inactive pools would be used to support biological flow targets when natural stream flows are inadequate to provide the biologically justified flows. This measure would allow the water stored in the inactive pool to be used when needed without additional analysis on a case-by-case or year-by-year basis.

The lowest outlet in the reservoir would be used to draft the reservoir to the desired elevation without a need for structural modifications. If the minimum conservation pool elevation is reached before September 1, the elevation would be dropped to the low flow target. If the

minimum conservation pool elevation is reached after September 1, the existing flow target would be retained.

2.8.1.5 Reduce Minimum Flows to Congressionally Authorized Minimum Flow Requirements (723)

Under this measure, minimum flows would be reduced to the Congressionally authorized minimum flows to benefit reservoir refill objectives. This would allow USACE to capture more spring runoff in reservoirs rather than releasing it. Minimum flows released real-time from a reservoir may be governed by operating limits of the outlets, which are higher than House Document (HD) 531 flows at some dams. Summer mainstem flow targets are based on flow targets identified in HD531 for Albany and Salem and would occur from June through September.

2.8.2 Water Quality Measures

Water quality downstream of a dam can affect all life stages of fish species. Temperature is an important environmental factor affecting salmonid distribution, behavior, and physiology (Groot and Margolis 1991; Brett 1995; Newell and Quinn 2005) and affects their distributions and migratory behavior (Behnke 1992; Quinn 2005).

Downstream water temperatures in the Willamette River Basin affected by the dams disrupt fish spawning and rearing life stages because water is too warm in the fall/winter and too cool in the summer/spring. Most of the WVS dams are considered high-head dams, meaning they are over 100 feet tall. As a result, their deep reservoirs experience thermal stratification in summer.

Thermal stratification occurs when reservoir surface warming by the sun causes water density variations, and cooler, denser water settles to the bottom of the reservoir. A layer of warmer water floats on top.

The coldest water will be released in the summer if the only available outlets for releasing water are the deep regulating outlets or if a deep penstock is being used to create power (Chapter 1, Introduction, Figure 1.10-2, Figure 1.11-1, Figure 1.11-2).

Willamette River Basin rivers have been historically warmer in the summer than under current conditions (Appendix F1, Qualitative Assessment of Climate Change Impacts). Fish have adapted to the historical, warm summer conditions; therefore, the unseasonably cool water released from the reservoirs disrupts their life stages in summer. By fall, most of this cool water has been released, leaving mostly warm surface water at a time when rivers would historically be cooling off with increased precipitation, further disrupting salmonid life stages. In the winter, a lake may “turnover,” meaning cooler water will move to the surface and any remaining warmer water will move to the bottom.

Total dissolved gas (TDG) supersaturation also negatively effects fish and other aquatic species (EPA 1973). Discharging water through the spillway or regulating outlets entraps air in the plunge pools downstream from the dams, leading to increasing TDG in the downstream river (Qu et al. 2011). TDG supersaturation can easily cause fish to suffer from gas bubble disease by producing air bubble blockages in the blood, heart, and gill filaments (Johnson E.L. et al. 2005). Gas bubble disease can cause a variety of physiological impairments to fish and negatively impact their typical life processes, increasing the mortality of both adult and juvenile fish (Weitkamp and Katz 1980).

Based on Clean Water Act (CWA) requirements, state and other resource agencies have implemented total maximum daily loads (TMDLs) for both temperature and TDG. A TMDL is a plan for restoring impaired waters that identifies the maximum amount of a pollutant that a body of water can receive while still meeting water quality standards.

The TMDLs in the Willamette River Basin provide temperature targets throughout the year to coincide with life cycle stages of ESA-listed fish. This section describes the structural and operational measures to address temperature and TDG. Details specific to each basin/reservoir are provided where appropriate.

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2.8.2.1 Construct Selective Withdrawal Structures (105)

Under this measure, selective withdrawal structures would be constructed to help regulate water temperatures downstream of dams and reservoirs (Figure 2.8-1 and Figure 2.8-2). Selective withdrawal structures blend warmer surface water with cooler deep water by using multiple gates at varying elevations within the reservoir.

Figure 2.8-1. Water Temperature Control Tower at Cougar Dam and Reservoir.

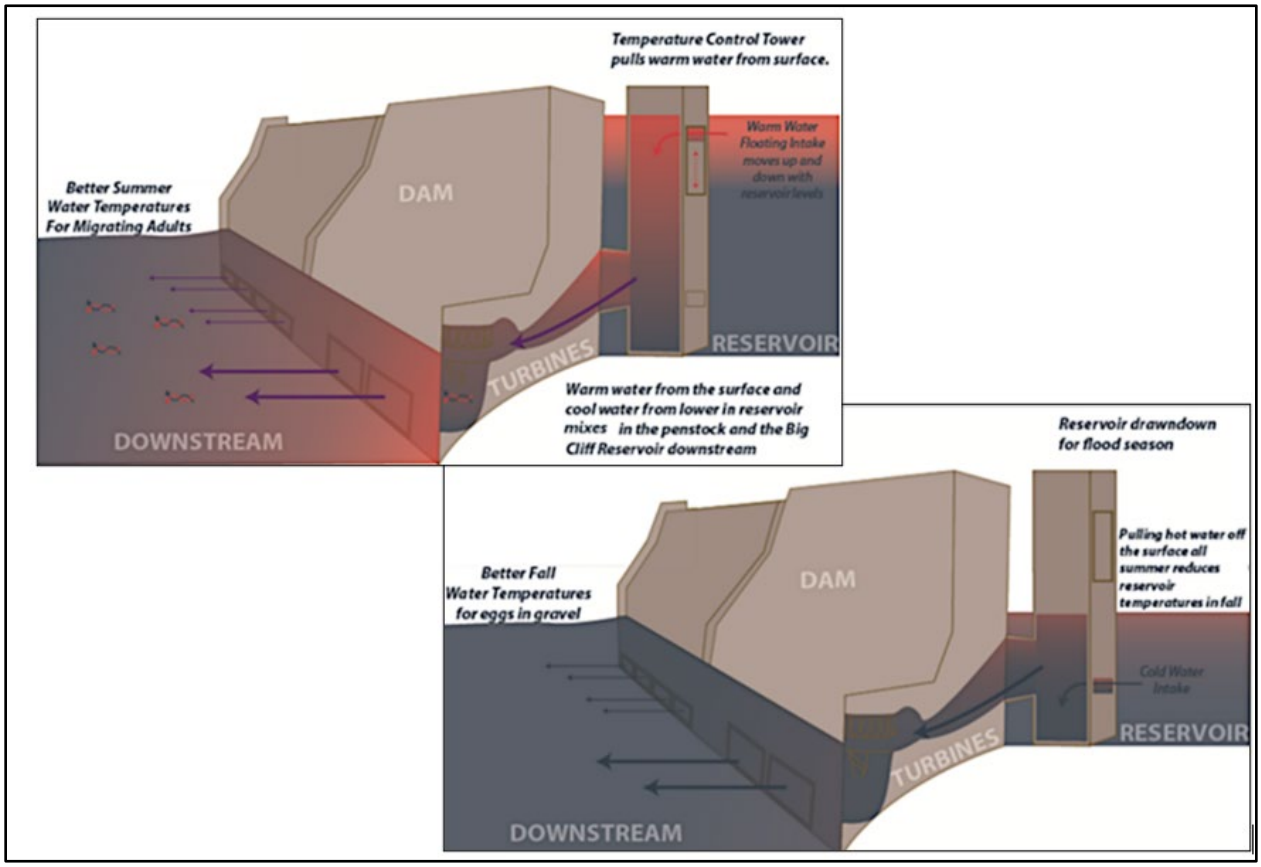

Figure 2.8-2. Selective Withdrawal Structure Operation (at Detroit Dam).

The structures would allow USACE to route this blended water through the powerhouses and continue to generate power while still meeting downstream water quality targets. Site-specific design and environmental compliance documentation would be prepared for the construction of each structure (Chapter 1, Introduction, Section 1.3.1.1, Programmatic Reviews and Subsequent Tiering under the National Environmental Policy Act).

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2.8.2.2 Use Regulating Outlets for Temperature Management (166)

Under this measure, dams with regulating outlets would be managed to release relatively cool water from the outlets during the fall to benefit natural UWR spring Chinook salmon egg incubation (Table 2.8-1).

Table 2.8-1. Outlet Invert Elevations and Current Restrictions.

Regulating Outlet Location	Invert Outlet Elevation (feet)	Current Restrictions
Green Peter	745	No restrictions
Lookout Point	724	No restrictions
Detroit Upper	1,335	Usable when lake is below 1,541 feet
Detroit Lower	1,260	Usable when lake is below 1,460 feet

The WVS reservoirs experience strong temperature stratification during the spring, summer, and fall before reservoir turnover. Generally, warm water rises and cool water sinks, resulting in the stratification of reservoirs with the warmest water on the surface and the coldest at the bottom. When the reservoir is stratified, there is an opportunity at some dams to release relatively cool water from the regulating outlets below the power intakes. This water is comparatively cooler than water released through the turbines and can provide a benefit for spring Chinook salmon egg incubation downstream.

Regulating outlets consist of tunnels and gates through the dams (Figure 2.8-3 and Figure 2.8-4). They are designed to provide a means of releasing reservoir water apart from turbine outlets and spillways. Regulating outlets are used to manage a range of flows from low flow to activation of the spillway and can be used in combination with the spillway to manage very high flows.

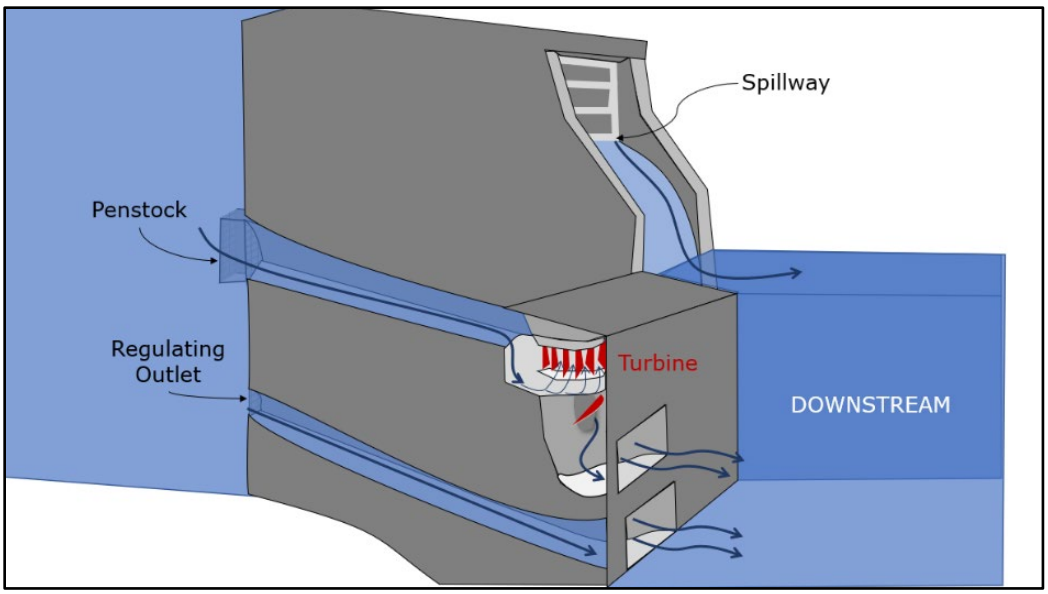

Figure 2.8-3. Hydropower Dam Outlet Configuration.

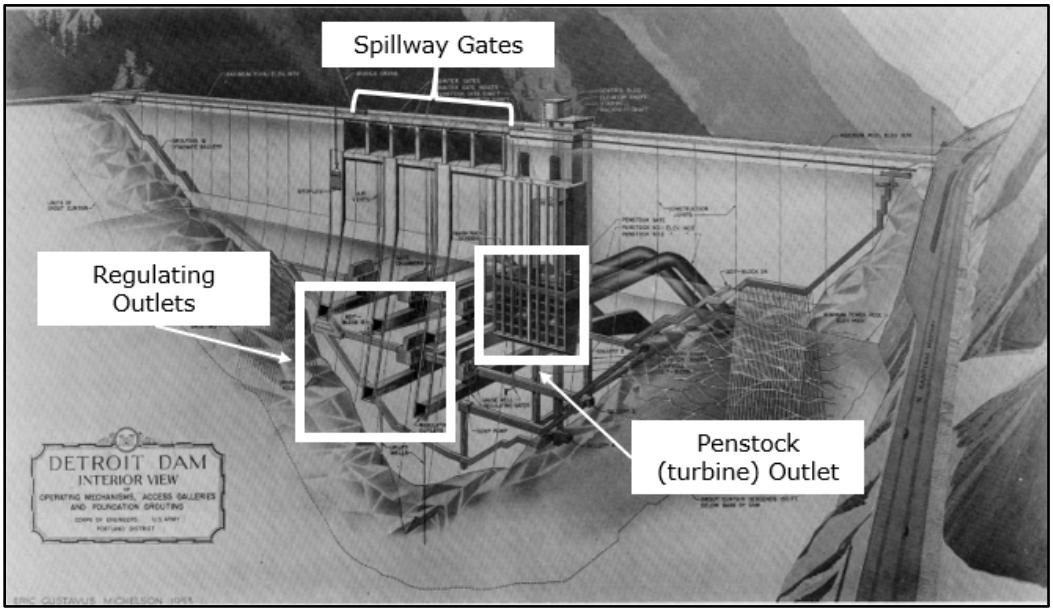

Figure 2.8-4 Interior View of Detroit Dam and the Outlet Configuration.

Depending on the dam, the regulating outlet and spillway can be used simultaneously. There would be limited benefit of Measure 166 at Lookout Point and Green Peter Dams due to the close proximity of the outlets to the turbines. Likewise, the ability of the lower regulating outlets to expel cold water during fall provides limited benefit as the operation has a relatively short duration (a few weeks) before the reservoirs become fully mixed in mid to late fall.

While the regulating outlets were designed for use during high flows, they were not specifically designed for regular use at relatively low flow or frequent gate changes, as is often desired for temperature management. The outlets are also aging and would need to be reinforced and

modernized if they are to be used routinely with high-head pressure (during times when the lake is full).

For example, under Measure 166 at Detroit Dam, the lining of the regulating outlet tunnels may need to be reinforced and gate reliability would likely need to be improved to limit the effects of cavitation, a corrosive process that can lead to major damage to dam structures (Figure 2.8-5) and scouring of the dam when head pressure exceeds 200 feet above an outlet. Use of additional outlets would provide additional capability to release cooler flows in the late fall (typically November).

Figure 2.8-5. Photo of Cavitation Damage to an Upper Regulating Outlet Tunnel.

Measure 166 would be implemented between October 1 and November 15. The implementation frequency and duration of this measure would be dependent on the seasonal reservoir hydrology and temperature conditions as well as the observed conditions downstream of a dam.

2.8.2.3 Structural Improvements to Reduce Total Dissolved Gas (174)

Under this measure, structural improvements would be implemented to reduce TDG. Improvements may include:

- Structural modifications focused on the redesign of current outlets, spillways, or stilling basins that should not increase erosional scouring forces. Scouring forces would decrease structural integrity of the dam.
- Deflectors at the base of spillways that redirect the spill jet (Figure 2.8-6). The jet transports air bubbles deep into the stilling basin. The jet would be redirected to a

horizontal jet that maintains entrained air closer to the water surface. This redirection would allow the entrained air to dissipate more quickly, thus reducing the probability of fish contracting gas bubble disease.

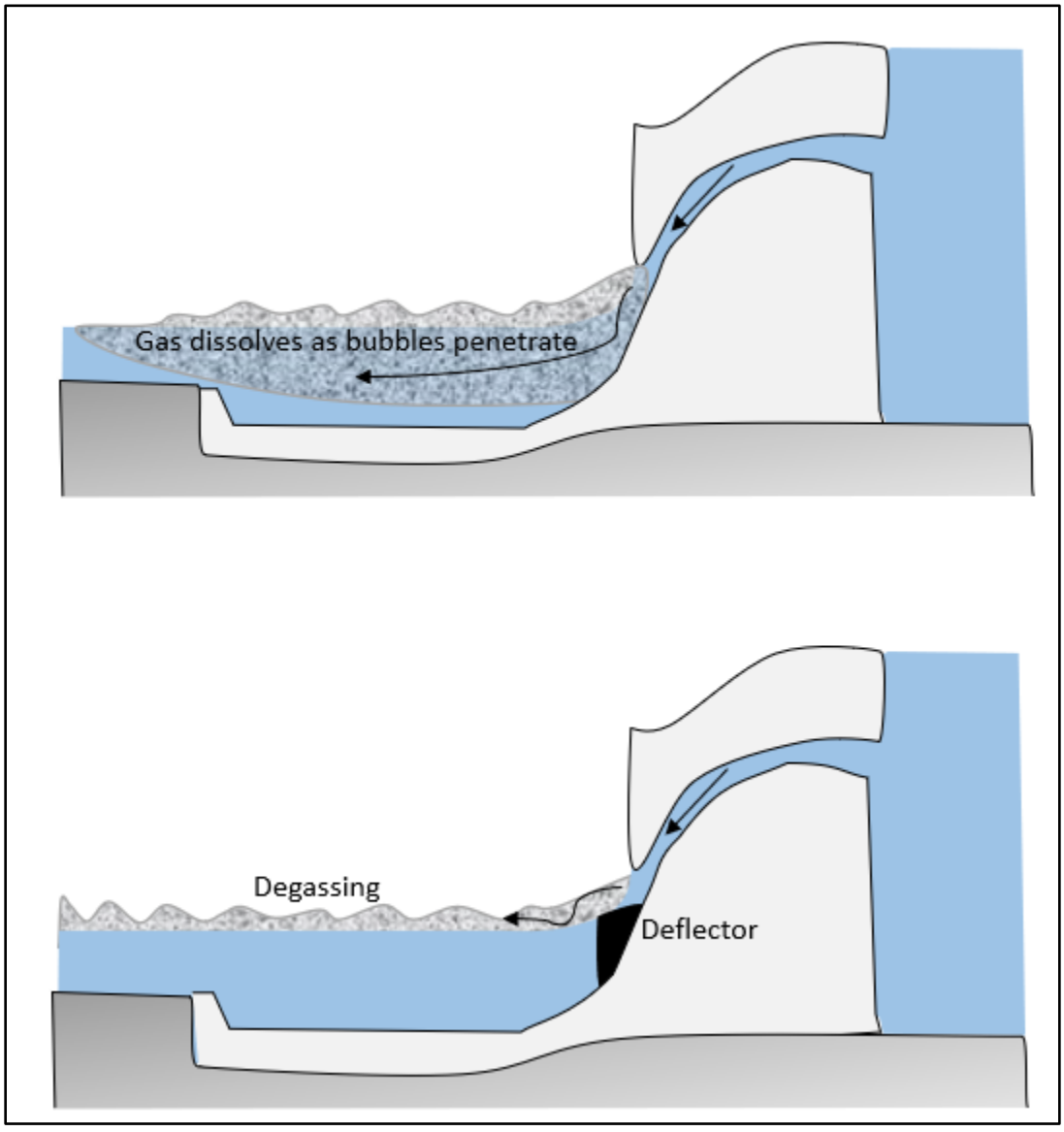

Figure 2.8-6. Spillway Deflector Reducing Total Dissolved Gas.

- Boulder augmentation or debris jams to create more natural riffles downstream of dams and to help de-gas supersaturated water.
- Implementation of spill patterns that distribute spill bay flows uniformly across the entire spillway to help reduce downstream TDG.
- Construction of pipe extensions on the downstream side of regulating outlets to submerge releases in the stilling basin and to reduce jet impact on the tailwater surface.

