US Army Corps of Engineers®
Portland District

WILLAMETTE VALLEY SYSTEM OPERATIONS AND MAINTENANCE

DRAFT SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT

NOVEMBER 2025

WILLAMETTE VALLEY SYSTEM OPERATIONS AND MAINTENANCE DRAFT SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT

Lead Agency

U.S. Army Corps of Engineers, Portland District

Cooperating Agencies

Bonneville Power Administration
Confederated Tribes of Grand Ronde Community of Oregon
National Marine Fisheries Service
Oregon Department of Agriculture
Oregon Department of Environmental Quality
Oregon Department of Fish and Wildlife
Oregon Water Resources Department
U.S. Bureau of Reclamation
U.S. Environmental Protection Agency
U.S. Fish and Wildlife Service

Affected Areas

State: Oregon
Counties: Benton, Lane, Linn, and Marion Counties

Contact for Further Information

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Federal Permits, Licenses, and Entitlements Required to Implement the Proposal

USACE will identify any permits, licenses, or entitlements in subsequent environmental reviews consistent with the National Environmental Policy Act and U.S. Army Corps of Engineers Procedures for Implementing the National Environmental Policy Act.

Detroit Dam. Unknown Photo Credit (USACE Media Images Database).

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The Supplemental EIS (SEIS) only includes new information related to the addition of an alternative that ceases Federal hydropower operations in the Willamette Valley System, and revisions to the Interim Operations including a late fall/early winter deep drawdown for fish passage at Detroit Dam and change to the minimum flow targets. Generally, the SEIS does not reproduce information from the Final EIS (FEIS) but incorporates information by reference as encouraged by NEPA and USACE policy and procedures. This results in a more concise document.

Some graphs and tables are reproduced to provide context. One example is the effects summary tables have been reproduced, retaining the effects of the seven alternatives presented in the FEIS, and then supplemented with new information.

Chapter and section numbers in the SEIS match the chapter and section numbers in the FEIS, which allows readers to quickly reference information from the FEIS and understand updates. Some sections have been descoped from the SEIS based on changes to laws, regulations, and recent executive orders; however, the SEIS retains those section number headings to mirror the FEIS. Tables and figures that are reproduced in the SEIS have different numbers than the FEIS, but include a footnote with the corresponding table in the FEIS. New tables created for the SEIS do not have a footnote, and they may repeat table numbers in the FEIS.

The Detroit Drawdown, as a part of the Interim Operations, has proven to be a primary interest of commenters during the scoping of this SEIS. The effects of the Detroit Drawdown are discussed throughout Chapter 3 but may be more efficiently accessed by searching the phrase “Detroit Drawdown”. Also, a brief summary of the effects of the drawdown is provided in section 7.2.2 of the Executive Summary.

The FEIS is available in the USACE Digital Library at:
https://usace.contentdm.oclc.org/digital/collection/p16021coll7/id/27619

ABSTRACT

The U.S. Army Corps of Engineers (USACE), Portland District prepared this Draft Supplemental Environmental Impact Statement (DSEIS) to address the directive in the 2024 Water Resources Development Act (WRDA 24) to formally analyze an alternative that ceases Federal hydropower operations at USACE owned and operated Willamette Valley dams and reservoirs. This DSEIS supplements previous efforts, the Willamette Valley System (WVS) Draft and Final EIS (FEIS), to study how to continue to operate the WVS in a manner that complies specifically with the Endangered Species Act (ESA) as well as all other applicable legal requirements.

This SEIS complies with the National Environmental Policy Act (NEPA), 42 U.S.C. §§ 4321. Ten Cooperating Agencies and interested tribes provided information and review throughout the EIS process.

Public involvement during the scoping process informed the DSEIS. Public scoping began on May 16, 2025, with publication of a Notice of Intent in the Federal Register (90 FR 21015). The Public Comment Scoping Report is in Appendix P.

The Proposed Action is to continue operations and maintenance of the Willamette Valley System for specific, authorized purposes. Congress directed responsibility for operating each dam and reservoir individually and as part of a system to USACE in authorizing legislation. Consequently, the Proposed Action is to continue to operate this system to achieve the objectives set by Congress while meeting ESA requirements.

USACE operates a complex water management system in western Oregon's Willamette Valley by storing and releasing water from 13 reservoirs to balance needs and demands throughout the year. USACE coordinates the operations and maintenance of the 13 reservoirs and dams, which function together as the WVS. Water needs and demands are balanced among eight Congressional authorized uses: flood risk management, hydropower, fish and wildlife, recreation, navigation, irrigation, municipal and industrial water supply, and water quality. The system also must operate, follow, and comply with all applicable laws including the ESA, which it was found to be out of compliance.

This SEIS analyzes a new alternative that ceases Federal hydropower operations at the eight dams that produce Federal hydropower in the WVS. In the FEIS USACE analyzed the No-action Alternative and seven action alternatives. The seven action alternatives include various combinations of operational or structural measures to continue to improve conditions for ESA listed species including flow, water quality, and fish passage. The FEIS also included measures common to all action alternatives, including gravel augmentation and operation and maintenance of adult fish facilities among other measures. This SEIS only describes the new alternative in detail because it incorporates the other alternatives by reference.

This SEIS also analyses new operations required by the National Marine Fisheries Service's (NMFS) 2024 *Endangered Species Act Section 7(a)(2) Biological Opinion (Biological Opinion) and*

Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Response for the Continued Operation and Maintenance of the Willamette Valley System. This includes a new requirement for a deeper drawdown of Detroit Reservoir until a long-term fish passage solution is in place and continuation of NMFS's 2008 Biological Opinion flow requirements until a new flow management plan is developed. The operation is part of a suite of interim operations and its effects are often described in combination with the other operations. *If you are looking for information on the Detroit fall drawdown for fish passage it will be contained in the discussion of Interim Operations throughout Chapter 3.*

ACRONYMS AND ABBREVIATIONS

°C	Degrees Celsius
°F	Degrees Fahrenheit
µg/L	micrograms per liter
µg/m^3	micrograms per cubic meter
7dADM	7-day average daily maximum
A	
A.D.	Anno Domini
ACM	asbestos-containing materials
ALBO	Mainstem Willamette River at Albany
aMW	average megawatt
ARPA	Archaeological Resources Protection Act
B	
BCLO	Downstream of Big Cliff and Detroit Dams
BLM	U.S. Bureau of Land Management
BMP	Best Management Practices
BOR	U.S. Bureau of Reclamation
B.P.	years Before the Present
BPA	Bonneville Power Administration
C	
CAA	Clean Air Act
CBSA	Core-based Statistical Area
CCS	Cross Cascades South
CEJST	Climate and Environmental Justice Screening Tool
CEQ	Council on Environmental Quality
CERCLA	Comprehensive Environmental Response and Liability Act
CFR	Code of Federal Regulations
cfs	cubic feet per second
CGRO	Downstream of Cougar Dam
CH_3Hg	methylmercury
CO	carbon monoxide
CO2	carbon dioxide
CTCLUSI	Confederated Tribes of the Coos, Lower Umpqua, and Siuslaw
CTGR	Confederated Tribes of Grand Ronde
CTUIR	Confederated Tribes of the Umatilla Indian Reservation
CWA	Clean Water Act
D	

dBA	a-weighted decibel
DEXO	Downstream of Dexter Dam
DOE	U.S. Department of Energy
DPS	distinct population segment
E	
EA	Environmental Assessment
E-flow	Environmental Flow
EIS	Environmental Impact Statement
EPA	Environmental Protection Agency
ESA	Endangered Species Act
ESU	evolutionarily significant unit
F	
FCRPS	Federal Columbia River Power System
FEIS	Final Environmental Impact Statement
FEMA	Federal Emergency Management Agency
FERC	Federal Energy Regulatory Commission
FSS	floating screen structure
FMWQT	Flow Management and Water Quality Team
G	
GIS	Geographic Information Systems
H	
HCRO	Downstream of Hills Creek
HEC-RAS	Hydrologic Engineering Center River Analysis System
HEC-ResSim	Hydrologic Engineering Center Reservoir Simulation
Hg	mercury
HGMP	Hatchery Genetic Management Plan
HTRW	hazardous, toxic, and radioactive waste
I	
IES	Issue Evaluation Study
IRRMs	Interim Risk Reduction Measures
K	
Kaf	thousand acre-feet
Km^2	kilometers squared
kV	kilovolt
KW	kilowatt
kWh	kilowatt hour
L	

LCOG	Levelized Cost of Generation
LOLP	loss of load probability
M	
Maf	million acre-feet
mg/kg	milligrams per kilogram
MOP	minimum operating pool
MOU	Memorandum of Understanding
mph	miles per hour
MPSFs	Minimum Perennial Streamflows
MSA	Metropolitan Statistical Area
MSL	mean sea level
MW	megawatt
MWh	megawatt hour
N	
NAA	No-action Alternative
NEPA	National Environmental Policy Act
ng/L	nanograms per Liter
NGO	non-governmental organization
NHPA	National Historic Preservation Act
NMFS	National Marine Fisheries Service
NO_2	nitrogen dioxide
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
NPV	Net Present Value
NWFSC	Northwest Fisheries Science Center
O	
O3	ozone
OAR	Oregon Administrative Rules
ODEQ	Oregon Department of Environmental Quality
ODFW	Oregon Department of Fish and Wildlife
ODLCD	Oregon Department of Land Conservation and Development
ODOT	Oregon Department of Transportation
ODWS	Oregon Drinking Water Services
OEA	Oregon Office of Economic Analysis
OED	State of Oregon Employment Department
OHWM	Ordinary High Water Mark
OPRD	Oregon Parks and Recreation Department
ORS	Oregon Revised Statues

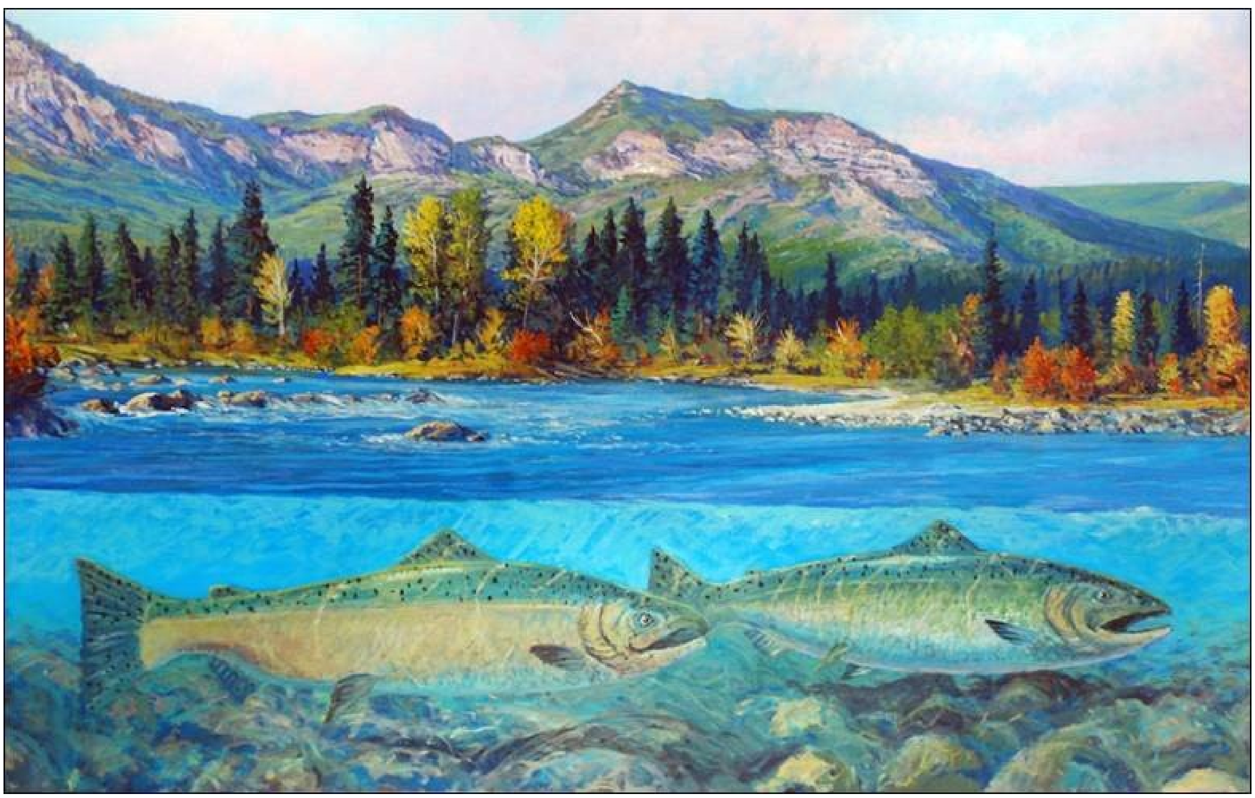
OSHA	Occupational Safety and Health Administration
OWRD	Oregon Water Resources Department
P	
Pb	lead
PCBs	polychlorinated biphenyls
PFMC	Pacific Fishery Management Council
pH	potential of hydrogen or acidity
pHOS	proportion of hatchery-origin spawners
PIT	passive integrated transponders
PM	particulate matter
pNOB	proportion of natural-origin brood
pp.	pages
ppb	parts per billion
ppm	parts per million
PUDs	Public Utility Districts
R	
RCRA	Resource Conservation and Recovery Act
RECONS	Regional Economic System
RED	Regional Economic Development
RFFA	reasonably foreseeable future action
RM	river mile
RO	regulating outlet
ROD	Record of Decision
RPA	Reasonable and Prudent Alternative
S	
SEIS	Supplemental Environmental Impact Statement
SHPO	State Historic Preservation Office
SLMO	Mainstem Willamette River at Salem
SO_2	sulfur dioxide
SOA	South of Allston
SSFO	Downstream of Foster and Green Peter Dams
T	
TDG	total dissolved gas
THg	total mercury
TMDL	total maximum daily load
TRGs	tolerable risk guidelines
U	
U.S.	United States

USACE	U.S. Army Corps of Engineers
USC	United States Code
USDA	U.S. Department of Agriculture
USDOT	U.S. Department of Transportation
USFS	U.S. Forest Service
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
UWR	Upper Willamette River
V	
VOCs	volatile organic compounds
VRM	Visual Resource Management
VSP	Viable Salmonid Population
W	
WATER	Willamette Action Team for Ecosystem Restoration (also WATER forum)
WFPOM	Willamette Fish Passage Operations & Maintenance
WLCTRT	Willamette/Lower Columbia Technical Recovery Team
WRDA	Water Resources Development Act
WVS	Willamette Valley System
WWSS	Willamette Water Supply System

WILLAMETTE VALLEY SYSTEM OPERATIONS AND MAINTENANCE

DRAFT SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT

EXECUTIVE SUMMARY


Painting by Lee Jensen, USACE Employee, 1991-2001 (USACE, Portland District Media Images).

1 - INTRODUCTION

The U.S. Army Corps of Engineers (USACE), Portland District prepared this Draft Supplemental Environmental Impact Statement (SEIS) in response to Section 1326 of the Water Resources Development Act of 2024 (WRDA 24). WRDA 24 states:

> The Secretary [of the Army] may not complete its review of, and consultation with other Federal agencies on, the operation and maintenance of the projects for flood control, navigation, and other purposes, Willamette River Basin, Oregon, authorized by section 4 of the Act of June 28, 1938 (chapter 795, 52 Stat. 1222; 62 Stat. 1178; 64 Stat. 177; 68 Stat. 1264; 74 Stat. 499; 100 Stat. 4144), until the Secretary prepares and formally analyzes an alternative that ceases hydropower operations at the projects, notwithstanding hydropower being an authorized purpose of such projects.

USACE published the Willamette Valley System Operations and Maintenance Final Environmental Impact Statement (FEIS) in April 2025. USACE signed a Record of Decision (ROD) on the interim operation and Foster Warm Water Supply Pipe in May 2025. This ROD allows USACE to comply with the National Environmental Policy Act (NEPA) requirements for Interim Operations while continuing to evaluate a new alternative addressed by this SEIS.

USACE is supplementing the FEIS to include a new alternative that ceases Federal hydropower operations at Willamette Valley System dams. Eight of the thirteen dams generate Federal hydropower. As described in WRDA 24, the new alternative only analyzes ending Federal operations to generate hydropower. The alternative maintains the remaining authorizations of flood control (flood risk management), fish and wildlife, recreation, navigation, irrigation, municipal and industrial water supply, and water quality.

The SEIS complies with the NEPA, 42 U.S.C. §§ 4321. The NEPA process for this EIS began in 2019, prior to Congress amending NEPA in 2023 under the Fiscal Responsibility Act, and revisions to the Council on Environmental Quality's (CEQ) 1978 implementing NEPA regulations. USACE complied with the previous statute in preparing this SEIS while also trying to carry out the provisions of the amendments as practical. CEQ rescinded all its implementing regulations on April 11, 2025. The Trump-Vance Administration rescinded several Executive Orders and related guidance regarding climate change and environmental justice analyses just prior to finalization of the FEIS. Consequently, references to the CEQ regulations and analyses of greenhouse gas emissions, social cost of carbon, and climate change were not removed from the FEIS to avoid delay in decision-making and the significant time and resources required for document revisions.

Ten Cooperating Agencies provided information and review throughout the SEIS process. Public involvement during the scoping process informed the development of the SEIS including the types of analyses to conduct and how to scope the additional alternative. Public scoping began on May 16, 2025, with publication of a Notice of Intent in the Federal Register (90 FR 21015). The Public Comment Scoping Report is in Appendix P.

Unknown Photo Credit (USACE Media Images Database)

McKenzie River.

2 - BACKGROUND

The United States Congress, through the Flood Control Act of 1938 and subsequent acts, authorized USACE to construct, operate, and maintain a system of dams, reservoirs and bank protection revetments primarily for flood control, now known as flood risk management, in the Willamette River Basin (Figure ES-1). USACE operates and maintains the Willamette Valley System (WVS) as a system of 13 dams and reservoirs and associated hatchery and fish collection facilities:

- Hills Creek, Lookout Point, Dexter, and Fall Creek dams and reservoirs in the Middle Fork Willamette River Subbasin
- Dorena and Cottage Grove dams and reservoirs in the Coast Fork Willamette River Subbasin
- Cougar and Blue River dams and reservoirs in the McKenzie River Subbasin
- Fern Ridge Dam and Reservoir in the Long Tom River Subbasin
- Green Peter and Foster Dams and Reservoirs in the South Santiam River Subbasin
- Detroit and Big Cliff dams and reservoirs on the North Santiam River

Congress authorized eight purposes for the WVS - flood risk management, hydropower, fish and wildlife, recreation, navigation, irrigation, municipal and industrial water supply, and water quality. To meet these purposes, the WVS stores and releases water from the 13 reservoirs to balance needs and demands for water resources. Congress authorized nine WVS dams for Federal hydropower: Hills Creek, Lookout Point, Dexter, Fall Creek, Cougar, Blue River, Detroit, Big Cliff, Green Peter and Foster. Blue River Dam was authorized for hydropower, but USACE never installed power generators.

Congress delegated other Federal agencies responsibilities for the WVS, including the Bonneville Power Administration, which markets and transmits the electrical power generated by the eight Federal hydropower-producing dams, and the U.S. Bureau of Reclamation, which markets water for irrigation purposes to users within the Willamette River Basin.

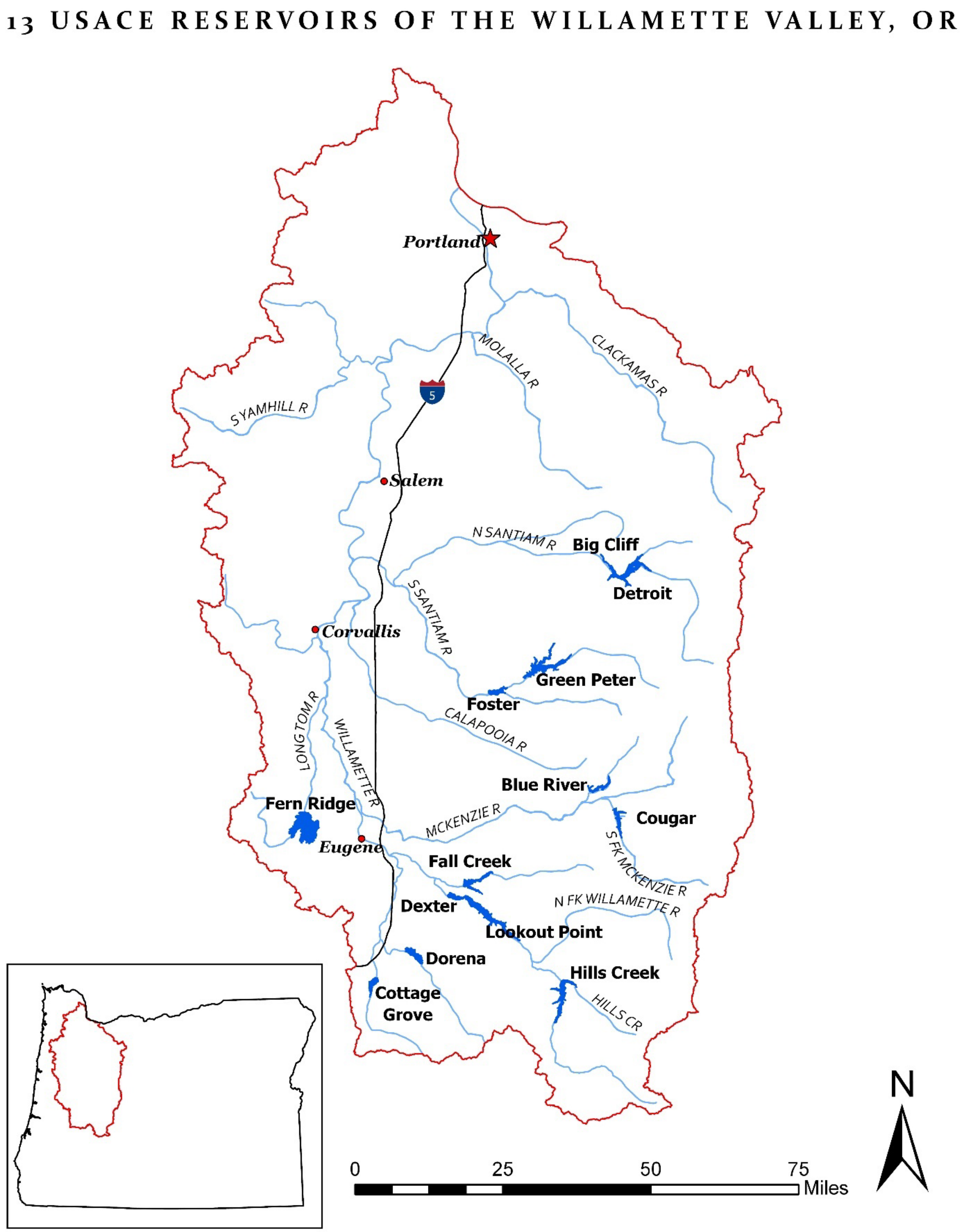


Figure ES-1. Willamette Valley System Dams, Reservoirs, Adult Fish Facilities, and Fish Hatcheries.

3 - PROPOSED ACTION

The Proposed Action is to continue operations and maintenance of the Willamette Valley System (WVS) for specific, authorized purposes. Congress directed responsibility for operating each dam and reservoir individually and as part of a system to USACE in authorizing legislation. USACE would implement the Proposed Action over a 30-year timeframe.

4 - PURPOSE 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 and in compliance with the ESA and all other applicable treaties, laws, and regulations (Chapter 1, Introduction, Section 1.10, Congressionally Authorized Purposes).

In the DEIS and FEIS, measures and alternatives were screened from further consideration if they did not meet the purpose and need statement. USACE interpreted the purpose and need statement very broadly when screening out measures or alternatives from further consideration. For example, the Cougar diversion tunnel operation only provides conservation storage and operates for hydropower purposes for a few days out the entire 84-year hydrological period of record analyzed. Because the measure did not eliminate these purposes entirely the Cougar diversion tunnel operation was retained for formal analysis, even though it is outside USACE's current authorities. This broad interpretation was the result of significant input from cooperators. Ultimately the screening process resulted in a reasonable range of seven different action alternatives composed of various measures.

As stated in Section 2.1, four months before publication of the FEIS and six years into the NEPA process, Congress passed a provision in WRDA 24 that required USACE to formally analyze an alternative that ceases hydropower operations at the WVS projects. WRDA 24 does not reference NEPA or proscribe that the alternative be formally analyzed in a NEPA document. However, USACE determined it had the discretion to supplement the FEIS to include the alternative required by WRDA 24. USACE decided that providing additional information for the public to comment on and context for the decision maker would be in furtherance of NEPA. However, USACE did not revise its purpose and need statement to include numerous other alternatives to keep the process efficient and timely, as emphasized in the Fiscal Responsibility Act (FRA) of 2023 (Pub. L. No. 118-5, 137 Stat. 10). Instead, it is relying on the clear directive in WRDA to analyze a single alternative that ceases hydropower operations at the WVS projects.

5 - CONSTRAINTS

USACE identified constraints on an alternative to ensure the actions properly considered the purpose and the need for the study and USACE responsibilities. For example, potential alternative measures were eliminated from consideration for the following:

- Flood Risk Management: Preliminary modeling results aided screening measures with potential adverse flood risk effects. Specifically, measures that would result in flood risk increases from current protection levels were eliminated as an alternative measure.
- Dam Safety: USACE performed a preliminary evaluation of measures for dam safety. Measures that would compromise dam safety and could not be mitigated were eliminated. USACE will evaluate components in a more detailed dam safety analysis during site-specific planning and design.