- Integration of TDG management in the design of new selective withdrawal structures. While selective withdrawal structures would reduce, to some degree, the amount of spill that typically occurs during operational temperature management and, therefore, the amount of TDG, elevated TDG would still likely exist during high flow events, turbine outages, or turbine maintenance. Therefore, the design of new structures should incorporate how/if to address TDG abatement.

Site-specific design and environmental compliance documentation would be prepared for the construction of this measure at each location (Chapter 1, Introduction, Section 1.3.1.1, Programmatic Reviews and Subsequent Tiering under the National Environmental Policy Act).

2.8.2.4 Foster Dam Fish Ladder Temperature Improvement (479)

Currently, upstream fish migration at Foster Dam has been observed to be delayed, and consensus among regional fisheries managers is that water temperature in the fish ladder is too cold to attract fish in the spring and early summer (May and June). This measure would provide more normative temperatures at the fish ladder entrance. Under this measure, a structural modification to Foster Dam would be implemented to increase water temperature in the fish ladder.

During the later spring and summer months, the Foster Dam forebay is temperature-stratified. The existing water supply for the fish ladder is located at the powerhouse intakes at a depth where the water is coldest when the reservoir is stratified. 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 compared to the historical or ambient river temperatures.

The major feature of this measure is construction of a new forebay warm water supply pipe that would draw warm water from near the surface of the reservoir in the Foster Dam forebay (Figure 2.8-7). 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.

A juvenile fish exclusion screen would be provided upstream of the water supply pipe intake to keep juvenile fish from entering the pipe. Site-specific design and environmental compliance documentation would be prepared for Measure 479 implementation (Chapter 1, Introduction, Section 1.3.1.1, Programmatic Reviews and Subsequent Tiering under the National Environmental Policy Act).

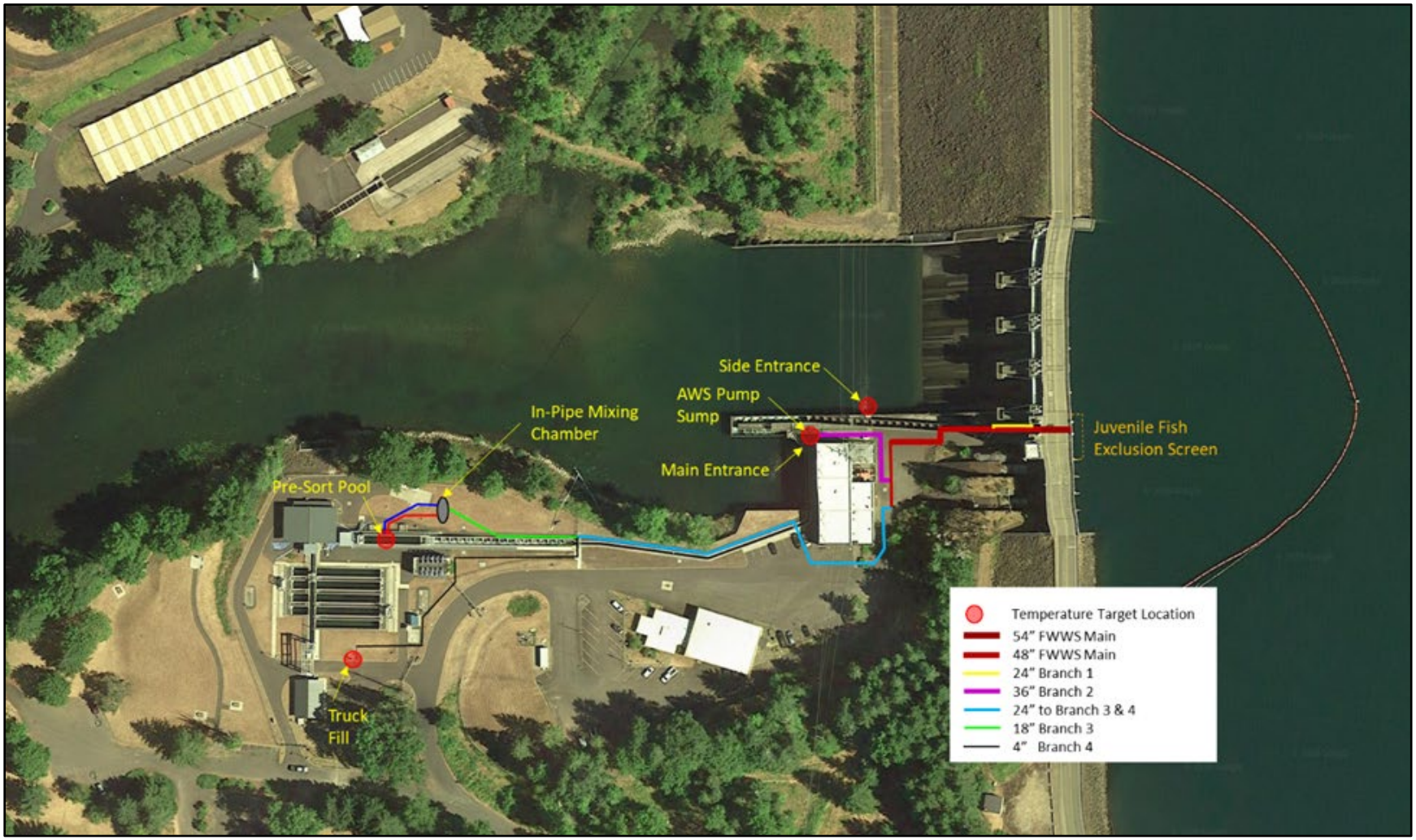

Figure 2.8-7. Forebay Warm Water Supply Pipe Schematic with Temperature Target Locations at Foster Dam.

2.8.2.5 Use Spillways to Release Warm Surface Water in Summer (721)

Under this measure, spillways would be used to further improve downstream water temperature management into the fall (Table 2.8-2). A larger volume of warm surface water from the reservoirs could be released by extending the use of the spillway, while deeper cold water could be reserved for later in the fall and early winter when necessary for fish incubation (Figure 2.8-8). The actual mix between outlets would depend on temperature targets. The downstream temperature target will determine the discharge ratio between the spillway and turbines.

Table 2.8-2. Spillway Crest Elevation and Durations for Warm Surface Water Releases.

Dam Location	Spillway Elevation (feet)	Approximate Duration (dates)
Lookout Point	888	June 1 – August 1
Hills Creek	1,495	May – July
Blue River	1,321	May – July
Foster	597	May – July
Green Peter	969	June1 – August 1
Detroit	1,541	April 15 – August 30

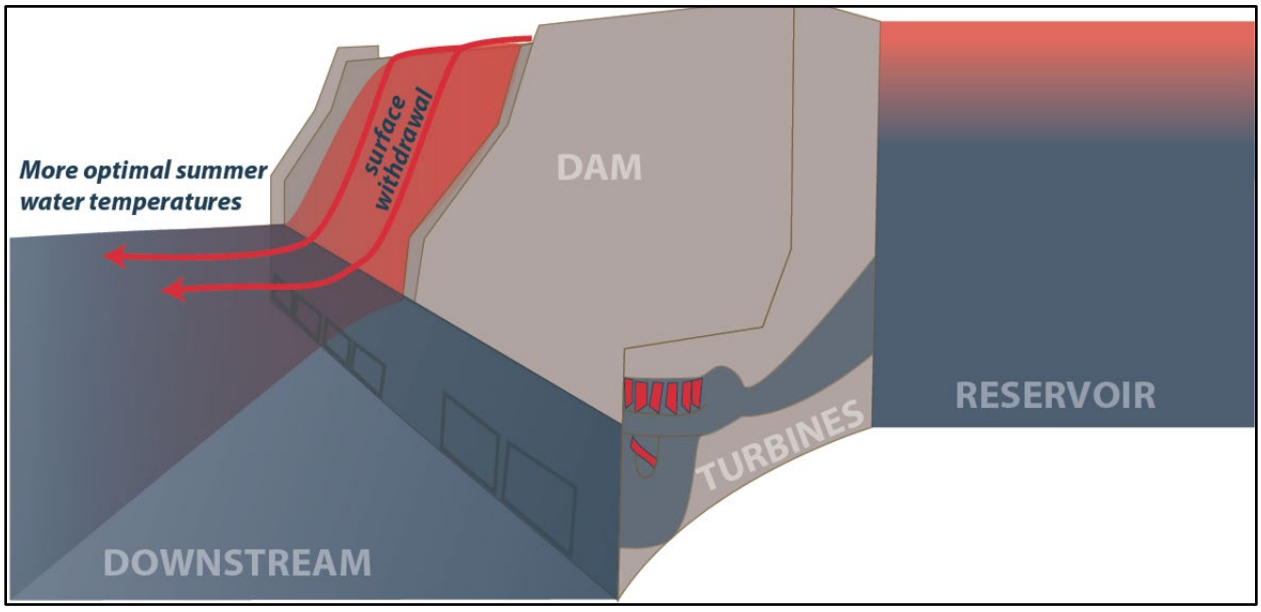

Figure 2.8-8. Warm Water Surface Spill over a Dam Spillway.

Structural modifications would be required to use the spillways at Hills Creek and Blue River Dams under Measure 721 because they were designed for only occasional use during flood risk management operations. The Hills Creek Dam spillway channel and spillway gates would

require modifications to allow for low flow rates and a useable low-flow channel that would not affect the powerhouse (Figure 2.8-9).

Figure 2.8-9. Hills Creek Dam Spillway Channel.

The fish weir at Foster Dam would also need to be modified to implement Measure 721.

Site-specific design and environmental compliance documentation would be prepared for necessary modifications at Hills Creek, Blue River, and Foster Dams (Chapter 1, Introduction, Section 1.3.1.1, Programmatic Reviews and Subsequent Tiering under the National Environmental Policy Act).

2.8.3 Downstream Fish Passage Measures

Juvenile UWR spring Chinook salmon and UWR winter steelhead located upstream of WVS dams must pass the dam to migrate downstream on their way to the ocean. The fish will actively search for a way downstream and are strongly directed by the current. Juvenile salmonids are also surface-oriented, meaning they migrate close to the water surface and are not likely to dive in search of a passage through deep outlets.

Some dam passage routes are also safer than others. The safest and easiest path through a dam is usually a spillway. However, a large volume of water and, therefore, strong current, also passes through turbines. This can be a dangerous and difficult course for juvenile fish. This section describes the structural and operational measures to improve downstream fish passage. Details specific to each basin/reservoir are provided where appropriate.

2.8.3.1 Deeper Fall Reservoir Drawdown for Downstream Fish Passage (40)

Under Measure 40, reservoir elevation would be decreased in the fall to 25 feet over a dam's regulating outlets (also the diversion tunnel at Cougar Dam to improve downstream passage for migrating ESA-listed and other fish). Fish are more likely to survive passage when the water elevation over the outlet is relatively shallow; higher elevations of water over the outlet result in lower survival rates during passage. Water levels below the outlet would not allow for passage at all.

Measure 40 Locations

Measure 40 implementation locations depend on the given alternative. Dams where this measure could be implemented include Detroit, Green Peter, Lookout Point, Hills Creek, Blue River, and Cougar Dams. This measure is already implemented at Fall Creek Dam.

At Cougar Dam, this measure could alternatively involve drawing down to within 25 feet of the diversion tunnel, located at the bottom of the reservoir. A drawdown to the diversion tunnel would require several dam modifications and a change in operational authority:

- Dam safety concerns associated with fluctuating pool levels would need to be addressed.
- Redundant gate structures to allow for safe, remote, routine operation of the diversion tunnel would need to be designed and constructed.
- The diversion tunnel would need to be made accessible for operations and maintenance through the construction of a tower and bridge.

Site-specific design and environmental compliance documentation would be prepared for these required modifications (Chapter 1, Introduction, Section 1.3.1.1, Programmatic Reviews and Subsequent Tiering under the National Environmental Policy Act).

Measure 40 Implementation

Drafting of each reservoir would begin on or about July 1 each year and would proceed at a rate necessary to achieve the October 1 rule curve[6] elevation 1 month earlier, on September 1 (Figure 2.8-10, Number 1). During the September 1 to October 15 spawning season for UWR spring Chinook salmon, the total discharge from the dam would be maintained at or below the maximum flows for spawning (Figure 2.8-10, Number 2) (Table 2.8-3). After the spawning season ends on October 15, the draft rate would then be revised as needed to achieve the November 15 target elevation (Figure 2.8-10, Number 3) (Table 2.8-3).

[6] A rule curve comprises seasonal reservoir elevation targets or restrictions, represented graphically as curves, that guide reservoir operations.

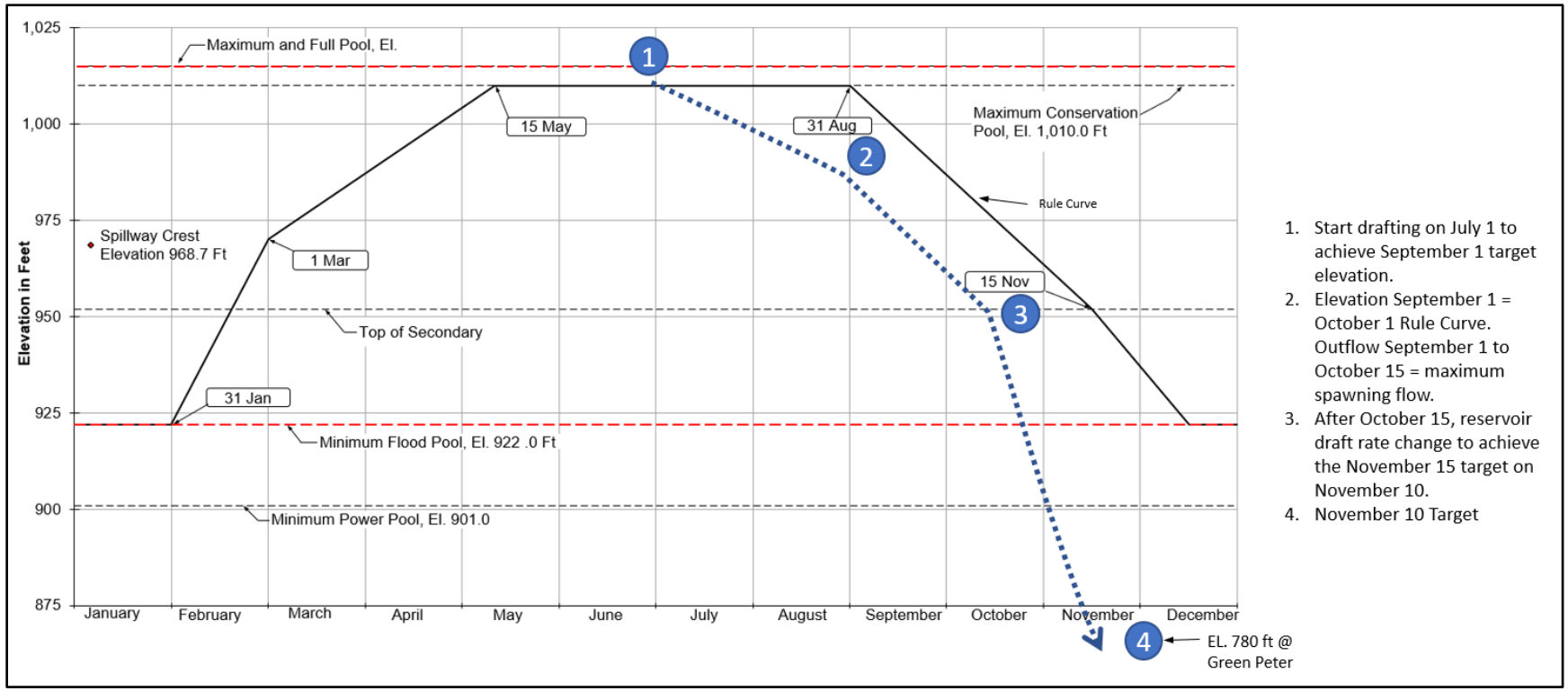

Figure 2.8-10. Example Green Peter Dam Rule Curve for Reservoir Drafting Approach.

Table 2.8-3. Fall Reservoir Drawdown Target Elevations.

Dam	Target Elevation (feet) (25 feet above top of the outlet)[1]
Detroit	1,370
Green Peter	780
Lookout Point	761
Hills Creek	1,446
Blue River	1,165
Cougar Regulating Outlet	1,516
Cougar Diversion Tunnel	1,330

Target elevations = invert elevation + height of outlet + 25 feet

[1] Top of regulating outlets (plus 25 feet) and elevations below which turbine operations would be limited between 10:00 a.m. and 6:00 p.m. daily.

Pool target elevations (Figure 2.8-10) would be achieved beginning at the earliest on November 15 and at the latest on December 15 (Figure 2.8-10, Number 4, developed for demonstration only). Turbine operations would be limited from dusk to dawn and whenever reservoir elevation is at or below 50 feet over the top of the penstock, and during the dates of October 15 to December 15.

Reservoirs would be operated at the fish passage target elevations for 21 days (Table 2.8-3). Three weeks was chosen due to the observed response of juvenile UWR spring Chinook salmon to fall operations when pool elevations are reduced closer to regulating outlets (e.g., Nesbit et al. 2014; Keefer et al. 2013). Observations indicate most juveniles pass downstream during the reservoir drawdown period before the target elevation is achieved and likely within hours to a few days after it is achieved and continue to pass at the target elevation.

Three weeks was also chosen to provide additional opportunity to pass juvenile UWR spring Chinook salmon downstream that may move downstream from the upper reservoir, while balancing time for refill back to minimum conservation pool elevation before February 1. This would avoid impacting the ability to augment downstream flows during the following conservation season.

2.8.3.2 Construct Structural Downstream Fish Passage (392)

Under Measure 392, downstream fish passage structures would be constructed to provide passage for migrating ESA-listed and other native fish.

Downstream fish passage structures either float in the reservoir or are attached to the spillway. For in-reservoir floating structures, juvenile fish are collected near the dam and transported downstream via 'trap and haul' methods like upstream passage methods (Figure 2.8-11). In the case of downstream passage structures attached to the spillway, fish can volitionally swim over the spillway structure and past the dam.

Figure 2.8-11. Adult Fish Trap and Haul Tanker Truck.

A description of in-reservoir floating structures and a downstream structure attached to a dam spillway is provided below. Site-specific design and environmental compliance documentation would be prepared for construction of either type of downstream fish passage structure (Chapter 1, Introduction, Section 1.3.1.1, Programmatic Reviews and Subsequent Tiering under the National Environmental Policy Act).

Structural Downstream Fish Passage at Detroit, Green Peter, Cougar, Lookout Point, and Hills Creek Dams

Under this measure, a floating downstream passage structure would be constructed and operated to capture downstream migrating UWR spring Chinook salmon and UWR winter steelhead as well as other species and life stages. Water flowing into the entrance of the floating structure attracts juvenile fish. The fish enter and are held for transport around the dam by truck or barge or guided into a pipe that safely carries them downstream of the dam.

Capture structures that rely on gravity flows (and may also utilize supplemental pumped flow) are called floating screen structures. Capture structures that utilize only pumped flow are called floating surface collectors. Both types of floating structures typically consist of large barges attached to vertical tracks on a mooring structure that allow the structure to rise and fall with the reservoir (Figure 2.8-12).

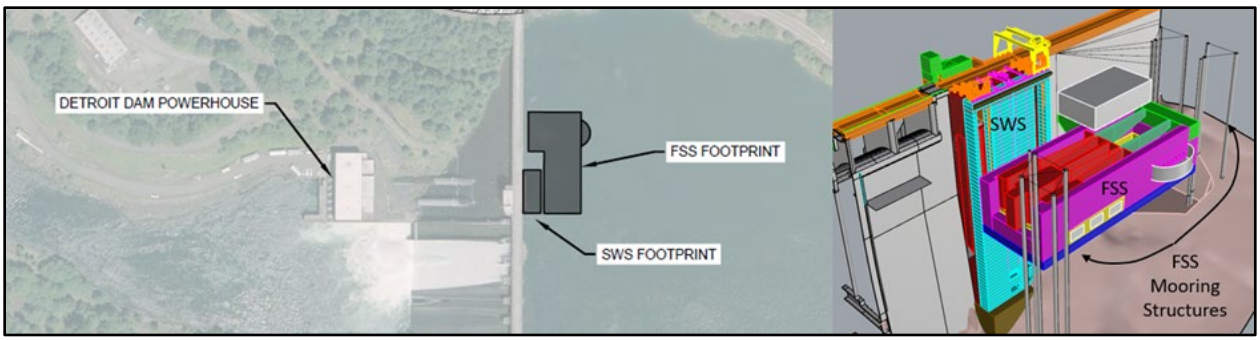

Figure 2.8-12. Proposed Detroit Selective Withdrawal Structure with Attached Floating Screen Structure.

The construction approach, feasibility, and design of either structure would be site-dependent and would be determined during the construction design phase. Existing examples of both structures have shown that consistent flows result in higher collection efficiency (Kock et al. 2019) (Table 2.8-4).

Table 2.8-4. Minimum and Maximum Flows to Attract Fish through a Floating Screen Structure by Dam.

Dam	Minimum Flow[1] (cfs)	Maximum Flow (cfs)[2]
Detroit	1,050	5,600
Green Peter	1,000[3]	4,000
Cougar	300	1,000
Lookout Point	1,350	6,000
Hills Creek	300	1,000

cfs = cubic feet per second

[1] Minimum flow is the minimum dam discharge.

[2] Maximum flow is the maximum amount of flow that can pass through a floating fish structure.

[3] At Green Peter Dam, the minimum dam discharge is 50 cfs, so the FSS would be supplemented with pumped flow up to 1,000 cfs.

Adaptive management would inform how to operate for hydropower and collection efficiency at locations where Measure 392 is implemented. The proposed Detroit Dam downstream passage facility would be used for modeling and analyzing effects of Measure 392 implementation at Detroit Dam (USACE 2019b). Available design concepts for other locations, including Detroit and Cougar Dams, would be adapted to model and analyze effects.

Structural Downstream Fish Passage at Foster Dam

Spillways can be the safest route for juvenile fish to pass a dam, but the spillway may be difficult for fish to locate. Most salmon and steelhead juveniles prefer the top 20 feet of a water column. Spillway openings may be as much as 60 feet below the surface, which is too deep for fish to utilize.

At Foster Dam, the spillway has been equipped with a spillway weir, a movable gate on the up-river side (Figure 2.8-13). When juvenile fish are migrating, the dam is operated so that water flows over the top of the weir and out through the spill gate. Consequently, because fish do not have to dive down to find the spillway entrance, more fish could pass with less water spilled. Further, fish may escape predators above the dam if they are able to pass quickly. Currently, the Foster Dam spillway weir does not efficiently pass fish downstream.

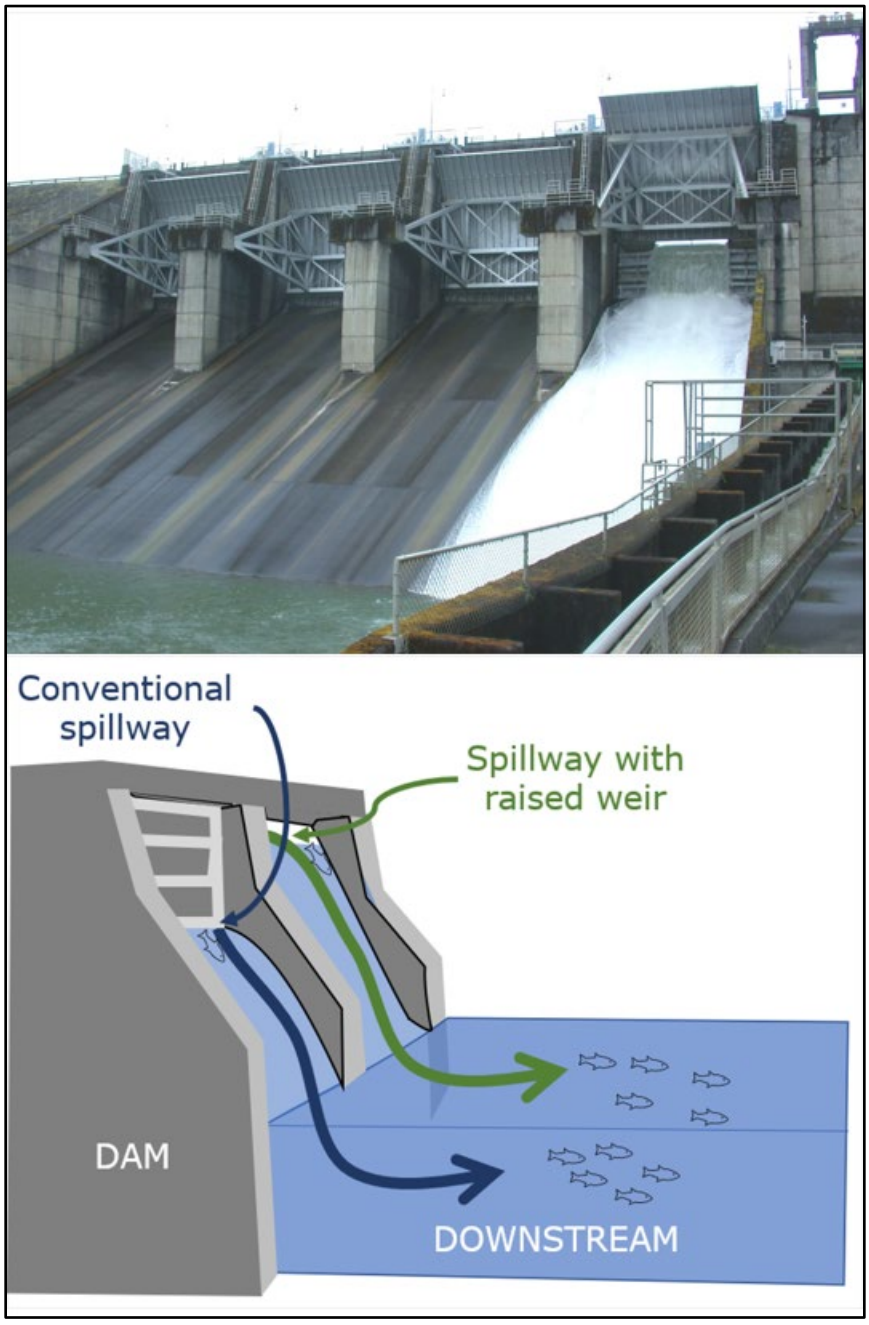

Figure 2.8-13 Foster Dam Fish Weir (top) and General Weir Configuration (bottom).

Structural downstream passage at Foster Dam would not be provided by a floating surface collector or a floating screen structure. A surface structural route would be constructed under Measure 392. This could include modification of the existing Foster Dam fish weir or construction of a surface collector with volitional downstream passage. The approach, feasibility, and design of the structure would be determined during the design phase. The design would utilize a flow rate of 500 to 800 cubic feet per second (cfs) and assumes ability to operate year-round between elevations 615 feet and 635 feet.

2.8.3.3 Pass Water over Spillways in Spring for Downstream Fish Passage (714)

Under this measure, water would be discharged using the spillway in late spring and early summer to increase passage and survival rates of juvenile UWR spring Chinook salmon and UWR winter steelhead passing downstream. The spillway outflow attracts migrating juvenile salmonids, which can use the spillway flows to pass the dam rather than passing through turbines. The dams at which this measure would be implemented depend on the alternative.

Factors considered in determination of facilities that warrant implementation of Measure 714 include the types of turbines, the hydraulic head of the dam, and the downstream biological impact due to elevated TDG levels from spill operations. Dams where this measure could be implemented include Big Cliff, Detroit, Green Peter, Cougar, Dexter, Lookout Point, Hills Creek, and Fall Creek Dams. The measure would be implemented on approximately May 1, or as soon as pool elevations allow, and would continue to be implemented until July 1, or as long as hydrology supports the operation. The maximum pool elevation would be less than or equal to 25 feet above spillway crest.

Structural modifications would be required to safely implement the Measure at Hills Creek Dam because the spillway was not designed for frequent use—it was designed to occasionally pass flow due to flooding events. Site-specific design and environmental compliance documentation would be prepared for these required modifications (Chapter 1, Introduction, Section 1.3.1.1, Programmatic Reviews and Subsequent Tiering under the National Environmental Policy Act).

2.8.3.4 Deep Spring Reservoir Drawdown for Downstream Fish Passage (720)

Under Measure 720, reservoir elevation would be decreased in the spring to 25 feet over a regulating outlet to improve downstream passage for migrating ESA-listed and other fish (Table 2.8-5).

Table 2.8-5. Reservoir Drawdown Target Elevations.

Dam	Target Elevation (feet) (25 feet above top of the outlet)[1]	Duration Held at this Elevation (weeks)
Detroit	1,370	6
Green Peter	780	3
Lookout Point	761	6
Hills Creek	1,446	6
Cougar Regulating Outlet	1,516	6
Cougar Diversion Tunnel	1,330	6

[1] These are targets. If a reservoir is lower, it would be filled to the target (inflow allowing) while meeting minimum flows; if higher, it would be drafted without exceeding maximum flows.

At Cougar Dam, this measure could alternatively involve drawing down to within 25 feet of the diversion tunnel at the bottom of the reservoir, depending on the alternative. A drawdown to the diversion tunnel at Cougar Dam would require several dam modifications to make this operation possible (Section 2.8.3.1, Deeper Fall Reservoir Drawdown for Downstream Fish Passage (40)). Site-specific design and environmental compliance documentation would be prepared for these required modifications (Chapter 1, Introduction, Section 1.3.1.1, Programmatic Reviews and Subsequent Tiering under the National Environmental Policy Act).

For operation of this measure, the reservoir would be held at minimum conservation pool elevation until March 1, then drafted down as needed to reach the target elevation by May 1. The target elevation would be held until June 15, as hydrology allows, to increase survival of juvenile UWR spring Chinook salmon and UWR winter steelhead during downstream passage.

2.8.4 Upstream Fish Passage Measures

Adult salmon migrate from the ocean to spawn in fresh water, migrating upstream to the river where they were hatched. Dams and other structures across the river block this upstream migration unless passage is provided.

The most common way for adult fish to get past a dam is to use a fish ladder, a water-filled structure that allows fish to pass up and over in a series of steps. Migrating salmon are attracted to the current at the base of an extended concrete stairway. The fish swim or jump from step to step. However, due to the height of the WVS high-head dams (between 93 feet and 463 feet tall), fish ladders are not practical. Where ladders are not practical, a trap and haul operation can be used to move adult fish upstream.

In trap and haul operations, migrating salmon are attracted to flow at the base of a fish ladder. They climb the ladder to a loading system where they wait in pools or tanks before transfer into specialized tankers or barges. These vehicles release the salmon into the river on the other side of the dam. This section describes the structural and operational measures to address upstream passage. Details specific to each basin/reservoir are provided where appropriate.

2.8.4.1 Provide Pacific Lamprey Passage Infrastructure (52)

THE DEIS HAS BEEN MODIFIED TO REVISE THE FOLLOWING INFORMATION IN THE FEIS

Lamprey swim differently than salmon, and passage facilities built for salmon present a difficult obstacle for this species. Square corners in the ladders are particularly difficult for lamprey. Lamprey grip onto vertical or horizontal surfaces then release, burst ahead, and grip again onto a near, up-ladder location. This passage method is precarious; they can lose their grip and be washed down the ladder.

Under Measure 52, the following features would be added to any new adult fish facilities constructed under Measure 722, or facility modifications and upgrades for ESA-listed species, including at the drop structures under Measures 639. These features would be implemented to benefit lamprey.

- rounded corners in turning pools
- rounded side edges of the ladder opening
- replacement of diffuser screens with lamprey-friendly screens

Other nature-based features could also be included in the design of ESA-listed adult fish facilities.

Site-specific design and environmental compliance documentation for these features would be included in the design and environmental compliance documentation for modifications or construction of ESA-listed adult fish facilities (Chapter 1, Introduction, Section 1.3.1.1, Programmatic Reviews and Subsequent Tiering under the National Environmental Policy Act).

END REVISED TEXT

2.8.4.2 Restore Upstream and Downstream Passage at Drop Structures (639)

A drop structure, also known as a low-head dam, grade control, sill, or weir, is a manmade structure, typically small and built on minor streams, to pass water to a lower elevation. Unlike most dams, drop structures are usually not built for water impoundment, diversion, or to raise the water level. Drop structures are built to control the velocity and energy of water as it flows from higher to lower elevation and can also help control erosion (Figure 2.8-14). However, drop structures are nearly impossible for fish to traverse if they were constructed without fish passage measures.

Figure 2.8-14. Drop Structure Downstream of the Fern Ridge Dam.

Under Measure 639, infrastructure would be improved downstream of Fern Ridge Dam at Monroe, Stroda, and Cox Butte drop structures to provide improved fish passage. This measure is intended to provide passage for fish, including juvenile UWR spring Chinook salmon and other aquatic organisms, along the mainstem Long Tom River between the confluence with the Willamette River and Fern Ridge Dam.

Infrastructure improvements could include installation of fish ladders, notching or other direct modifications to drop structures, installation of bypass channels, or drop structure removal and replacement with riffle and pool systems. These improvements would include design features to provide Pacific lamprey passage (Section 2.8.4.1, Provide Pacific Lamprey Passage Infrastructure (52)). Site-specific design and environmental compliance documentation for these features would be included in the design and environmental compliance documentation for construction to restore passage at drop structures (Chapter 1, Introduction, Section 1.3.1.1, Programmatic Reviews and Subsequent Tiering under the National Environmental Policy Act).

2.8.4.3 Construct Adult Fish Facilities (722)

Measure 722 would include the construction of new adult fish facilities at Green Peter, Hills Creek, and Blue River Dams. Facilities would be similar to the Cougar Dam facility (Figure 2.8-15).

Figure 2.8-15. Cougar Dam Adult Fish Facility.

The approach and design of the facility and/or upgrades would be determined during the construction design phase. Site-specific design and environmental compliance documentation for these features would be included in the design and environmental compliance documentation for construction of each new adult fish facility (Chapter 1, Introduction, Section 1.3.1.1, Programmatic Reviews and Subsequent Tiering under the National Environmental Policy Act). These facilities would be designed with the flexibility to provide adequate water supply, provide normative temperatures in the fish ladder, and attract upstream migrant fish in a timely manner during the spring (Figure 2.8-16).

Figure 2.8-16. Fish Ladder at the Cougar Dam Adult Fish Facility.

2.8.5 Interim Operations

THE DEIS HAS BEEN MODIFIED TO REVISE THE FOLLOWING INFORMATION IN THE FEIS

USACE evaluated operations for interim implementation until full implementation of a given alternative similar to the injunction operations ordered by the District Court in *Northwest Environmental Defense Center, et al. v. United States Army Corps of Engineers, et al.,* No. 3:18-cv-00437-HZ, (D. Or. September 2021) (Table 2.8-6). Interim Operations are not a separate alternative but would occur under all action alternatives except Alternative 1. These operations would not be implemented under the No-action Alternative.

The Interim Operations have been revised since the DEIS was published (Table 2.8-6). Revisions include the following:

- There would be no Interim Operations at Fall Creek Dam.
- Operations throughout the WVS would include the 2008 NMFS Biological Opinion minimum flows until new flow targets are developed.

Table 2.8-6. Interim Operations.

Description of Interim Operations by Dam Location	Duration of Operation	Priority Outlet	Target Elevation
Detroit			
Spring downstream fish passage and operational downstream temperature management	mid-March to Fall	Spillway/ Turbines/Regulating Outlets	N/A
Nighttime regulating outlet prioritization for improved downstream fish passage	Winter	Upper Regulating Outlets/ Lower Regulating Outlets	Less than 1,500 feet
Big Cliff			
Spread spill across spill bays to reduce downstream TDG exceedances	Year-round	Spillway	Discharges greater than powerhouse capacity
Green Peter			
Outplanting plan for reintroduction of adult Chinook salmon above Green Peter Dam	Summer	N/A	N/A
Utilize spillway for improved downstream fish passage in the spring; perform spill operation until May 1 or for 30 days, whichever is longer	mid-March to April/May	Spillway	Greater than 971 feet (spillway crest)
Deep drawdown and regulating outlet prioritization for improved downstream fish passage	Gradual drawdown beginning September 1; rapid drawdown beginning mid-October and ending approximately mid-December	Regulating Outlets	780 feet
Foster			
Delay refill and utilize spillway in the spring for improved downstream fish passage; use the fish weir in the summer for improved downstream temperature management and upstream fish migration/passage	February 1 to June 15 June 16 to approximately late-July (similar to No-action Alternative)	Spillway (spring) Fish Weir (summer)	613 feet (February to May) 637 feet (May to July)
Utilize the spillway for improved downstream fish passage in the fall	October 1 to December 5	Spillway	613 feet
Cougar			
Deep drawdown and regulating outlet prioritization for improved downstream fish passage	Early November to December 15	Regulating Outlets	1,505 feet
Delayed reservoir refill and regulating outlet prioritization for improved downstream fish passage	Feb to May/June	Regulating Outlets	1,520 to 1,532 feet

Description of Interim Operations by Dam Location	Duration of Operation	Priority Outlet	Target Elevation
Hills Creek			
Nighttime regulating outlet prioritization for improved downstream fish passage	Approximately November to March	Regulating Outlets	Less than 1,460 feet
Lookout Point			
Utilize spillway for improved downstream fish passage in the spring; regulating outlet use in the fall for downstream temperature management	mid-March to May/June (spring) July to October 15 (Regulating Outlets)	Spillway/ Regulating Outlets	890 to 893 feet spring spill Less than 887.5 feet late summer/fall regulating outlets
Deep drawdown and regulating outlet prioritization for improved downstream fish passage	November 15 to December 15	Regulating Outlets	750 feet
Minimum Flow Targets			
Operate under 2008 Biological Opinion flow targets throughout the Willamette River Basin	Year-round	N/A	N/A

N/A = not applicable

TDG = total dissolved gas

The timing and duration of Interim Operations would vary depending on a given alternative. Interim operations could extend to nearly the 30-year implementation timeframe under Alternatives 1, 2A, 2B, 4, and 5 (Figure 2.8-17). However, Interim Operations under Alternative 3A and Alternative 3B may not be fully implemented or required because long-term operational strategies for these alternatives are intended to be implemented immediately upon Record of Decision finalization.

The operations would be conducted until the structural measures under the alternative selected in the Record of Decision supersede or replace the operations. The operations, modeled after the injunction, have been slightly refined through adaptive management during implementation (Appendix N, Implementation and Adaptive Management Plan). Details for each of these operations are provided in Appendix A, Alternatives Development.

These operations are designed to improve fish passage and water quality until the structural or long-term operational measures under an alternative can be implemented.

Figure 2.8-17. Example Implementation Timeline Illustrating Interim Operations Correlation with Long-term Measures for Downstream Fish Passage and Temperature Management.

Notes:

This figure is a representation, and dates do not reflect exact transition timeframes. The figure is intended to illustrate that Interim Operations (green) would be in place until a long-term measure (blue) is online. The blue arrows depict activities into the future; green bands indicate when the Interim Operation ends because the long-term activity is being implemented. The green band in the Detroit Dam and Reservoir category overlaps with the blue arrow for temperature management because a lag would occur between selective withdrawal structure construction and operation and floating screen structure construction and operation.

Interim Operations were not developed as a complete, stand-alone, practicable alternative because these operations would not contain sufficient fish survival and passage rates as demonstrated through modeling of Alternative 3A and Alternative 3B operations. Operational passage and survival measures such as deep drawdowns and fish collection and transport were incorporated into the reasonable range of alternatives based on modeling results, which presents a more realistic implementation scenario targeting fish impact issues than would occur under an alternative comprised solely of Interim Operations.