6 - OBJECTIVES

Objectives represent desired outcomes, as identified by the Federal agencies and scoping comments during the development of the FEIS. The SEIS retained the objectives. The seven primary objectives are:

1. Allow greater flexibility in water management (related to refill, drawdown timing, and other water management measures).
2. Increase opportunities for the creation of nature-based structures during maintenance of USACE-owned revetments (structures that help prevent bank erosion).
3. Allow greater flexibility in hydropower production.
4. Increase ESA-listed fish passage survival at WVS dams.
5. Improve water management during the conservation season to benefit anadromous ESA- listed fish and other authorized project purposes.
6. Reduce pollutant levels to restore impaired water quality associated with the WVS dams to benefit anadromous ESA-listed species.
7. Reduce spawning and rearing habitat competition caused by hatchery fish.

These objectives, along with the purpose and need, guided the development of a reasonable range of alternatives in the FEIS. As the SEIS is a supplement to the FEIS and retained the same purpose and need, the objectives are also carried forward in the analysis. However, as described above, Alternative 6 was developed in response to the requirements in WRDA 24 and is not aligned with the original purpose and need.

7 - MEASURES AND ALTERNATIVES

As part of the development of the FEIS, the USACE EIS team identified and compiled a list of operational and structural measures, or actions, that met at least one of the seven objectives for the Proposed Action. A measure is the action an agency would take to achieve a given objective. It describes either a physical (structural) change requiring construction or an operational change, usually in a precise location, that meets an objective, in whole or in part.

The team screened out potential measures based on criteria for meeting the purpose and need for the project, achieving stated objectives, and technical considerations. Using input from the public and cooperating agencies during scoping and professional judgement the team then created alternatives using combinations of the remaining measures around unifying themes or strategies. An alternative is a combination of one or more measures that, together, would address one or more of the objectives.

After multiple rounds of screening, the team compiled the measures that demonstrated the best outcomes for meeting project objectives into three hybrid alternatives (Alternatives 2A, 2B, and 5) that represents a fusion of four action alternatives (Alternatives 1, 3A, 3B, and 4). How each of the action alternatives meet the objectives is listed in Table ES-1.

Table ES- 1. Project Alternative Strategies and Associated Objectives.

Alternative	Strategy	Objectives
No Action	Current O&M Practices	None
1	Improve Fish Passage Through Storage-Focused Measures: Increase the probability of refilling WVS reservoirs and supplemental water delivery for authorized purposes	1, 2, 3, 4, 5, 6, 7
2A	Integrated Water Management Flexibility and ESA-Listed Fish Alternative	1, 2, 4, 5, 6, 7
2B	Integrated Water Management Flexibility and ESA-Listed Fish Alternative	2, 4, 5, 6, 7
3A & 3B	Operations Focused: Improve passage of ESA-listed fish through existing structures by modifying water control operations	2, 4, 5, 6, 7
4	Structures Focused: Improve passage of ESA-listed fish by constructing fish passage and temperature control structures	1, 2, 3, 4, 5, 6, 7
5	Refined Integrated Water Management Flexibility and ESA-Listed Fish Alternative - Preferred Alternative	2, 4, 5, 6, 7
6	Ceasing Federal Hydropower Operations	2, 4, 5, 6, 7

7.1 Assessment and Comparison of Alternatives

For each resource topic, such as Water Quality, Fish and Wildlife, Cultural Resources, environmental effects are discussed in Chapter 3. The analysis of the resource effects in Chapter 3 is at a broad and macroscopic scale and scope given the regional nature of the study. USACE will conduct subsequent NEPA analyses of future site-specific actions. Additional information on how USACE intends to conduct subsequent site-specific NEPA analysis and environmental compliance is in Chapter 7 of the FEIS.

In the effects analysis, USACE compares the benefits, environmental consequences, and tradeoffs of each of the action alternatives against the No Action Alternative (NAA). USACE developed multiple criteria to evaluate how effectively each alternative met the objectives, while considering costs and environmental, economic, and social effects. USACE then performed a tradeoff analysis using these criteria to compare the alternatives. To develop criteria, USACE considered the benefits and environmental and social consequences as reflected in Chapters 3 and 4 and then assessed the tradeoffs presented under each alternative. Descriptions of the criteria, the procedure for comparing alternatives, and the results of that comparison to identify a preferred alternative are discussed in detail in Chapter 5 of the draft EIS and the draft SEIS. This information is solely to provide the public with USACE's current rational and may change before the final SEIS and subsequent ROD.

7.2 Alternative 6 and Interim Operations

USACE developed Alternative 6 to meet WRDA 24 requirements to include an alternative in the EIS that ceases Federal hydropower operations in the WVS. The specific language in WRDA 24 informed key portions of Alternative 6. For example, Congress directed the USACE to analyze ceasing hydropower operations at the projects, not reduce hydropower operations or remove the projects. The other features of Alternative 6 were developed like all the other alternatives in the FEIS, to meet the stated alternative strategies and associated objectives (Appendix A, Section 1.1.4 Development of Alternative 6).

Interim Operations are a suite of independent operations that would occur until the long-term solution for downstream fish passage and water temperature management at the respective location is in place and operational. Interim Operations in the SEIS are the same as the Interim Operations evaluated in the FEIS but now include a late fall/early winter deep drawdown for fish passage at Detroit Dam and replacement of the integrated temperature and flow management targets with the 2008 Biological Opinion minimum flow targets until a new flow management plan is developed in conjunction with the National Marine Fisheries Service (NMFS).

7.2.1 Effects of Alternative 6 – Ceasing Federal Hydropower Operations

The effects of Alternative 6 are discussed in detail in Chapter 3, but some of the more noteworthy effects are summarized here. In general, Alternative 6 is expected to have adverse effects on hydropower generation and increase construction costs. It would also remove the ability of the communities of Blue River and Oak Ridge to obtain power directly from the dam in emergency situations, which has historically been possible. Adverse effects to fish are reduced compared to the NAA primarily due to structural downstream passage improvements at Detroit, Foster and Lookout Point dams, and deep reservoir drawdowns to the diversion tunnel at Cougar Dam. At other dams adverse effects on fish passing downstream passage at dams are increased, along with impacts for fish below dams from high TDG, both due to modification of penstocks with removal of turbines and installation of cone valves or in-line orifices.

7.2.2 Effects of Detroit Drawdown

The effects of the Detroit Drawdown are a part of the Interim Operations and discussed in detail in Chapter 3, but some effects are summarized here. In general, the deep drawdown at Detroit Reservoir is expected to adversely affect water supply, water quality, drinking water (facility operation), and recreation. The effects of the drawdown on fish are mixed as described below.

Regarding water supply, the late fall/early winter drawdown could affect peak summer reservoir levels at Detroit Reservoir. In very dry winters, USACE may not be able to refill the reservoir to minimum conservation pool by February 1, which could result in a lower reservoir level than currently experienced in very dry years. Under current operations, naturally dry years affect how much water USACE is able to store while still meeting NMFS 2008 Biological Opinion downstream minimum flow targets. During dry years, USACE would coordinate with regional partners to minimize effects to downstream users reliant on the augmented streamflows.

For water quality and drinking water, the deeper drawdown of Detroit Reservoir would cause a moderate increase in sediment and turbidity levels downstream of Detroit Reservoir during the operation. This effect determination is based on knowledge of sediment and geologic characteristics of the basin, comparison to other drawdowns, and proposed approach to the drawdown operation. The deeper drawdown at Detroit Dam has not been conducted at the time of the SEIS development. USACE expects sediment to be mobilized by the drawdown action, resulting in increased turbidity downstream of Detroit and Big Cliff dams, but to a much lesser extent than experienced downstream during the recent deep drawdown of Green Peter Reservoir 2023 and 2024 because the drawdown of Detroit Reservoir will expose a significantly smaller area of sediment and retain a much larger residual pool relative to the Green Peter drawdown operation. Additionally, USACE is proposing to conduct the deep drawdown in a stepwise manner, reaching the target elevation over the course of several fall/winters, minimizing how much new sediment is mobilized and exposed each year. The larger residual pool is expected to act as a sediment sink more so than the Green Peter residual pool due to the differences in the type of clay in each sub-basin; though the fine clay material eroded from exposed sediment is likely to stay in suspension and pass downstream of Detroit dam.

Detroit Reservoir is one of the most popular reservoirs in the analysis area with high visitation numbers. A late fall/early winter deep drawdown of Detroit Reservoir would result in lower summer pool elevations, in dry years. Though it is difficult to determine if users would experience a meaningful increase because of the underlying issue is hydrologic conditions in dry years and USACE conducts in season adaptive management to limit these effects. Low summer pool elevations during dry years would result in boat ramp(s) being unusable. Mongold Boat Ramp, which is at the minimum conservation pool elevation, would be the only boat ramp available during extreme dry years, same as under current operations, but for a shorter duration. This would likely impact recreational opportunities for fishing and boating. These effects are not expected every year but may reoccur over the 30-year implementation timeframe.

Effects of Detroit Reservoir deep drawdowns on fish would vary by species, lifestage and their locations. The late fall/early winter deep reservoir drawdowns would benefit downstream fish passage for Chinook and steelhead salmon, by adding an option for greater survival of juvenile migrants through non-turbine routes when hydraulic conditions are safer (due to lower pool elevations) and allowing diverse migratory life history stages. Sport fishing in Detroit Reservoir would be adversely affected due to changes in the reservoir habitat conditions and food availability affecting fish growth and survival and increasing rates of entrainment for resident fish downstream of the dam (Appendix E, Chapter 6). Many entrained resident fish would be injured or not survive passage through the dam. For some species, significant reductions in abundance within Detroit Reservoir are possible. Ongoing future stocking of hatchery reared species (e.g. rainbow trout and kokanee) by ODFW in Detroit Reservoir would mitigate some of these effects.

7.3 Preferred Alternative

The FEIS identified Alternative 5 as the Preferred Alternative; and the DSEIS also identifies Alternative 5 as the Preferred Alternative. Identification of a preferred alternative does not prevent USACE from selecting a different alternative once the public has reviewed and commented on the SEIS. USACE developed Alternative 5 to (1) improve fish passage throughout the WVS, (2) to manage water quality downstream of WVS dams using a combination of modified operations and structural improvements, and (3) to balance water management flexibility to meet downstream water requirements for fish and wildlife.

Operations under Alternative 5 include implementing the NMFS 2024 Biological Opinion Reasonable and Prudent Alternatives, including Interim Operations for downstream fish passage and temperature management. The Interim Operations included in the FEIS now additionally include the drawdown of Detroit Reservoir in the late fall/early winter timeframe. As required by the NMFS 2024 Biological Opinion, USACE would implement the NMFS 2008 Biological Opinion minimum flow targets until USACE and NMFS develop a new flow management plan.

Under Alternative 5, USACE would construct fish passage structures at Detroit, Foster, and Lookout Point dams, and use operations to aid fish passage at Green Peter, Cougar and Fall Creek dams. Measures under Alternative 5 would also include:

- Construction of a selective withdrawal structure for temperature management at Detroit Dam.
- Operations to manage downstream temperatures at Green Peter Dam.
- Continue the fall drawdown to support fish passage at Fall Creek Reservoir.
- Operations of fish facilities and adult fish transport above the dams.
- Operations for environmental flows under the Sustainable Rivers Program.
- Gravel augmentation downstream of Cougar, Blue River, Foster, and Big Cliff dams.

- Nature-based approach to maintaining revetments.

8 - REGIONAL INPUT

USACE has the responsibility and legal authority for managing the WVS in coordination with tribal, Federal, and state partners, and for collaborating with these partners and other cooperating agencies under NEPA to develop this SEIS. When initiating and preparing the SEIS, USACE held three cooperating agency meetings and four public scoping meetings in May and June of 2025. A detailed description of the public involvement process is in Chapter 6 of the SEIS.

8.1 Cooperating Agencies

As the lead agency for this SEIS, USACE invited agencies with jurisdiction by law or special expertise relevant to the WVS and its O&M to be cooperating agencies. Agencies that accepted cooperating agency status are listed in Table ES-2, below, and are described briefly in Section 1.6 of the FEIS and in detail in Appendix L. These cooperating agencies contributed to the SEIS by providing information and input throughout the NEPA process.

Table ES-2. Cooperating Agencies.

Agency
Tribal
Confederated Tribes of Grand Ronde Community of Oregon
Federal
Bonneville Power Administration
U.S. Bureau of Reclamation
National Marine Fisheries Service
U.S. Fish and Wildlife Service
United States Environmental Protection Agency
State of Oregon
Oregon Department of Agriculture
Oregon Department of Environmental Quality
Oregon Department of Fish and Wildlife
Oregon Water Resources Department

8.2 Public Scoping for SEIS

Two scoping meetings were held in person, the first in Detroit, Oregon and the second in Salem, Oregon. Two additional virtual meetings were held on Microsoft Teams. All meetings included a presentation. The virtual meeting presentations were followed by an open question and answer period. At the in-person meetings, an open house format followed the presentation to encourage discussion and information sharing and to ensure the public had opportunities to speak with USACE representatives. An average of 20 people attended each scoping meeting.

USACE received 117 correspondence documents via email, mail, and comment brochures that were distributed and then collected at the meetings. Many of the correspondence documents contained multiple comments on different topics. A total of 246 comments were received from private citizens, non-governmental organizations, government agencies, and tribes (Table 6-1). The comments were then organized, analyzed, and categorized according to four topics as found in Table ES-3, below.

Table ES-3. Public Scoping Comments Received by Topic.

Topic	# of Comments Received
Hydropower	30
Deep Drawdown	133
NEPA process	65
Environmental impacts	18
Total	**246**

About half of the comments USACE received during scoping concerned the deep drawdown at Detroit Reservoir. Comments were used to inform the scope of analysis, alternatives development, and identification of potentially significant issues to be addressed in the Draft SEIS.

8.3 Key Issues and Resource Concerns

Several key issues were raised during scoping including, but not limited to, those listed in Table ES-4, below.

Table ES-4. Summary of Key Concerns Identified During Public Scoping for the SEIS[1].

Issue Category	Summary of Concern
Alternative/SEIS Development	USACE should consider a dam-by-dam analysis of hydropower operations. The scope of the alternative is too narrow. Differing perspectives on how to balance all the authorized purposes and ESA requirements. The SEIS should analyze impacts to water supply, sedimentation and turbidity.
Hydropower Operations	Support for continuing hydropower production, and support for ending hydropower production. Questions about how ending hydropower operations would impact climate goals, cost for operation and maintenance of the dams. Questions regarding what would happen to the reregulation dams with hydropower production.
Deep drawdown at Detroit Reservoir	Downstream water quality impacts to water supplies. Recreational and economic impacts. Impact to kokanee fishery.

[1] Appendix P, Public Scoping Report.

9 – ISSUES TO BE RESOLVED

The SEIS analyzes the implementation of alternatives, comprised of structural modification to the dams and operation changes, across several environmental resources. The analysis discloses and documents the adverse and beneficial effects of these measures, including their effects on fish and aquatic habitat, which will inform USACE decisions on how to operate the WVS.

In total, USACE developed eight alternatives that incorporate a range of operational and structural measures to achieve the objectives, while maintaining authorized purposes. Seven alternatives were addressed in the Final EIS, and an additional alternative is here. WRDA 24 directed USACE to add an alternative that formally analyzes stopping hydropower operations at USACE dams, while maintaining all other authorized purposes. The SEIS addresses the need for a new alternative which ceases Federal hydropower operations while also analyzing revisions to the Interim Operations based on adaptive management.

The agency decision maker will use these analyses to select an alternative. This decision will balance operating and maintaining the WVS without jeopardizing the continued existence of listed species with anticipated effects to the human environment.

WILLAMETTE VALLEY SYSTEM
OPERATIONS AND MAINTENANCE

DRAFT SUPPLEMENTAL
ENVIRONMENTAL IMPACT STATEMENT

CHAPTER 1 THROUGH CHAPTER 11

Painting by Lee Jensen, USACE Employee, 1991-2001 (USACE Portland District Media Images).

CHAPTER 1 - INTRODUCTION

On April 11, 2025, the U.S. Army Corps of Engineers (USACE), published the notice of availability for its final environmental impact statement (FEIS) for the Willamette Valley System (WVS) Operations and Maintenance. In Section 1326 of the Water Resources Development Act of 2024 (WRDA 24), Congress directed the Secretary of the Army to formally analyze an alternative that ceases Federal hydropower operations at the WVS before completing its overall review of the system. USACE determined the most appropriate way to address this directive is to supplement its analysis in the FEIS with a new alternative while also updating the proposed Interim Operations to reflect what has been learned during adaptive management as well as actions included in the 2024 National Marine Fisheries Service (NMFS) Biological Opinion but not previously analyzed. On May 15, 2025, USACE published a notice of intent to prepare this Supplemental Environmental Impact Statement (SEIS).

Specifically, USACE is supplementing the FEIS to include Alternative 6, which will analyze ceasing Federal hydropower operations at the WVS system projects. The supplement also includes revisions to the Interim Operations consisting of an interim late fall/early winter deep drawdown for fish passage at Detroit Dam and changes to minimum flow targets. This SEIS is a supplement to the FEIS; together, they comprise the full range of alternatives and their evaluations for the operation and maintenance of the WVS and should be read together. The SEIS incorporates much of the information in the FEIS by reference; therefore, the FEIS should be reviewed to facilitate a full understanding of the SEIS.

Most of this chapter is incorporated by reference. Some sections are updated with new information related to the addition of Alternative 6 and the Interim Operations. Some figures are reproduced for context.

1.1 Background

Incorporated by reference.

1.2 Chapter Terminology and Organization

Incorporated by reference.

1.3 Regulatory Background

Incorporated by reference.

1.3.1 National Environmental Policy Act

Incorporated by reference.

1.3.2 Endangered Species Act

Incorporated by reference.

1.3.3 Willamette Valley System Endangered Species Act and National Environmental Policy History Since 2008

This section has been incorporated by reference with the following addition:

In December 2024, the National Marine Fisheries Service published the *Biological Opinion and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Response for the Continued Operation and Maintenance of the Willamette Valley System* (NMFS 2024b). NMFS determined the proposed action would jeopardize the continued existence of Upper Willamette River (UWR) Chinook salmon (Oncorhynchus tshawytscha) and UWR steelhead (O. mykiss) and would result in adverse modification of their designated critical habitat. The Biological Opinion identified a Reasonable and Prudent Alternative (RPA)—a suite of measures that, when implemented in conjunction with the proposed action, is expected to avoid jeopardizing the continued existence of all listed species and prevent adverse modification of designated critical habitat.

In April 2025, USACE completed a six-year study on the operations and maintenance of the WVS of dams and reservoirs and published the FEIS. The FEIS publicly discloses how USACE operations affect the environment, people, and ecosystems—and examines seven alternatives, or different ways USACE could adjust operations for the WVS.

In May 2025, USACE signed a Record of Decision (ROD) on the Interim Operations (minus the Detroit late fall/early winter drawdown) and Foster Warm Water Supply Pipe based on the analysis in the Final EIS. This ROD allows USACE to comply with the National Environmental Policy Act (NEPA) requirements for Interim Operations while continuing to evaluate a new alternative ceasing hydropower operations at the WVS and other changes to the Interim Operations based on adaptive management and the 2024 Biological Opinion.

1.4 Geographic and Temporal Scopes

1.4.1 Geographic Scope

Incorporated by reference.

1.5 Proposed Action

The Proposed Action is to continue operations and maintenance of the Willamette Valley System (WVS) for specific, authorized purposes. Congress directed responsibility for operating each dam and reservoir individually and as part of a system to USACE in authorizing legislation. USACE would implement the Proposed Action over a 30-year timeframe.

1.6 National Environmental Policy Act Cooperating Agencies and Endangered Species Act Action Agencies

Incorporated by reference.

1.7 U.S. Army Corps of Engineers-managed Dams, Reservoirs, and Bank Protection Structures in the Willamette River Basin

1.7.1 Dams and Reservoirs

Incorporated by reference.

1.7.2 Revetments and Other Structures for Bank Protection

Incorporated by reference.

1.8 Non-U.S. Army Corps of Engineers-managed Dams in the Willamette River Basin

Incorporated by reference.

1.9 U.S. Army Corps of Engineers Programs and Planning in the Willamette River Basin

Incorporated by reference.

1.9.1 Willamette River Basin Bank Protection Program

Incorporated by reference.

1.9.2 Willamette Hatchery Mitigation Program

Incorporated by reference.

1.9.3 Adult Fish Facilities

Incorporated by reference.

1.9.4 Research, Monitoring, and Evaluation

Incorporated by reference.

1.9.5 Forecast-informed Reservoir Operations

Incorporated by reference.

1.10 Congressionally Authorized Purposes

Th Incorporated by reference.

1.10.1 Flood Risk Management

Incorporated by reference.

1.10.2 Hydropower

Incorporated by reference.

1.10.3 Fish and Wildlife

Incorporated by reference.

1.10.4 Recreation

Incorporated by reference.

1.10.5 Navigation

Incorporated by reference.

1.10.6 Irrigation

Incorporated by reference.

1.10.7 Municipal and Industrial Water Supply

Incorporated by reference.

1.10.8 Water Quality

Incorporated by reference.

1.11 Willamette Valley System Operations and Annual Operational Planning

Incorporated by reference.

1.11.1 Reservoir Pools and Water Control

Incorporated by reference.

1.11.2 Water Control Annual Planning

Congress authorized USACE to construct, operate, and maintain each WVS dam for multiple, specific purposes—known as the "authorized purposes"— including flood control (flood risk management), hydropower generation, water quality, municipal and industrial water supply, irrigation, public recreation, fish and wildlife conservation, and navigation. USACE operates the 13 individual dams and reservoirs together as a system in accordance with their authorized purposes. Operational changes or constraints (e.g., turbine or other outlet outage, recreational event, construction activities) at one dam, in combination with factors outside of USACE control (e.g., local inflow of water downstream of the USACE dams) impact how USACE can operate the rest of the dams and reservoirs in the WVS.

During the summer months, USACE releases water stored in the reservoirs to supplement natural flows in the rivers downstream of the dams. These releases represent a significant increase over the natural flows downstream of the dams, especially in drought years, and help to improve the water quantity and quality. In addition, the public drinking water infrastructure of many communities downstream of the dams, including the City of Salem, is dependent on certain water levels in the river and these increased flows support the necessary water levels. Water stored in the reservoirs is also available for use by the agricultural communities for irrigation through contracts with the BOR.

Several communities rely upon the recreation opportunities provided by the WVS reservoirs. When reservoir levels are abnormally low due to drought or other factors during peak recreation season, many boat ramps and marinas become unusable, which can impact the amount of recreation in the area.

Stored water is used to generate hydropower, which at full power production, is enough to power 300,000 homes. USACE uses the hydropower produced at each dam as the principal source of electricity to operate the dams, such as raising and lowering gates to control water releases throughout the year.

If water is not stored according to the water control diagrams during the conservation storage season, then there may not be adequate water to meet all the needs the system is designed for. To ensure reservoirs are as full as possible while balancing downstream needs, USACE prepares the annual Willamette Basin Project Conservation Release Season Operating Plan (referred to as the Conservation Plan).

Starting in the early part of each year, USACE uses the anticipated precipitation and runoff patterns and total system storage in mid-May to identify flow and storage needs for each tributary and reservoir in the WVS. The objective is to develop a collaborative planned schedule for the release of stored water to accommodate the broad range of beneficial uses described above. The plan provides detailed individual project and system flow objectives, project operating drawdown priorities, minimum and maximum flows, and recommends flow shaping operations to balance the multipurpose needs given the available water.

1.11.2.1 Operational Considerations for Streamflow and Water Quality

Incorporated by reference.

1.11.2.2 Operational Considerations for Hydropower

Eight of the 13 projects in the WVS produce hydropower. As contemplated in the original authorizing documents for the projects, power generation at the WVS usually depends on water releases for other project purposes such as flood risk management and flow augmentation for water quality and fish and wildlife. However, within these operating criteria, some flexibility exists to generate electricity at different levels throughout the day and during different seasons at the request of Bonneville Power Administration (BPA). All WVS projects with hydropower facilities include exclusive storage space for power generation called the power pool. This storage, between the minimum flood pool/conservation pool and the minimum power pool, is relatively small (see Figure 1.11-2 in the Willamette Valley System Operations and Maintenance Final Environmental Impact Statement). In general, exclusive power storage is kept full to increase power generation efficiency and reliability for the federal Columbia River Power System (FCRPS).

Operation of the power facilities at the projects is a highly coordinated effort between the USACE and BPA. Project releases are also coordinated with NMFS and the U.S. Fish and Wildlife Service (USFWS) if they deviate from Biological Opinion criteria during non-flood operations. The distribution and marketing of power produced by the WVS is BPA's responsibility, as authorized in the Flood Control Act of 1944. USACE makes daily generation schedules, after discussions with the BPA. The close coordination between agencies allows for additional flexibility in project operation when the need arises for power and non-power emergencies.

Coordination for power production considers non-power uses for water resources as a part of the comprehensive development and management of water resources for maximum sustained benefit for the public good.

BPA is the regional power marketing agency of the U.S. Department of Energy for hydropower generated at USACE projects in the Pacific Northwest and must track generation to manage real time power load requirements. Scheduling generation adds significant complexity to day-to-day operations and some risk to flow operations, in particular minimum flows and ramping rates. Each of the power projects in the WVS has different capacity to meet short-term BPA scheduling requests. There are preferred operational choices when scheduling hydropower generation on a short-term or real time basis. ESA requirements have changed operations and impacted generation at the projects over the last few decades only further complicating coordination.