Structural measures require additional design, site-specific NEPA evaluation, permitting, planning, construction, etc., delaying implementation. Effects of the Interim Operations are analyzed for the 30-year implementation timeframe, ensuring a full range of potential impacts from these operations are analyzed because duration of an operation at a particular location is uncertain. Interim Operations analyses did not include consideration of the impacts assessed under action Alternatives 2A, 2B, 3A, 3B, 4, and 5 because Interim Operations will be implemented in succession with, and not in addition to, action alternative implementation.

USACE would comply with NEPA and other environmental compliance requirements if operations are modified through the adaptive management process.

2.9 Alternatives Considered but Eliminated from Further Review

As noted above, measures were combined to form distinct alternatives with a particular management strategy. Two potential alternatives were considered but eliminated from further review.

A hydropower-only alternative was determined not to be distinctive enough from other action alternatives considered and was, therefore, eliminated from further review. After development of the alternatives and identification of measures to be implemented under each of the alternatives, USACE determined that a hydropower-only alternative was not necessary because measures that would benefit hydropower production were integrated into other action alternatives.

Conversely, an alternative to eliminate hydropower (a Congressionally authorized purpose) was also eliminated from further review for several reasons as described in Appendix A, Alternatives Development, Attachment 1, Initial Measures Screening.

END REVISED TEXT

2.10 Alternatives Considered in Detail and the Preferred Alternative

The following sections describe the alternatives evaluated in detail in Chapter 3, Affected Environment and Environmental Consequences and in Chapter 4, Cumulative Effects. Alternatives considered in detail include the No-action Alternative (NAA) and Alternative 5, Preferred Alternative. All the action alternatives described below would meet the USACE purpose and need for the Proposed Action, which is to continue operations and maintenance of

the WVS while operating the system in accordance with the eight Congressionally authorized purposes and in compliance with the ESA and all other applicable treaties, laws, and regulations (Section 2.4, Purpose of and Need for the Proposed Action).

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Action alternatives are distinguished from the NAA because they represent WVS management that would differ from the scope of existing operations and maintenance. Action alternatives include actions, or measures, that would modify the scope of operations and maintenance in comparison to no action—or not selecting and implementing an alternative that differs from existing WVS management.

END NEW TEXT

The measures outlined in Section 2.8, Final Measures Developed for the Action Alternatives, are incorporated under each alternative as applicable. Summary tables of the measures incorporated into an alternative are provided at the end of each alternative description.

A summary table comparing measures under each alternative is provided at the end of this chapter (Table 2.10-14).

2.10.1 Adaptive Management Common to All Alternatives

Adaptive management would be applied to any selected alternative. An Adaptive Management Plan would be prepared that outlines the governance framework[7] to be used for adaptive decision-making, the annual adaptive management process for engaging with stakeholders, and the process to incorporate new learning into management priorities[8]. The Adaptive Management Plan would also outline the decision criteria relevant to monitoring and evaluating the success of management measures at achieving stated objectives (Appendix N, Implementation and Adaptive Management Plan).

2.10.2 Existing Operations Common to All Alternatives

The following operations would continue under all alternatives.

[7] A governance framework as part of the Adaptive Management Plan will specifically describe how USACE will continue to work the WATER Forum to design a robust research, monitoring, and evaluation plan to inform decision-making during implementation of the selected alternative.

[8] A summary of the Implementation and Adaptive Management Plan is provided in Appendix A, Alternatives Development, Attachment 4, DEIS Chapter 5, Preferred Alternative Identification and Implementation . Details on this plan are provided in Appendix N, Implementation and Adaptive Management Plan.

2.10.2.1 Fall Creek Reservoir Drawdown Operations

The annual drawdown at Fall Creek Reservoir would continue under all alternatives. Fall Creek Reservoir would continue to be drawn down to its lowest outlet, elevation 690 feet, for a few weeks in November lasting sometime into December. The actual operation would vary based on when the majority of fish are observed to be present and are passing the dam.

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2.10.2.2 Environmental Flow Operations

USACE would continue to implement the environmental flow pulses, commonly referred to as e-flows, under all alternatives (Chapter 1, Introduction, Section 1.11.2.4, Operational Considerations for Environmental Flows). USACE reservoir regulators and operators would manage discharges from the WVS when possible to achieve e-flow volumes.

2.10.2.3 Maintenance, Repair, Replacement, and Rehabilitation Operations

Includes a spectrum of activities that range from regular maintenance activities, such as repainting a rusty guardrail or replacement of lightbulbs, to major maintenance and rehabilitation activities such as the repair, replacement, or rehabilitation of entire facility components (e.g., the replacement of the slide gate seals or repair of hydraulics in a dam). These collective activities occur at all facilities in the WVS, including within and around the dams and powerhouses, adult fish facilities, and hatcheries (Chapter 1, Introduction, Section 1.11.3, Operation, Maintenance, Repair, Replacement, and Rehabilitation).

END NEW TEXT

2.10.2.4 Continued Operations of Existing Adult Fish Facilities

USACE would continue to operate and maintain existing adult fish facilities located at Dexter, Foster, Fall Creek, Minto (downstream of Big Cliff), and Cougar Dams in accordance with the Willamette Fish Operation Plan (Chapter 1, Introduction, Section 1.11.4, Coordination of Willamette Valley System Operations with Other Agencies) (Figure 2.8-15 and Figure 2.8-16). Generally, adult fish facilities would be operated annually between April and October.

2.10.3 No-action Alternative

THE DEIS HAS BEEN MODIFIED TO REVISE THE FOLLOWING INFORMATION IN THE FEIS

Per CEQ regulations, the NAA for program reviews is defined as the continuation of ongoing programs under existing legislation and regulations with no change in current management direction or level of management intensity (CEQ 1981 at Number 3). Under the NAA, WVS operations and maintenance would be consistent with 2019 operations and maintenance during the 30-year implementation timeframe (Table 2.10-1).

Table 2.10-1. No-action Alternative Measures and Locations.

Measure	FRN	CTG	DOR	DEX	LOP	FCR	HCR	CGR	BLU	FOS	GPR	BCL	DET
Flow Operations	–	–	–	–	–	–	–	–	–	–	–	–	–
2008 NMFS Biological Opinion Targets	X	X	X	X	X	X	X	X	X	X	X	X	X
Augment flows using the inactive or power pool	–	–	–	–	–	–	–	–	–	–	X	–	–
Water Quality Operations	–	–	–	–	–	–	–	–	–	–	–	–	–
Use spillway to release warm surface water to manage downstream temperatures	–	–	–	–	–	–	–	–	–	X	–	–	X
Strategic use of outlets to meet temperature targets when possible	–	–	–	–	–	X	–	–	–	–	–	–	X
Selective withdrawal structure operation to manage downstream temperatures	–	–	–	–	–	–	–	X	–	–	–	–	–
Spread spill across spill bays to reduce TDG	–	–	–	X	–	–	–	–	–	–	–	X	–
Discharge water through the powerhouse to reduce/dilute the TDG generated from use of the spillways or regulating outlets	–	–	–	X	X	–	X	X	–	X	X	X	X
Downstream Passage Operations	–	–	–	–	–	–	–	–	–	–	–	–	–
Pass fish over spillway	–	–	–	–	–	–	–	–	–	X	–	–	–
Drawdown to pass fish through regulating outlets (lowest outlet)	–	–	–	–	–	X	–	–	–	–	–	–	–
Upstream Passage Operations	–	–	–	–	–	–	–	–	–	–	–	–	–
Continued operation and maintenance of existing adult fish facility	–	–	–	X	–	X	–	X	–	X	–	X	–
Maintain fish release sites	–	–	–	–	X	X	X	X	–	X	–	–	X
Actions Common to All Alternatives	–	–	–	–	–	–	–	–	–	–	–	–	–
Adaptive management	X	X	X	X	X	X	X	X	X	X	X	X	X
Fall Creek Reservoir drawdown	–	–	–	–	–	X	–	–	–	–	–	–	–
Environmental flows	–	–	–	X	X	X	X	X	–	–	–	X	X
Maintenance of WVS facilities	X	X	X	X	X	X	X	X	X	X	X	X	X
Continued operation of existing adult fish facilities	–	–	–	X	–	X	–	X	–	X	–	X	–

FRN = Fern Ridge Dam
CTG = Cottage Grove Dam
DOR = Dorena Dam
DEX = Dexter Dam
LOP = Lookout Point Dam
FCR = Fall Creek Dam
HCR = Hills Creek Dam
CGR = Cougar Dam
BLU = Blue River Dam
FOS = Foster Dam
GPR = Green Peter Dam
BCL = Big Cliff Dam
DET = Detroit Dam

The NAA does not include operations or structural improvements implemented as a result of the ongoing litigation and court-ordered injunction, issued in August 2021 (Chapter 1, Introduction, Section 1.12.3, Court-ordered Injunction Measures), because those operations were not in place as of April 2019.

No large-scale construction is contemplated under the NAA. WVS configurations would remain unchanged except for necessary scheduled and routine maintenance and unscheduled and non-routine maintenance activities and structural modifications (Chapter 1, Introduction, Section 1.11.3, Operation, Maintenance, Repair, Replacement, and Rehabilitation). However, such maintenance would remain consistent with current "management intensity."

All ongoing, scheduled, and routine maintenance actions for the USACE-managed infrastructure in the Willamette River Basin and all USACE-managed structural features, including those recently constructed or that were reasonably foreseeable when the EIS was initiated in 2019, are included under the NAA. However, it is unknown where activities associated with maintenance would occur, the extent of these activities, or the seasonality of these activities.

This alternative would not meet the purpose of and need for the Proposed Action because the current operating conditions of the WVS do not adequately protect ESA-listed fish species, specifically UWR spring Chinook salmon and UWR winter steelhead or designated critical habitat for these species.

The 2018 hydrology dataset and information on waters within the WVS were used as input for the EIS reservoir regulation model. Modeling for the EIS analyses began in April 2019, which is the date establishing benchmark operations for alternative analyses comparisons. This benchmark was necessary given the length of time needed to complete the EIS and several temporary operational changes that were shifting throughout EIS development due to temporary dam safety operations and litigation (Chapter 1, Introduction, Section 1.12.2, Dam Safety and Interim Risk Reduction Measures; Section 1.12.3, Court-ordered Injunction Measures).

Each of the 13 dams and reservoirs within the WVS are operated according to a Water Control Manual that is authorized by Engineering Regulation 1110-2-240 (Chapter 1, Introduction, Section 1.10, Congressionally Authorized Purposes). These manuals provide specific information to meet the congressionally authorized purposes of flood risk management, generation of hydropower, fish and wildlife, recreation, navigation, irrigation, municipal and industrial water supply, and water quality. The manuals also detail operations, procedures, and rule curves for each dam and reservoir.

The Water Control Manual would be applied under the NAA with minor variations made in response to changes in Willamette River Basin conditions and new information related to system operations and technology, the Affected Environment, polices, and regulations.

END REVISED TEXT

2.10.3.1 No-action Alternative Measures

Stream Flow

Under the NAA, water control annual planning would continue to be implemented (Chapter 1, Introduction, Section 1.11.2, Water Control Annual Planning). This planning process would determine how the Congressionally authorized purposes would be accomplished during the conservation season[9] based on the water supply forecast and the 2008 NMFS Biological Opinion targets.

Operational flow targets at Salem would continue to be set on April 1, based on a storage forecast (i.e., adequate[10], abundant, insufficient, or deficit) for mid-May (May 10 to May 20) (Table 2.10-2 and Table 2.10-3).

Water from the power pool at Green Peter Reservoir would continue to be used on an as-needed basis, depending on hydrologic conditions, to augment flow in the South Santiam River Subbasin and mainstem Willamette River.

Unknown Photo Credit (USACE Media Images Database)

The McKenzie River—a Willamette River tributary—drains the heavily forested west slopes of the Cascade Range.

[9] The term ‘conservation season’ encompasses spring, summer, and fall seasons and is composed of 'conservation storage season' and 'conservation use season.' The conservation season is in contrast to the flood season.

[10] Appendix D, Water Quality Analysis, Water Temperature and Total Dissolved Gas Methodology, defines “Adequate” and “Abundant” water years, and describes how flow objectives can be decreased in “Deficit” water years.

Table 2.10-2. Mainstem Willamette Flow Objectives.

Time Period	7-Day Moving Average[1] Minimum Flow at Salem (cfs)[3]	Instantaneous Minimum Flow[2] at Salem (cfs)[3]	Minimum Flow[2] at Albany (cfs)[4]
April 1 - 30	17,800	14,300	–
May 1 - 31	15,000	12,000	–
June 1 - 15	13,000	10,500	4,500[3]
June 16 - 30	8,700	7,000	4,500[3]
July 1 - 31	–	6,000[3]	4,500[3]
August 1 - 15	–	6,000[3]	5,000[3]
August 16 - 31	–	6,500[3]	5,000[3]
September 1 - 30	–	7,000[3]	5,000[3]
October 1 - 31	–	7,000	5,000

[1] An average of the mean daily flows in cubic feet per second (cfs) observed over the prior 7-day period.

[2] Congressionally authorized minimum flows (HD531). September flows were extended into October.

[3] USGS gage 14191000 Willamette River at Salem, Oregon

[4] USGS gage 14174000 Willamette River at Albany, Oregon

Table 2.10-3. Minimum and Maximum Tributary Flow Objectives.

Dam	Period	Primary Use	Minimum Flow (cfs)[1]	Maximum Flow (cfs)[2]
Hills Creek	September 1 - January 31	Migration and rearing	400	–
	February 1 - August 31	Rearing	400	–
Fall Creek	September 1 - October 15	UWR Chinook salmon spawning	200	400 through September 30, when possible
	October 16 - January 31	UWR Chinook salmon incubation	50[3]	–
	February 1 - March 31	Rearing	50	–
	April 1 - May 31	Rearing	80	–
	June 1 - June 30	Rearing/adult migration	80	–
	July 1 – August 31	Rearing	80	–
Dexter	September 1 - October 15	UWR Chinook salmon spawning	1,200	3,500 through September 30, when possible
	October 16 – January 31	UWR Chinook salmon incubation	1,200[3]	–
	February 1 – June	Rearing	1,200	–
	July 1 – August 31	Rearing	1,200	–
Big Cliff	September 1 – October 15	UWR Chinook salmon spawning	1,500	3,000 through September 30, when possible
	October 16 – January 31	UWR Chinook salmon incubation	1,200[3]	–

Dam	Period	Primary Use	Minimum Flow (cfs)[1]	Maximum Flow (cfs)[2]
	February 1 – March 15	Rearing/adult migration	1,000	–
	March 16 – May	UWR steelhead spawning	1,500	3,000
	June 1 – July 15	UWR steelhead incubation	1,200[3]	–
	July 16 – August 31	Rearing	1,000	
Foster	September 1 – October 15	UWR Chinook salmon spawning	1,500	3,000 through September 30, when possible
	October 16 – January 31	UWR Chinook salmon incubation	1,100[3]	–
	February 1 – March 15	Rearing	800	–
	March 16 – May	UWR steelhead spawning	1,500	3,000
	May 16 – June	UWR steelhead incubation	1,100[3]	–
	July 1 – August 31	Rearing	800	–
Blue River	September 1 – October 15	UWR Chinook salmon spawning	50	–
	October 16 – January 31	UWR Chinook salmon incubation	50	–
	February 1 – August 31	Rearing	50	–
Cougar	September 1 – October 15	UWR Chinook salmon spawning	300	580 through September 30, when possible
	October 16 – January 31	UWR Chinook salmon incubation	300	–
	February 1 – May	Rearing	300	–
	June 1 – June 30	Rearing/adult migration	400	–
	July 1 – July 31	Rearing	300	–
	August 1 – August 30	Rearing	300	–

[1] When a reservoir is at or below minimum conservation pool elevation, the minimum outflow would equal inflow or the Congressionally authorized minimum flows, whichever is higher.

[2] Maximum flows are intended to minimize the potential for spawning to occur in stream areas that might subsequently be dewatered at the specified minimum flow during incubation.

[3] USACE would attempt to avoid prolonged releases in excess of the recommended maximum spawning season discharge to avoid spawning in areas that would require high incubation flows that would be difficult to achieve and maintain throughout the incubation period. When maximum flow objectives are exceeded for a period of 72 hours or longer, the WATER Forum will review available monitoring information (e.g., regarding redd deposition in relation to flow rates), projected runoff, and reservoir storage, and will formulate a recommendation for an appropriate and sustainable incubation flow rate prior to the initiation of the subsequent incubation period.

Water Quality Operations

Under the NAA, water quality management objectives would continue to include management of instream water temperature and reduction in TDG concentrations in river reaches below WVS dams as described below.

Temperature Management

There are no water temperature goals set for the WVS at Salem. The focus, instead, would be on in-tributary conditions (directly downstream of USACE dams) where spawning, rearing, and incubation of ESA-listed anadromous fish occurs (Table 2.10-4).

Table 2.10-4. Operational Temperature Management Strategies.

Dam	Strategy
Cougar	Water temperature control tower operation would occur to support water temperature goals for ESA-listed species. Cougar Dam is the only dam in the WVS with selective withdrawal capabilities to manage downstream water temperatures.
Detroit	Downstream temperature management would start June 1 or as soon as the reservoir reaches the spillway after June 1 by blending flow released over the spillway with flow released through the upper regulating outlets or through turbines. Mixing would occur in Big Cliff Reservoir before water is passed downstream through Big Cliff Dam.
Fall Creek	Operational water temperature management would be informally conducted through a combination of the fish horns[1] and regulating outlets. The main objective for Fall Creek Dam temperature management is to attract adult fish back to the fish facility located at the base of Fall Creek Dam.
Foster	The Foster Dam fish weir would be used during approximately June 15 through approximately July 30 annually to pass warm surface water from the reservoir to blend with the cold water released through the turbines to attract adult salmon back to the adult fish facility. This operation would be conducted to improve adult salmon collection at the Foster Dam adult fish facility. Without this fish weir operation, the river downstream of Foster Dam would remain cold due to cold water released through the turbines and would create a temperature block for returning adult salmon, meaning, returning adult salmon would remain downstream instead of returning to the adult fish facility.

[1] Fish horns are levels of fish passage conduits on the upstream face of Fall Creek Dam (see Chapter 3, Affected Environment and Environmental Consequences, Section 3.5, Water Quality).

Total Dissolved Gas

Under any alternative, including the NAA, the amount of TDG generated through dam operations would be highly dependent on the amount of water discharged, the dam outlets

used to pass water, and the water temperatures observed during a particular operation. To reduce high levels of TDG, the general operating guidance under the NAA would be as follows:

- Discharge water through the powerhouse to reduce/dilute TDG generated from use of the spillways or regulating outlets.
- Under high flows, distribute the discharge over as many spill bays as possible with a uniform pattern, rather than operating all discharge through one bay.
- TDG generated at high-head peaking dams would likely decrease before being passed through the downstream re-regulating dam. USACE would focus on using the powerhouse to further reduce/limit TDG from being passed downstream under the NAA.

Downstream Fish Passage Operations

Under the NAA, there are two locations where downstream fish passage operations would occur. Although a surface outlet is available for fish to pass at other dams, the use of those outlets is for temperature management, not for fish passage.

Fall Creek Reservoir would be drawn down to its lowest outlet for up to a few weeks in the late fall. The operation typically occurs in November or early December. The timing of the operation would vary based on hydrologic conditions and on when fish are present and are passing the dam.

At Foster Reservoir, fish pass downstream via the spillway. The analysis under the NAA considers this operation as releasing half of the flow over the spillway from March 16 through June 16 and then again from October 16 through December 16. Additionally, the NAA includes releasing 300 cfs over the spillway from June 16 through August 16.

Upstream Fish Passage Operations

Under the NAA, the adult fish facilities would continue to be operated and maintained in accordance with the Willamette Fish Operation Plan (Chapter 1, Introduction, Section 1.11.4, Coordination of Willamette Valley System Operations with Other Agencies). The Plan is developed annually by USACE in coordination with the Bonneville Power Administration (BPA) as well as Federal, state, and tribal fish agencies and other partners through the Willamette Fish Passage Operations and Maintenance (WFPOM) forum.

Generally, adult fish facilities are operated annually between April and October. However, the Willamette Fish Operation Plan describes year-round operations and maintenance activities of the facilities as coordinated through WFPOM to protect and enhance anadromous and resident fish species listed as endangered or threatened under the ESA as well as non-listed species of concern, including Pacific lamprey. The Plan guides USACE activities related to fish protection and passage at the 13 WVS dams and reservoirs.

Willamette River Basin Bank Protection Program

Under the NAA, when funding is available, USACE would continue to maintain and repair the USACE-maintained bank protection structures in the Willamette River Basin (Chapter 1, Introduction, Section 1.9.1, Willamette River Basin Bank Protection Program; Appendix S, USACE-managed Dams, Reservoirs, and Bank Protection Structures).

Willamette Hatchery Mitigation Program

The Hatchery Mitigation Program would continue to be operated under the NAA (Section 1.9.2, Willamette Hatchery Mitigation Program).

Hydropower Generation

Under the NAA, hydropower generation would occur as described in Chapter 1, Introduction, Section 1.10.3, Hydropower and Section 1.11.2.2, Operational Considerations for Hydropower.

Municipal and Industrial Water Use

THE DEIS HAS BEEN MODIFIED TO REVISE THE FOLLOWING INFORMATION IN THE FEIS

The estimated 2050 Willamette River Basin municipal and industrial demand of 73,300 acre-feet of stored water would be applicable under NAA operations (USACE 2019a).

END REVISED TEXT

Agricultural Irrigation Water Use

The NAA includes the existing volume of U.S. Bureau of Reclamation (BOR)-issued water service contracts as of October 2023 (82,765 acre-feet of water per year, or approximately 5 percent of the conservation storage) because of the existing cap on irrigation contracts required under the 2008 NMFS Biological Opinion.

At the current low level of use for water service contracts, USACE does not make special operational adjustments. However, in deficit water years, the NMFS Biological Opinion Reasonable and Prudent Alternative (RPA) requires BOR to curtail water service contract diversions. In other years, the RPA requires USACE to release more than minimum flow to ensure water service contractees do not use water intended for fish purposes from Fern Ridge or Detroit Dams. These conditions would remain in effect under the NAA.

In deficit water years, as defined in the 2008 NMFS Biological Opinion, partial water supply or no water supply may be available to satisfy some existing and new irrigation contracts. Water deliveries may be ceased or curtailed under these conditions, per RPA 3.4, under the NAA.

2.10.4 Action Alternatives

2.10.4.1 Measures and Actions Common to All Action Alternatives

Measures common to all action alternatives are those that would be implemented regardless of the action alternative selected. Measures common to all action alternatives include both operational measures and structural measures in multiple locations throughout the WVS. They also include new measures, existing operations, and operations and maintenance activities that would be carried forward (Table 2.10-5).

Table 2.10-5. Measures and Actions Common to All Action Alternatives.

Measure or Action	New or Existing Measure	Location
Gravel Augmentation Below Dams	New	North Santiam, South Santiam, and McKenzie River Subbasins below Big Cliff, Foster, Cougar, and Blue River Dams
Adapt Willamette Hatchery Mitigation Program	New	North Santiam, South Santiam, McKenzie, and Middle Fork Willamette River Subbasins
Maintain Revetments considering Nature-based Engineering or Alter Revetments for Aquatic Ecosystem Restoration	New	Basin-wide
Maintenance of Existing and New Fish Release Sites above Dams	New	North Santiam, South Santiam, South Fork McKenzie, and Middle Fork Willamette River Subbasins
Augment Instream Flows using Power or Inactive Pool	New	Basin-wide
Fall Creek Dam Drawdown	Existing	Fall Creek Dam
U.S. Bureau of Reclamation Irrigation Water Marketing Program	Existing	Basin-wide
Maintenance of WVS Facilities	Existing	Basin-wide
Environmental Flows	Existing	Basin-wide
Operation and Maintenance of Existing Adult Fish Facilities	Existing	Dexter, Foster, Fall Creek, Minto (downstream of Big Cliff), and Cougar Dams
Adaptive Management	Existing	Basin-wide

Some actions would also continue under all action alternatives that are not specified as measures, such as adaptive management and scheduled and routine maintenance and unscheduled and non-routine maintenance activities and structural modifications (Chapter 1, Introduction, Section 1.11.3, Operation, Maintenance, Repair, Replacement, and Rehabilitation).

THE DEIS HAS BEEN MODIFIED TO INCLUDE THE FOLLOWING INFORMATION IN THE FEIS

The following information describes measures that would be newly implemented under the action alternatives. Except for the BOR Irrigation Water Marketing Program, other actions noted in Table 2.10-5 are described in Chapter 1, Introduction. BOR would initiate consultations with NMFS to issue irrigation contracts in excess of 95,000 acre-feet when demand for irrigation contracting increases under all action alternatives during the 30-year implementation timeframe. The total agricultural irrigation uses of stored water is assumed to be 255,385 acre-feet, which consists of the 2050 level of new irrigation water service contracts forecasted in the Willamette Basin Review Feasibility Study (USACE 2019a).

END NEW TEXT

Maintain Revetments Considering Nature-based Engineering or Alter Revetments for Aquatic Ecosystem Restoration (9)

Under Measure 9, USACE would continue to maintain bank protection structures throughout the Willamette River Basin, as funded (Chapter 1, Introduction, Section 1.7, U.S. Army Corps of Engineers-managed Dams, Reservoirs, and Bank Protection Structures) (Appendix S, USACE-managed Dams, Reservoirs, and Bank Protection Structures).

Existing information would be used to identify projects with the greatest potential for improving habitat without posing an increased flood risk; however, additional technical analyses would likely be necessary to further evaluate potential effects of proposed modifications. Nature-based methods would be implemented by decreasing hard surfaces (e.g., rock) to provide habitat for various fish and wildlife species within river margins and riparian zones to the extent that authorized purposes are maintained.

Post-construction monitoring would also be conducted to ensure restoration projects perform as intended, both biologically and for bank protection. This information would also be used to investigate implementation of future bank protection structure alterations.

This measure would be implemented as part of maintenance actions and would include:

- Consideration of nature-based engineering options as part of any USACE maintenance activity for USACE-managed bank protection structures.
- Adherence to standard engineering practices for system maintenance.

In addition, USACE would seek opportunities to work with non-Federal sponsors to conduct studies and to develop processes for environmental restoration projects that would substantially alter USACE or non-Federally managed WVS bank protection structures. Continuing Authority Program Section 1135, Project Modifications for Improvement of the Environment, is the only authority that allows USACE to alter a Federal project for ecosystem restoration purposes (WRDA 1986).

Under Continuing Authority Program studies, USACE must have a non-Federal sponsor to cost-share the project, acquire all necessary real estate permissions, and agree to operate and maintain the project in perpetuity. Working with NMFS and USFWS, as well as local agencies and stakeholders, USACE would seek non-Federal sponsors for substantial alterations to provide ecological improvements to one or more structures that are determined to be in the Federal interest using Aquatic Ecosystem Restoration metrics (cost per habitat unit). The requirement to find a sponsor would severely limit the ability to carry out large scale changes under Measure 9.

Project-specific design and environmental compliance documentation would be prepared for Continuing Authority Program studies (Chapter 1, Introduction, Section 1.3.1.1, Programmatic Reviews and Subsequent Tiering under the National Environmental Policy Act).

Gravel Augmentation Below Dams (384)

Operation of the WVS is restricting sediment transport and subsequently degrading habitat for ESA-listed and other native fish below dams. Measure 384 would develop and implement a sediment nourishment program below targeted WVS Dams. The program would first involve surveying below the dams to determine where gravel placement could increase usable spawning areas while considering channel bathymetry[11], water temperature, hydrology, and hydraulics. Then, clean, round river gravel would be added to the areas of wetted streambeds that were identified to best 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 spring Chinook salmon and UWR winter steelhead, and to the maximum extent feasible, locally sourced. Site-specific design and environmental compliance documentation would be prepared for each location prior to implementation of gravel augmentation (Chapter 1, Introduction, Section 1.3.1.1, Programmatic Reviews and Subsequent Tiering under the National Environmental Policy Act).

Adapt Willamette Hatchery Mitigation Program (719)

The overall goal of this measure would be to adjust production of WVS hatcheries for mitigation obligations and conservation needs after demonstrated improvements to fish access to habitat

[11] Bathymetry is the measurement of water depth.

above dams (i.e., Measure 719 would only be implemented if passage provides increased access to habitat) (Appendix A, Alternatives Development).

Congress authorized USACE to mitigate for construction of the WVS, recognizing that the dams would block habitat access for migratory fish and inundate habitat and existing hatcheries. USACE has historically implemented a hatchery mitigation program to produce and release hatchery salmon, steelhead trout, and game fish in the Willamette River Basin (Chapter 1, Introduction, Section 1.9.2, Willamette Hatchery Mitigation Program) (Figure 2.10-1). The purpose of the Hatchery Mitigation Program is to supplement the natural origin population and to support reintroduction of spring UWR Chinook salmon in the WVS due to very low abundances, high extinction risks, and lack of fish passage at some WVS dams.

Figure 2.10-1. McKenzie River Fish Hatchery Near Leaburg, Oregon.

Congress did not define detailed goals for mitigation, including the level of fish production to be achieved. Current levels of mitigation production are defined in HGMPs prepared by Oregon Department of Fish and Wildlife and USACE (Chapter 1, Introduction, Section 1.9.2, Willamette Hatchery Mitigation Program).

THE DEIS HAS BEEN MODIFIED TO INCLUDE THE FOLLOWING INFORMATION IN THE FEIS

Anticipated reductions in hatchery production are recognized in the HGMPs as a result of improved fish passage at WVS dams. Potential reductions were not evaluated under this measure under any alternative. Measure 719 addresses only the location of outplanting consistent with the Upper Willamette Chinook Salmon and Winter Steelhead Recovery Plan (ODFW and NMFS 2011). The timing and magnitude of total hatchery outplant reductions above dams would depend on demonstrated passage improvements and, therefore, as noted above, reductions in hatchery production are not incorporated into the analyses of any

alternative. Reductions in hatchery fish production would not be implemented until after future coordination with NMFS and ODFW.

END NEW TEXT

Maintenance of Existing and New Fish Release Sites above Dams (726)

Basin-wide actions would be taken to ensure safe and effective release of outplanted adult fish and to support upstream passage above dams. Outplanting refers to transporting adult UWR spring Chinook salmon and UWR winter steelhead and releasing them in stream reaches above WVS reservoirs.

Specific activities would vary within the Willamette River Basin by outplant river reach. Transport of adult spring Chinook salmon and natural and hatchery origin fish above dams would occur according to HGMPs and NMFS' 2019 Biological Opinion to support salmonid reintroduction and research, monitoring, and evaluation. Several release sites were evaluated for this measure based on their access to high quality habitat (Table 2.10-6).

Table 2.10-6. Current and Proposed Outplanting Sites.

Dam	Description	Existing or Proposed New Site
Detroit	Private Site	Proposed
	Breitenbush USGS Gage Site (#14179000)	Proposed
	Parrish Lake Road (Upper)	Existing
	Cooper's Ridge (Lower)	Existing
Minto (Big Cliff)	North Santiam River upstream of Minto	Existing
Foster	Gordon Road (Upper)	Existing
	River Bend A (Lower)	Existing
	Reservoir release	Proposed
Cougar	Hardrock campground (lower)	Existing
	Homestead campground (upper)	Proposed
Lookout Point	Site 1 (lower)	Existing
	Site 3 (upper)	Proposed
Fall Creek	Gold Creek confluence (upper)	Existing
	Site C (lower)	Existing
Hills Creek	Construction site (spur road)	Existing
	Paddy's Valley	Existing
Blue River	Lower release site 2 to 5 miles above head of reservoir	Proposed

Dam	Description	Existing or Proposed New Site
Green Peter	Lower release site 2 to 5 miles above head of reservoir in Quartzville Creek	Proposed
Green Peter	Lower release site 2 to 5 miles above head of reservoir in Middle Santiam River	Proposed

Some proposed sites may require minor improvements with minimal construction. In cases where construction would be required, site-specific designs and environmental compliance may be completed as needed (Chapter 1, Introduction, Section 1.3.1.1, Programmatic Reviews and Subsequent Tiering under the National Environmental Policy Act).

2.10.4.2 General Construction Activities Common to Action Alternatives

Measures described above could be applied programmatically under the action alternatives. Some measures would require construction activities; however, details of these activities were largely unknown at the time the alternatives were analyzed[12]. Limited analyses and a range of potential effects of general construction activities are included in the effects analysis for each resource in Chapter 3, Affected Environment and Environmental Consequences.

Although site-specific design and construction are not yet available, descriptions of general activities that could occur during implementation of measures under an alternative are summarized below. Measure numbers correspond to measure descriptions above. The following subsections provide a summary of the anticipated construction needed for specific measures.

Maintain Revetments Considering Nature-based Engineering or Alter Revetments for Aquatic Ecosystem Restoration (9)

This work would involve a hydraulic excavator to maintain the revetment using natural materials. The work would not require a cofferdam but would be performed during the in-water-work period.

Maintenance of a revetment would take about 1 week. Altering revetments for aquatic ecosystem restoration could require more extensive work that could take up to several months during the in-water-work period over 1 or more years.

Deeper Fall Reservoir Drawdown for Downstream Fish Passage (Measure 40) only at Cougar Dam for the Drawdown Operation to the Diversion Tunnel

An intake and access tower would need to be constructed at Cougar Dam to use the diversion tunnel as a routine outlet. Construction of the tower would require an extended deep drawdown of Cougar Reservoir and a cofferdam around the diversion tunnel intake so that

[12] Large-scale construction is not included under the NAA.

concrete placement can be completed in-the-dry. The concrete tower would be constructed by equipment staged on barges in the reservoir.

Multiple seasons of deep drawdowns would be required to get the tower to full height. Once the concrete placement is complete, the mechanical and electrical systems would be installed. Construction is expected to take 5 years.

Provide Pacific Lamprey Passage Infrastructure (52)

Lamprey passage measures would be incorporated into an upstream fish passage structure. Lamprey passage features consist of minor modifications that help lamprey navigate up the ladder (Section 2.8.4.1, Provide Pacific Lamprey Passage Infrastructure (52)). For example, metal strips would be welded to diffuser grating, also known as a diffuser screen, so that there is a continuous strip of metal for lamprey suction. Construction would require the fish ladder to be dewatered to provide access. It would take a few months to complete modifications.

Construct Selective Withdrawal Structures (105)

Selective withdrawal structures would be built to pass water from multiple elevations between the minimum pool and maximum pool. A tower, which can be constructed out of steel or concrete, is one component of a selective withdrawal structure.

Construction in-the-dry:
Building in dry construction sites
Construction in-the-wet:
Building underwater

The Cougar Dam temperature control tower was built in dry conditions out of concrete by using the diversion tunnel to lower the reservoir (i.e., in-the-dry). The concrete tower was then built using traditional concrete construction methods like slip forming. In contrast, the water control tower at Shasta Dam in California was built out of steel in wet conditions by constructing steel modules off site, lowering the modules into position with a crane, and then attaching them to the face of the dam using divers (i.e., in-the-wet).

A Design Decision Document was completed for the Detroit Dam temperature control project that proposes to build a tower out of concrete in-the-wet using pre-cast concrete modules. This would involve dredging the forebay to make room for the foundation, placing a concrete foundation that is level, and then using a large crane to place the pre-cast concrete modules on top of the foundation. After the concrete is in position, the mechanical and electrical features would be installed, and the tower would be plumbed into the existing dam outlets. Construction of the selective withdrawal structure at Detroit Dam would take 3 to 5 years.

Structural Improvements to Reduce Total Dissolved Gas (174)

TDG improvements are at a conceptual design level. A possible method is to place concrete structures in the tail race (e.g., baffle blocks—several identical structures arranged in one or several rows orientated perpendicular to the direction of flow).

Construction would involve building a cofferdam during the summer low flow and in-water-work period, excavating for a foundation, potentially drilling into the bedrock and embedding rebar dowels, placing concrete, and then removing the cofferdam. Construction can only take place during the summer when flows are low. Depending on the number of concrete structures to be placed and how far apart they are spaced, it could take multiple seasons to complete all the structures at a dam.

Gravel Augmentation Below Dams (384)

THE DEIS HAS BEEN MODIFIED TO REVISE THE FOLLOWING INFORMATION IN THE FEIS

Gravel augmentation would involve placement of gravel onto an existing gravel bar and/or adjacent to an existing in-water gravel feature and in a location that is expected to inundate and erode in a typical water year. Gravel would be brought to the site and placed with dump trucks. Site access would be developed for dump trucks and heavy equipment. Heavy equipment would be used to shape the pile.

Placement details would be site-dependent. Gravel import and shaping may take up to 1 week.

END REVISED TEXT

Construct Structural Downstream Fish Passage (392)

Floating surface collectors and floating screen structures are largely built off-site at a metal fabrication shop in modules that are as large as possible but can still be trucked to the shoreline of a reservoir. A staging area along the shore of the reservoir would be identified, typically at an existing boat ramp.

Structures would be assembled at the staging area with as much mechanical testing and commissioning completed as possible prior to launching into the water. Once complete, the structure would be launched by driving, pushing, or rolling it down a hill. It would then be towed into position by tugs and anchored into place. Construction of a downstream passage structure would take 2 to 3 years.

Structural downstream passage at Foster Dam would not be provided by a floating surface collector or a floating screen structure (Section 2.8.3.2, Construct Structural Downstream Fish Passage (392)). Instead, a fixed surface route structure would be installed, potential modifications to the existing fish weir would be made, or another volitional passage structure would be constructed to improve downstream passage.

Foster Dam Fish Ladder Temperature Improvement (479)

Temperature control at Foster Dam is currently targeting a narrow range of forebay elevations. A smaller intake structure is being proposed at Foster Dam that would pass warm water during the spring and summer months.

Construction would involve boring a hole through Foster Dam, attaching the prefabricated intake structure to the face of the dam using barge mounted cranes, and then installing the mechanical and electrical systems. Construction is expected to take 3 years.

Restore Upstream and Downstream Passage at Drop Structures (639)

There are several versions of fish ladders that can provide passage for fish over drop structures. The simplest version would be to use stones and gravel to create a series of pools for fish navigation.

A more complex design would involve construction of a concrete fish ladder. Construction would involve using hydraulic excavators to regrade the ladder area and then placing necessary building materials into the area. These structures typically do not have any mechanical or electrical features. A temporary cofferdam is likely required to dewater the construction area. It would take several months to 1 year to complete. Construction details would be developed during the engineering and design phases of a project.

Pass Water over the Spillway in Spring for Downstream Fish Passage (Measure 714) Only at Hills Creek Dam

The spillway at Hills Creek Dam would require civil and structural improvements to be used on a regular basis. Hydraulic excavators would be used to excavate and regrade the spillway channel back to the river and then concrete would be placed to armor the channel. A cofferdam may be required at the bottom of the spillway channel to place concrete below ordinary high water. This work is expected to take 1 to 2 years.

Deep Spring Reservoir Drawdown for Downstream Fish Passage (Measure 720) only at Cougar Dam for the Drawdown Operation to the Diversion Tunnel

An intake and access tower would need to be constructed at Cougar Dam to use the diversion tunnel as a routine outlet. Construction of the tower would require an extended deep drawdown of Cougar Reservoir and a cofferdam around the diversion tunnel intake so that concrete placement can be completed in-the-dry. The concrete tower would be constructed by equipment staged on barges in the reservoir.