Federal hydropower projects in the WVS consist of two general types: larger storage reservoirs used for power peaking (outflows are increased when more electricity is needed to meet daily changes in demand) and reregulation dams located downstream of the power peaking projects. Lookout Point, Detroit, and Green Peter are the storage projects, and their reregulation dams are Dexter, Big Cliff, and Foster respectively. The purpose of a reregulation project is to smooth out flows downstream of the power projects. Foster Reservoir also has a small conservation pool in addition to being a re-regulation project. They run steady, much like the baseload projects described below, with their pool level varying on a daily cycle.

Hills Creek and Cougar are base load projects typically generating a steady amount all the time and are not used for peaking.

Generation is often based upon load throughout the day or week, and therefore subject to frequent fluctuations. Generation at the reregulation projects is more uniform. The reregulation reservoirs absorb the fluctuations in flows from their upstream storage projects and release flows at a more uniform level. Information related to power generation for each power project is below.

1. Detroit. The Detroit power project consists of a peaking plant with two Francis turbines each with a capacity of 50 MW. The hydraulic capacity of the powerhouse is 5,300 cfs. The maximum power pool/minimum flood pool is at elevation 1,450 feet and minimum power pool is at elevation of 1,425 feet. As a peaking plant within the Federal Columbia River Power System (FCRPS), the Detroit power plant normally operates during peak demand hours as determined by BPA at loads which range from those at points of best efficiency to maximum capacity. Peak demand hours are usually in the morning and late afternoon. Detroit reservoir has exclusive power storage of approximately 36,400 acre-feet within its 25-foot power pool. It has approximately 280,500 acre-feet of conservation storage above that.
2. Big Cliff. The Big Cliff power project serves as a base load plant and operates as a reregulating project for Detroit. One Kaplan turbine with a capacity of 18 MW generates the power. The hydraulic capacity of the powerhouse is 3,100 cfs. The power pool is 1,800 acre-feet between elevations 1,182 and 1,206 feet. Pool elevation fluctuates several feet per day while reregulating flows from the Detroit power plant.
3. Green Peter. The Green Peter power project consists of a peaking plant with two Francis units, each with 40 MW capacity. The maximum hydraulic capacity of the powerhouse is 4,600 cfs, while the minimum is 700 cfs. The Green Peter power pool is approximately 63,000 acre-feet between elevations 887 and 922 feet. The conservation pool stores approximately 259,000 acre-feet above the power pool. Although the minimum power pool is at elevation 887 feet, the units can no longer generate when the pool elevation drops below 900 feet. Under most conditions, all flow from Green Peter passes through the power plant.
    a. A 1 MW turbine and energy dissipater operates on the 50-cfs water line that runs from the Green Peter penstock entrance to the adult fish ladder. The unit produces 0.25 MW to 0.5 MW of continuous power and operates as backup for station service. Any energy in excess of station service needs goes into the main power grid. This unit has not been operated since 2014.
4. Foster. The Foster power and storage project serves to re-regulate flows from the Green Peter powerhouse and is located about 8 miles downstream. The Foster power facility consists of two Kaplan units, each of 10 MW capacity. The hydraulic capacity of the powerhouse is between 1,600 and 3,600 cfs. Outflows above the maximum turbine capacity are released over the spillway and are generally limited to the 18,000 cfs downstream channel capacity. The minimum power pool is at El. 609 feet. The power pool holds approximately 3,600 acre-feet while the conservation pool holds approximately 24,800 acre-feet.
5. Cougar. The Cougar power project consists of a base load plant of two Francis units, each with a capacity of 12.5 MW. The maximum hydraulic capacity of the powerhouse is 1,050 cfs. The Cougar power pool has storage of 9,900 acre-feet between pool

elevations 1,516 and 1,532 feet. The conservation pool above that stores approximately 136,800 acre-feet

6. Lookout Point. The Lookout Point power project has three Francis turbines with a total capacity of 120 MW. The hydraulic capacity of the powerhouse is 9,300 cfs. Lookout Point power pool is 12,300 acre-feet between pool elevations 819 and 825 feet. Lookout Point holds approximately 324,550 acre-feet above the power pool in the conservation pool. Lookout Point operates as a peaking plant within the FCRPS. Under most conditions, all flow released at Lookout Point is through the power plant.
7. Dexter. The Dexter reregulating project is located 3.1 miles downstream from Lookout Point. It serves as a base load plant. Power is generated by one Kaplan turbine with a capacity of 15 MW. Outflows from Dexter are held constant, with limited changes in outflows, smoothing irregular releases from Lookout Point before they go downstream. Dexter must meet downstream minimum flow requirements to protect fish life. From February 1 to June 30, Dexter maintains a minimum flow of 1,200 cfs. At this minimum flow level, generation from Dexter is between 4,200 and 4,700 kilowatts depending on pool elevation. From July 1 to November 15, a 1,000 cfs minimum flow is met, which is at the minimum generation limit of the Dexter power unit. From June through August, a constant flow of about 2,500 cfs is maintained for angler safety. At this outflow the Dexter power unit generates between 10 and 11 MW.
8. Hills Creek. The Hills Creek power facility has two Francis turbines each with a capacity of 15 MW. The hydraulic capacity of the turbines is 1,800 cfs. Its power pool is 49,000 acre-feet between pool elevations 1,414 and 1,448 feet. The conservation pool in comparison holds 194,600 acre-feet. Hills Creek is often drafted below its rule curve in September and October, with releases up to 1,800 cfs for the entire month to maximize power generation in those periods and reduce spill in November. Since there is no downstream reregulation dam, peaking with Hills Creek is limited by the need to protect the public from dangerous surges in river elevations. A rate of increase and decrease in flow per half-hour has been established. During low flow periods, a 100 cfs minimum flow must be maintained. However, this is below the minimum discharge for operation of a power unit.
9. Dorena. Dorena Hydro LLC completed construction of a non-Federal hydropower facility in December 2014. The facility has two turbines with a total capacity of 7.5 MW. The first is a 1.4 MW Francis turbine and the second is a 6.1 MW Kaplan turbine. Dorena Hydro LLC controls all water releases from the dam below 812 cfs when in operation. During times when the project is off-line all flow will be passed through the regulating outlets. When outflows are scheduled to be greater than 812 cfs, the flow above 812 cfs will be passed through the regulating outlets. The USACE does not schedule hydropower operations at Dorena. The hydropower facility only uses the water the USACE would normally release for current USACE missions.

10. Hydropower Status of Non-Power Projects.
    a. Congress authorized adding hydropower at Blue River in the Water Resources Development Act of 1986 (PL99-662) and included a provision that non-Federal agencies could develop the hydropower project if licensed by the Federal Energy Regulatory Commission (FERC). However, the authorizing documents contained a sunset provision if hydropower was not developed within a certain amount of time. Development did not occur and there are no hydropower facilities at Blue River.
    b. Fall Creek does not produce hydroelectric power. USACE approved an interim feasibility study for adding power generation to Fall Creek in July 1984. The recommended plan was to construct two generating units, with installed capacity of 9.8 MW. Existing operations of Fall Creek would not change. Five FERC permits to install power generation facilities at Fall Creek Dam have been filed in the past. None of these permits are currently valid, and there are no current plans to install power generation at this site.
    c. No Federal power facilities exist within the Long Tom Subbasin at the Fern Ridge Dam or Cottage Grove Dam within the coast Fork Willamette Subbasin. There are no plans to install power generating facilities at these projects

1.11.3 Operation, Maintenance, Repair, Replacement, and Rehabilitation

Incorporated by reference.

1.11.4 Coordination of Willamette Valley System Operations with Other Agencies

Incorporated by reference.

1.12 Ongoing U.S. Army Corps of Engineers Planning and Environmental Reviews in the Willamette River Basin

Incorporated by reference.

1.12.1 Master Plans and Operational Management Plans

Incorporated by reference.

1.12.2 Interim Risk Reduction Measures

Incorporated by reference.

1.12.3 Court-ordered Injunction Measures

Incorporated by reference. In December of 2024, NMFS published a new Biological Opinion which supersedes the 2008 NMFS Biological opinion, thus ending the Injunctive Order.

1.12.4 Willamette Valley System Vegetation Management Plans

Incorporated by reference.

1.12.5 Dexter Reservoir Shoreline Management

Incorporated by reference.

1.12.6 Long Tom River Ecosystem Restoration Project

Incorporated by reference.

1.12.7 2022 Water Resource Development Act Report to Congress on Willamette Valley System Hydropower

Congress, in section 8220 of WRDA 22, directed the Secretary of the Army to conduct a study on the effects of deauthorizing hydropower produced by eight dams in the WVS, and to determine if there is a Federal interest in hydropower. The USACE Implementation Plan for section 8220 of WRDA 22 called for a two-phase approach (USACE 2023b). The first phase is a Report to Congress documenting the findings of Federal interest for hydropower at each WVS dam in a disposition report, while the second phase, if warranted, is a complete disposition study.

Consequently, USACE submitted an initial assessment of hydropower deauthorization as its WRDA 22 Report to the Assistant Secretary of the Army for Civil Works in June 2024. The Report is under review by the current Administration and will be released to Congress when that review is complete (Appendix A, Alternatives Development, Attachment 4).

1.12.8 2024 Water Resource Development Act Willamette Valley System Ceasing Hydropower Alternative

In January 2025, Congress directed the Secretary of the Army to formally analyze an alternative that ceases hydropower operations at the WVS, notwithstanding hydropower being an authorized purpose of such projects, as stated in Section 1326 of WRDA 24:

> "The Secretary may not complete its review of, and consultation with other Federal agencies on, the operation and maintenance of the projects for flood control, navigation, and other purposes, Willamette River Basin, Oregon, authorized by section 4 of the Act of June 28, 1938 (chapter 795, 52 Stat. 1222; 62 Stat. 1178; 64 Stat. 177; 68 Stat. 1264; 74 Stat. 499; 100 Stat. 4144), until the Secretary prepares and formally analyzes an alternative that ceases hydropower operations at the projects, notwithstanding hydropower being an authorized purpose of such projects."

Section 1326 prevents the USACE from completing its environmental review of the WVS until such analysis is completed. Consequently, the USACE is drafting this SEIS to meet that requirement.

CHAPTER 2 - ALTERNATIVES

2.1 Introduction

Federal agencies must evaluate a reasonable range of feasible alternatives to their Proposed Actions (40 CFR 1502.14). Chapter 2 details the process USACE used to formulate the alternatives it considered but dismissed and those it formally analyzed. A key reason for supplementing the Final EIS was to include an additional Interim Operation at Detroit and to formally analyze ceasing hydropower operations at the WVS projects as required by WRDA 24.

Agencies are required to supplement an EIS when the agency makes a substantial change to the proposed action or there are substantial new circumstances or information about the significance of adverse effects that bear on the analysis. An agency may also choose to supplement an EIS when it determines that the purposes of NEPA would be furthered by doing so (33 CFR 230.13(b) *citing* 40 CFR 1502.9). The criteria requiring supplementation have not been met.

In the WRDA 24, Congress directed USACE to “formally analyze an alternative that ceases hydropower operations at the projects” in the WVS. WRDA 24 did not specifically reference NEPA or proscribe that the alternative be analyzed in a NEPA document. However, USACE determined that supplementing its recent Final EIS for the Operation and Maintenance of the Willamette Valley System to include an alternative required by WRDA 24 would be in furtherance of NEPA while also meeting the requirements of WRDA 24. That analysis is contained in Alternative 6.

2.2 Chapter Terminology and Organization

Incorporated by reference.

2.3 Proposed Action

Incorporated by reference.

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 and in compliance with the ESA and all other applicable treaties, laws, and regulations (Chapter 1, Introduction, Section 1.10, Congressionally Authorized Purposes).

In the DEIS and FEIS, measures and alternatives were screened from further consideration if they did not meet the purpose and need statement. USACE interpreted the purpose and need statement very broadly when screening out measures or alternatives from further consideration. For example, the Cougar diversion tunnel operation only provides conservation storage and operates for hydropower purposes for a few days out the entire 84-year hydrological period of record analyzed. Because the measure did not eliminate these purposes entirely the Cougar diversion tunnel operation was retained for formal analysis, even though it is outside USACE's current authorities. This broad interpretation was the result of significant input from cooperators. Ultimately the screening process resulted in a reasonable range of seven different action alternatives composed of various measures.

As stated in Section 2.1, four months before publication of the FEIS and six years into the NEPA process, Congress passed a provision in WRDA 24 that required USACE to formally analyze an alternative that ceases hydropower operations at the WVS projects. WRDA 24 does not reference NEPA or proscribe that the alternative be formally analyzed in a NEPA document. However, USACE determined it had the discretion to supplement the FEIS to include the alternative required by WRDA 24. USACE decided that providing additional information for the public to comment on and context for the decision maker would be in furtherance of NEPA. However, USACE did not revise its purpose and need statement to include numerous other alternatives to keep the process efficient and timely, as emphasized in the Fiscal Responsibility Act (FRA) of 2023 (Pub. L. No. 118-5, 137 Stat. 10). Instead, it is relying on the clear directive in WRDA to analyze a single alternative that ceases hydropower operations at the WVS projects.

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

Incorporated by reference.

2.5 Decision-making

Incorporated by reference.

2.6 Alternatives Development Overview

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

2.6.1 The Scoping Process

This section from the FEIS is incorporated by reference. Scoping for this SEIS began with publication in the Federal Register of the 2025 Notice of Intent to prepare a Supplemental EIS (FR Doc. 2025-08689), which invited participation in the NEPA process by the public and other Entities (Chapter 6, Public Involvement). Through the scoping process, USACE solicited input from stake holders, such as affected tribes, state and federal agencies and the public (including both private citizens and non-governmental organizations). USACE prepared a Scoping Report at the conclusion of the public scoping process that summarizes the process and comments received (see Appendix P, Public Scoping Report).

2.6.1.1 Interdisciplinary Preparation and Cooperating Agency Involvement

Incorporated by reference.

2.7 Range of Reasonable Alternatives Development

This section has been updated from the FEIS to include the additional alternative development steps associated with meeting the requirements of WRDA 24. The remainder of this section is incorporated by reference.

The specific language in WRDA 24 was used to develop key portions of Alternative 6. For example, Congress directed the USACE to analyze *ceasing* hydropower *operations* at the projects, not the reduce hydropower operations or remove projects. The other features of Alternative 6 were developed like all the other alternatives in the FEIS, to meet the stated alternative strategies and associated objectives (Appendix A, Section 1.1.4 Development of Alternative 6). How each of the action alternatives meet the objectives is listed in Table 2-1. The USACE process for developing alternatives as described in the WVS FEIS is incorporated by reference.

Table 2-1. 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	Integrate water management flexibility with operations and structures for ESA-listed fish.	X	X	–	X	X	X	X
2B & 5	Integrate water management flexibility with operations and structures for ESA-listed fish.	–	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
6	Ceasing Federal hydropower operations	–	X	–	X	X	X	X

Table 2.7-1 in the FEIS

[1] Objectives:

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 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 (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.

2.8 Final Measures Developed for the Action Alternatives

This section has been updated from the FEIS to include the additional measures needed to cease hydropower operations at the projects and changes to the Interim Operations, including modifications based on adaptive management of injunction operations, the deep late fall/early winter drawdown at Detroit minimum flow target requirements from the 2024 NMFS Biological Opinion, and large woody debris collection. The remainder of this section is incorporated by reference.

2.8.1 Flow Measures

Incorporated by reference.

2.8.1.1 Integrated Temperature and Habitat Flow Regime (30a)

Incorporated by reference.

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

Incorporated by reference.

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

Incorporated by reference.

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

Incorporated by reference.

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

Incorporated by reference.

2.8.1.6 2008 Biological Opinion Flow Objectives

Incorporated by reference.

2.8.2 Water Quality Measures

Incorporated by reference.

2.8.3 Downstream Fish Passage Measures

Incorporated by reference.

2.8.4 Upstream Fish Passage Measures

Incorporated by reference.

2.8.5 Ceasing Federal Hydropower Operations Measures

As part of the WRDA 22 report to Congress, USACE developed three new measures needed to safely operate the dams in the absence of hydropower operations, including removing or decommissioning all hydropower infrastructure; reconfiguring the penstocks (pipes that transfer water from the intake structure to the turbine), penstock outlets, and powerhouse systems; and replacing power required to operate the dam and auxiliary facilities (Figure 2-1). Appendix A, Section 2.6 describes these measures in more detail. These measures were brought forward into this SEIS so they could be analyzed formally as part of the alternative.

Hydropower infrastructure includes, but is not limited to, the entire turbine unit, station service systems, auxiliary systems, and powerhouse bridge cranes. The turbine units must be removed because power would be generated if the turbines were left in place. This is because when water flows through the penstocks it turns the turbine unit. When the turbine turns it converts the kinetic energy of moving water into mechanical energy. This mechanical energy then powers a generator, which produces electricity. Therefore, to maintain the penstock outlet for routine flow management and stop generating power, the turbines must be removed.

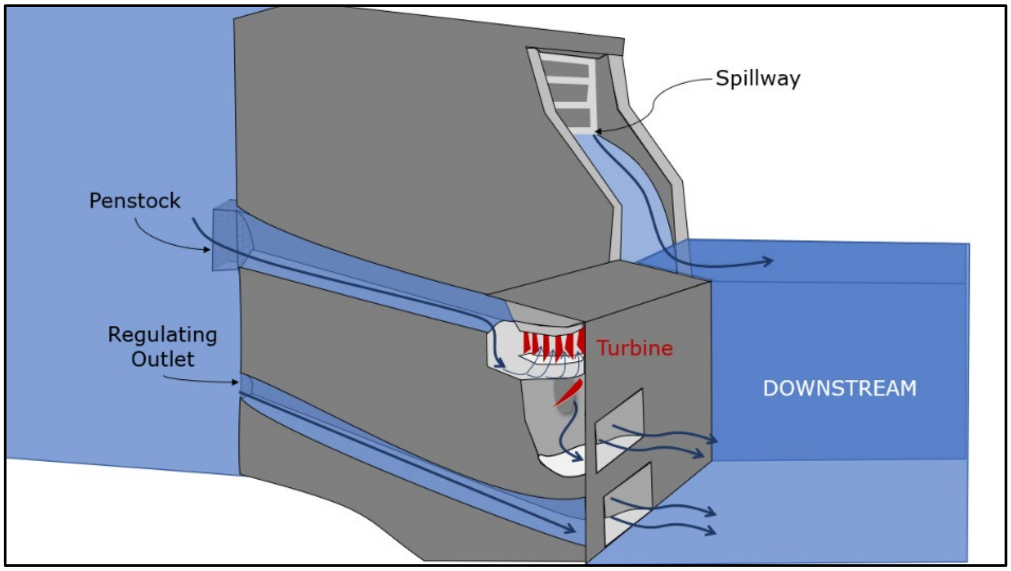


Figure 2-1. Hydropower Dam Outlet Configuration.

Following turbine unit removal, the penstocks and penstock outlets would be reconfigured to allow continued use of the outlet for releasing flows. Turbines dissipate the energy of the water discharged downstream. Without them another method of energy dissipation is required to make the outlet safe to use. Without energy dissipation the flows released to the tailrace would be destructive, and the penstock and internal flow control features would experience damage from low pressures and cavitation. Cavitation is when tiny bubbles form because of a fast change in pressure. These bubbles can suddenly pop, which makes a strong force that damages metal and concrete. The method of outlet reconfiguration for energy dissipation would depend on the dam and whether there is a fish ladder downstream that needs the penstock outflow for attraction flow.

A major redesign of the integrated supervisory control and automation system would be necessary to sustain continuity of operations throughout the Willamette Valley, including but not limited to consolidation of control rooms.

Power required to operate each dam would be pulled from the grid and/or provided through emergency diesel generators. USACE would need to purchase a utility feeder, transformer, meter, and disconnect to sustain station service loads from a local utility and integrate them into the remaining 480V station service systems. Each dam requires a backup power source, such as a diesel generator. As the adult fish facilities at Dexter and Foster currently rely on power from the dam, these facilities would also need an alternative power source. Appendix A further describes the development of these measures and Alternative 6.

2.8.6 Interim Operations

Interim Operations are a suite of independent operations that would occur until the long-term solution for downstream fish passage and water temperature management at the respective location is in place and operational.

The Interim Operations (Table 2-2) described in the FEIS are incorporated by reference with the following changes as required by the 2024 Biological Opinion RPA:

- Addition of a late fall/early winter deep drawdown of Detroit reservoir to an elevation of 1395 feet for downstream fish passage. This operation would start on December 1 and end on December 31.
- Implementation of the 2024 WVS NMFS Biological Opinion RPAs for flow and water management, which include implementing the 2008 Biological Opinion flows until new flow management targets can be developed in coordination with NMFS and USFWS. New flow management targets will be tiered to this effort.

The Detroit drawdown operation was developed based on lessons learned from previous drawdowns at Green Peter and Lookout Point reservoirs, with a primary goal of minimizing water temperature impacts on aquatic life while improving volitional downstream fish passage. USACE would aim to initiate the drawdown closer to late November or early December, a period when the reservoir typically undergoes temperature destratification or at least cools at the surface. This timing reduces the potential for warm water releases in late fall/early winter and minimizes destratification effects on fish in the reservoir itself. The duration of the drawdown is set to last for two weeks based on passage studies at other reservoirs that have been drawn down. These studies suggest that fish are likely to migrate or "move out" of the reservoir during the drawdown process. Aligning the timing and duration of the drawdown with these findings, should facilitate fish passage while minimizing disruptions to the downstream river.

Table 2-2. 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
Winter drawdown to 50 feet above the upper regulating outlets for improved downstream fish passage	Fall/Winter	Upper Regulating Outlets	1,395 feet
Big Cliff			
Spread spill across spill bays to reduce downstream total dissolved gas (TDG) exceedances	Year-round	Spillway	Discharges greater than powerhouse capacity

Description of Interim Operations by Dam Location	Duration of Operation	Priority Outlet	Target Elevation
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	Spring (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; maintain target elevation for up to 30 days.	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 15	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
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	mid-March to May/June (spring)	Spillway	890 to 893 feet spring spill
Regulating outlet use in the fall for downstream temperature management	July to October 15	Regulating Outlets	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

Description of Interim Operations by Dam Location	Duration of Operation	Priority Outlet	Target Elevation
Minimum Flow Targets			
Operate under 2008 Biological Opinion flow targets throughout the Willamette River Basin and provide pulses for mainstem temperature management (same as part of Measures 30a and b)	Year-round	N/A	N/A

Table 2.8-6 in the FEIS

N/A = not applicable

2.9 Alternatives Considered but Eliminated from Further Review

This section is incorporated by reference with the following clarification related to Alternative 6:

Measure screening resulted fewer measures, limiting the breadth of alternatives the USACE could develop. For instance, the dam breach and removal measures were screened out because they would result in the USACE inability to meet the dams' authorized purposes and would increase flood risk. Therefore, a dam removal alternative was eliminated from further consideration. Similarly, in the FEIS, an alternative that eliminated hydropower operations was screened from further review because hydropower is an authorized purpose and analyzing an alternative that ceases hydropower does not meet the purpose and need of continuing to operate the system in accordance with its authorized purposes in a way that also meets ESA requirements. However, in WRDA 24 Congress specifically directed the USACE to analyze "an alternative that ceases hydropower operations at the projects, notwithstanding hydropower being an authorized purpose of such projects." USACE carefully applied this language to develop the criteria and measures for a single alternative that would stop generation of hydropower at the projects in the system.

In developing this alternative, USACE considered but dismissed an alternative where hydropower generation did not stop but the responsibility for power marketing moved from the current power marketer, BPA, to a private entity or USACE. USACE dismissed this alternative because the WRDA 24 language requires USACE to consider an alternative that stops hydropower operations. USACE also dismissed alternatives that would eliminate non-hydropower purposes at the projects (i.e. water supply, irrigation, flood control, etc.) or dam removal because Congress only directed USACE to look at ending hydropower operations (Section 2.1, Introduction).

Given the detailed and intricate operations of each project and the complexity of operating all 13 projects for various purposes, USACE relied on its reasoned professional judgment to determine the reasonable range of alternatives to include for further analysis. Appendix A discusses measures and alternatives considered but not brought forward for further evaluations.

2.10 Alternatives Considered in Detail and the Preferred Alternative

This section is incorporated by reference with the following clarification related to Alternative 6:

Alternative 6 does not meet the purpose and need for this statement because it formally analyzes eliminating hydropower, eliminating the hydropower authorization at the projects (Section 2.4).

2.10.1 Adaptive Management Common to All Alternatives

Incorporated by reference.

2.10.2 Existing Operations Common to All Alternatives

The following operations would continue under all alternatives.

2.10.2.1 Fall Creek Reservoir Drawdown Operations

Incorporated by reference.

2.10.2.2 Environmental Flow Operations

Incorporated by reference.

2.10.2.3 Maintenance, Repair, Replacement, and Rehabilitation Operations

Incorporated by reference.

2.10.2.4 Continued Operations of Existing Adult Fish Facilities

Incorporated by reference.

2.10.3 No-action Alternative

Incorporated by reference.

2.10.4 Action Alternatives

2.10.4.1 Measures and Actions Common to All Action Alternatives

This section is incorporated by reference with the additional clarification that the collection of large woody debris as discussed in Section 2.10.2.5 is included in all action alternatives.

2.10.4.2 General Construction Activities Common to Action Alternatives

Incorporated by reference.

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

Incorporated by reference.

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

Incorporated by reference.

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

Incorporated by reference.

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

Incorporated by reference.

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

Incorporated by reference.

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

Incorporated by reference.

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

Incorporated by reference.