Multiple seasons of deep drawdowns would be required to get the tower to full height. Once the concrete placement is complete, the mechanical and electrical systems would be installed. Construction is expected to take 5 years.

Use Spillways to Release Warm Surface Water in Summer (Measure 721) (only at Hills Creek and Blue River Dams)

The spillways at Hills Creek and Blue River Dams would require civil and structural improvements to be used on a regular basis. Hydraulic excavators would be used to excavate and regrade the spillway channel back to the river and then concrete would be placed to armor

the channel. A cofferdam may be required at the bottom of the spillway channel to place concrete below ordinary high water. This work is expected to take 1 to 2 years.

Construct Adult Fish Facility (722)

Upstream passage at WVS dams involves building a trap and haul facility similar to those at Cougar, Minto, Foster, and Fall Creek Dams. A facility would be built on a river bank immediately downstream of a structure that prevents fish from swimming upstream. Construction would involve building a cofferdam along the bank so that the water intake and fish ladder entrance can be built below ordinary high water.

The fish ladder would bring the fish upland to a presort pool. Fish would then be processed through the sorting area, post-sort pools, and then loaded into trucks and transported above the dam. This would require earthwork, concrete placement, in-water-work, and mechanical and electrical work. Construction of an upstream passage facility would typically take 2 to 3 years.

Maintenance of Existing and New Fish Release Sites above Dams (726)

Some proposed fish release sites may require minor improvements consisting of minor grading or occasional tree removal.

Major Maintenance and Rehabilitation Sequencing and Timing

The timing, duration, and extent of non-routine major maintenance are unforeseeable (Chapter 1, Introduction, Section 1.11.3, Operation, Maintenance, Repair, Replacement, and Rehabilitation). The type of construction activities required would be unique to each maintenance requirement and cannot be predicted. Each action would be routinely assessed for environmental compliance prior to implementation.

2.10.4.3 Alternative 1—Improve Fish Passage through Storage-focused Measures

Under Alternative 1, USACE would implement measures to maximize the refill volumes of conservation pools at WVS reservoirs to meet authorized purposes that depend on full reservoirs, including municipal and industrial water supply, agricultural irrigation, recreation, and water quality (Table 2.10-7). Additionally, USACE would improve fish passage through the WVS dams to increase survival of ESA-listed fish under Alternative 1.

Table 2.10-7. Alternative 1 Measures and Locations.

Measure	FRN	CTG	DOR	DEX	LOP	FCR	HCR	CGR	BLU	FOS	GPR	BCL	DET
Interim Operations	–	–	–	–	–	–	–	–	–	–	–	–	–
Flow Measures	–	–	–	–	–	–	–	–	–	–	–	–	–
30a. Integrated temperature and habitat flow regime	–	–	–	–	–	–	–	–	–	–	–	–	–
30b. Refined integrated temperature and habitat flow regime	–	–	–	–	–	–	–	–	–	–	–	–	–
304. Augment instream flows by using the power pool	–	–	–	–	X	–	X	X	–	–	X	–	X
718. Augment instream flows by using inactive pool	–	X	X	–	–	X	–	–	X	–	–	–	–
723. Reduce minimum flows to Congressionally authorized minimum flow requirements	X	X	X	X	X	X	X	X	X	X	X	X	X
Water Quality Measures	–	–	–	–	–	–	–	–	–	–	–	–	–
105. Construct selective withdrawal structure	–	–	–	–	X	–	–	–	–	–	X	–	X
166. Use regulating outlets for temperature management	–	–	–	–	–	–	–	–	–	–	–	–	–
174. Structural improvements to reduce TDG	–	–	–	X	X[1]	–	–	X	–	X	X[1]	–	X[1]
479. Foster Dam fish ladder temperature improvement	–	–	–	–	–	–	–	–	–	X	–	–	–
721. Use spillways to release warm surface water in summer	–	–	–	–	–	–	–	–	–	–	–	–	–
Downstream Passage Measures	–	–	–	–	–	–	–	–	–	–	–	–	–
40. Deeper fall reservoir drawdowns for downstream fish passage	–	–	–	–	–	–	–	–	–	–	–	–	–
392. Construct structural downstream fish passage	–	–	–	X[2]	X	–	–	–	–	X	X	X[2]	X
714. Pass water over spillway in spring for downstream fish passage	–	–	–	–	–	–	–	–	–	–	–	–	–
720. Deep spring reservoir drawdown for downstream fish passage	–	–	–	–	–	–	–	–	–	–	–	–	–
Upstream Passage Measures	–	–	–	–	–	–	–	–	–	–	–	–	–
52. Provide Pacific lamprey passage infrastructure	X	–	–	–	–	–	–	–	–	–	X	–	–
639. Restore upstream and downstream passage at drop structures	X	–	–	–	–	–	–	–	–	–	–	–	–
722. Construct adult fish facility	–	–	–	–	–	–	–	–	–	–	X	–	–

Measure	FRN	CTG	DOR	DEX	LOP	FCR	HCR	CGR	BLU	FOS	GPR	BCL	DET
Measures and Actions Common to All Action Alternatives	–	–	–	–	–	–	–	–	–	–	–	–	–
9. Maintain revetments considering nature-based engineering or alter revetments for aquatic ecosystem restoration[3]	–	–	–	–	–	–	–	–	–	–	–	–	–
384. Gravel augmentation	–	–	–	–	–	–	–	X	X	X	–	X	–
719. Adapt Willamette hatchery mitigation program	–	–	–	X	X	X	X	X	X	X	X	X	X
726. Maintenance of existing and new fish release sites above dams	–	–	–	–	X	X	X	X	–	X	X	–	X
Adaptive management	X	X	X	X	X	X	X	X	X	X	X	X	X
Fall Creek Reservoir drawdown	–	–	–	–	–	X	–	–	–	–	–	–	–
Environmental flows	–	–	–	X	X	X	X	X	–	–	–	X	X
Maintenance of WVS facilities	X	X	X	X	X	X	X	X	X	X	X	X	X
Continued operation of existing adult fish facilities	–	–	–	X	–	X	–	X	–	X	–	X	–

FRN = Fern Ridge Dam
CTG = Cottage Grove Dam
DOR = Dorena Dam
DEX = Dexter Dam
LOP = Lookout Point Dam
FCR = Fall Creek Dam
HCR = Hills Creek Dam
CGR = Cougar Dam
BLU = Blue River Dam
FOS = Foster Dam
GPR = Green Peter Dam
BCL = Big Cliff Dam
DET = Detroit

[1] Incorporated into design of Measure 105

[2] Fish would be collected at an upstream dam location and transported downstream of a re-regulation dam.

[3] Basin-wide, including Willamette River, but not associated with a dam or reservoir.

Stream Flow

Flows would be reduced to the Congressionally authorized minimum flows to benefit reservoir refill objectives at all dams and reservoirs (Section 2.8.1.5, Reduce Minimum Flows to Congressionally Authorized Minimum Flow Requirements (723)). This would increase the likelihood of refilling WVS reservoirs to maximum conservation pool levels in the spring.

However, Alternative 1 would also augment instream flows by using the inactive pools at Cottage Grove, Dorena, Fall Creek, and Blue River Dams in late summer or early fall (Measure 718). Additionally, operations under Alternative 1 would use power pools at Lookout Point, Hills Creek, Cougar, Green Peter, and Detroit Dams if needed for ESA flows in summer or late fall (Measure 304) (Section 2.8.1.4, Augment Instream Flows by Using the Inactive Pool (718); Section 2.8.1.3, Augment Instream Flows by Using the Power Pool (304)). These two measures would augment flows for biological purposes at critical times of the year and would reduce water temperature.

Water Quality

Structural improvements would also be implemented under Alternative 1 for water quality purposes and for downstream and upstream fish passage. Structural measures for water quality would include structural improvements to reduce TDG at Dexter, Cougar, and Foster Dams (Measure 174) and selective withdrawal structures at Lookout Point, Green Peter, and Detroit Dams (Measure 105) (Section 2.8.2.3, Structural Improvements to Reduce Total Dissolved Gas (174); Section 2.8.2.1, Construct Selective Withdrawal Structures (105)).

Fish Passage

THE DEIS HAS BEEN MODIFIED TO REVISE THE FOLLOWING INFORMATION IN THE FEIS

Downstream fish passage would be achieved by floating structures (Measure 392) (Section 2.8.3.2, Construct Structural Downstream Fish Passage (392)). The structures would allow for fish collection over various water levels throughout the year, with the intent of minimizing effects on storage from operations for fish passage and water quality.

END REVISED TEXT

Juvenile fish collected at Lookout Point, Green Peter, and Detroit Dams would be transported and released downstream of their re-regulation dams (Dexter, Foster, and Big Cliff Dams, respectively) to avoid passage over the re-regulating dams. There would also be a modification of the existing surface route structure (fish weir) at Foster Dam for improved downstream passage under Alternative 1 (Measure 392).

To address upstream passage needs, an adult fish facility would be constructed at Green Peter Dam (Measure 722) (Section 2.8.4.3, Construct Adult Fish Facilities (722)). Upstream and downstream fish passage would be restored downstream of Fern Ridge Dam at the Monroe, Stroda, and Cox Butte drop structures (Measure 639) (Section 2.8.4.2, Restore Upstream and Downstream Passage at Drop Structures (639)). Design of the adult fish facility at Green Peter Dam and fish passage restoration at the drop structures below Fern Ridge Dam would both include Pacific lamprey passage infrastructure (Measure 52) (Section 2.8.4.1, Provide Pacific Lamprey Passage Infrastructure (52)).

2.10.4.4 Alternative 2A—Integrated Water Management Flexibility and ESA-listed Fish Alternative

Alternative 2A was developed to improve fish passage through the WVS dams using a combination of modified operations and structural improvements, along with other measures, to balance water management flexibility and to meet ESA-listed fish obligations.

Cursory modeling results from Alternatives 1, 3A, 3B, and 4 were used to inform the formulation of Alternative 2A. Prior to this modeling, it was difficult to know which operational measures under Alternative 3A or Alternative 3B would provide suitable downstream passage results when compared to Alternative 4, the structure-focused alternative.

Structural measures require comprehensive design and engineering efforts, additional environmental compliance (such as site-specific NEPA reviews), and often long construction timeframes. These requirements can substantially delay implementation of a structural measure and substantially increase the cost of an alternative. Consequently, Alternative 2A was developed to identify the combination of structural and operational downstream fish passage measures that could more effectively meet ESA objectives while balancing the challenges of large-scale structural changes (Table 2.10-8).

Table 2.10-8. Alternative 2A Measures and Locations.

Measure	FRN	CTG	DOR	DEX	LOP	FCR	HCR	CGR	BLU	FOS	GPR	BCL	DET
Interim Operations	–	–	–	–	X	X	X	X	–	X	X	X	X
Flow Measures	–	–	–	–	–	–	–	–	–	–	–	–	–
30a. Integrated temperature and habitat flow regime	X	X	X	X	X	X	X	X	X	X	X	X	X
30b. Refined integrated temperature and habitat flow regime	–	–	–	–	–	–	–	–	–	–	–	–	–
304. Augment instream flows by using the power pool	–	–	–	–	X	–	X	X	–	–	X	–	X
718. Augment instream flows by using inactive pool	–	–	–	–	–	X	–	–	X	–	–	–	–
723. Reduce minimum flows to Congressionally authorized minimum flow requirements	–	–	–	–	–	–	–	–	–	–	–	–	–
Water Quality Measures	–	–	–	–	–	–	–	–	–	–	–	–	–
105. Construct selective withdrawal structure	–	–	–	–	–	–	–	–	–	–	–	–	X
166. Use regulating outlets for temperature management	–	–	–	–	–	–	–	–	–	–	X	–	–
174. Structural improvements to reduce TDG	–	–	–	–	–	–	–	–	–	–	–	–	–
479. Foster Dam fish ladder temperature improvement	–	–	–	–	–	–	–	–	–	X	–	–	–
721. Use spillways to release warm surface water in summer	–	–	–	–	–	–	–	–	–	–	X	–	–
Downstream Passage Measures	–	–	–	–	–	–	–	–	–	–	–	–	–
40. Deeper fall reservoir drawdowns for downstream fish passage	–	–	–	–	–	–	–	–	–	–	X	–	–
392. Construct structural downstream fish passage[1]	–	–	–	–	X	–	–	X	–	X	–	–	X
714. Pass water over spillway in spring for downstream fish passage	–	–	–	–	–	–	–	–	–	–	X	–	–

Measure	FRN	CTG	DOR	DEX	LOP	FCR	HCR	CGR	BLU	FOS	GPR	BCL	DET
720. Deep spring reservoir drawdown for downstream fish passage	–	–	–	–	–	–	–	–	–	–	–	–	–
Upstream Passage Measures	–	–	–	–	–	–	–	–	–	–	–	–	–
52. Provide Pacific lamprey passage infrastructure	–	–	–	–	–	–	–	–	–	–	X	–	–
639. Restore upstream and downstream passage at drop structures	–	–	–	–	–	–	–	–	–	–	–	–	–
722. Construct adult fish facility	–	–	–	–	–	–	–	–	–	–	X	–	–
Measures and Actions Common to All Action Alternatives	–	–	–	–	–	–	–	–	–	–	–	–	–
9. Maintain revetments considering nature-based engineering or alter revetments for aquatic ecosystem restoration[2]	–	–	–	–	–	–	–	–	–	–	–	–	–
384. Gravel augmentation	–	–	–	–	–	–	–	X	X	X	–	X	–
719. Adapt Willamette hatchery mitigation program	–	–	–	X	X	X	X	X	X	X	X	X	X
726. Maintenance of existing and new fish release sites above dams	–	–	–	–	X	X	X	X	–	X	X	–	X
Adaptive management	X	X	X	X	X	X	X	X	X	X	X	X	X
Fall Creek Reservoir drawdown	–	–	–	–	–	X	–	–	–	–	–	–	–
Environmental flows	–	–	–	X	X	X	X	X	–	–	–	X	X
Maintenance of WVS facilities	X	X	X	X	X	X	X	X	X	X	X	X	X
Continued operation of existing adult fish facilities	–	–	–	X	–	X	–	X	–	X	–	X	–

FRN = Fern Ridge Dam
CTG = Cottage Grove Dam
DOR = Dorena Dam
DEX = Dexter Dam
LOP = Lookout Point Dam
FCR = Fall Creek Dam
HCR = Hills Creek Dam
CGR = Cougar Dam
BLU = Blue River Dam
FOS = Foster Dam
GPR = Green Peter Dam
BCL = Big Cliff Dam
DET = Detroit

[1] At Dexter and Big Cliff Dams, fish would be collected at an upstream dam location and transported downstream of re-regulation dam.

[2] Basin-wide, including Willamette River, but not associated with a dam or reservoir.

Stream Flow

Under Alternative 2A, all dams in the WVS would be operated under the integrated temperature and habitat flow regime (Measure 30a) (Section 2.8.1.1, Integrated Temperature and Habitat Flow Regime). USACE would also augment instream flows under Alternative 2A by using the inactive pools in late summer or early fall at Fall Creek and Blue River Dams (Measure 718) and by using the power pools if needed for ESA flows in summer or late fall at Lookout

Point, Hills Creek, Cougar, Green Peter, and Detroit Dams (Measure 304) (Section 2.8.1.4, Augment Instream Flows by Using the Inactive Pool (718); Section 2.8.1.3, Augment Instream Flows by Using the Power Pool (304)). These two measures would augment flows for biological purposes at critical times of the year.

Water Quality

A combination of structural and operational measures to address water quality would be implemented under Alternative 2A. The fish passage structure at Detroit Dam would be integrated with a selective withdrawal structure (Measure 105) (Section 2.8.2.1, Construct Selective Withdrawal Structures (105)). However, a selective withdrawal structure at Lookout Point Dam was omitted from this alternative after initial modeling demonstrated an inability to affect temperatures downstream of Dexter Dam.

Alternative 2A would include the following operational measures to address temperature control at Green Peter Dam:

- Using the regulating outlets to discharge colder water during drawdown operations in fall and winter to reduce water temperatures below these dams (Measure 166) (Section 2.8.2.2, Use Regulating Outlets for Temperature Management (166)).
- Using the spillway for surface spill in summer (Measure 721) (Section 2.8.2.5, Use Spillways to Release Warm Surface Water in Summer (721)).

At Foster Dam, Alternative 2A would include the Foster Dam fish ladder temperature improvement (Measure 479) (Section 2.8.2.4, Foster Dam Fish Ladder Temperature Improvement (479).

Fish Passage

THE DEIS HAS BEEN MODIFIED TO REVISE THE FOLLOWING INFORMATION IN THE FEIS

Alternative 2A incorporates operational and structural solutions through operational downstream fish passage measures at Green Peter Dam, including passing water over the spillway in the spring (Measure 714), a deep fall drawdown (Measure 40), and the construction of downstream fish passage structures at Detroit, Lookout Point, Cougar, and Foster Dams (Measure 392) (Section 2.8.3.3, Pass Water over Spillways in Spring for Downstream Fish Passage (714); Section 2.8.3.1, Deeper Fall Reservoir Drawdown for Downstream Fish Passage (40); Section 2.8.3.2, Construct Structural Downstream Fish Passage (392)).

END REVISED TEXT

Fish collected at Lookout Point and Detroit Dams would be transported and released downstream of re-regulation dams (Dexter and Big Cliff Dams, respectively) to avoid passage over the re-regulating dams. Alternative 2A would also include a new adult fish facility for upstream fish passage at Green Peter Dam (Measure 722) that would provide passage

infrastructure for Pacific lamprey (Measure 52) (Section 2.8.4.3, Construct Adult Fish Facilities (722); Section 2.8.4.1, Provide Pacific Lamprey Passage Infrastructure (52)).

Interim Operations

THE DEIS HAS BEEN MODIFIED TO REVISE THE FOLLOWING INFORMATION IN THE FEIS

Interim Operations would be implemented under Alternative 2A (Section 2.8.5, Interim Operations). The Interim Operations at a location would be implemented until the structural or long-term operation measure for that location is completed.

If no structure or operation would replace the Interim Operation, it would cease upon full implementation of all the measures under the alternative (a detailed analysis of how Interim Operations would be replaced by the measures under the Preferred Alternative is provided in Appendix A, Alternatives Development, Attachment 4, DEIS Chapter 5, Preferred Alternative Identification and Implementation). Integration of the Interim Operations would be approximately the same under Alternatives 2B, 3A, 3B, 4, and 5; only differences are highlighted under each alternative description.

END REVISED TEXT

2.10.4.5 Alternative 2B—Integrated Water Management Flexibility and ESA-listed Fish Alternative

Activities and measures under Alternative 2B would be the same as those described under Alternative 2A, except for the downstream fish passage measure at Cougar Dam (Table 2.10-9).

Unlike Alternative 2A, Alternative 2B presents an operational option for downstream fish passage rather than a structural option under Alternative 2A. This is the only distinction as compared to Alternative 2A. Only the differences between Alternative 2B and Alternative 2A are discussed below.

Table 2.10-9. Alternative 2B Measures and Locations.