2.10.4.10 Alternative 6—Ceasing Federal Hydropower Operations

USACE developed Alternative 6 to meet WRDA 24 requirements to include an alternative in the EIS that ceases Federal hydropower operations in the WVS. Alternative 6 and Alternative 5 include the same measures to improve fish passage through the WVS dams using a combination of modified operations and structural improvements along with measures to balance water management flexibility, and to meet ESA-listed fish obligations, as required in the NMFS 2024 Biological Opinion. Alternative 6 includes the following changes from Alternative 5:

- The cessation of hydropower operations at the eight dams where Federal hydropower is an authorized purpose. This would require three interdependent measures including: removal or decommissioning of all hydropower infrastructure; reconfiguration of the penstock outlets and reconfiguration of the powerhouse systems; and replacement of power required to operate the dam and auxiliary facilities (Section 2.8.5, Ceasing Federal Hydropower Operations).

- The replacement of the refined integrated temperature and habitat flow regime (Section 2.8.1.2, Refined Integrated Temperature and Habitat Flow Regime) with the mainstem and tributary flow objectives from the 2008 NMFS biological opinion (similar to the NAA), and mainstem temperature pulses from Measure 30b. These flows would be implemented until new flow management targets are developed with NMFS and USFWS.

Detailed descriptions of how USACE would implement the Ceasing Federal Hydropower Operations measures at each dam (Table 2.3) is provided in Appendix A, Alternatives Development. Detailed descriptions of the fish passage and temperature management measures in Alternative 6 are also in Appendix A.

Table 2-3. Alternative 6 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
Ceasing Federal Hydropower Operations Measures	–	–	–	–	–	–	–	–	–	–	–	–	–
Hydropower Infrastructure Removal or Decommissioning	–	–	–	X	X	–	X	X	–	X	X	X	X
Replace station service power with alternative to onsite hydropower	–	–	–	X	X	–	X	X	–	X	X	X	X
Penstock and Powerhouse Systems Reconfiguration	–	–	–	X	X	–	X	X	–	X	X	X	X
Flow Measures	–	–	–	–	–	–	–	–	–	–	–	–	–
30a. Integrated temperature and habitat flow regime	–	–	–	–	–	–	–	–	–	–	–	–	–
30b[1]. Refined integrated temperature and habitat flow regime	X	X	X	X	X	X	X	X	X	X	X	X	X
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	–	–	–	–	–	–	–	–	–	–	–	–	–
2008 Biological Opinion Flow Targets and Ramping Rates	X	X	X	X	X	X	X	X	X	X	X	X	X
Water Quality Measures	–	–	–	–	–	–	–	–	–	–	–	–	–
105. Construct selective withdrawal structure	–	–	–	–	–	–	–	–	–	–	–	–	X
166. Use regulating outlets for temperature	–	–	–	–	–	–	–	–	–	–	X	–	–

Measure	FRN	CTG	DOR	DEX	LOP	FCR	HCR	CGR	BLU	FOS	GPR	BCL	DET
management													
174. Structural improvements to reduce TDG	–	–	–	–	–	–	–	–	–	–	–	–	–
721. Use spillways to release warm surface water in summer	–	–	–	–	–	–	–	–	–	–	X	–	–
Downstream Passage Measures	–	–	–	–	–	–	–	–	–	–	–	–	–
40. Deeper fall reservoir drawdowns for downstream fish passage	–	–	–	–	–	–	–	X[2]	–	–	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[2]	–	–	–	–	–
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[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	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	–
Collection of Large Woody Debris	X	X	X	X	X	X	X	X	X	X	X	X	X

Table 2.10-1 in the FEIS

FRN = Fern Ridge Dam FCR = Fall Creek Dam GPR = Green Peter Dam

CTG = Cottage Grove Dam	HCR = Hills Creek Dam	BCL = Big Cliff Dam
DOR = Dorena Dam	CGR = Cougar Dam	DET = Detroit
DEX = Dexter Dam	BLU = Blue River Dam	
LOP = Lookout Point Dam	FOS = Foster Dam	

[1] Only the temperature pulses from Measure 30b are included under Alternative 6. All other operations from Measure 30b are not include in Alternative 6.

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

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

Stream Flow

Similar to the NAA, Alternative 6 includes use of the 2008 NMFS Biological Opinion tributary and mainstem flow targets and ramping rates. 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 using the power pools in summer or late fall at Lookout Point, Hills Creek, Green Peter, and Detroit Dams (Measure 304). These two measures would augment flows for biological purposes at critical times of the year.

Water Quality

As under Alternative 5, Alternative 6 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). 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 6 would be the same as Alternative 5:

- Using the regulating outlets to discharge colder water during drawdown operations in fall and winter to reduce water temperatures below these dams (Measure 166).
- Using the spillway for surface spill in summer (Measure 721).
- Construct the Foster Dam fish ladder temperature improvement to improve temperatures for the adult fish facility (Measure 479).

Unlike the NAA, Alternative 6 would include flow pulses to mitigate potentially warmer water temperatures on the mainstem. These flow pulses would occur on an as needed basis based on forecasted air temperatures.

Operations at Cougar Dam under Alternative 6 would be the same as under Alternative 5 (Measure 40 and Measure 720). These deep fall and spring drawdowns to the diversion tunnel for fish passage would limit how much water would be stored in the reservoir, limiting streamflow augmentation.

Same as under Measure 30b in Alternative 5, USACE would release water from the WVS reservoirs April-June in each year to reduce and stabilize water temperature during important migration timeframes for UWR spring Chinook salmon and UWR steelhead, mitigating warmer air temperatures. In addition to meeting the base 2008 biological opinion flow targets, additional water would be released to achieve specified temperature targets. The specific flow targets within this measure are based on the observed relationship between flow, air temperature, and water temperature during 2001-2018 (Stratton, et.al., in press).

USACE will coordinate with NMFS when the interagency Flow Management and Water Quality Team proposes these pulse events based on weather conditions in the basin, to decide if these releases are appropriate, based on the following:

- The presence of life history stages of UWR Chinook salmon and steelhead in the mainstem.
- Adjust the proposed timing to prevent longer periods of warm weather temperatures, using the proposed 7-day average daily maximum trigger, or to release water earlier if higher water temperatures are present.
- The trade-offs between releasing water for mainstem temperatures and reducing stored water for instream flow targets later in the spring or summer.

Fish Passage

Alternative 6 includes a new adult fish facility for upstream fish passage at Green Peter Dam (Measure 722) that would also provide passage features for Pacific lamprey (Measure 52).

As under Alternative 5, Alternative 6 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 at Lookout Point, Detroit, and Foster dams.

Interim Operations

USACE would implement Interim Operations under Alternative 6 as under Alternatives 2 - 5 (Section 2.8.6, Interim Operations).

Appendix N, Implementation and Adaptive Management Plan, provides detailed information about how measures would replace Interim Operations.

2.10.4.11 Summary of Measures under the Action Alternatives

A list of all action alternatives and associated measures is provided in Table 2-4.

Table 2-4. Summary of Measures under Each Action Alternative[1].

Measures	Alt 1	Alt 2A	Alt 2B	Alt 3A	Alt 3B	Alt 4	Alt 5	Alt 6
Interim Operations*		X	X	X	X	X	X	X
Cease Federal Hydropower Operations								
Hydropower Infrastructure Removal or Decommissioning								X
Replace station service power with alternative to onsite hydropower								X
Penstock Reconfiguration								X
Flow Measures								
30a. Integrated temperature and habitat flow regime		X	X	X	X	X		
30b. Integrated temperature and habitat flow regime							X	
2008 Biological Opinion Flow Targets and Ramping Rates								X
304. Augment instream flows by using the power pool	X	X	X	X	X	X	X	X
718. Augment instream flows by using inactive pool	X	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	X
166. Use regulating outlets for temperature management	X	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	X
721. Use spillways to release warm surface water in summer		X	X	X	X	X	X	X

Measures	Alt 1	Alt 2A	Alt 2B	Alt 3A	Alt 3B	Alt 4	Alt 5	Alt 6
Downstream Passage Measures								
40. Deeper fall reservoir drawdowns for downstream fish passage		X	X	X	X		X	X
392. Construct structural downstream fish passage	X	X	X			X	X	X
714. Pass water over spillway in spring for downstream fish passage		X	X	X	X		X	X
720. Deep spring reservoir drawdown for downstream fish passage			X	X	X		X	X
Upstream Passage Measures								
52. Provide Pacific lamprey passage infrastructure	X	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	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	X
384. Gravel augmentation	X	X	X	X	X	X	X	X
719. Adapt Willamette hatchery mitigation program	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

Measures	Alt 1	Alt 2A	Alt 2B	Alt 3A	Alt 3B	Alt 4	Alt 5	Alt 6
Adaptive management	X	X	X	X	X	X	X	X
Fall Creek Reservoir drawdown	X	X	X	X	X	X	X	X
Environmental flows	X	X	X	X	X	X	X	X
Collection of Large Woody Debris	X	X	X	X	X	X	X	X
Maintenance of WVS facilities	X	X	X	X	X	X	X	X
Continued operation of existing adult fish facilities	X	X	X	X	X	X	X	X

Table 2.10-14 in the FEIS

[1] This table does not include the NAA, the continuation of existing operations and maintenance (Section 2.10.3, No-action Alternative), because measures address new action alternatives.

* The Detroit fall drawdown for fish passage is included in the Interim Operations.

CHAPTER 3 - AFFECTED ENVIRONMENT AND ENVIRONMENTAL CONSEQUENCES

3.1 Introduction

Incorporated by reference.

Since the start of the SEIS there have been several key changes to federal law, regulations, and case law. On February 25, 2025, the Council on Environmental Quality (CEQ) published an Interim Final Rule removing CEQ's NEPA implementing regulations, effective April 11, 2025 (90 Fed. Reg. 10610). As a result, the FRA and USACE's implementing regulations at 33 C.F.R. §230 are applicable to this document but CEQ's previous regulations are not.

The decision maker will not consider areas analyzed that are no longer required to be considered by regulation or executive order in their decision. However, to keep the process efficient and timely, as emphasized in the FRA, some references to environmental justice, greenhouse gas, and climate change may appear in the draft SEIS. Social, economic, and community impacts will continue to be disclosed and considered, where appropriate, in accordance with USACE's NEPA regulations at 33 C.F.R. §230, which were applicable at the start of this SEIS but have been subsequently repealed.

3.1.1 Large Woody Debris

The FEIS did not include the collection and removal of large woody debris though it is an action USACE took prior to 2019. This measure would continue and is common to all alternatives. WVS dams block contributions of large wood from upstream. USACE would continue to collect large wood during annual maintenance operations that accumulates at WVS dams and make it available for habitat restoration projects. USACE would store material on USACE land for other appropriate entities to collect and use for habitat projects in the region. The effects of this measure would be minor and beneficial and are not discussed further in this SEIS. This analysis is commensurate with the minor beneficial impact of this action.

3.2 Hydrologic Processes

3.2.1 Affected Environment

Incorporated by reference.

3.2.2 Environmental Consequences

3.2.2.1 Methodology

Incorporated by reference.

3.2.2.2 Environmental Consequences Summary

The No Action Alternative (NAA) represents the management of the WVS as of April 2019. Each of the action alternatives would change the seasonal flow and use of stored water in the system. The summaries of hydrologic effects for the NAA and Alternatives 1 – 6 are provided in Tables 3-1 through Table 3-6). A summary of alternative effects on seasonal stored water is provided here. For a more detailed assessment of alternative effects on water supply, refer to Section 3.13.

In comparison to the NAA, operations under Alternative 1 and Alternative 4 would store more water in the spring and release it during the summer and fall. Alternative 1 results in more stored water because the House Document 531 (HD531) minimum flow targets are markedly lower than flow targets in the NAA throughout the conservation season (USACE 1948). Alternative 4 results in more stored water because the Measure 30 variable tributary and mainstem targets have lower releases in the spring when inflows are low. Operations under Alternative 2A and Alternative 2B also adhere to the Measure 30 variable tributary and mainstem targets resulting in similar spring storage as Alternative 4, but also include fall drawdowns that draft storage sooner. Alternatives 3A and 3B adhere to Measure 30 targets but also include spring drawdowns that significantly reduce conservation season storage. Alternative 5 operations and effects on system storage are similar to Alternative 2B. Alternative 6 operations are identical to those in Alternative 5 but adhere to the same flow targets as the No-Action Alternative. System storage in Alternative 6 is less than in Alternative 5 because of the change in flow target timing, and markedly less than in the NAA primarily because of the delayed refill at Cougar, and potentially as a result late refill from the fall drawdown at Green Peter.

Table 3-1. Santiam River Subbasin Summary of Hydrologic Processes Environmental Consequences as Compared to the No-action Alternative.

Location	No-action Alternative	Alternative 1	Alternative 2A	Alternative 2B	Alternative 3A	Alternative 3B
Detroit Reservoir[1]	Detroit would fill in most years during the spring and very rarely draft to the minimum conservation elevation before the end of the conservation season.	Detroit fills faster and drafts slower due to lower HD531 tributary targets relative to the 2008 biological opinion targets. The reservoir is not likely to draft to the minimum conservation elevation before the end of the conservation season, even in exceedingly dry years.	Detroit fills faster and more often because Measure 30 variable tributary flow targets are lower in the spring of years when inflows are low. As a result, the reservoir is unlikely to draft to the minimum conservation elevation before the end of the conservation season, even in exceedingly dry years.	Operations are the same as in Alternative 2A; therefore, the effects are as well.	Detroit drafts much deeper in the spring and again in the fall for the spring and fall drawdowns. Minimal refill is achieved between drawdowns.	Detroit drafts much deeper in the fall for the fall drawdown. The fall drawdown may impede spring refill in years with exceptionally dry late winter and spring months.
Detroit Reservoir/ Big Cliff Reservoir Outflow	Detroit outflow would meet or exceed minimum tributary targets except in rare instances when Detroit drafts to the minimum conservation elevation early and is only required to release inflow.	HD 531 tributary targets are low and the functional minimum release for the reservoir becomes the minimum powerhouse flow for Big Cliff Dam. The lower targets are met even in exceedingly dry years.	Releases are lower in the spring in years when inflow is low because of the Measure 30 variable tributary targets. The target in the spring of dry years defaults to the minimum powerhouse target for Big Cliff. Targets are met even in exceedingly dry years.	Operations are the same as in Alternative 2A; therefore, the effects are as well.	Releases are significantly higher in the spring when Detroit is drawing down for the spring drawdown. Releases during the conservation season frequently drop to inflow because the reservoir has little or no storage to draft from for flow augmentation. Fall and winter releases are lower when the reservoir is refilling after the fall drawdown.	Releases are significantly higher in the fall when drafting for the fall drawdown and lower in late winter when the reservoir is refilling from the drawdown.
North Santiam River at Mehama	Flows at Mehama reflect flows out of Detroit and Big Cliff. Flows very rarely fall below the tributary targets.	Flows at Mehama would exceed the HD531 minimum flow targets even in extremely dry years.	Flows at Mehama reflect flows out of Detroit and Big Cliff, exceeding the Measure 30 variable minimum tributary targets even in extremely dry years.	Operations are the same as in Alternative 2A; therefore, the effects are as well.	Flows at Mehama reflect flows out of Detroit and Big Cliff, with higher spring flows and significantly lower flows the remainder of the year.	Flows at Mehama reflect flows out of Detroit and Big Cliff, with higher flows in the fall and lower flows in late winter as a result of the Detroit fall drawdown.
Green Peter Reservoir[2]	Green Peter would fill in most years during the spring and very rarely draft to the minimum conservation elevation before the end of the conservation season.	Green Peter fills faster and drafts slower due to HD 531 tributary targets. The reservoir is not likely to ever draft to the minimum conservation pool elevation before the end of the conservation season, even in exceedingly dry years.	Green Peter fills moderately faster in dry springs because of the lower variable tributary targets. Fall and winter elevations are much lower because of the fall drawdown. The fall drawdown impedes spring refill in exceedingly dry years.	Operations are the same as in Alternative 2A; therefore, the effects are as well.	Operations are the same as in Alternative 2A; therefore, the effects are as well.	Green Peter drafts much deeper in the spring and again in the fall for spring and fall drawdown. Minimal refill is achieved between drawdowns.

Location	No-action Alternative	Alternative 1	Alternative 2A	Alternative 2B	Alternative 3A	Alternative 3B
Foster Reservoir[3]	Foster would only vary from rule curve during flood operations.	Foster elevations would only vary from the rule curve during flood operations.	Foster elevations would only vary from the rule curve during flood operations.	Foster elevations would only vary from the rule curve during flood operations.	Foster elevations would only vary from the rule curve during flood operations.	Foster will frequently have to draft all conservation season storage to try and maintain tributary minimums in the absence of Green Peter outflows.
Green Peter Reservoir / Foster Reservoir Outflow	Green Peter and Foster would meet or exceed outflow targets except in summer and fall of very dry years.	Green Peter and Foster outflows would meet or exceed the HD531 tributary targets even in exceedingly dry years.	Green Peter and Foster releases are moderately lower in the spring of dry years as a result of the Measure 30 variable tributary targets. Releases are significantly higher in the fall during the drawdown, and lower in mid-winter when the reservoir is attempting to refill.	Operations are the same as in Alternative 2A; therefore, the effects are as well.	Operations are the same as in Alternative 2A; therefore, the effects are as well.	Releases are higher in the spring to achieve the Green Peter drawdown and lower the rest of the year when the reservoirs are passing inflow or attempting to refill.
South Santiam River at Waterloo	Flows would meet or exceed tributary targets except in summer and fall of very dry years, reflecting releases from Foster Dam with additions from local inflows.	Flows would meet or exceed the HD531 tributary targets even in exceedingly dry years.	Flows would meet or exceed Measure 30 variable tributary targets even in exceedingly dry years. Flows are significantly higher in the fall and lower in mid-winter as a result of the Green Peter fall drawdown.	Operations are the same as in Alternative 2A; therefore, the effects are as well.	Operations are the same as in Alternative 2A; therefore, the effects are as well.	Flows are substantially higher in the spring and lower the remainder of the year, reflecting releases from Foster and additions of local inflows.
Santiam River at Jefferson	There are no tributary targets at Jefferson. Flows at Jefferson reflect releases from Detroit/Big Cliff, Green Peter, Foster, and local runoff below the dams that moderate changes in flows resulting from changes in dam releases.	Flows are lower than in the NAA because the HD531 upstream tributary targets are lower, though local runoff below the dams would moderate changes in flows resulting from lower dam releases.	Flows will be substantially higher in the fall and lower in mid-winter because of the Green Peter fall drawdown.	Operations are the same as in Alternative 2A; therefore, the effects are as well.	Flows are higher in the spring as a result of the Detroit spring drawdown and higher in early fall when both Green Peter and Detroit are drafting for their fall drawdowns. Winter flows are lower when the reservoirs are refilling.	Flows are higher in the spring as a result of the Green Peter spring drawdown and higher in early fall when both Green Peter and Detroit are potentially drafting for their fall drawdowns. Winter flows are lower when the reservoirs are refilling.

Table 3-1. Santiam River Subbasin Summary of Hydrologic Processes Environmental Consequences as Compared to the No-action Alternative (continued).

Location	No-action Alternative	Alternative 4	Alternative 5	Alternative 6	Interim Operations
Detroit Reservoir[1]	Detroit would fill in most of years during the spring and very rarely draft to the minimum conservation elevation before the end of the conservation season.	Operations are the same as in Alternative 2A; therefore, the effects are as well.	Operations are the same as in Alternative 2A; therefore, the effects are as well.	Operations are the same as in the No-Action Alternative except that Detroit is permitted to draft into the power pool.	Detroit elevations are lower in the winter as a result of the deep fall drawdown. Spring refill may be impeded in years with exceedingly low inflow in late winter and spring.
Detroit Reservoir/ Big Cliff Reservoir Outflow	Detroit Would meet or exceed minimum tributary targets except in rare instances when the reservoir drafts to the minimum conservation elevation early and is only permitted to release inflow.	Operations are the same as in Alternative 2A; therefore, the effects are as well.	Operations are the same as in Alternative 2A; therefore, the effects are as well.	Operations are the same as in the No-Action Alternative except that Detroit releases minimum tributary flows in drier years by releasing from the power pool.	Releases are higher in late fall and early winter when Detroit is drawing down and lower for the remainder of the winter when Detroit is refilling from the drawdown.
North Santiam River at Mehama	Flows at Mehama reflect flows out of Detroit and Big Cliff, meeting or exceeding tributary targets except in exceedingly dry years.	Operations are the same as in Alternative 2A; therefore, the effects are as well.	Flows at Mehama reflect flows out of Detroit and Big Cliff which are the same as in Alternative 2A	Flows at Mehama reflect flows out of Detroit and Big Cliff which are the same as in the No-Action Alternative, with slightly higher flows in the late summer of very dry years.	Flows at Mehama reflect flows out of Detroit and Big Cliff with higher flows in early winter and lower flows the remainder of the winter.
Green Peter Reservoir[2]	Green Peter would fill in most of years during the spring and very rarely draft to the minimum conservation elevation before the end of the conservation season	Green Peter fills faster but drafts to the rule curve about the same as in the No-Action Alternative. Differences are a consequence of the timing of mainstem flow target support.	Operations are the same as in Alternative 2A; therefore, the effects are as well.	Green Peter elevations are lower in the fall and winter as a result of the deep fall drawdown. Exceedingly dry late winter and spring conditions may impede refill in the spring.	Operations are the same as in Alternative 6
Foster Reservoir[3]	Foster elevations would only vary from rule curve during flood operations.	Foster elevations would only vary from rule curve during flood operations.	Operations are the same as in Alternative 2A; therefore, the effects are as well.	Operations are the same as in the No-Action Alternative, but elevations spike more often in the fall when Green Peter is drawing down.	Foster elevations are lower in the spring as a result of the delayed refill. Fall elevations are lower as a result of the earlier fall drawdown.
Green Peter Reservoir / Foster Reservoir Outflow	Green Peter and Foster Would meet or exceed outflow targets except in summer and fall of very dry years.	Green Peter releases less in the spring and more in the fall as a consequence of changes in the timing of mainstem flow augmentation.	Operations are the same as in Alternative 2A; therefore, the effects are as well.	Releases are higher in the fall and lower in the winter because Foster attempts to pass flows during the Green Peter fall drawdown.	Foster releases slightly more in the spring as a result of the delayed refill. Foster and Green Peter both release significantly more water in the fall as a result of the fall drawdowns. Winter releases are lower when Green Peter is refilling. Releases are also lower in mid-May when Foster initially fills.

Location	No-action Alternative	Alternative 4	Alternative 5	Alternative 6	Interim Operations
South Santiam River at Waterloo	Waterloo flows reflect releases from Foster with additions from local inflows. Flows would meet or exceed tributary targets except in summer and fall of very dry years.	Flows at Mehama reflect flows out of Green Peter and Foster. Flows are lower in the spring and higher in the late summer to meet Measure 30 variable tributary and mainstem flow targets.	Operations are the same as in Alternative 2A; therefore, the effects are as well.	Flows at Mehama reflect flows out of Green Peter and Foster which are higher in the fall and lower in the winter.	Flows at Mehama reflect flows out of Green Peter. Flows are slightly higher in the spring and substantially higher in the fall. Winter flows are lower when Green Peter is filling.
Santiam River at Jefferson	Flows at Jefferson reflect releases from Detroit/Big Cliff, Green Peter, Foster, and local runoff below the dams that moderate changes in flows resulting from changes in dam releases.	Flows are lower in the spring and higher in the late summer to meet Measure 30 variable tributary and mainstem flow targets, reflecting releases from Detroit/Big Cliff, Green Peter, Foster, and local runoff below the dams.	Operations are the same as in Alternative 2A; therefore, the effects are as well.	Flows at Jefferson reflect releases from Detroit/Big Cliff, Green Peter, Foster, and local runoff. Flows are higher in the fall and lower in the winter as a result of the Green Peter fall drawdown.	Flows at Jefferson reflect releases from Detroit/Big Cliff, Green Peter, Foster, and local runoff below the dams that moderate changes in flows resulting from changes in dam releases. Flows are higher in the fall and lower in the winter as a result of the Green Peter and Detroit fall drawdowns.

Table 3.2-2 in the FEIS

cfs = cubic feet per second

[1] Detroit Reservoir top and bottom conservation storage elevations are 1,563.5 feet and 1,450 feet, respectively.

[2] Green Peter Reservoir top and bottom conservation storage elevations are 1,010 feet and 922 feet, respectively.

[3] Foster Reservoir top and bottom conservation storage elevations are 637 feet and 613 feet, respectively.

Table 3-2. Long Tom River Subbasin Summary of Hydrologic Processes Environmental Consequences as Compared to the No-action Alternative.

Location	No-action Alternative	Alternative 1	Alternative 2A	Alternative 2B	Alternative 3A	Alternative 3B
Fern Ridge Reservoir[1]	Fern ridge fills in most years and does not draft to the minimum conservation elevation before the end of the conservation season even in exceptionally dry years.	Operations are the same as in the No-Action Alternative	Operations are the same as in the No-Action Alternative	Operations are the same as in the No-Action Alternative	Operations are the same as in the No-Action Alternative	Operations are the same as in the No-Action Alternative
Long Tom River at Monroe	Flows at Long Tom reflect releases out of Fern Ridge and additional local runoff. Flows meet or exceed the minimum tributary flows even in exceptionally dry years.	Flows at Long Tom reflect releases out of Fern Ridge and additional local runoff. Operations are the same as in the No-Action Alternative	Flows at Long Tom reflect releases out of Fern Ridge and additional local runoff. Operations are the same as in the No-Action Alternative	Flows at Long Tom reflect releases out of Fern Ridge and additional local runoff. Operations are the same as in the No-Action Alternative	Flows at Long Tom reflect releases out of Fern Ridge and additional local runoff. Operations are the same as in the No-Action Alternative	Flows at Long Tom reflect releases out of Fern Ridge and additional local runoff. Operations are the same as in the No-Action Alternative

Table 3.2. Long Tom River Subbasin Summary of Hydrologic Processes Environmental Consequences as Compared to the No-action Alternative (continued).

Location	No-action Alternative	Alternative 4	Alternative 5	Alternative 6	Interim Operations
Fern Ridge Reservoir[1]	Fern ridge fills in most years and does not draft to the minimum conservation elevation before the end of the conservation season even in exceptionally dry years.	Operations are the same as in the No-Action Alternative	Operations are the same as in the No-Action Alternative	Operations are the same as in the No-Action Alternative	Operations are the same as in the No-Action Alternative.
Long Tom River at Monroe	Flows at Long Tom reflect releases out of Fern Ridge and additional local runoff. Flows meet or exceed the minimum tributary flows even in exceptionally dry years.	Flows at Long Tom reflect releases out of Fern Ridge and additional local runoff. Operations are the same as in the No-Action Alternative	Flows at Long Tom reflect releases out of Fern Ridge and additional local runoff. Operations are the same as in the No-Action Alternative	Flows at Long Tom reflect releases out of Fern Ridge and additional local runoff. Operations are the same as in the No-Action Alternative	Flows at Long Tom reflect releases out of Fern Ridge and additional local runoff. Operations are the same as in the No-Action Alternative

Table 3.2-3 in the FEIS

cfs = cubic feet per second

[1] Fern Ridge Reservoir top and bottom conservation storage elevations are 373.5 feet and 353 feet, respectively.

Table 3-3. McKenzie River Subbasin Summary of Hydrologic Processes Environmental Consequences as Compared to the No-action Alternative.

Location	No-action Alternative	Alternative 1	Alternative 2A	Alternative 2B	Alternative 3A	Alternative 3B
Blue River Reservoir[1]	Blue River fills in most years and doesn't draft to the minimum conservation season elevation before the end of the conservation season even in exceptionally dry years.	Blue River fills in all but the very driest years and doesn't draft to the minimum conservation season elevation before the end of the conservation season even in exceptionally dry years.	Blue river retains storage longer in most years because the Green Peter fall drawdown reduces reliance on Blue River to supplement mainstem flows. Blue River fills slightly faster in the spring and retains water longer in the fall as a result of the Cougar Spring and Fall drawdowns, except in very dry years when Cougar runs out of water and Blue River releases to compensate.	Blue River fills faster in the spring as a result of the Cougar spring drawdown. Elevations are lower in the late summer and fall because Cougar commonly run out of water and Blue River is called on to make up the flow.	Blue River fills faster in the spring as a result of the Cougar spring drawdown. Elevations are lower in the late summer and fall because Cougar commonly run out of water and Blue River is called on to make up the flow.	Blue River fills faster in the spring as a result of the Cougar spring drawdown. Elevations are lower in the late summer and fall because Cougar commonly run out of water and Blue River is called on to make up the flow.
Blue River Reservoir Outflow	Blue River releases flows at or above tributary minimums, even in exceptionally dry years.	Blue River releases less in the summer because the HD531 tributary targets are lower. Releases in fall are higher because the reservoir drafts from higher in the reservoir earlier in the fall.	Releases are marginally different based on when Blue River reaches the drawdown rule curve in the fall.	Releases are marginally different based on when Blue River reaches the drawdown rule curve in the fall.	Blue River releases more in early fall to compensate for lack of releases from Cougar.	Blue River releases more in early fall to compensate for lack of releases from Cougar.
Cougar Reservoir[2]	Cougar fills in about half of years and drafts to the minimum conservation elevation before the end of the conservation season in exceptionally dry years.	Cougar elevations are marginally different than in the No-Action alternative, except that the reservoir is permitted to draft into the power pool in extremely dry years.	Cougar fills more in dry years often resulting in higher elevations later in the conservation season. Cougar still drafts into the power pool in extremely dry years.	Cougar drafts to the reservoir bottom in the spring and again in the fall, virtually never filling to the normal minimum conservation elevation in the conservation season.	Cougar drafts to 50 feet above the regulating outlet in the spring and again in the fall. A brief refill season begins in mid-June. The reservoir rarely fills to the minimum conservation season elevation during the conservation season.	Operations are the same as in Alternative 2B.
Cougar Reservoir Outflow	Minimum tributary flows are released except in late summer of very dry years.	HD531 minimum tributary targets are slightly lower. As a result, releases are slightly lower, and the lower targets are met more often in very dry years.	Cougar releases slightly lower flows in spring of dry years because Measure 30 variable flow targets are lower, sometimes resulting in the reservoir reaching the rule curve earlier in the fall resulting in higher releases.	Cougar releases higher flows in the spring when drawing down and lower flows the remainder of the year when either passing inflow when the reservoir is empty or releasing the minimum tributary flow when refilling from the drawdowns.	Cougar releases higher flows in the spring when drawing down and lower flows the remainder of the year when either passing inflow when the reservoir is empty or releasing the minimum tributary flow when refilling from the drawdowns.	Operations are the same as in Alternative 2B.
McKenzie River at Vida	Flows at Vida reflect releases from Cougar and Blue River with additions from local runoff.	Flows at Vida reflect releases from Cougar and Blue River with additions from local runoff. Summer flows are typically lower because HD531 tributary targets are lower. These lower targets are met more often.	Flows at Vida reflect releases from Cougar and Blue River with additions from local runoff. Flows are slightly lower in spring and higher in fall in years dry years as a result of the Measure 30 variable flow targets.	Flows at Vida reflect releases from Cougar and Blue River with additions from local runoff. Flows are higher in spring and lower the remainder of the year.	Flows at Vida reflect releases from Cougar and Blue River with additions from local runoff. Flows are higher in spring and lower the remainder of the year.	Flows at Vida reflect releases from Cougar and Blue River with additions from local runoff. Operations are the same as in Alternative 2B.

Table 3-3. McKenzie River Subbasin Summary of Hydrologic Processes Environmental Consequences as Compared to the No-action Alternative (continued).

Location	No-action Alternative	Alternative 4	Alternative 5	Alternative 6	Interim Operations
Blue River Reservoir[1]	Blue River fills in most years and doesn't draft to the minimum conservation season elevation before the end of the conservation season even in exceptionally dry years.	Operations are the same as in Alternative 2A.	Operations are the same as in Alternative 2B.	Blue River elevations are nearly identical to the No-Action Alternative in all but the driest years when the reservoir may draft below normal low pool to supplement flows when Cougar runs out of water during the fall drawdown.	Blue River elevations are consistently higher in the late conservation season when other reservoirs are drawing down, including Cougar, Lookout Point, and Green Peter.
Blue River Reservoir Outflow	Blue River releases flows at or above tributary minimums even in exceptionally dry years.	Operations are the same as in Alternative 2A.	Operations are the same as in Alternative 2B.	Blue River elevations are nearly identical to the No-Action Alternative in all but the driest years when releases are higher to supplement flows when Cougar runs out of water during the fall drawdown.	Blue River releases are similar to the NAA in the early conservation season and slightly lower in the late conservation season when the reservoir releases less because Cougar, Lookout Point, and Green Peter are drawing down providing sufficient augmentation for mainstem targets. .
Cougar Reservoir[2]	Cougar fills in about half of years and drafts to the minimum conservation elevation before the end of the conservation season in exceptionally dry years.	Cougar stays full for longer because it releases less for mainstem minimum flow target augmentation.	Operations are the same as in Alternative 2B.	Operations are the same as in Alternative 2B	Cougar drafts to 50 feet above the regulating outlet in the spring and again in the fall. A brief refill season begins in mid-May allowing for partial refill of the conservation season storage.
Cougar Reservoir Outflow	Minimum tributary flows are released except in late summer of extremely dry years.	Operations are the same as in Alternative 2A.	Operations are the same as in Alternative 2B.	Operations are the same as in Alternative 2B	Releases are higher in spring as a result of the spring drawdown. Flows are lower in fall because the reservoir has typically already drafted to the drawdown elevation to meet minimum tributary flows.
McKenzie River at Vida	Flows at Vida reflect releases from Cougar and Blue River with additions from local runoff.	Flows at Vida reflect flows out of Cougar and Blue River, which are the same as in Alternative 2A.	Flows at Vida reflect flows out of Cougar and Blue River, which are the same as in Alternative 2B.	Flows at Vida reflect flows out of Cougar and Blue River, which are very nearly identical to flows in Alternative 2B	McKenzie River at Vida reflects the combined releases from Cougar and Blue River reservoirs, with higher spring and fall flows and lower summer and winter flows.

Table 3.2-4 in the FEIS

% = percent; cfs = cubic feet per second

[1] Blue River Reservoir top and bottom conservation storage elevations are 1,350 feet and 1,180 feet, respectively.

[2] Cougar Reservoir top and bottom conservation storage elevations are 1,690 feet and 1,532 feet, respectively.

Table 3-4. Middle Fork Willamette River Subbasin Summary of Hydrologic Processes Environmental Consequences as Compared to the No-action Alternative.

Location	No-action Alternative	Alternative 1	Alternative 2A	Alternative 2B	Alternative 3A	Alternative 3B
Hills Creek Reservoir[1]	Hills Creek very nearly fills in about half of years and is very unlikely to draft to the minimum conservation season elevation before the end of the conservation season.	Hills creek fills in all but the driest years and only drafts below the minimum conservation elevation before the end of the conservation season in exceptionally dry years.	Hills Creek is more likely to fill in the spring but also more likely to draft deeper in the summer and fall to support Lookout Point releasing for variable Measure 30 tributary and mainstem targets.	Operations are the same as in Alternative 2A, except Hills Creek drafts more to support Lookout Point.	Hills Creek is more likely to fill in the spring because Lookout Point is drafting for the spring drawdown. Hills Creek then draws down for its own fall drawdown beginning mid-spring.	Hills Creek elevations are much lower in the spring and in the fall because of the spring and fall deep drawdown. The reservoir briefly attempts to refill mid-summer but typically fills very little.
Hills Creek Reservoir Outflow	Hills Creek meets or exceeds minimum flow targets downstream and commonly releases significantly more to support refill and minimum releases at lookout point.	Hills Creek tributary targets are lower, but the reservoir typically releases more to support lookout point. Target releases are consistently met or exceeded.	Hills Creek releases slightly less in the spring and more in the summer and fall to support Lookout Point releasing for Measure 30 variable tributary and mainstem targets.	Operations are the same as in Alternative 2A, Except Hills Creek releases more to support Lookout Point.	Hills Creek outflows are lower in the spring when Lookout Point is drafting for the spring drawdown. Releases are higher in the summer when Hills Creek is drawing down, but often lower later in the summer because the reservoir has drafted all available storage.	Hills Creek releases more in the spring to achieve the spring drawdown but typically releases below the tributary target for extended periods of time in the summer because the reservoir runs out of water.
Lookout Point Reservoir[2]	Lookout Point fills in most years and only drafts to the minimum conservation elevation before the end of the conservation season in extremely dry years.	Lookout Point elevations are very similar to the No-Action alternative, despite the reduction in tributary release targets, because minimum releases default to powerhouse minimum for Dexter which is greater than the No-Action alternative release targets.	Lookout Point is more likely to fill in the spring and retains water longer with the support of releases from Hills Creek.	Operations are the same as in Alternative 2A except that Lookout Point drafts more to supplement mainstem targets to make up for lack of storage at Cougar	Lookout Point elevations are lower in the spring and fall because of the spring and fall deep drawdowns. The reservoir briefly refills above the normal minimum conservation season in about half of years.	Lookout Point fills faster in the spring because Hills Creek is attempting to maintain a drawdown. Elevations are lower in beginning mid-summer through the fall to draft and maintain the fall drawdown.
Lookout Point Reservoir/ Dexter Reservoir Outflow	Lookout Point meets or exceeds tributary targets except in the fall of extremely dry years and commonly targets releases well in excess of tributary targets to support mainstem flow targets.	Lookout Point releases are very similar to the No-Action alternative releases because both default to the Dexter powerhouse minimum release.	Releases are slightly lower in the spring and slightly higher in the fall meeting variable tributary targets and supplementing mainstem targets.	Operations are the same as in Alternative 2A except that Lookout Point releases more to supplement mainstem targets making up for lack of releases from Cougar.	Lookout Point releases are higher in the spring and fall because of the spring and fall deep drawdowns, except for periods where the drawdown elevation is maintained and the reservoir only passes inflow. In the driest of years, only inflow is passed for extended periods of time.	Lookout Point releases more in the spring when releasing to maintain the rule curve while Hills Creek is simultaneously drawing down, and releases more in early fall for the Lookout Point fall drawdown. Winter releases are lower when Lookout Point is refilling from the fall drawdown.
Fall Creek Reservoir[3]	Fall creek fills in most years and does not draft below the minimum conservation elevation before the end of the conservation season. The reservoir does draft to the bottom of the reservoir in the fall and consistently refills to the minimum conservation season elevation before conservation refill season begins.	Fall Creek elevations are very nearly the same as in the No-Action alternative.	Operations are the same as in the No-Action Alternative.	Operations are the same as in the No-Action Alternative.	Operations are the same as in the No-Action Alternative	Operations are the same as in the No-Action Alternative

Location	No-action Alternative	Alternative 1	Alternative 2A	Alternative 2B	Alternative 3A	Alternative 3B
Fall Creek Reservoir Outflow	Fall Creek meets or exceeds tributary targets consistently throughout the conservation season. Releases significantly exceed tributary targets during the fall drawdown. Targets are only missed occasionally when the reservoir has drafted to the lowest outlet for the drawdown.	Fall Creek releases are slightly lower because HD531 targets are slightly lower.	Operations are the same as in the No-Action Alternative.	Operations are the same as in the No-Action Alternative	Operations are the same as in the No-Action Alternative	Operations are the same as in the No-Action Alternative
Middle Fork Willamette River at Jasper	Flows at Jasper reflect releases from Lookout Point, Fall Creek, and local runoff.	Flows at Jasper reflect releases from Lookout Point, Fall Creek, and local runoff. As a result of lower HD531 tributary and mainstem targets, flows are slightly lower in early summer and slightly higher in late summer of dry years because usable storage is maintained longer.	Flows at Jasper reflect releases from Lookout Point, Fall Creek, and local runoff. Flows are slightly lower in the spring and slightly higher in the fall to meet the Measure 30 variable tributary targets.	Flows at Jasper reflect releases from Lookout Point, Fall Creek, and local runoff. Operations at reservoirs above Jasper are largely the same as in Alternative 2a, but flows are higher because Lookout Point releases more for mainstem augmentation to make up for lack of usable storage at Cougar.	Flows at Jasper reflect releases from Lookout Point, Fall Creek, and local runoff. Flows are much higher in the spring when Lookout Point is drafting for the spring drawdown. Summer and fall flows are lower because Lookout Point commonly runs out of water and cannot sustain minimum target releases.	Flows at Jasper reflect releases from Lookout Point, Fall Creek, and local runoff.

Table 3-4. Middle Fork Willamette River Subbasin Summary of Hydrologic Processes Environmental Consequences as Compared to the No-action Alternative (continued).

Location	No-action Alternative	Alternative 4	Alternative 5	Alternative 6	Interim Operations
Hills Creek Reservoir[1]	Hills Creek very nearly fills in about half of years and is very unlikely to draft to the minimum conservation season elevation before the end of the conservation season.	Operations are the same as in Alternative 2A.	Operations are the same as in Alternative 2B.	Hills Creek drafts significantly faster than in the No-Action Alternative in about half of years to support Lookout Point.	Hills Creek drafts lower in the spring to help Lookout Point fill to the spillway crest.
Hills Creek Reservoir Outflow	Hills Creek meets or exceeds minimum flow targets downstream and commonly releases significantly more to support refill and minimum releases at lookout point.	Operations are the same as in Alternative 2A.	Operations are the same as in Alternative 2B.	Hills Creek releases more to support Lookout Point in about half of years when Lookout Point is making up for lack of usable storage at Cougar.	Hills Creek releases more in the spring to help Lookout Point fill to the spillway crest.
Lookout Point Reservoir[2]	Lookout Point fills in most years and only drafts to the minimum conservation elevation before the end of the conservation season in extremely dry years.	Operations are the same as in Alternative 2A.	Operations are the same as in Alternative 2B.	Lookout Point elevations are consistently lower due to more pressure to support mainstem targets in the absence of storage at Cougar, but the reservoir still fills in over half of years. The reservoir only drafts into the power pool in the driest years.	Lookout Point refill in the spring is restricted to the spillway crest to support ungated spillway releases. The fall drawdown begins in May, targeting 750’ on 15-November, drafting at approximately 1 ft/day. Refill to the rule curve begins on 01-December.
Lookout Point Reservoir/ Dexter Reservoir Outflow	Lookout Point meets or exceeds tributary targets except in the fall of extremely dry years, and commonly targets releases well in excess of tributary targets to support mainstem flow targets.	Operations are the same as in Alternative 2A.	Operations are the same as in Alternative 2B.	Lookout Point releases are higher, most notably beginning in June when Cougar has a higherr potential to run out of water.	Lookout Point releases are higher in the spring during the ungated spill operation and in the summer, fall, and winter when the reservoir is drafting for the fall drawdown.

Location	No-action Alternative	Alternative 4	Alternative 5	Alternative 6	Interim Operations
Fall Creek Reservoir[3]	Fall creek fills in most years and does not draft below the minimum conservation elevation before the end of the conservation season. The reservoir does draft to the bottom of the reservoir in the fall, and consistently refills to the minimum conservation season elevation before conservation refill season begins.	Operations are the same as in the No-Action Alternative.	Operations are the same as in the No-Action Alternative.	Operations are the same as in the No-Action Alternative.	Operations are the same as in the No-Action Alternative.
Fall Creek Reservoir Outflow	Fall Creek meets or exceeds tributary targets consistently throughout the conservation season. Releases significantly exceed tributary targets during the fall drawdown. Targets are only missed occasionally when the reservoir has drafted to the lowest outlet for the drawdown.	Operations are the same as in the No-Action Alternative.	Operations are the same as in the No-Action Alternative.	Operations are the same as in the No-Action Alternative.	Operations are the same as in the No-Action Alternative.
Middle Fork Willamette River at Jasper	Flows at Jasper reflect releases from Lookout Point, Fall Creek, and local runoff.	Flows at Jasper reflect releases from Lookout Point, Fall Creek, and local runoff, which are the same as in Alternative 2A.	Operations are the same as in Alternative 2B.	Flows at Jasper mirror releases from Lookout Point, with releases higher than the No-Action Alternative typically beginning in June reflecting releases to supplement the mainstem. Flow changes are muted by local flows and releases from Fall Creek that are nearly identical to the No-Action Alternative.	Flows at Jasper mirror releases from Lookout Point, with releases higher than the No-Action Alternative beginning in May when the ungated spill operation begins and continuing throughout the summer, fall, and winter when Lookout Point is drafting for the fall drawdown.

Table 3.2-5 in the FEIS

% = percent; cfs = cubic feet per second

[1] Hills Creek Reservoir top and bottom conservation storage elevations are 1,541 feet and 1,448 feet, respectively.

[2] Lookout Point Reservoir top and bottom conservation storage elevations are 926 feet and 825 feet, respectively.

[3] Fall Creek Reservoir top and bottom conservation storage elevations are 830 feet and 728 feet, respectively.

Table 3-5. Coast Fork Willamette River Subbasin Summary of Hydrologic Processes Environmental Consequences as Compared to the No-action Alternative.

Location	No-action Alternative	Alternative 1	Alternative 2A	Alternative 2B	Alternative 3A	Alternative 3B
Dorena Reservoir[1]	Dorena fills in most years and does not draft to the minimum conservation elevation before the end of the conservation season.	Dorena fills faster and stays full longer.	Dorena reservoir elevations stay higher for longer as a result of lower contributions to spring mainstem targets.	Operations are the same as in the No-Action alternative, except that Dorena drafts slightly more to release for mainstem targets.	Dorena fills a little faster in the fall but end of season elevations are relatively unchanged.	Would reach the top of conservation storage more than 50% of years during the spring and lower minimum elevation about 25% of years in late fall.
Dorena Reservoir Outflow	Dorena consistently releases at or above the minimum tributary target, even in the driest of years.	Dorena summer releases are lower because the HD531 targets are lower. The reservoir meets the conservation season drawdown curve sooner which results in higher fall releases many years.	Dorena releases slightly more in the fall because it meets the drawdown rule curve slightly sooner.	Operations are the same as in the No-Action Alternative except that Dorena releases slightly more to augment Salem targets making up for lack of releases from Cougar.	Dorena releases slightly less in the spring and slightly more in the fall because of shifts in contributions to mainstem targets.	Would maintain minimum flows except in fall of dry years.
Cottage Grove Reservoir[2]	Cottage Grove fills in most years and does not draft to the minimum conservation elevation before the end of the conservation season.	Cottage Grove fills faster and stays full longer.	Cottage Grove reservoir elevations stay higher for longer as a result of lower contributions to spring mainstem targets.	Operations are the same as in the No-Action alternative, except that Cottage Grove drafts slightly more to release for mainstem targets.	Cottage Grove fills a little faster in the fall but end of season elevations are relatively unchanged.	Would reach the top of conservation storage about 50% of years during the spring and lower minimum elevation in about 25% of years during fall.
Cottage Grove Reservoir Outflow	Cottage Grove consistently releases at or above the minimum tributary target, even in the driest of years.	Cottage Grove summer releases are lower because the HD531 targets are lower. The reservoir meets the conservation season drawdown curve sooner which results in higher fall releases many years.	Dorena releases slightly more in the fall because it meets the drawdown rule curve slightly sooner.	Operations are the same as in the No-Action Alternative except that Cottage Grove releases slightly more to augment Salem targets making up for lack of releases from Cougar.	Cottage Grove releases slightly less in the spring and slightly more in the fall because of shifts in contributions to mainstem targets.	Operations are the same as in the No-Action Alternative.
Coast Fork Willamette River at Goshen	Flows at Goshen reflect releases from Cottage Grove, Dorena, and local runoff.	Flows at Goshen reflect releases from Cottage Grove, Dorena, and local runoff. Summer flows are slightly lower because HD531 targets are lower. Flows are briefly higher in the fall because the reservoirs meet their conservation drawdown curves sooner.	Flows at Goshen reflect releases from Cottage Grove, Dorena, and local runoff. Flows are briefly higher in the fall because the reservoirs meet the conservation drawdown curve sooner.	Flows at Goshen reflect releases from Cottage Grove, Dorena, and local runoff. Operations are the same as in the No-Action Alternative, except that flows are slightly higher because the reservoirs release more to support mainstem flows making up for lower releases from Cougar.	Flows at Goshen reflect releases from Cottage Grove, Dorena, and local runoff. Operations are the same as in the No-Action Alternative except that the timing of releases to augment mainstem minimum flows is shifted slightly to later in the season.	Lower spring flow in dry years. Low flow in fall about 90 cfs in very dry years.

Table 3-5. Coast Fork Willamette River Subbasin Summary of Hydrologic Processes Environmental Consequences as Compared to the No-action Alternative (continued).

Location	No-action Alternative	Alternative 4	Alternative 5	Alternative 6	Interim Operations
Dorena Reservoir[1]	Dorena fills in most years and does not draft to the minimum conservation elevation before the end of the conservation season.	Operations are the same as in the No-Action Alternative except for small changes resulting from a shift in timing of mainstem flow augmentation	Operations are the same as in the No-Action Alternative.	Operations are the same as in the No-Action Alternative.	Operations are the same as in the No-Action Alternative.
Dorena Reservoir Outflow	Dorena consistently releases at or above the minimum tributary target, even in the driest of years.	Operations are the same as in the No-Action Alternative except for small changes resulting from a shift in timing of mainstem flow augmentation	Operations are the same as in the No-Action Alternative.	Operations are the same as in the No-Action Alternative.	Operations are the same as in the No-Action Alternative.
Cottage Grove Reservoir[2]	Cottage Grove fills in most years and does not draft to the minimum conservation elevation before the end of the conservation season.	Operations are the same as in the No-Action Alternative except for small changes resulting from a shift in timing of mainstem flow augmentation	Operations are the same as in the No-Action Alternative.	Operations are the same as in the No-Action Alternative.	Operations are the same as in the No-Action Alternative.
Cottage Grove Reservoir Outflow	Cottage Grove consistently releases at or above the minimum tributary target, even in the driest of years.	Operations are the same as in the No-Action Alternative except for small changes resulting from a shift in timing of mainstem flow augmentation	Operations are the same as in the No-Action Alternative.	Operations are the same as in the No-Action Alternative.	Operations are the same as in the No-Action Alternative.
Coast Fork Willamette River at Goshen	Flows at Goshen reflect releases from Cottage Grove, Dorena, and local runoff.	Flows at Goshen reflect releases from Cottage Grove, Dorena, and local runoff which are similar to the No-Action alternative except for minor changes resulting from a shift in timing of mainstem augmentation.	Flows at Goshen reflect releases from Cottage Grove, Dorena, and local runoff. Operations are the same as in the No-Action Alternative.	Flows at Goshen reflect releases from Cottage Grove, Dorena, and local runoff. Operations are the same as in the No-Action Alternative.	Flows at Goshen reflect releases from Cottage Grove, Dorena, and local runoff. Operations are the same as in the No-Action Alternative.

Table 3.2-6 in the FEIS

% = percent; cfs = cubic feet per second

[1] Dorena Reservoir top and bottom conservation storage elevations 832 feet and 771 feet, respectively.