Measure	FRN	CTG	DOR	DEX	LOP	FCR	HCR	CGR	BLU	FOS	GPR	BCL	DET
Interim Operations	–	–	–	–	X	X	X	X	–	X	X	X	X
Flow Measures	–	–	–	–	–	–	–	–	–	–	–	–	–
30a. Integrated temperature and habitat flow regime	X	X	X	X	X	X	X	X	X	X	X	X	X
30b. Refined integrated temperature and habitat flow regime	–	–	–	–	–	–	–	–	–	–	–	–	–
304. Augment instream flows by using the power pool	–	–	–	–	X	–	X	–	–	–	X	–	X

Measure	FRN	CTG	DOR	DEX	LOP	FCR	HCR	CGR	BLU	FOS	GPR	BCL	DET
718. Augment instream flows via inactive pool	–	–	–	–	–	X	–	–	X	–	–	–	–
723. Reduce minimum flows to Congressionally authorized minimum flow requirements	–	–	–	–	–	–	–	–	–	–	–	–	–
Water Quality Measures	–	–	–	–	–	–	–	–	–	–	–	–	–
105. Construct selective withdrawal structure	–	–	–	–	–	–	–	–	–	–	–	–	X
166. Use regulating outlets for temperature management	–	–	–	–	–	–	–	–	–	–	X	–	–
174. Structural improvements to reduce TDG	–	–	–	–	–	–	–	–	–	–	–	–	–
479. Foster Dam fish ladder temperature improvement	–	–	–	–	–	–	–	–	–	X	–	–	–
721. Use spillways to release warm surface water in summer	–	–	–	–	–	–	–	–	–	–	X	–	–
Downstream Passage Measures	–	–	–	–	–	–	–	–	–	–	–	–	–
40. Deeper fall reservoir drawdowns for downstream fish passage	–	–	–	–	–	–	–	X[1]	–	–	X	–	–
392. Construct structural downstream fish passage	–	–	–	–	X	–	–	–	–	X	–	–	X
714. Pass water over spillway in spring for downstream fish passage	–	–	–	–	–	–	–	–	–	–	X	–	–
720. Deep spring reservoir drawdown for downstream fish passage	–	–	–	–	–	–	–	X[1]	–	–	–	–	–
Upstream Passage Measures	–	–	–	–	–	–	–	–	–	–	–	–	–
52. Provide Pacific lamprey passage infrastructure	–	–	–	–	–	–	–	–	–	–	X	–	–
639. Restore upstream and downstream passage at drop structures	–	–	–	–	–	–	–	–	–	–	–	–	–
722. Construct adult fish facility	–	–	–	–	–	–	–	–	–	–	X	–	–
Measures and Actions Common to All Action Alternatives	–	–	–	–	–	–	–	–	–	–	–	–	–
9. Maintain revetments considering nature-based engineering or alter revetments for aquatic ecosystem restoration[2]	–	–	–	–	–	–	–	–	–	–	–	–	–
384. Gravel augmentation	–	–	–	–	–	–	–	X	X	X	–	X	–
719. Adapt Willamette hatchery mitigation program	–	–	–	X	X	X	X	X	X	X	X	X	X
726. Maintenance of existing and new fish release sites above dams	–	–	–	–	X	X	X	X	–	X	X	–	X

Measure	FRN	CTG	DOR	DEX	LOP	FCR	HCR	CGR	BLU	FOS	GPR	BCL	DET
Adaptive management	X	X	X	X	X	X	X	X	X	X	X	X	X
Fall Creek Reservoir drawdown	–	–	–	–	–	X	–	–	–	–	–	–	–
Environmental flows	–	–	–	X	X	X	X	X	–	–	–	X	X
Maintenance of WVS facilities	X	X	X	X	X	X	X	X	X	X	X	X	X
Continued operation of existing adult fish facilities	–	–	–	X	–	X	–	X	–	X	–	X	–

FRN = Fern Ridge Dam
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HCR = Hills Creek Dam
CGR = Cougar Dam
BLU = Blue River Dam
FOS = Foster Dam
GPR = Green Peter Dam
BCL = Big Cliff Dam
DET = Detroit

[1] Drawdown to the diversion tunnel. Requires structural modification to the diversion tunnel.

[2] Basin-wide, including Willamette River, but not associated with a dam or reservoir.

THE DEIS HAS BEEN MODIFIED TO REVISE THE FOLLOWING INFORMATION IN THE FEIS

Under Alternative 2B, downstream fish passage at Cougar Dam would be provided by drafting the reservoir down to within 25 feet of the top of the diversion tunnel, located at the bottom of the reservoir, so that fish can pass through the tunnel in the fall and spring (Measures 40 and Measure 720) (Section 2.8.3.1, Deeper Fall Reservoir Drawdown for Downstream Fish Passage (40); Section 2.8.3.4, Deep Spring Reservoir Drawdown for Downstream Fish Passage (720)). Implementation of these measures under Alternative 2B would contrast with construction of a downstream fish passage structure under Alternative 2A (Measure 392) (Section 2.8.3.2, Construct Structural Downstream Fish Passage (392)).

A drawdown to the diversion tunnel at Cougar Dam would require several dam modifications and a change in operational authority. Dam safety concerns associated with fluctuating pool levels in Cougar Reservoir would need to be addressed. Redundant gate structures to allow for safe, remote, routine operation of the diversion tunnel would need to be designed and constructed. Further, the tunnel would need to be accessible for operations and maintenance through the construction of a tower and bridge.

Under Alternative 2B, fall and spring deep drawdowns to the diversion tunnel for fish passage would draft the reservoir below the power pool most of the time, making the conservation and power pools inaccessible for flow augmentation (Measure 30a and Measure 304, respectively) (Section 2.8.1.1, Integrated Temperature and Habitat Flow Regime (30a); Section 2.8.1.3, Augment Instream Flows by Using the Power Pool (304)).

END REVISED TEXT

2.10.4.6 Alternative 3A—Improve Fish Passage through Operations-focused Measures

Alternative 3A was developed to improve fish passage through the WVS dams by modifying operations rather than focusing on storage (as under Alternative 1) or structural measures (as under Alternative 4) (Table 2.10-10).

Table 2.10-10. Alternative 3A Measures and Locations.

Measure	FRN	CTG	DOR	DEX	LOP	FCR	HCR	CGR	BLU	FOS	GPR	BCL	DET
Interim Operations	–	–	–	–	X	X	X	X	–	X	X	X	X
Flow Measures	–	–	–	–	–	–	–	–	–	–	–	–	–
30a. Integrated temperature and habitat flow regime	X	X	X	X	X	X	X	X	X	X	X	X	X
30b. Refined integrated temperature and habitat flow regime	–	–	–	–	–	–	–	–	–	–	–	–	–
304. Augment instream flows by using the power pool	–	–	–	–	X	–	X	X	–	–	X	–	X
718. Augment instream flows by using inactive pool	–	X	X	–	–	X	–	–	X	–	–	–	–
723. Reduce minimum flows to Congressionally authorized minimum flow requirements	–	–	–	–	–	–	–	–	–	–	–	–	–
Water Quality Measures	–	–	–	–	–	–	–	–	–	–	–	–	–
105. Construct selective withdrawal structure	–	–	–	–	–	–	–	–	–	–	–	–	–
166. Use regulating outlets for temperature management	–	–	–	–	X	–	–	–	–	–	X	–	X[1]
174. Structural improvements to reduce TDG	–	–	–	–	–	–	–	–	–	–	–	–	–
479. Foster Dam fish ladder temperature improvement	–	–	–	–	–	–	–	–	–	–	–	–	–
721. Use spillways to release warm surface water in summer	–	–	–	–	X	–	X[2]	–	X[2]	X[2]	X	–	X
Downstream Passage Measures	–	–	–	–	–	–	–	–	–	–	–	–	–
40. Deeper fall reservoir drawdowns for downstream fish passage	–	–	–	–	X	–	X	X[3]	X	–	X	–	X
392. Construct structural downstream fish passage	–	–	–	–	–	–	–	–	–	–	–	–	–
714. Pass water over spillway in spring for downstream fish passage	–	–	–	X	–	X	X	–	–	–	X	X	–
720. Deep spring reservoir drawdown for downstream fish passage	–	–	–	–	X	–	–	X[3]	–	–	–	–	X

Measure	FRN	CTG	DOR	DEX	LOP	FCR	HCR	CGR	BLU	FOS	GPR	BCL	DET
Upstream Passage Measures	–	–	–	–	–	–	–	–	–	–	–	–	–
52. Provide Pacific lamprey passage infrastructure	–	–	–	–	–	–	X	–	X	–	X	–	–
639. Restore upstream and downstream passage at drop structures	–	–	–	–	–	–	–	–	–	–	–	–	–
722. Construct adult fish facility	–	–	–	–	–	–	X	–	X	–	X	–	–
Measures and Actions Common to All Action Alternatives	–	–	–	–	–	–	–	–	–	–	–	–	–
9. Maintain revetments considering nature-based engineering or alter revetments for aquatic ecosystem restoration[4]	–	–	–	–	–	–	–	–	–	–	–	–	–
384. Gravel augmentation	–	–	–	–	–	–	–	X	X	X	–	X	–
719. Adapt Willamette hatchery mitigation program	–	–	–	X	X	X	X	X	X	X	X	X	X
726. Maintenance of existing and new fish release sites above dams	–	–	–	–	X	X	X	X	–	X	X	–	X
Adaptive management	X	X	X	X	X	X	X	X	X	X	X	X	X
Fall Creek Reservoir drawdown	–	–	–	–	–	X	–	–	–	–	–	–	–
Environmental flows	–	–	–	X	X	X	X	X	–	–	–	X	X
Maintenance of WVS facilities	X	X	X	X	X	X	X	X	X	X	X	X	X
Continued operation of existing adult fish facilities	–	–	–	X	–	X	–	X	–	X	–	X	–

FRN = Fern Ridge Dam
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CGR = Cougar Dam
BLU = Blue River Dam
FOS = Foster Dam
GPR = Green Peter Dam
BCL = Big Cliff Dam
DET = Detroit

[1] May require structural modification of the regulating outlet to allow for routine use.

[2] Requires structural modification to the spillway.

[3] Drawdown to the regulating outlet.

[4] Basin-wide, including Willamette River, but not associated with a dam or reservoir.

This alternative includes operational measures that allow for increased survival of ESA-listed fish while maintaining USACE flood risk management. Operational measures under Alternative 3A are intended to improve downstream fish passage, increase water management flexibility, optimize conservation season draft rates, and reduce impaired water quality below the WVS dams to benefit ESA-listed fish species. Some operational measures may require the modification of existing infrastructure or the construction of adult fish facilities for benefits to be realized from the proposed operational measures.

Stream Flow

Under Alternative 3A, the integrated temperature and habitat flow regime would be applied the same as under Alternative 2A and Alternative 2B (Measure 30a) (Section 2.8.1.1, Integrated Temperature and Habitat Flow Regime (30a)). Instream flows would also be augmented by using the inactive pools in late summer and early fall and power pools as needed for ESA flows in summer and late fall (Measure 718 and Measure 340) (Section 2.8.1.4, Augment Instream Flows by Using the Inactive Pool (718); Section 2.8.1.3, Augment Instream Flows by Using the Power Pool (304)). These measures would augment flows for biological purposes at critical times of the year and would reduce temperatures.

Water Quality

Regulating outlets would be used under Alternative 3A to discharge colder water during drawdown operations in fall and winter to reduce water temperatures below Lookout Point, Green Peter, and Detroit Dams (Measure 166) (Section 2.8.2.2, Use Regulating Outlets for Temperature Management (166)). Also at these dams, and at Hills Creek, Blue River, and Foster Dams, the spillways would be used for surface spill in summer (Measure 721) (Section 2.8.2.5, Use Spillways to Release Warm Surface Water in Summer (721)). The spillways at Hills Creek and Blue River Dams and the fish weir at Foster Dam would be modified to implement Measure 721.

Fish Passage

Under Alternative 3A, new adult fish facilities for upstream fish passage would be implemented at Hills Creek, Blue River, and Green Peter Dams (Measure 722) (Section 2.8.4.3, Construct Adult Fish Facilities (722). These facilities would also provide Pacific lamprey infrastructure (Measure 52) (Section 2.8.4.1, Provide Pacific Lamprey Passage Infrastructure (52)). Upstream fish passage at other dams would be provided through existing trap and haul facilities. No structural downstream fish passage measures are included under Alternative 3A.

Operations-based fish passage measures include:

- Deeper fall season reservoir drawdowns at Lookout Point, Hills Creek, Green Peter, Detroit, Blue River, and Cougar Dams (to the regulating outlets) (Measure 40) (Section 2.8.3.1, Deeper Fall Reservoir Drawdown for Downstream Fish Passage (40)).
- Spring drawdowns at Lookout Point, Detroit, and Cougar Dams (to the regulating outlets) (Measure 720) (Section 2.8.3.4, Deep Spring Reservoir Drawdown for Downstream Fish Passage (720)).
- The use of spillways to facilitate downstream fish passage at Dexter, Fall Creek, Hills Creek, Green Peter, and Big Cliff Dams (Measure 714) (Section 2.8.3.3, Pass Water over Spillways in Spring for Downstream Fish Passage (714)).

Interim Operations

THE DEIS HAS BEEN MODIFIED TO REVISE THE FOLLOWING INFORMATION IN THE FEIS

Interim Operations would be implemented under Alternative 3A as under Alternatives 2A, 2B, 3B, 4, and 5 (Section 2.8.5, Interim Operations). Operations would be replaced immediately at locations where the long-term operation under Alternative 3A is proposed.

Interim Operations under Alternative 3A and Alternative 3B may not be fully implemented or required because long-term operational strategies for these alternatives are intended to be implemented immediately upon Record of Decision finalization.

END REVISED TEXT

2.10.4.7 Alternative 3B—Improve Fish Passage through Operations-focused Measures

Activities and measures under Alternative 3B would be the same as those described under Alternative 3A, including Interim Operations, but would include a modification to the combination of operational measures for downstream fish passage (Table 2.10-11). This alternative was developed as an option to spring operations for downstream fish passage as distinguished from spring operations under 3A. The description for Alternative 3B addresses only the distinction with Alternative 3A.

Table 2.10-11. Alternative 3B Measures and Locations.

Measure	FRN	CTG	DOR	DEX	LOP	FCR	HCR	CGR	BLU	FOS	GPR	BCL	DET
Interim Operations	–	–	–	–	X	X	X	X	–	X	X	X	X
Flow Measures	–	–	–	–	–	–	–	–	–	–	–	–	–
30a. Integrated temperature and habitat flow regime	X	X	X	X	X	X	X	X	X	X	X	X	X
30b. Refined integrated temperature and habitat flow regime	–	–	–	–	–	–	–	–	–	–	–	–	–
304. Augment instream flows by using the power pool	–	–	–	–	X	–	X	–	–	–	X	–	X
718. Augment instream flows by using inactive pool	–	X	X	–	–	X	–	–	X	–	–	–	–
723. Reduce minimum flows to Congressionally authorized minimum flow requirements	–	–	–	–	–	–	–	–	–	–	–	–	–

Measure	FRN	CTG	DOR	DEX	LOP	FCR	HCR	CGR	BLU	FOS	GPR	BCL	DET
Water Quality Measures	–	–	–	–	–	–	–	–	–	–	–	–	–
105. Construct selective withdrawal structure	–	–	–	–	–	–	–	–	–	–	–	–	–
166. Use regulating outlets for temperature management	–	–	–	–	X	–	–	–	–	–	X	–	X[1]
174. Structural improvements to reduce TDG	–	–	–	–	–	–	–	–	–	–	–	–	–
479. Foster Dam fish ladder temperature improvement	–	–	–	–	–	–	–	–	–	–	–	–	–
721. Use spillways to release warm surface water in summer	–	–	–	–	X	–	X[2]	–	X[2]	X[2]	X	–	X
Downstream Passage Measures	–	–	–	–	–	–	–	–	–	–	–	–	–
40. Deeper fall reservoir drawdowns for downstream fish passage	–	–	–	–	X	–	X	X[3]	X	–	X	–	X
392. Construct structural downstream fish passage	–	–	–	–	–	–	–	–	–	–	–	–	–
714. Pass water over spillway in spring for downstream fish passage	–	–	–	X	X	–	–	–	–	–	–	X	X
720. Deep spring reservoir drawdown for downstream fish passage	–	–	–	–	–	–	–	X	X[3]	–	X	–	–
Upstream Passage Measures	–	–	–	–	–	–	–	–	–	–	–	–	–
52. Provide Pacific lamprey passage infrastructure	–	–	–	–	–	–	X	–	X	–	X	–	–
639. Restore upstream and downstream passage at drop structures	–	–	–	–	–	–	–	–	–	–	–	–	–
722. Construct adult fish facility	–	–	–	–	–	–	X	–	X	–	X	–	–
Measures and Actions Common to All Action Alternatives	–	–	–	–	–	–	–	–	–	–	–	–	–
9. Maintain revetments considering nature-based engineering or alter revetments for aquatic ecosystem restoration[4]	–	–	–	–	–	–	–	–	–	–	–	–	–
384. Gravel augmentation	–	–	–	–	–	–	–	X	X	X	–	X	–
719. Adapt Willamette hatchery mitigation program	–	–	–	X	X	X	X	X	X	X	X	X	X
726. Maintenance of existing and new fish release sites above dams	–	–	–	–	X	X	X	X	–	X	X	–	X

Measure	FRN	CTG	DOR	DEX	LOP	FCR	HCR	CGR	BLU	FOS	GPR	BCL	DET
Adaptive management	X	X	X	X	X	X	X	X	X	X	X	X	X
Fall Creek Reservoir drawdown	–	–	–	–	–	X	–	–	–	–	–	–	–
Environmental flows	–	–	–	X	X	X	X	X	–	–	–	X	X
Maintenance of WVS facilities	X	X	X	X	X	X	X	X	X	X	X	X	X
Continued operation of existing adult fish facilities	–	–	–	X	–	X	–	X	–	X	–	X	–

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FOS = Foster Dam
GPR = Green Peter Dam
BCL = Big Cliff Dam
DET = Detroit

[1] May require structural modification of the regulating outlet to allow for routine use.

[2] Requires structural modification to spillway.

[3] Drawdown to Cougar Dam diversion tunnel. Requires structural modification to the diversion tunnel.

[4] Basin-wide, including Willamette River, but not associated with a dam or reservoir.

Alternative 3A includes downstream fish passage elements at a different combination of dams and reservoirs than under Alternative 3B. Alternative 3A also includes drawdown drafting to 25 feet over the top of the Cougar Dam regulating outlet for deep fall and spring drawdown measures. Conversely, Alternative 3B includes drawdown drafting to the diversion tunnel at Cougar Dam for both the spring and fall drawdown measures, a much deeper drawdown than would occur under Alternative 3A.

As under Alternative 3A, Alternative 3B includes the two measures that augment flows for biological purposes at critical times of the year to reduce water temperatures. Instream flows would be augmented, if needed, under both Alternative 3A and Alternative 3B by using the inactive pools in late summer or early fall at Cottage Grove, Dorena, Fall Creek, and Blue River Dams (Measure 718) and the power pools in summer or late fall at Lookout Point, Hills Creek, Green Peter, and Detroit Dams (Measure 304) (Section 2.8.1.4, Augment Instream Flows by Using the Inactive Pool (718); Section 2.8.1.3, Augment Instream Flows by Using the Power Pool (304)).

Unlike Alternative 3A, Alternative 3B includes the deep fall and spring drawdowns to the Cougar Dam diversion tunnel for downstream fish passage that would draft the reservoir below the power pool most of the time and result in the power pool becoming inaccessible for flow augmentation (Measure 40 and Measure 720) (Section 2.8.3.1, Deeper Fall Reservoir Drawdown for Downstream Fish Passage (40); Section 2.8.3.4, Deep Spring Reservoir Drawdown for Downstream Fish Passage (720)). The Cougar Dam diversion tunnel would require modifications for USACE to implement Alternative 3B.

Downstream passage measures proposed under Alternative 3B include:

- Deeper fall season reservoir drawdowns than under the NAA and identical to Alternative 3A.
- Spring drawdowns at Hills Creek and Green Peter Dams (as compared to spring drawdowns at Lookout Point and Detroit Dams under Alternative 3A) (Measure 720) (Section 2.8.3.4, Deep Spring Reservoir Drawdown for Downstream Fish Passage (720)).
- The use of spillways to facilitate downstream fish passage at four dams: Dexter, Lookout Point, Big Cliff, and Detroit Dams (Measure 714) (Section 2.8.3.3, Pass Water over Spillways in Spring for Downstream Fish Passage (714)). This differs from Alternative 3A where spillway use would occur at five dams: Dexter, Big Cliff, Fall Creek, Hills Creek, and Green Peter Dams.