[2] Cottage Grove Reservoir top and bottom conservation storage elevations are 790 feet and 750 feet, respectively.

Table 3-6. Mainstem Willamette River Summary of Hydrologic Processes Environmental Consequences as Compared to the No-action Alternative.

Location	No-action Alternative	Alternative 1	Alternative 2A	Alternative 2B	Alternative 3A	Alternative 3B
Willamette River at Harrisburg	Flows at Harrisburg reflect releases from Cougar, Blue River, Fall Creek, Lookout Point, Cottage Grove, Dorena, and local runoff.	Flows at Harrisburg reflect releases from Cougar, Blue River, Fall Creek, Lookout Point, Cottage Grove, Dorena, and local runoff. Flows at Harrisburg are lower in the spring as a result of lower HD531 tributary and mainstem targets, but higher in late summer and fall of very dry years because reservoirs maintain usable storage longer.	Flows at Harrisburg reflect releases from Cougar, Blue River, Fall Creek, Lookout Point, Cottage Grove, Dorena, and local runoff. Harrisburg flows are lower in the spring and higher in late summer and fall as a result of the Measure 30 variable flow targets.	Flows at Harrisburg reflect releases from Cougar, Blue River, Fall Creek, Lookout Point, Cottage Grove, Dorena, and local runoff. Harrisburg flows are lower in the spring and higher in late summer and fall to meet the Measure 30 targets. Flows frequently spike in spring when Cougar is drafting for the spring drawdown.	Flows at Harrisburg reflect releases from Cougar, Blue River, Fall Creek, Lookout Point, Cottage Grove, Dorena, and local runoff. Flows in early spring are higher because of the spring drawdowns at Cougar and Lookout Point. Late spring flows are lower because the variable Measure 30 targets are lower. Late summer and fall flows are lower because both Cougar and Lookout Point did not substantially refill during the conservation season, draft less than normal, and run out of water in many years.	Flows at Harrisburg reflect releases from Cougar, Blue River, Fall Creek, Lookout Point, Cottage Grove, Dorena, and local runoff. Flows at Harrisburg are briefly higher in early spring when Cougar is drafting for its deep spring drawdown. Late spring flows are lower and and summer flows are higher to meet the Measure 30 flow targets. Fall flows are higher because of the deep fall drawdowns a Lookout Point and Cougar, although in dry years Cougar may have little or no water to draft in the fall.
Willamette River at Albany, Oregon	Flows at Albany reflect contributions from reservoirs above Harrisburg, Fern Ridge, and local inflows. Mainstem target minimum flows are except in the late summer of extremely dry years.	Flows at Albany reflect contributions from reservoirs above Harrisburg, Fern Ridge, and local inflows. Flows at Albany are lower in the spring as a result of lower HD531 tributary targets, but higher in late summer and fall of very dry years because reservoirs maintain usable storage longer.	Flows at Albany reflect contributions from reservoirs above Harrisburg, Fern Ridge, and local inflows. Harrisburg flows are lower in spring and higher in the summer as a result of the Measure 30 variable flow targets.	Flows at Albany reflect contributions from reservoirs above Harrisburg, Fern Ridge, and local inflows. Albany flows are slightly higher in early spring when Cougar is drafting for its deep drawdown. Late spring flows are lower and late summer flows are higher to meet the Measure 30 flow targets. Flows frequently spike in spring when Cougar is drafting for the spring drawdown.	Flows at Albany reflect contributions from reservoirs above Harrisburg, Fern Ridge, and local inflows. Albany flows are slightly higher in early spring when Cougar and Lookout Point draft for the spring drawdown. Albany flows are lower for the remainder of the year because Cougar and Lookout Point commonly run out of water and cannot sustain minimum target releases.	Flows at Albany reflect contributions from reservoirs above Harrisburg, Fern Ridge, and local inflows. Flows at Albany are briefly higher in early spring when Cougar is drafting for its deep spring drawdown. Late spring flows are lower and and summer flows are higher to meet the Measure 30 flow targets. Fall flows are higher because of the deep fall drawdowns a Lookout Point and Cougar, although in dry years Cougar may have little or no water to draft in the fall.

Location	No-action Alternative	Alternative 1	Alternative 2A	Alternative 2B	Alternative 3A	Alternative 3B
Willamette River at Salem, Oregon	Flows at Salem reflect contributions from reservoirs above Albany, Green Peter, Foster, Detroit, and substantial inflow from runoff and unregulated tributary inflows. Salem flow targets are met except in the late summer of extremely dry years.	Flows at Salem reflect contributions from reservoirs above Albany, Green Peter, Foster, Detroit, and substantial inflow from runoff and unregulated tributary inflows. Flows at Salem are lower in the spring as a result of lower HD531 tributary targets, but higher in late summer and fall of very dry years because reservoirs maintain usable storage longer.	Flows at Salem reflect contributions from reservoirs above Albany, Green Peter, Foster, Detroit, and substantial inflow from runoff and unregulated tributary inflows. Salem flows are lower in the spring and higher in late summer and fall as a result of the Measure 30 variable flow targets. Late fall flows are also higher because of the Green Peter fall drawdown.	Flows at Salem reflect contributions from reservoirs above Albany, Green Peter, Foster, Detroit, and substantial inflow from runoff and unregulated tributary inflows. Salem flows are breifly higher in early spring when Cougar is drafting for the deep drawdown. Flows in late spring are lower and summer flows are higher to meet the Measure 30 flow targets. A small increase in spring flows is observed when Cougar is drafting for the spring drawdown.	Flows at Salem reflect contributions from reservoirs above Albany, Green Peter, Foster, Detroit, and substantial inflow from runoff and unregulated tributary inflows. Albany flows are slightly higher in early spring when Cougar and Lookout Point are drafting for their spring drawdowns. Flows are lower for the remainder of the year because Cougar and Lookout Point commonly run out of water and cannot sustain minimum target releases. Flows recover when Green Peter begins its fall drawdown after spawning maximum flow limits are removed.	Flows at Salem reflect contributions from reservoirs above Albany, Green Peter, Foster, Detroit, and substantial inflow from runoff and unregulated tributary inflows. Flows at Salem are briefly higher in early spring when Cougar is drafting for its deep spring drawdown. Late spring flows are lower and summer flows are higher to meet the Measure 30 flow targets. Fall flows are higher because of the deep fall drawdowns a Lookout Point and Cougar, although in dry years Cougar may have little or no water to draft in the fall.

Table 3-6. Mainstem Willamette River Summary of Hydrologic Processes Environmental Consequences as Compared to the No-action Alternative (continued).

Location	No-action Alternative	Alternative 4	Alternative 5	Alternative 6	Interim Operations
Willamette River at Harrisburg	Flows at Harrisburg reflect releases from Cougar, Blue River, Fall Creek, Lookout Point, Cottage Grove, Dorena, and local runoff.	Flows at Harrisburg reflect releases from Cougar, Blue River, Fall Creek, Lookout Point, Cottage Grove, Dorena, and local runoff. Flows are nearly identical to those in Alternative 2A.	Flows at Harrisburg reflect releases from Cougar, Blue River, Fall Creek, Lookout Point, Cottage Grove, Dorena, and local runoff. Harrisburg flows are lower in the spring and higher in late summer and fall to meet the Measure 30 targets. Flows frequently spike in spring when Cougar is drafting for the spring drawdown.	Harrisburg reflects the combined flow from McKenzie, Coast Fork Willamette, and Middle Fork Willamette and is most notably influenced by Operations at Cougar Reservoir. Compared to the No-Action Alternative, flows are higher in the spring to achieve the Cougar deep drawdown. Flows in the driest years are a result of decreased storage at Cougar.	Harrisburg reflects the combined flow from McKenzie, Coast Fork Willamette, and Middle Fork Willamette and is most notably influenced by the spring and fall drawdowns at Cougar Reservoir, the spring elevation restriction at Lookout Point, and the fall drawdown at Lookout Point. These operations result in higher flows at Harrisburg except in late May when both reservoirs are refilling.
Willamette River at Albany, Oregon	Flows at Albany reflect contributions from reservoirs above Harrisburg, Fern Ridge, and local inflows. Mainstem target minimum flows are except in the late summer of extremely dry years.	Flows at Albany reflect contributions from reservoirs above Harrisburg, Fern Ridge, and local inflows. Flows are nearly identical to those in Alternative 2A.	Flows at Albany reflect contributions from reservoirs above Harrisburg, Fern Ridge, and local inflows. Albany flows are slightly higher in early spring when Cougar is drafting for its deep drawdown. Late spring flows are lower and late summer flows are higher to meet the Measure 30 flow targets. Flows frequently spike in spring when Cougar is drafting for the spring drawdown.	Flows at Albany mirror flows at Harrisburg, but the influence of operations at Cougar are muted by the addition of local flows and releases from Fern Ridge which are identical to those in the No-Action Alternative.	Flows at Albany mirror flows at Harrisburg, but the influence of operations at Cougar and Lookout Point are muted by the addition of local flows and releases from Fern Ridge which are identical to those in the No-Action Alternative.

Location	No-action Alternative	Alternative 4	Alternative 5	Alternative 6	Interim Operations
Willamette River at Salem, **Salem, Oregon**	Flows at Salem reflect contributions from reservoirs above Albany, Green Peter, Foster, Detroit, and substantial inflow from runoff and unregulated tributary inflows. Salem flow targets are met except in the late summer of extremely dry years.	Flows at Salem reflect contributions from reservoirs above Albany, Green Peter, Foster, Detroit, and substantial inflow from runoff and unregulated tributary inflows. Flows are nearly identical to those in Alternative 2A except that flows in the driest years are more likely to drop below the varible Measure 30 mainstem target in late summer.	Flows at Salem reflect contributions from reservoirs above Albany, Green Peter, Foster, Detroit, and substantial inflow from runoff and unregulated tributary inflows. . Salem flows are breifly higher in early spring when Cougar is drafting for the deep drawdown. Flows in late spring are lower and summer flows are higher to meet the Measure 30 flow targets. A small increase in spring flows is observed when Cougar is drafting for the spring drawdown.	Flows at Salem reflect releases from all reservoirs in the basin but are most notably influenced by the deep drawdown at Green Peter, resulting in flows higher than in the No-Action alternative in late summer and fall.	Flows at Salem reflect releases from all reservoirs in the basin but are most notably influenced by the deep drawdowns at Green Peter, Lookout Point, Cougar, and Detroit resulting in higher flows during drawdown periods and slightly lower flows in May when Cougar and Lookout Point attempt to fill after spring spill operations.

Table 3.2-7 in the FEIS

cfs = cubic feet per second

Tributary and mainstem targets in the NAA refer to the typical flow target for a location, which the WATER forum can modify during seasonal operations.

3.2.2.3 Alternatives Analyses

No-action Alternative

Incorporated by reference.

Alternative 1—Improve Fish Passage through Storage-focused Measures

Incorporated by reference.

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

Incorporated by reference.

Interim Operations

The timing and duration of Interim Operations would vary by alternative. Interim Operations could extend to nearly the 30-year implementation timeframe under Alternatives 2A, 2B, 4, 5, and 6. However, under Alternative 3A and Alternative 3B Interim Operations may not be fully implemented because long-term operational strategies are intended to be implemented immediately upon Record of Decision.

Interim Operations are not an alternative (Chapter 2, Alternatives, Section 2.8.6, Interim Operations). Interim Operations analyses did not consider impacts assessed under action Alternatives 2A, 2B, 3A, 3B, 4, 5, and 6 because Interim Operations would be implemented before, not in addition to, the action described in the action alternative.

Interim Operations effects on hydrologic processes are assessed by subbasin. USACE modeled only the activities that would affect the flow from a WVS dam. Other activities as part of the Interim Operations, such as the reintroduction of salmonids into selected river reaches, would not affect flow and were not included in the analyses below.

Appendix B, Hydrologic Processes Technical Information, contains a complete explanation of the hydrologic operations model. Although there are some additional Interim Operations that would affect flow as compared to the NAA, the most notable operations from the perspective of hydrologic processes are:

- Deeper fall drawdown and change in outlet release allocation based on reservoir water surface elevation at Detroit Dam.
- Deeper fall reservoir drawdown at Green Peter Reservoir and increased use of the spillway during the spring.
- Delayed spring refill and earlier reduction in pool elevation at Foster Reservoir.
- Delayed spring refill and deeper fall reservoir drawdown at Cougar Reservoir, with a downstream flow restriction during some drawdown periods.

- Change in outlet operations based on reservoir water surface elevation at Hills Creek Dam.
- Lower spring maximum reservoir elevation to support 30-day ungated spillway spill at Lookout Point Reservoir and a deeper fall reservoir drawdown. Increased use of the spillway based on reservoir water surface elevation.

Interim Operations would reduce maximum achieved WVS storage in the conservation season as compared to the NAA in the Middle Fork Willamette River Subbasin and McKenzie River Subbasin. The delayed refill or lower maximum pool elevation would require USACE to release WVS water in the spring that would otherwise be stored under the NAA and other alternatives. This release would result in lower reservoir elevations and outflows throughout the summer and early fall until fall deep drawdowns at Cougar, Lookout Point, Green Peter, and Detroit begin.

On the mainstem Willamette River, Albany would show a greater change in flows from the lower WVS storage than Salem compared to the NAA. This would be primarily due to USACE releasing water at Detroit and Green Peter Reservoirs to contribute to Salem flow target, whereas Albany is upstream of the Willamette River confluence with the Santiam River.

Santiam River Subbasin

Under the Interim Operations, Detroit reservoir targets the same elevations and releases as in the NAA, except for the deep winter drawdown and gaining the ability to draft into the power pool in late summer to meet minimum flow requirements. Exceptionally dry Januarys may impede spring refill as indicated by the P5 line in Figure 3-1.

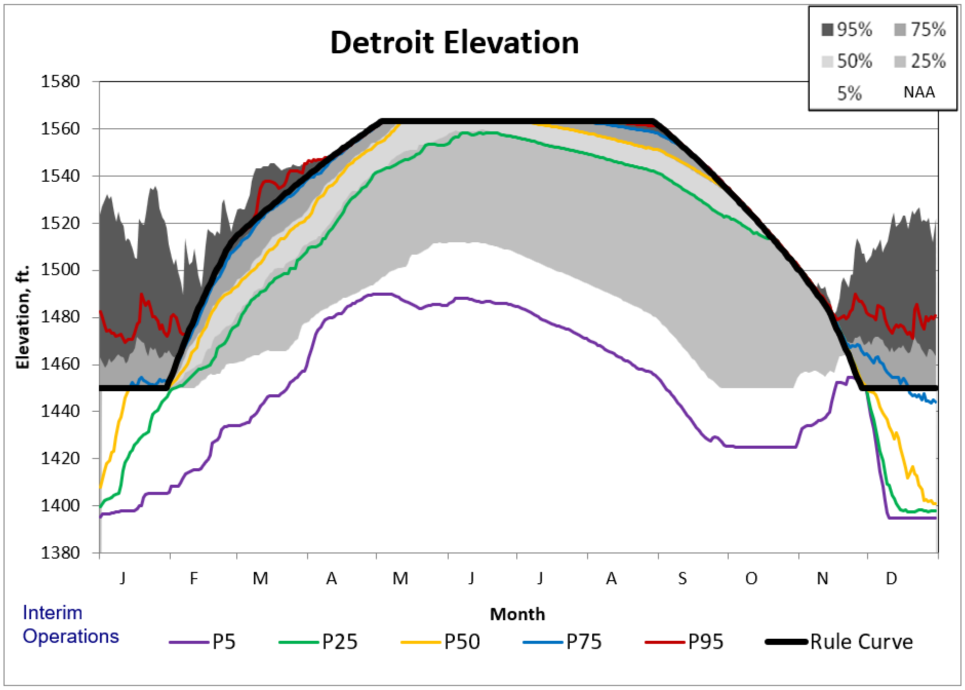


Figure 3-1. Interim Operations Detroit Reservoir Water Surface Elevation Non-exceedance as Compared to the No-action Alternative.

Figure 3.2-70 in the FEIS

Similar to Detroit, Green Peter fills to similar levels during Interim Operations as in the NAA in the spring except in years with exceptionally dry Januarys when the reservoir struggles to refill from the previous fall deep drawdown (Figure 3-2). Elevations are consistently lower in the late summer through late winter when the reservoir is drafting to meet and maintain the fall drawdown.

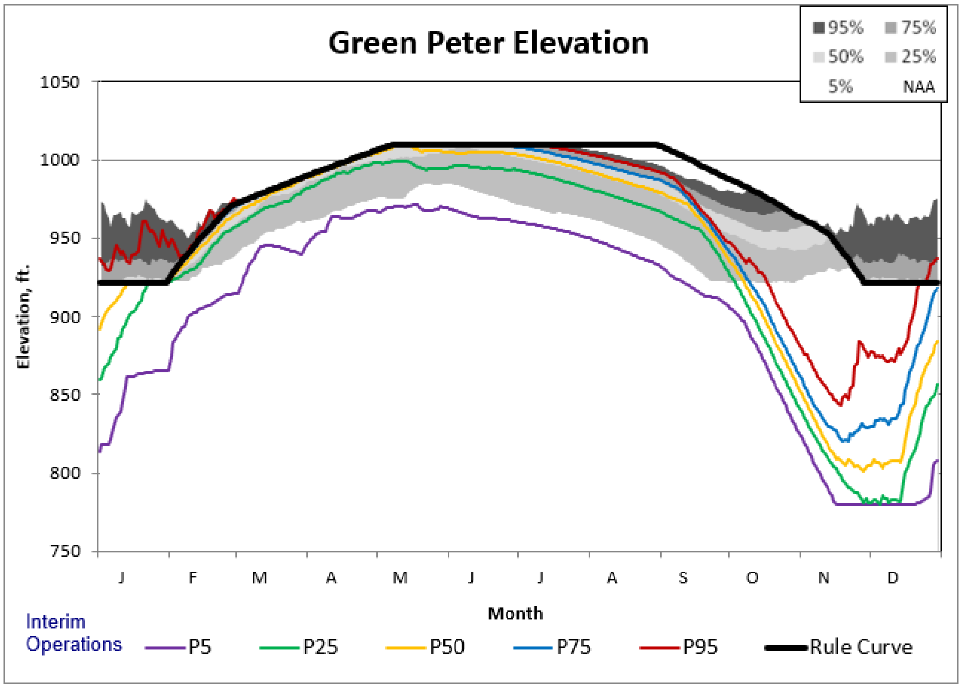


Figure 3-2. Interim Operations Green Peter Reservoir Water Surface Elevation Non-exceedance as Compared to the No-action Alternative.

Figure 3.2-71 in the FEIS

The small dip in reservoir elevation at Green Peter Dam in May is the result of Green Peter releasing to fill Foster Reservoir after the conclusion of Foster's delayed refill period (Figure 3-3). Because the usable storage in Foster Reservoir is less than 10 percent that of Green Peter Reservoir (28.3 thousand acre-feet and 312.5 thousand acre-feet, respectively), USACE could operate Green Peter Reservoir to supplement natural flows, prioritizing refill at Foster Reservoir in May.

Both the Foster and Green Peter drawdowns start earlier than in the NAA and Green Peter draws down considerably deeper. The additional flow from Green Peter Reservoir during its deeper fall reservoir drawdown, combined with downstream flow restrictions, would typically delay the Foster Reservoir reduction in pool elevation starting in September.

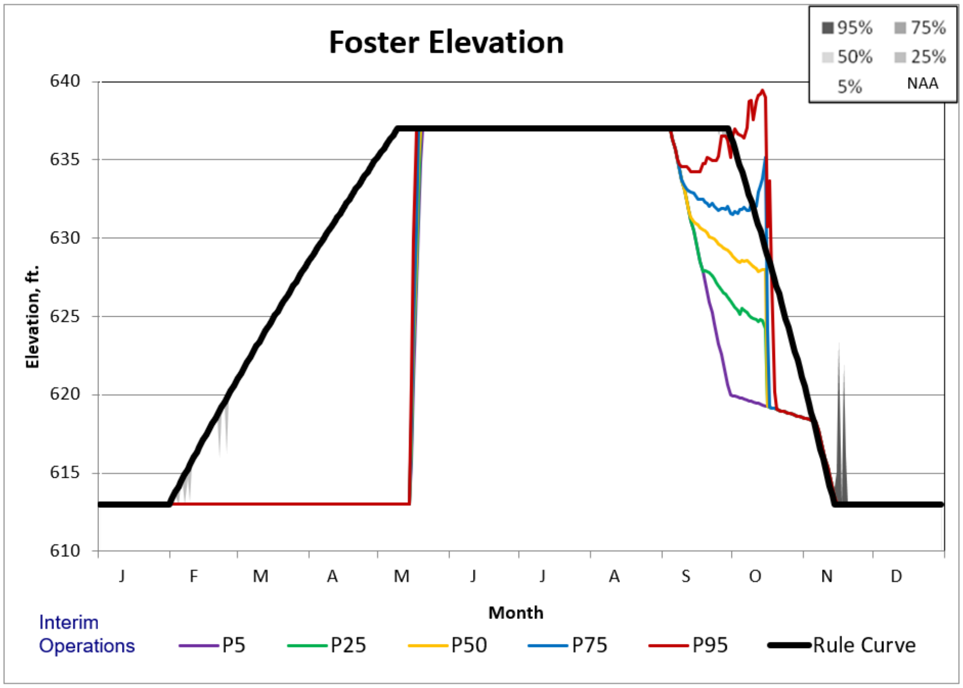


Figure 3-3. Interim Operations Foster Reservoir Water Surface Elevation Non-exceedance as Compared to the No-action Alternative.

Figure 3.2-72 in the FEIS

Spring and summer releases from Detroit, Green Peter, and Foster are very similar to releases in the NAA, potentially higher in late summer through early winter when drafting for the fall drawdowns, and potentially lower in mid and late winter because Green Peter and Detroit are refilling after the fall drawdowns, as indicated by flows observed on the Santiam River at Jefferson (Figure 3-4).

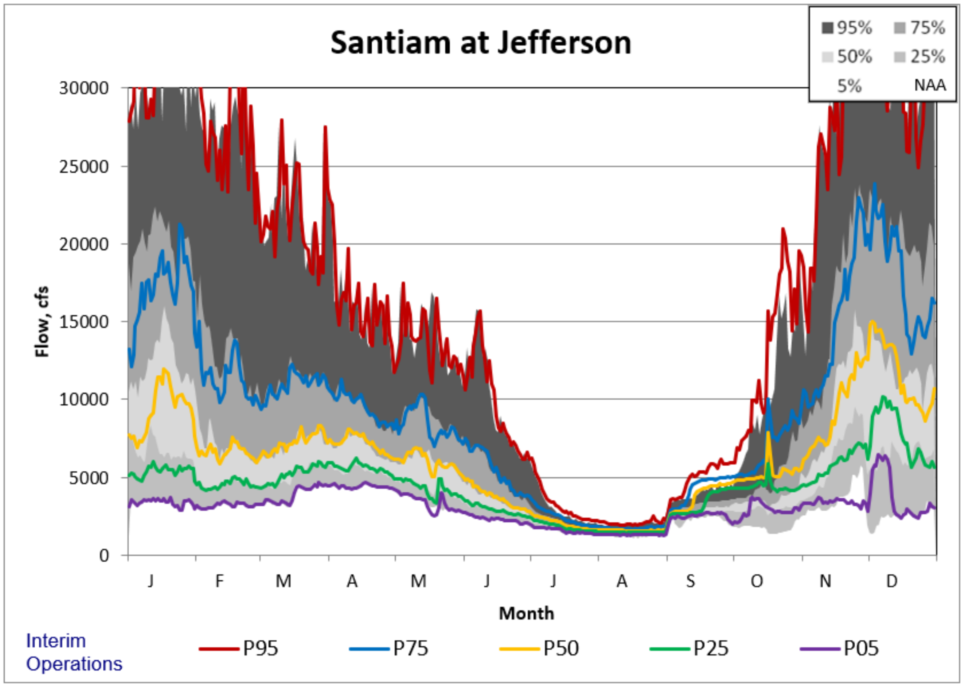


Figure 3-4. Interim Operations Santiam River at Jefferson, Oregon Flow Non-exceedance as Compared to the No-action Alternative.

Figure 3.2-74 in the FEIS

Long Tom River Subbasin

Water surface elevations within Fern Ridge Reservoir would show negligible changes under the Interim Operations as compared to the NAA (Figure 3-5). Downstream flows at Monroe would also remain unchanged under the Interim Operations as compared to the NAA.