2.10.4.8 Alternative 4—Improve Fish Passage with Structures-based Approach

Alternative 4 is a structures-based approach to improve fish passage through the WVS dams to increase the survival of ESA-listed fish. It also contains operational measures, such as minimum flows for fish (Table 2.10-12).

Table 2.10-12. Alternative 4 Measures and Locations.

Measure	FRN	CTG	DOR	DEX	LOP	FCR	HCR	CGR	BLU	FOS	GPR	BCL	DET
Interim Operations	–	–	–	–	X	X	X	X	–	X	X	X	X
Flow Measures	–	–	–	–	–	–	–	–	–	–	–	–	–
30a. Integrated temperature and habitat flow regime	X	X	X	X	X	X	X	X	X	X	X	X	X
30b. Refined integrated temperature and habitat flow regime	–	–	–	–	–	–	–	–	–	–	–	–	–
304. Augment instream flows by using the power pool	–	–	–	–	X	–	X	X	–	–	X	–	X
718. Augment instream flows by using inactive pool	–	X	X	–	–	X	–	–	X	–	–	–	–
723. Reduce minimum flows to Congressionally authorized minimum flow requirements	–	–	–	–	–	–	–	–	–	–	–	–	–

Measure	FRN	CTG	DOR	DEX	LOP	FCR	HCR	CGR	BLU	FOS	GPR	BCL	DET
Water Quality Measures	–	–	–	–	–	–	–	–	–	–	–	–	–
105. Construct selective withdrawal structure	–	–	–	–	X	–	X	–	–	–	–	–	X
166. Use regulating outlets for temperature management	–	–	–	–	–	–	–	–	–	–	X	–	–
174. Structural improvements to reduce TDG	–	–	–	X	X[1]	–	–	X	–	X	X	–	X[1]
479. Foster Dam fish ladder temperature improvement	–	–	–	–	–	–	–	–	–	X	–	–	–
721. Use spillways to release warm surface water in summer	–	–	–	–	–	–	–	–	–	–	X	–	–
Downstream Passage Measures	–	–	–	–	–	–	–	–	–	–	–	–	–
40. Deeper fall reservoir drawdowns for downstream fish passage	–	–	–	–	–	–	–	–	–	–	–	–	–
392. Construct structural downstream fish passage	–	–	–	X[2]	X	–	X	X	–	X	–	X[2]	X
714. Pass water over spillway in spring for downstream fish passage	–	–	–	–	–	–	–	–	–	–	–	–	–
720. Deep spring reservoir drawdown for downstream fish passage	–	–	–	–	–	–	–	–	–	–	–	–	–
Upstream Passage Measures	–	–	–	–	–	–	–	–	–	–	–	–	–
52. Provide Pacific lamprey passage infrastructure	X	–	–	–	–	–	X	–	–	–	–	–	–
639. Restore upstream and downstream passage at drop structures	X	–	–	–	–	–	–	–	–	–	–	–	–
722. Construct adult fish facility	–	–	–	–	–	–	X	–	–	–	–	–	–
Measures and Actions Common to All Action Alternatives	–	–	–	–	–	–	–	–	–	–	–	–	–
9. Maintain revetments considering nature-based engineering or alter revetments for aquatic ecosystem restoration[3]	–	–	–	–	–	–	–	–	–	–	–	–	–
384. Gravel augmentation	–	–	–	–	–	–	–	X	X	X	–	X	–
719. Adapt Willamette hatchery mitigation program	–	–	–	X	X	X	X	X	X	X	X	X	X
726. Maintenance of existing and new fish release sites above dams	–	–	–	–	X	X	X	X	–	X	X	–	X
Adaptive management	X	X	X	X	X	X	X	X	X	X	X	X	X
Fall Creek Reservoir drawdown	–	–	–	–	–	X	–	–	–	–	–	–	–
Environmental flows	–	–	–	X	X	X	X	X	–	–	–	X	X

Measure	FRN	CTG	DOR	DEX	LOP	FCR	HCR	CGR	BLU	FOS	GPR	BCL	DET
Maintenance of WVS facilities	X	X	X	X	X	X	X	X	X	X	X	X	X
Continued operation of existing adult fish facilities	–	–	–	X	–	X	–	X	–	X	–	X	–

FRN = Fern Ridge Dam
CTG = Cottage Grove Dam
DOR = Dorena Dam
DEX = Dexter Dam
LOP = Lookout Point Dam
FCR = Fall Creek Dam
HCR = Hills Creek Dam
CGR = Cougar Dam
BLU = Blue River Dam
FOS = Foster Dam
GPR = Green Peter Dam
BCL = Big Cliff Dam
DET = Detroit

[1] Incorporated into design of Measure 105.

[2] Fish would be collected at an upstream dam location and transported downstream of a re-regulation dam.

[3] Basin-wide, including Willamette River, but not associated with a dam or reservoir.

Stream Flow

Under Alternative 4, the integrated temperature and habitat flow regime would be implemented at all dams in the WVS (Measure 30a) (Section 2.8.1.1, Integrated Temperature and Habitat Flow Regime (30a)). Under Alternative 4, USACE would also augment instream flows, if needed, by using the inactive pools in late summer or early fall at Cottage Grove, Dorena, Fall Creek, and Blue River Dams (Measure 718) and the power pools in summer or late fall at Lookout Point, Hills Creek, Cougar, Green Peter, and Detroit Dams (Measure 304), and by using the (Section 2.8.1.4, Augment Instream Flows by Using the Inactive Pool (718); Section 2.8.1.3, Augment Instream Flows by Using the Power Pool (304)). These two measures would augment flows for biological purposes at critical times of the year and reduce water temperatures.

Water Quality

Measures under Alternative 4 would include structural improvements to reduce TDG at Dexter, Cougar, Foster, and Green Peter Dams (Measure 174) (Section 2.8.2.3, Structural Improvements to Reduce Total Dissolved Gas (174)). Structural measures would also include constructing selective withdrawal structures at Lookout Point, Hills Creek, and Detroit Dams (Measure 105) (Section 2.8.2.1, Construct Selective Withdrawal Structures (105)). The selective withdrawal structures at Lookout Point and Detroit Dams would also be designed to reduce TDG (Measure 174).

Fish Passage

To address upstream passage needs, an adult fish collection facility would be constructed at Hills Creek Dam (Measure 722) (Section 2.8.4.3, Construct Adult Fish Facilities (722). Upstream fish passage would be restored downstream of Fern Ridge Dam at the Monroe, Stroda, and Cox Butte drop structures (Measure 639) (Section 2.8.4.2, Restore Upstream and Downstream Passage at Drop Structures (639)). The design of the adult fish facility at Hills Creek Dam and

fish passage restoration at the drop structures below Fern Ridge Dam would include Pacific lamprey passage infrastructure (Measure 52) (Section 2.8.4.1, Provide Pacific Lamprey Passage Infrastructure (52)).

All three selective withdrawal structures would be paired with an attached floating screen structure to provide downstream fish passage (Measure 392) (Section 2.8.3.2, Construct Structural Downstream Fish Passage (392)). The structures would allow for fish collection over various water levels throughout the year, with the intent of minimizing effects on storage from operations for fish passage and water quality.

Fish collected at Lookout Point and Detroit Dams would be transported and released downstream of their re-regulation dams (Dexter and Big Cliff Dams, respectively) to avoid passage over the re-regulating dams. Alternative 4 includes the construction of a floating fish screen at Cougar Dam attached to the existing water temperature control tower.

Alternative 4 includes Foster Dam fish ladder temperature improvement (Measure 479) and structural features for improved downstream passage (Measure 392) (Section 2.8.2.4, Foster Dam Fish Ladder Temperature Improvement (479)).

Interim Operations

Interim Operations would be implemented under Alternative 4 as under Alternatives 2A, 2B, 3A, 3B, and 5 (Section 2.8.5, Interim Operations).

2.10.4.9 Alternative 5—Preferred Alternative—Refined Integrated Water Management Flexibility and ESA-listed Fish Alternative

Alternative 5 was identified in the DEIS as the Preferred Alternative; it is also the Preferred Alternative analyzed in the FEIS. Alternative 5 is the same as Alternative 2B except that the integrated temperature and habitat flow regime (Measure 30a) would be replaced by the refined integrated temperature and habitat flow regime (Measure 30b) (Section 2.8.1.1, Integrated Temperature and Habitat Flow Regime (30a); Section 2.8.1.2, Refined Integrated Temperature and Habitat Flow Regime (30b)) (Table 2.10-13).

Table 2.10-13. Alternative 5 Measures and Locations.

Measure	FRN	CTG	DOR	DEX	LOP	FCR	HCR	CGR	BLU	FOS	GPR	BCL	DET
Interim Operations	–	–	–	–	X	X	X	X	–	X	X	X	X
Flow Measures	–	–	–	–	–	–	–	–	–	–	–	–	–
30a. Integrated temperature and habitat flow regime	–	–	–	–	–	–	–	–	–	–	–	–	–
30b. Refined integrated temperature and habitat flow regime	X	X	X	X	X	X	X	X	X	X	X	X	X

Measure	FRN	CTG	DOR	DEX	LOP	FCR	HCR	CGR	BLU	FOS	GPR	BCL	DET
304. Augment instream flows by using the power pool	–	–	–	–	X	–	X	–	–	–	X	–	X
718. Augment instream flows by using inactive pool	–	–	–	–	–	X	–	–	X	–	–	–	–
723. Reduce minimum flows to Congressionally authorized minimum flow requirements	–	–	–	–	–	–	–	–	–	–	–	–	–
Water Quality Measures	–	–	–	–	–	–	–	–	–	–	–	–	–
105. Construct selective withdrawal structure	–	–	–	–	–	–	–	–	–	–	–	–	X
166. Use regulating outlets for temperature management	–	–	–	–	–	–	–	–	–	–	X	–	–
174. Structural improvements to reduce TDG	–	–	–	–	–	–	–	–	–	–	–	–	–
479. Foster Dam fish ladder temperature improvement	–	–	–	–	–	–	–	–	–	X	–	–	–
721. Use spillways to release warm surface water in summer	–	–	–	–	–	–	–	–	–	–	X	–	–
Downstream Passage Measures	–	–	–	–	–	–	–	–	–	–	–	–	–
40. Deeper fall reservoir drawdowns for downstream fish passage	–	–	–	–	–	–	–	X[1]	–	–	X	–	–
392. Construct structural downstream fish passage	–	–	–	–	X	–	–	–	–	X	–	–	X
714. Pass water over spillway in spring for downstream fish passage	–	–	–	–	–	–	–	–	–	–	X	–	–
720. Deep spring reservoir drawdown for downstream fish passage	–	–	–	–	–	–	–	X[1]	–	–	–	–	–
Upstream Passage Measures	–	–	–	–	–	–	–	–	–	–	–	–	–
52. Provide Pacific lamprey passage infrastructure	–	–	–	–	–	–	–	–	–	–	X	–	–
639. Restore upstream and downstream passage at drop structures	–	–	–	–	–	–	–	–	–	–	–	–	–
722. Construct adult fish facility	–	–	–	–	–	–	–	–	–	–	X	–	–
Measures and Actions Common to All Action Alternatives	–	–	–	–	–	–	–	–	–	–	–	–	–
9. Maintain revetments considering nature-based engineering or alter revetments for aquatic ecosystem restoration[2]	–	–	–	–	–	–	–	–	–	–	–	–	–
384. Gravel augmentation	–	–	–	–	–	–	–	X	X	X	–	X	–

Measure	FRN	CTG	DOR	DEX	LOP	FCR	HCR	CGR	BLU	FOS	GPR	BCL	DET
719. Adapt Willamette hatchery mitigation program	–	–	–	X	X	X	X	X	X	X	X	X	X
726. Maintenance of existing and new fish release sites above dams	–	–	–	–	X	X	X	X	–	X	X	X	X
Adaptive management	X	X	X	X	X	X	X	X	X	X	X	X	X
Fall Creek Reservoir drawdown	–	–	–	–	–	X	–	–	–	–	–	–	–
Environmental flows	–	–	–	X	X	X	X	X	–	–	–	X	X
Maintenance of WVS facilities	X	X	X	X	X	X	X	X	X	X	X	X	X
Continued operation of existing adult fish facilities	–	–	–	X	–	X	–	X	–	X	–	X	–

FRN = Fern Ridge Dam
CTG = Cottage Grove Dam
DOR = Dorena Dam
DEX = Dexter Dam
LOP = Lookout Point Dam
FCR = Fall Creek Dam
HCR = Hills Creek Dam
CGR = Cougar Dam
BLU = Blue River Dam
FOS = Foster Dam
GPR = Green Peter Dam
BCL = Big Cliff Dam
DET = Detroit

[1] Drawdown to the diversion tunnel. Requires structural modifications to the diversion tunnel.

[2] Basin-wide, including Willamette River, but not associated with a dam or reservoir.

Alternative 5 was developed to improve fish passage through the WVS dams using a combination of modified operations and structural improvements along with other measures to balance water management flexibility and to meet ESA-listed fish obligations. Development of Alternative 5 occurred after formulation of all other action alternatives. Alternative 2B was initially proposed as the Preferred Alternative. However, after engaging with BPA, NMFS, and USFWS, USACE determined that the integrated temperature and habitat flow regime proposed under Alternative 2B should be refined to improve outcomes for ESA-listed species. Because of this development history, comparisons with Alternative 2B are provided rather than highlighting only differences between the two alternatives.

Stream Flow

Unique to Alternative 5, the refined integrated temperature and habitat flow regime would be implemented at all dams in the WVS (Measure 30b) (Section 2.8.1.2, Refined Integrated Temperature and Habitat Flow Regime (30b)). Identical to Alternative 2B, USACE would augment instream flows, if needed, using the inactive pools in late summer or early fall at Fall Creek and Blue River Dams (Measure 718) and by using the power pools in summer or late fall at Lookout Point, Hills Creek, Green Peter, and Detroit Dams under Alternative 5 (Measure 304). These two measures would augment flows for biological purposes at critical times of the year.

Water Quality

As under Alternative 2B, Alternative 5 includes a combination of structural and operational measures to address water quality. The fish passage structure at Detroit Dam would be integrated with a selective withdrawal structure (Measure 105) (Section 2.8.2.1, Construct Selective Withdrawal Structures (105)). A selective withdrawal structure at Lookout Point Dam was omitted from this alternative after initial modeling demonstrated an inability to affect temperatures downstream of Dexter Dam.

Temperature control at Green Peter Dam under Alternative 5 would be the same as Alternative 2B:

- Using the regulating outlets to discharge colder water during drawdown operations in fall and winter to reduce water temperatures below these dams (Measure 166) (Section 2.8.2.2, Use Regulating Outlets for Temperature Management (166)).
- Using the spillway for surface spill in summer (Measure 721) (Section 2.8.2.5, Use Spillways to Release Warm Surface Water in Summer (721)).
- Construct the Foster Dam fish ladder temperature improvement (Measure 479) (Section 2.8.2.4, Foster Dam Fish Ladder Temperature Improvement (479) to improve temperatures for the adult fish facility.

Operations at Cougar Dam under Alternative 5 would be changed by drafting the reservoir down in the fall and spring so that fish can pass through the diversion tunnel, same as under Alternative 2B (Measure 40 and Measure 720) (Section 2.8.3.1, Deeper Fall Reservoir Drawdown for Downstream Fish Passage (40); Section 2.8.3.4, Deep Spring Reservoir Drawdown for Downstream Fish Passage (720)). These deep fall and spring drawdowns to the diversion tunnel for fish passage would draft the reservoir below the power pool most of the time, making the power pool inaccessible for flow augmentation under Alternative 5 (Measure 304) (Section 2.8.1.3, Augment Instream Flows by Using the Power Pool (304).

Fish Passage

Alternative 5 includes a new adult fish facility for upstream fish passage at Green Peter Dam (Measure 722) that would provide passage features for Pacific lamprey (Measure 52) (Section 2.8.4.3, Construct Adult Fish Facilities (722); Section 2.8.4.1, Provide Pacific Lamprey Passage Infrastructure (52)).

As under Alternative 2A and Alternative 2B, Alternative 5 includes operational downstream fish passage measures at Green Peter Dam, including passing water over the spillway in the spring (Measure 714) and a deep fall drawdown (Measure 40). Structural downstream passage measures (Measure 392) are proposed only at Lookout Point, Detroit, and Foster Dams (Section 2.8.3.3, Pass Water over Spillways in Spring for Downstream Fish Passage (714); Section 2.8.3.1, Deeper Fall Reservoir Drawdown for Downstream Fish Passage (40); Section 2.8.3.2, Construct Structural Downstream Fish Passage (392)).

Interim Operations

Interim Operations would be implemented under Alternative 5 as under Alternatives 2A, 2B, 3A, 3B, and 4 (Section 2.8.5, Interim Operations).

Appendix N, Implementation and Adaptive Management Plan, provides detailed information about how Interim Operations would be replaced by the measures under this alternative.

2.10.4.10 Summary of Measures under the Action Alternatives[13]

Table 2.10-14. Summary of Measures under each Action Alternative that would be Implemented during the 30-year Timeframe.

Measures	Alt 1	Alt 2A	Alt 2B	Alt 3A	Alt 3B	Alt 4	Alt 5
Interim Operations		X	X	X	X	X	X
Flow Measures							
30a. Integrated temperature and habitat flow regime		X	X	X	X	X	
30b. Integrated temperature and habitat flow regime							X
304. Augment instream flows by using the power pool	X	X	X	X	X	X	X
718. Augment instream flows by using inactive pool	X	X	X	X	X	X	X
723. Reduce minimum flows to Congressionally authorized minimum flow requirements	X						
Water Quality Measures							
105. Construct selective withdrawal structure	X	X	X			X	X
166. Use regulating outlets for temperature management	X	X	X	X	X	X	X
174. Structural improvements to reduce TDG						X	
479. Foster Dam fish ladder temperature improvement	X	X	X			X	X

[13] Note that this table does not include measures under the NAA because specified, numbered measures were not developed for the NAA, which is continuation of existing operations and maintenance (Section 2.10.3, No-action Alternative).

Measures	Alt 1	Alt 2A	Alt 2B	Alt 3A	Alt 3B	Alt 4	Alt 5
721. Use spillways to release warm surface water in summer		X	X	X	X	X	X
Downstream Passage Measures							
40. Deeper fall reservoir drawdowns for downstream fish passage		X	X	X	X		X
392. Construct structural downstream fish passage	X	X	X			X	X
714. Pass water over spillway in spring for downstream fish passage		X	X	X	X		X
720. Deep spring reservoir drawdown for downstream fish passage			X	X	X		X
Upstream Passage Measures							
52. Provide Pacific lamprey passage infrastructure	X	X	X	X	X	X	X
639. Restore upstream and downstream passage at drop structures	X					X	
722. Construct adult fish facility	X	X	X	X	X	X	X
Measures and Actions Common to All Alternatives							
9. Maintain revetments using nature-based engineering or alter revetments for aquatic ecosystem restoration	X	X	X	X	X	X	X
384. Gravel augmentation	X	X	X	X	X	X	X
719. Adapt Willamette hatchery mitigation program	X	X	X	X	X	X	X
726. Maintenance of existing and new fish release sites above dams	X	X	X	X	X	X	X

Measures	Alt 1	Alt 2A	Alt 2B	Alt 3A	Alt 3B	Alt 4	Alt 5
Adaptive management	X	X	X	X	X	X	X
Fall Creek Reservoir drawdown	X	X	X	X	X	X	X
Environmental flows	X	X	X	X	X	X	X
Maintenance of WVS facilities	X	X	X	X	X	X	X
Continued operation of existing adult fish facilities	X	X	X	X	X	X	X

Photo by Lorelle Sherman (USACE Media Images Database)

Purple martin nest box at Fern Ridge Dam.