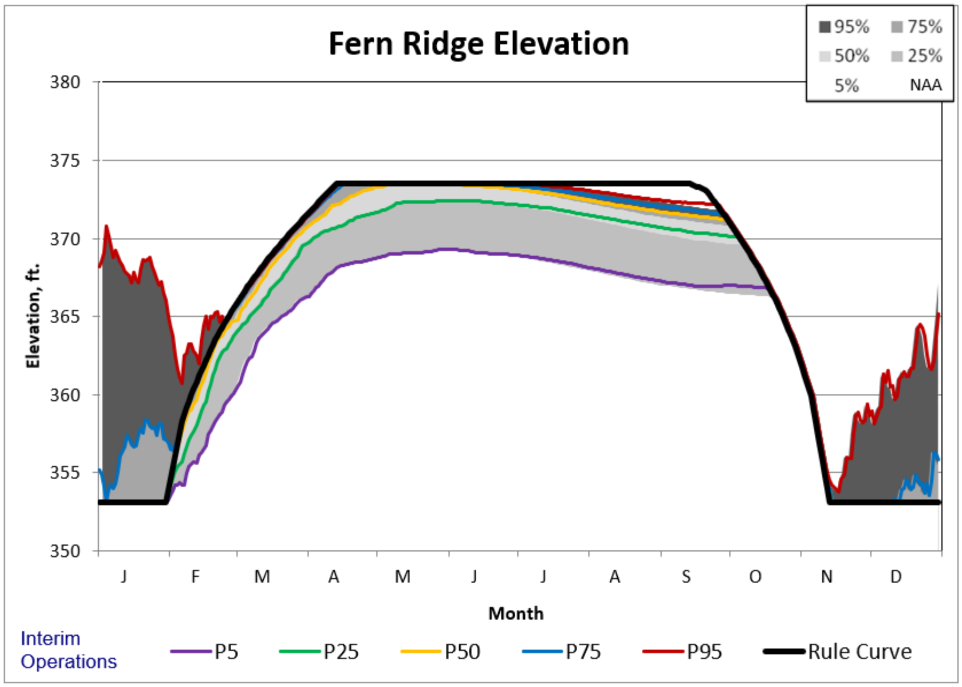


Figure 3-5. Interim Operations Fern Ridge Reservoir Water Surface Elevation Non-exceedance as Compared to the No-action Alternative.

Figure 3.2-75 in the FEIS

McKenzie River Subbasin

USACE would have drawdown targets at Cougar Reservoir below minimum conservation elevation (1,532 feet) during the spring (1,505 feet) and fall (1,520 feet) (Figure 3-6). Operations would limit releases to less than 880 cfs at night for water quality and to 2,700 cfs during the day, resulting in a daily average of 2,000 cfs under the Interim Operations. Consequently, USACE would meet the drawdown target elevations in nearly all years. However, USACE would bring the reservoir above the target during wet years (Figure 3-6, P95 line). Cougar Reservoir would draft within 10 feet of the drawdown target in the spring and the fall for at least a portion of every year.

After the spring drawdown, USACE would fill Cougar Reservoir to the extent allowed by inflow and operational flow requirements under the Interim Operations. Water surface elevations would very rarely reach the maximum conservation pool elevation (1,690 feet). During the driest years, the water would not meaningfully fill the reservoir above the spring elevation target. The median peak elevation would be approximately 1,590 feet (Figure 3.2-77, P50 line). The likelihood of pool elevations being significantly above the temperature control tower lowest usable elevation of 1571 feet on a given day between March and October is roughly 50% (Figure 3-6, P50 line).

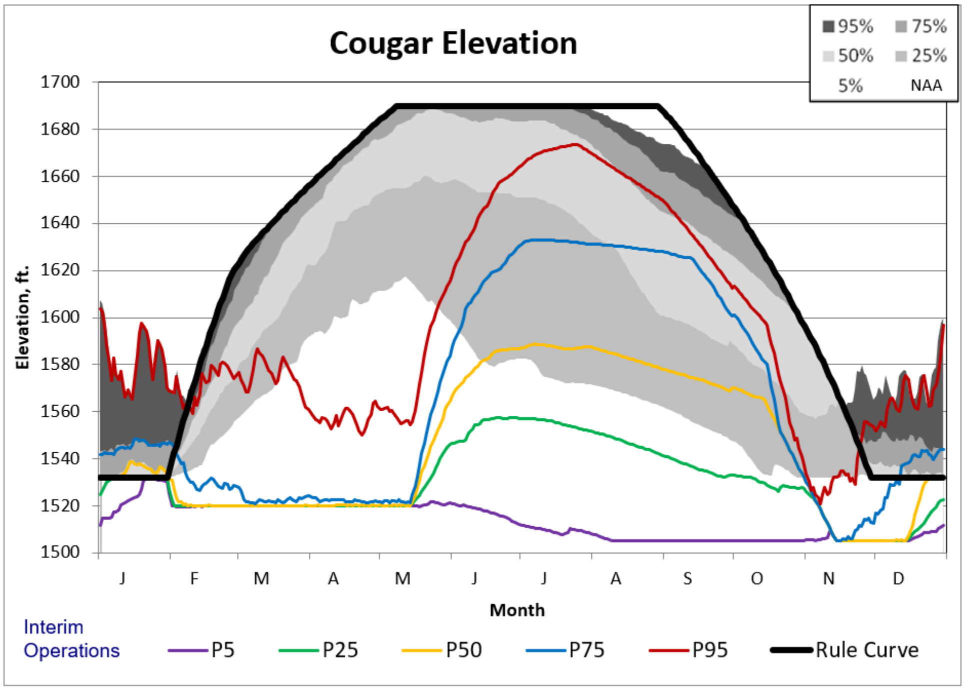


Figure 3-6. Interim Operations Cougar Reservoir Water Surface Elevation Non-exceedance as Compared to the No-action Alternative.

Figure 3.2-77 in the FEIS

Under the Interim Operations, Blue River drafts slower in late summer than in the NAA because Cougar, Lookout Point, and Green Peter are drafting for their fall drawdowns satisfying the need for mainstem flow augmentation (Figure 3-7).

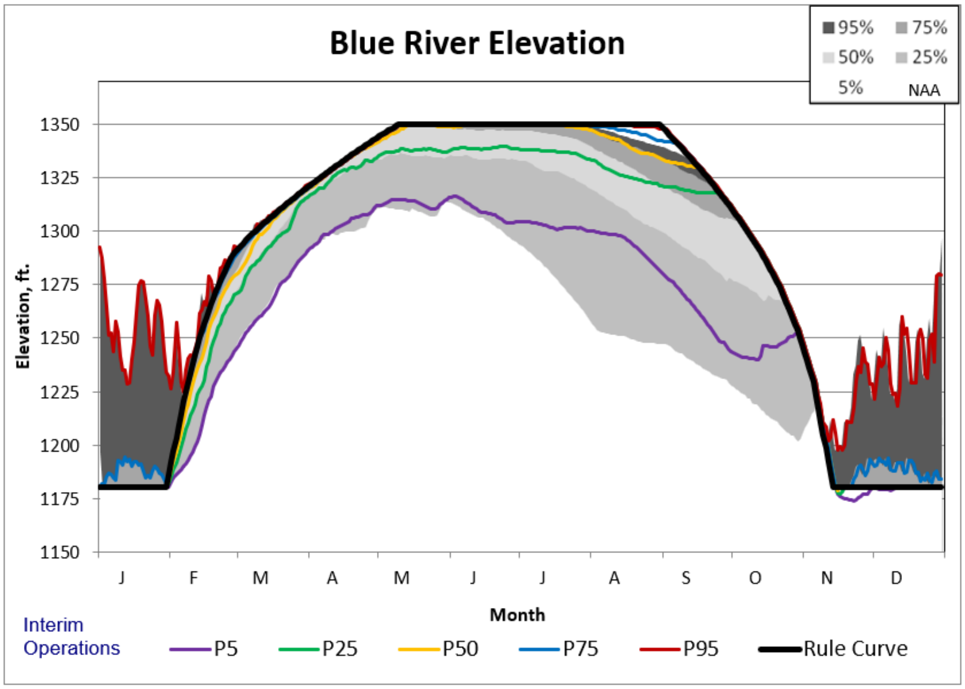


Figure 3-7. Interim Operations Blue River Reservoir Water Surface Elevation Non-exceedance as Compared to the No-action Alternative.

Figure 3.2-76 in the FEIS

Under the Interim Operations, USACE would meet or exceed its flow targets except during the driest summers and falls when Cougar Reservoir would be at its minimum elevation and only passing inflow (Figure 3-8). After the spring delayed refill, flows would be nearly the same across all years as the reservoir would store any inflow above the minimum downstream flow requirement.

In the driest years, USACE would only pass inflow at Cougar Dam from July until early December under the Interim Operations. The minimum downstream flows in these very dry years would be about one-third of the seasonal flow threshold, occurring continuously for several months.

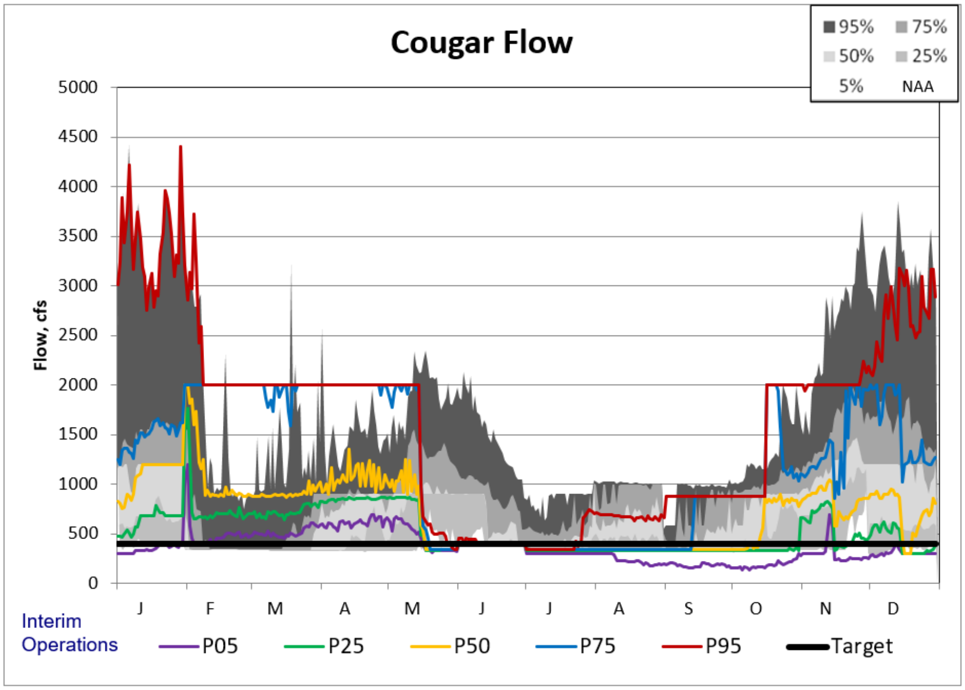


Figure 3-8. Interim Operations Cougar Reservoir Outflow Non-exceedance as Compared to the No-action Alternative.

Figure 3.2-78 in the FEIS

While the August flows at Vida would be somewhat lower across all years, the other flows would be similar when compared to the NAA (Figure 3-9). The relatively high summer base flow in the McKenzie River also contributes to the consistency with the NAA. Outflow from the reservoirs is a lower percentage of the total flow on the mainstem McKenzie River.

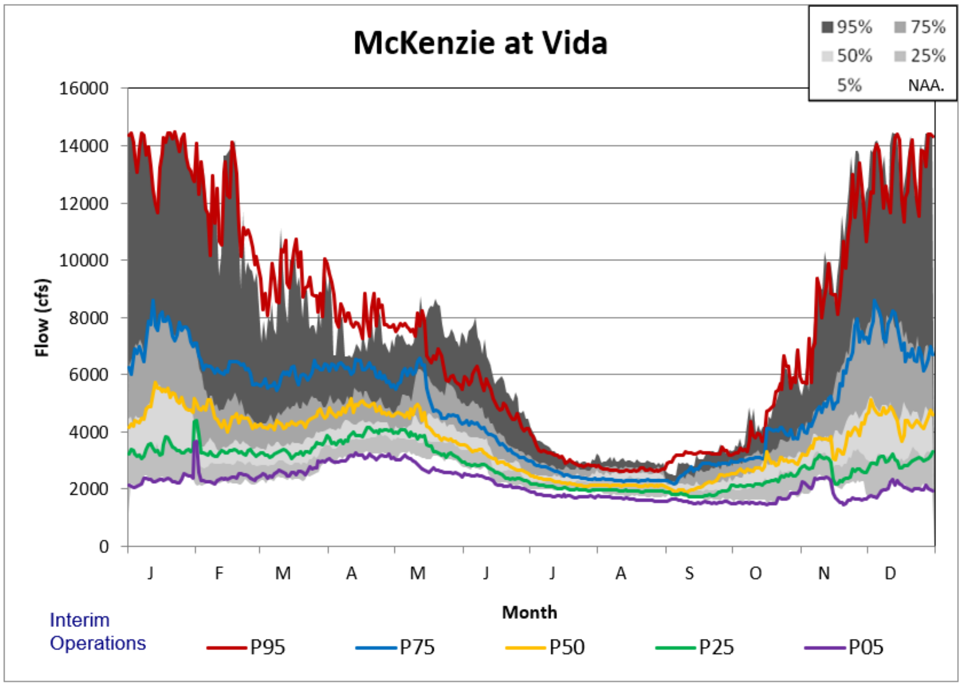


Figure 3-9. Interim Operations McKenzie River at Vida, Oregon Flow Non-exceedance as Compared to the No-action Alternative.

Figure 3.2-79 in the FEIS

Middle Fork Willamette River Subbasin

USACE would initially fill Hills Creek Reservoir more slowly than under the NAA due to the mandate under the Interim Operations to prioritize refill at Lookout Point Reservoir (Figure 3 - 10 and Figure 3-11, respectively). Early in the year, water stored at Hills Creek Reservoir under the NAA would be released to Lookout Point Reservoir instead.

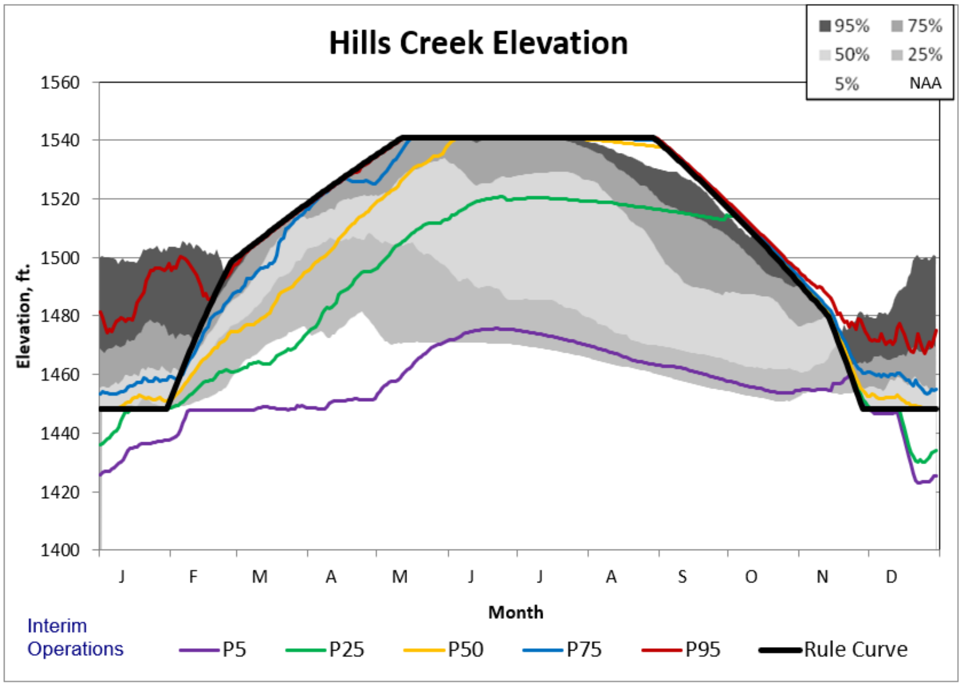


Figure 3-10. Interim Operations Hills Creek Reservoir Water Surface Elevation Non-exceedance as Compared to the No-action Alternative.

Figure 3.2-80 in the FEIS

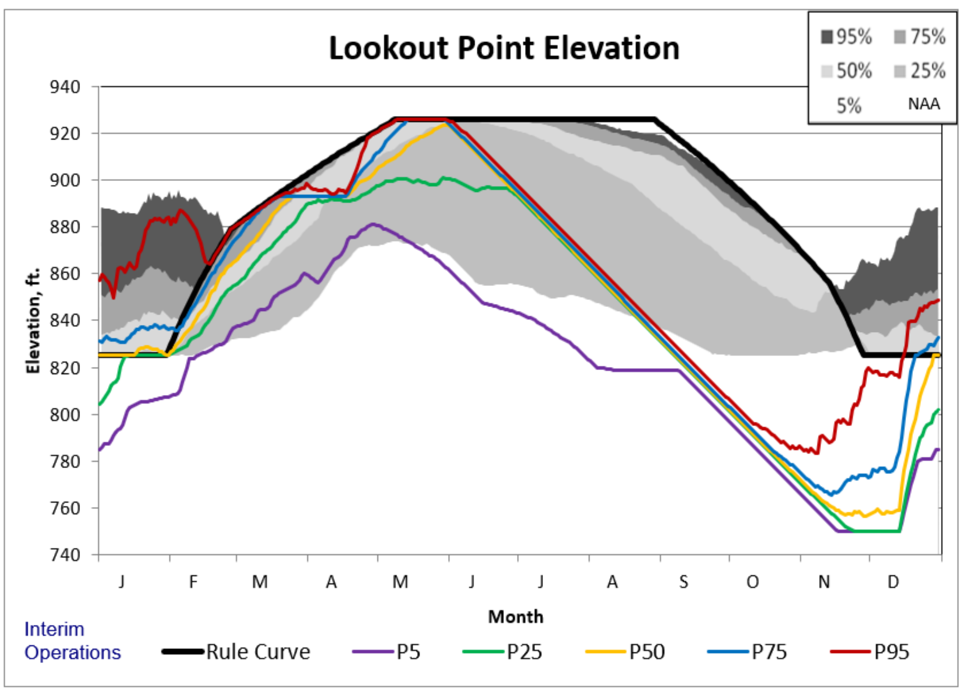


Figure 3-11. Interim Operations Lookout Point Reservoir Water Surface Elevation Non-exceedance as Compared to the No-action Alternative.

Figure 3.2-81 in the FEIS

Under the Interim Operations, Lookout Point fills faster and fuller because of the support provided by Hills Creek (Figure 3-11).

The deeper fall reservoir drawdown target would be achieved most years, with wet Octobers and Novembers preventing USACE from making the 761-foot target in Lookout Point Reservoir. This would be due to high seasonal inflow and because the lower outlets would not be able to release water fast enough with the pool elevation at low levels.

Interim Operations at Fall Creek Reservoir would be the same as those described under the NAA.

At the Middle Fork Willamette River at Jasper, the control point for Hills Creek, Lookout Point, and Fall Creek Reservoirs, flows are generally higher due to the Lookout Point lower fill target in the spring, higher in the fall as a result of the fall drawdown, and lower in the winter because of the increased storage provided by the fall drawdown (Figure 3-12).

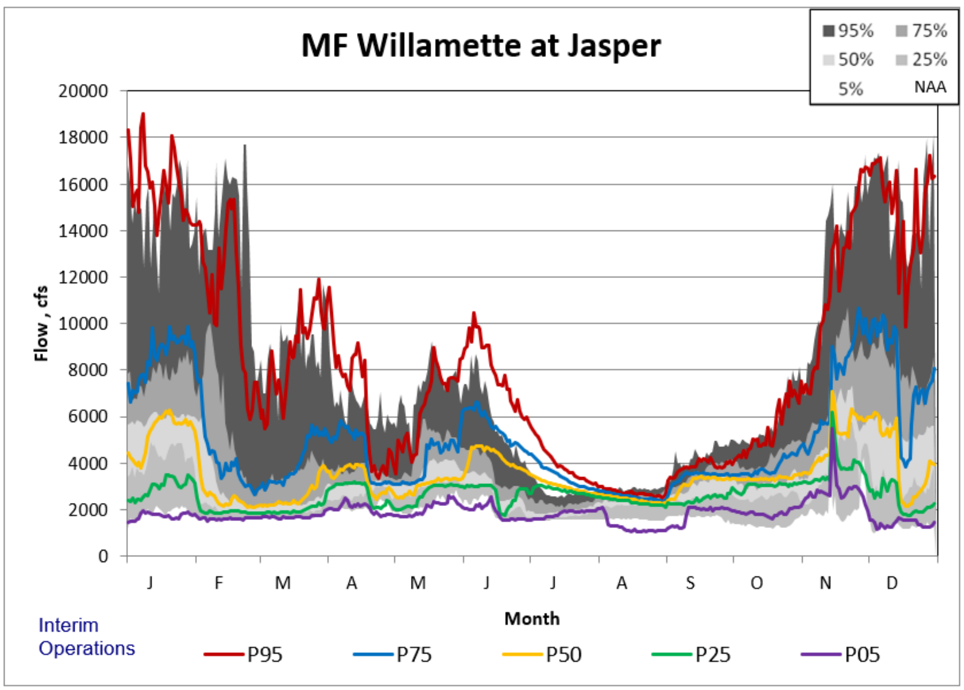


Figure 3-12. Interim Operations Middle Fork Willamette River at Jasper, Oregon Flow Non-exceedance as Compared to the No-action Alternative.

Figure 3.2-82 in the FEIS

Coast Fork Willamette River Subbasin

Spring elevations and releases at Dorena and Cottage Grove reservoirs are nearly identical to the NAA in the spring. After June, releases from the Coast Fork reservoirs are lower and elevations are higher (Figure 3-13) because Lookout Point and Green Peter fall drawdowns are supplementing mainstem minimum flow targets in their place. Dorena and Cottage Grove begin to draw down sooner and from higher elevations as a result, as indicated by the higher flows in September in Figure 3-14.

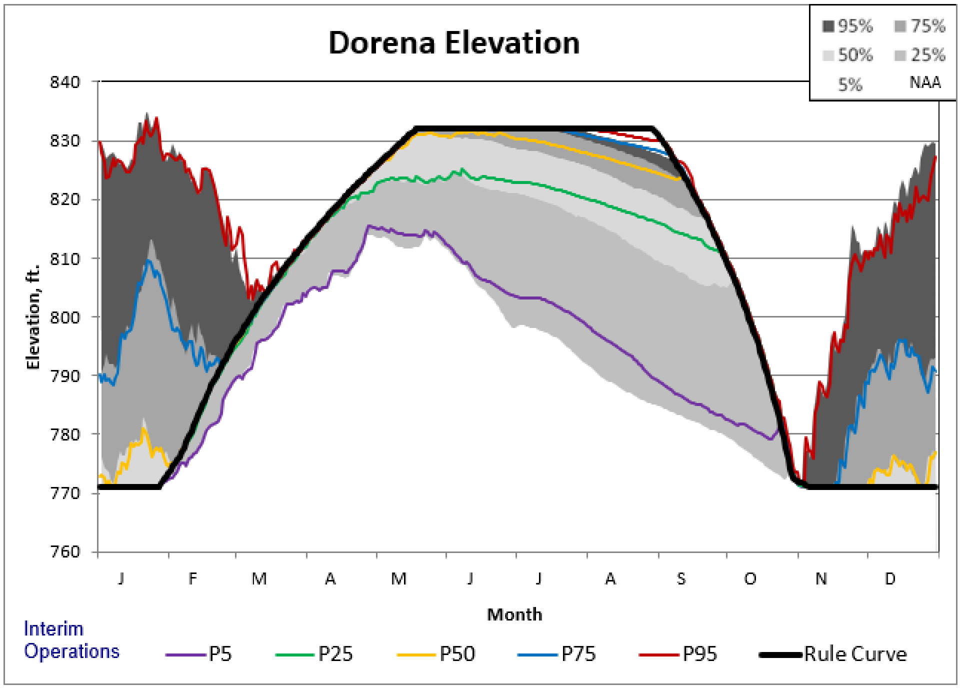


Figure 3-13. Interim Operations Dorena Reservoir Water Surface Elevation Non-exceedance as Compared to the No-action Alternative.

Figure 3.2-83 in the FEIS

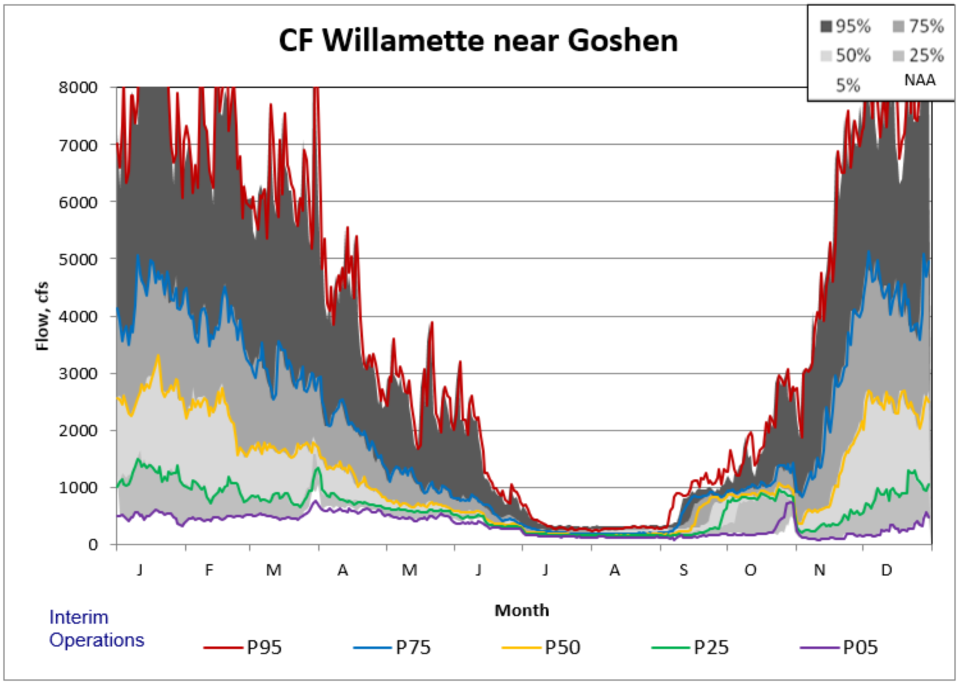


Figure 3-14. Interim Operations Coast Fork Willamette River at Goshen, Oregon Flow Non-exceedance as Compared to the No-action Alternative.

Figure 3.2-84 in the FEIS

Mainstem Willamette River Subbasins

Flows at Albany and Salem under Interim Operations most notably differ from the NAA in mid to late summer when flows are higher because of the fall drawdowns at Lookout Point, Green Peter, and Cougar. This occurs except in the driest years when the delayed refill at Cougar and reduced spring refill capacity at Lookout Point result in lower peak storage leading to the system running low on water in the late summer resulting in lower flows than in the NAA. Salem shows a flow increase in December in even the driest years because of the deeper drawdown at Detroit Reservoir. The effects of reservoirs regulating reaches above Albany are shown in Figure 3-15. Figure 3-16 shows flows at Salem, the lowest Willamette Valley Project regulatory control point in the Willamette Basin.

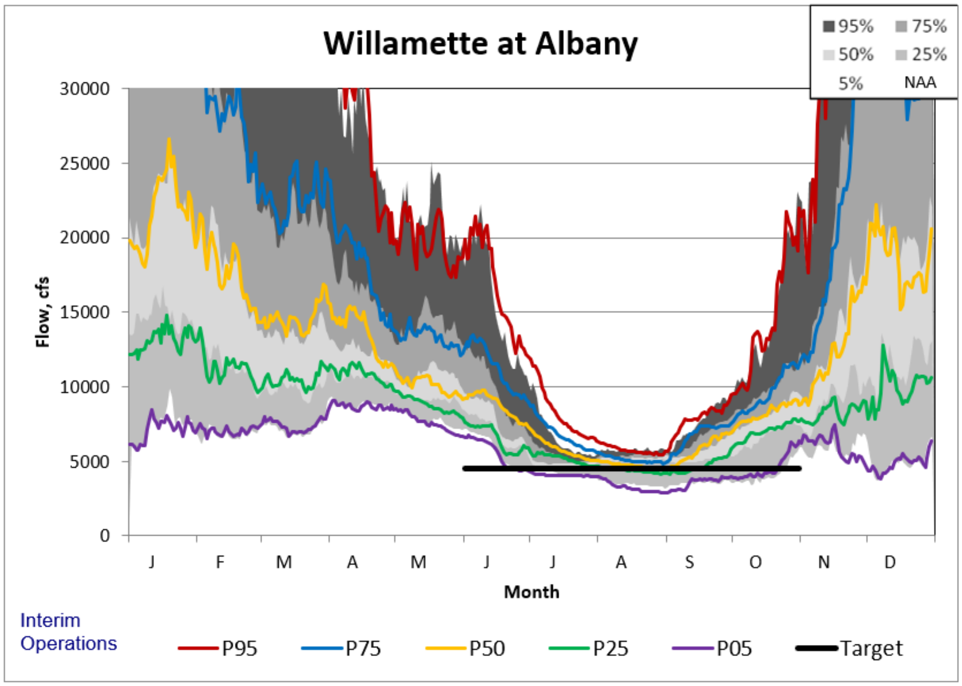


Figure 3-15. Interim Operations Willamette River at Albany, Oregon Flow Non-exceedance as Compared to the No-action Alternative.

Figure 3.2-85 in the FEIS

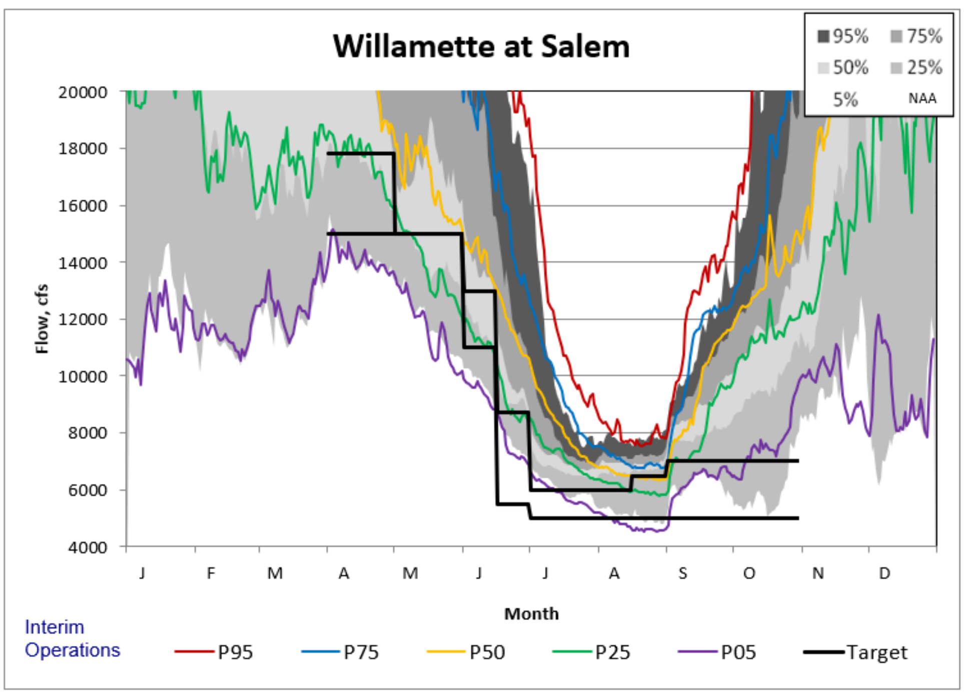


Figure 3-16. Interim Operations Willamette River at Salem, Oregon Flow Non-exceedance as Compared to the No-action Alternative.

Figure 3.2-86 in the FEIS

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

Incorporated by reference.

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

Incorporated by reference.

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

Incorporated by reference.

Alternative 4—Improve Fish Passage with Structures-based Approach

Incorporated by reference.

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

Incorporated by reference.

Alternative 6—Ceasing Federal Hydropower Operations

Reservoir operations under Alternative 6 are identical to those in Alternative 5 except that the minimum tributary and mainstem flow targets revert from the Measure 30 flow targets to the 2008 NMFS Biological Opinion flow targets. Flow pulses for temperature management are still included as an adaptive management tool. Unlike under Alternative 5, flow through the penstocks will not produce hydropower. The change in flow targets affect reservoir elevations, releases, and control point flows, but the cessation of hydropower does not.

The most hydrologically significant changes in operations from the NAA are the deep spring and fall drawdowns at Cougar, the deep fall drawdown at Green Peter, and the basin wide allowance to draft into the power or inactive pool to supplement minimum tributary and mainstem flows. In most years, this will result in higher early fall flows on the Santiam and slightly lower winter flows when Green Peter refills. Spring flows on the McKenzie will be higher than in the NAA when Cougar is drafting for the deep drawdown to the diversion tunnel. Because Cougar is drafting throughout refill season, conservation season storage at the reservoir will be significantly impacted and as a result the fall drawdown will not result in significantly higher flows. Instead, late summer and fall flows may be lower than in the NAA when Cougar can only pass inflow because there is very little or no storage to draw from. Lookout Point is left to pick up the slack supplementing minimum flows at Salem resulting in lower reservoir elevations at Lookout Point and Hills Creek and slightly higher flows on the Middle Fork.

Flows on the Mainstem at Albany are most notably lower in the fall as a result of the lack of releases from Cougar, and flows at Salem are most notably higher in the fall as a result of the deep drawdown at Green Peter.

Santiam River Subbasin

Detroit Reservoir target elevations and releases in Alternative 6 are identical to the NAA. The only difference in operations is that the reservoir is permitted to draft below 1450 feet in late summer to supplement minimum tributary flows (Figure 3-17).

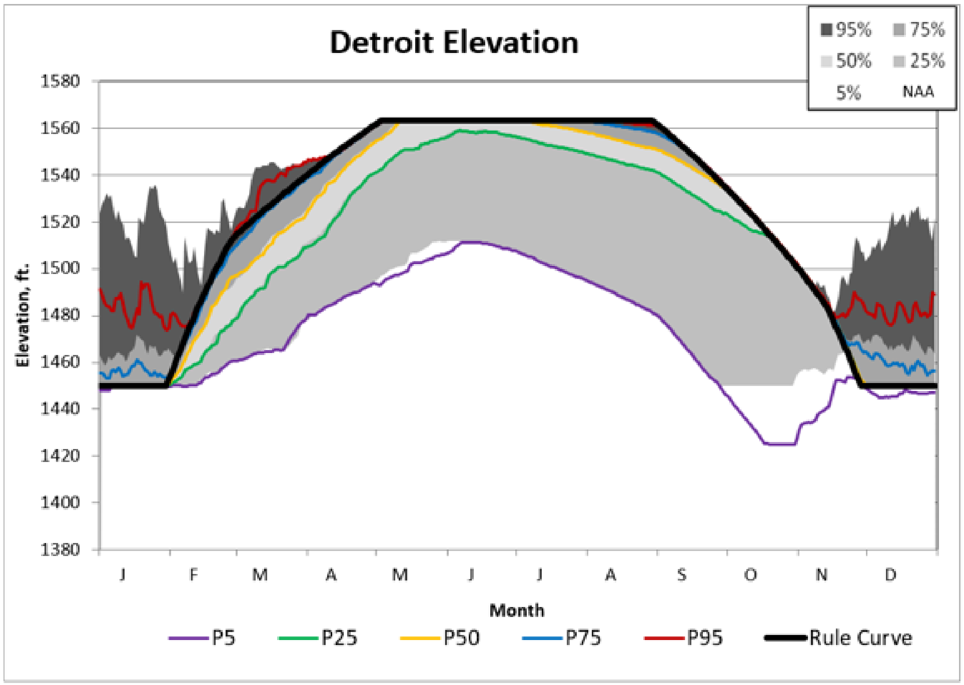


Figure 3-17. Alternative 6 Detroit Reservoir Water Surface Elevation Non-exceedance as Compared to the No-action Alternative.

Green Peter Reservoir targets 35 feet over the regulating outlet in the fall to promote volitional fish passage (Figure 3-18). Occasionally, this would result in USACE beginning the Green Peter Reservoir conservation refill season at a lower elevation under Alternative 6 as compared to the NAA operations. Drawing down to the regulating outlet would be most likely in years with dry summers when the reservoir does not fill. Deeper fall reservoir drawdowns of longer duration would be most likely in years with dry late fall and early winter seasons under Alternative 6.

Foster releases targets in Alternative 6 are identical to the NAA, but actual releases increase beginning July 1 when the Green Peter drawdown begins but reduce once Green Peter has drafted below the designated flood pool because the reservoir can absorb more inflows taking advantage of the extra storage. December and January releases are lower when Green Peter is refilling (Figure 3-19).

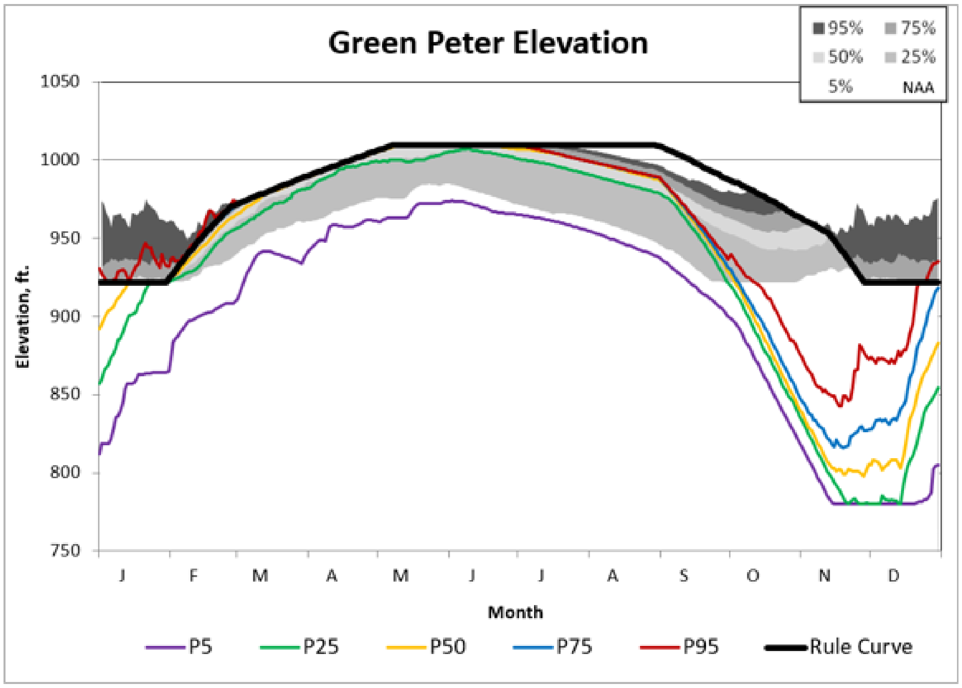


Figure 3-18. Alternative 6 Green Peter Reservoir Water Surface Elevation Non-exceedance as Compared to the No-action Alternative.

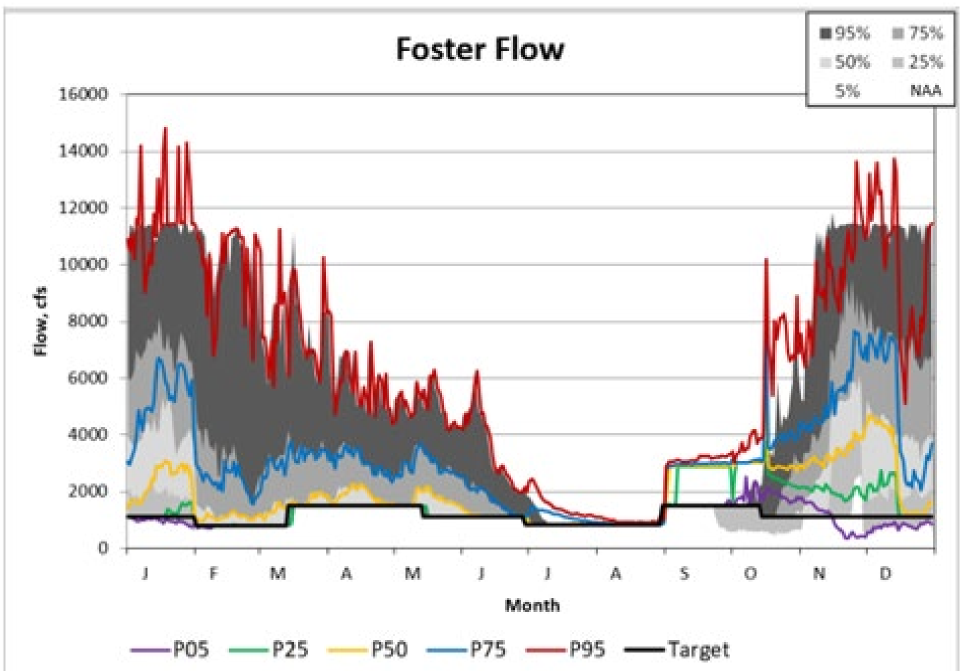


Figure 3-19. Alternative 6 Foster Flow Non-exceedance as Compared to the No-action Alternative.

The Santiam River at Jefferson shows some of the flow changes resulting from releases at Foster Reservoir under Alternative 6 (Figure 3-20). Higher outflows would be observed July through September when USACE draws down Green Peter Reservoir for the volitional fish passage operation. Flows continue to be regulated below bankfull except during extremely large inflow events. Late fall outflows would typically be lower under Alternative 6 when Green Peter Reservoir is below the designated flood pool and utilizes additional storage to store flood water, and when refilling after the deeper fall reservoir drawdown, as compared to the NAA.

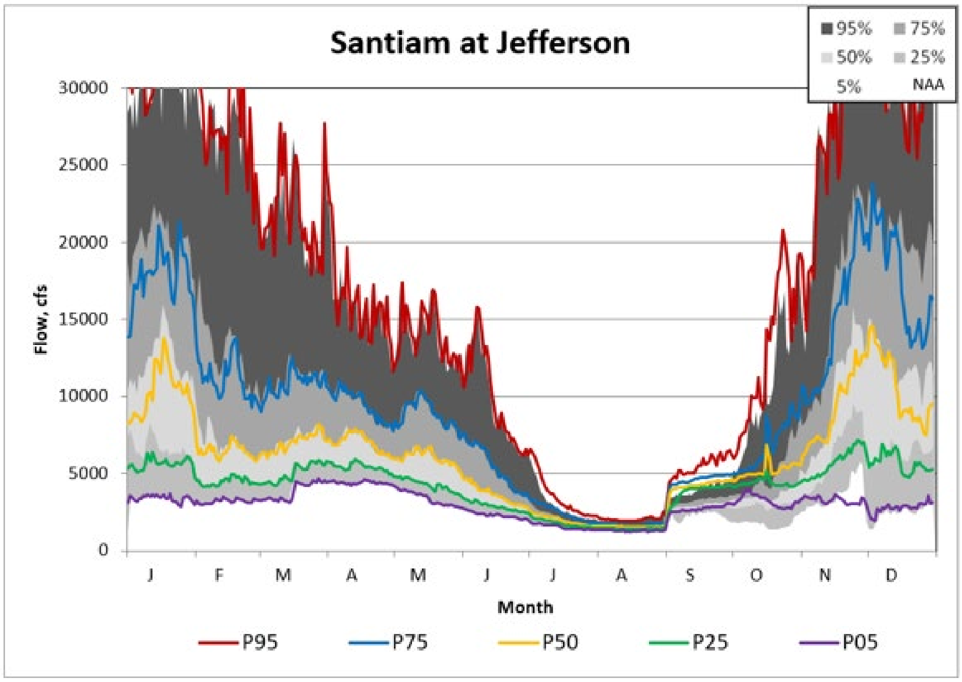


Figure 3-20. Alternative 6 Santiam River at Jefferson, Oregon Flow Non-exceedance as Compared to the No-action Alternative.

Long Tom River Subbasin

Fern Ridge Reservoir target elevations and releases in Alternative 6 are the same as in the NAA (Figure 3-21). Subsequently, downstream flows at Monroe are also the same.

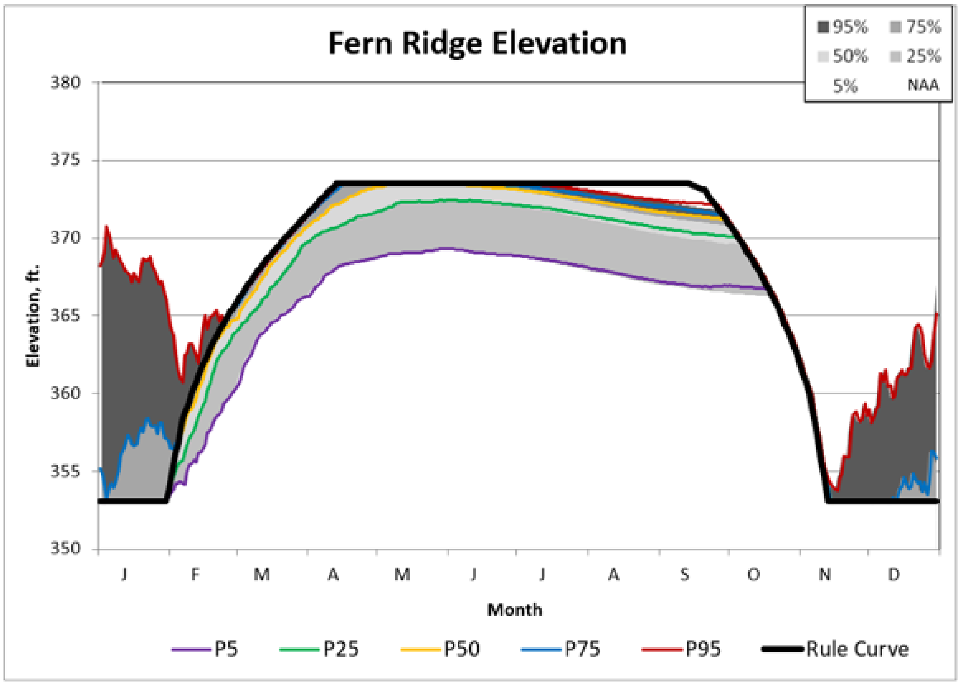


Figure 3-21. Alternative 6 Fern Ridge Reservoir Water Surface Elevation Non-exceedance as Compared to the No-action Alternative.

McKenzie River Subbasin

Both spring and fall reservoir drawdowns to 1,330 feet would occur at Cougar Reservoir under Alternative 6 (Figure 3-22). Conservation season refill would be delayed until June 15 after all the season's reliable rain has fallen. The reservoir water surface elevation would only rise above the minimum conservation pool at the end of winter and only in the wettest summers.

Spring reservoir drawdowns would reach target elevations in drier-than-average conditions under Alternative 6. Deeper fall reservoir drawdowns are most likely to occur in years with lower-than-average conservation season refill. USACE would release well below the NAA tributary target of 300 cfs from Cougar Reservoir for long durations because of the drawdowns.

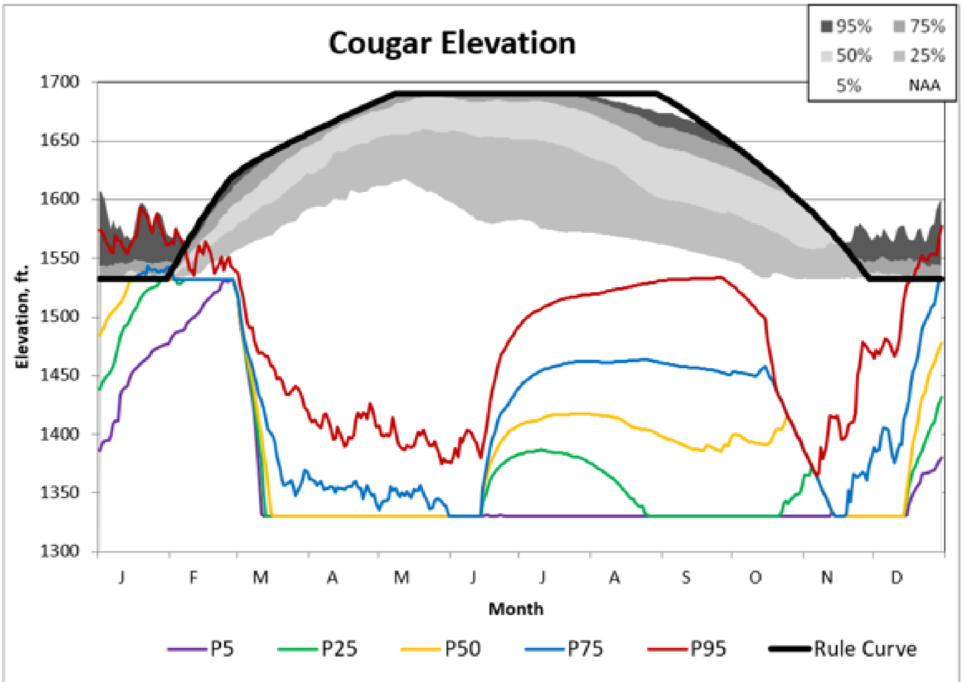


Figure 3-22. Alternative 6 Cougar Dam Reservoir Water Surface Elevation Non-exceedance as Compared to the No-action Alternative.

Under Alternative 6, Blue River continues to regularly fill in the spring but will draft sooner and deeper in the mid-summer and fall in very dry years to supplement mainstem flow targets in the absence of augmentation provided by Cougar (Figure 3-23).

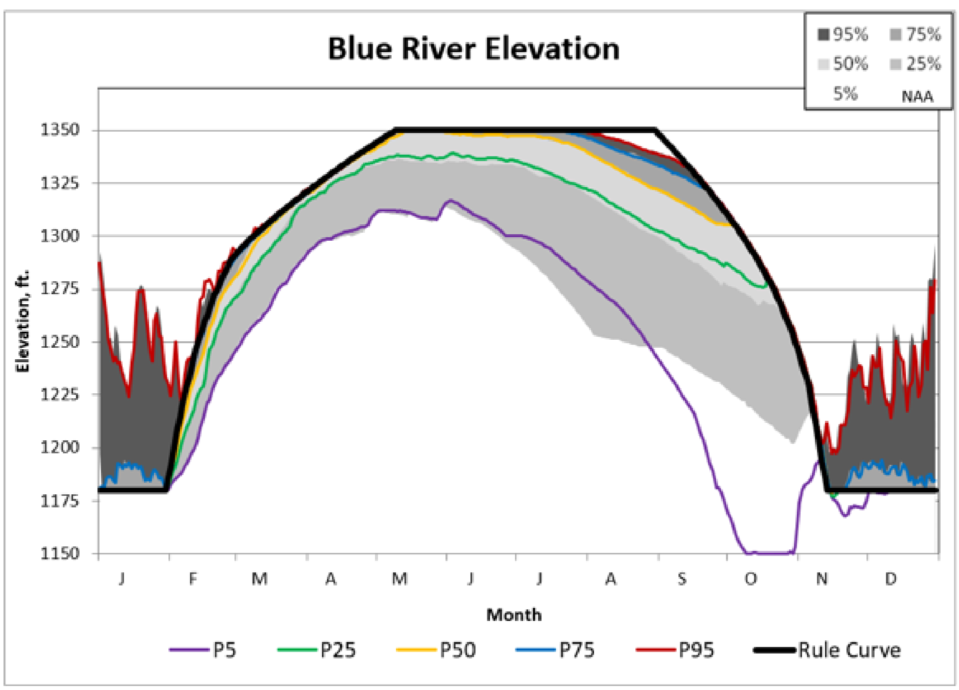


Figure 3-23. Alternative 6 Blue River Reservoir Water Surface Elevation Non-exceedance as Compared to the No-action Alternative.

The McKenzie River at Vida would show the effect of the Cougar Reservoir drawdowns downstream to the control point for both Cougar and Blue River as compared to the NAA (Figure 3-24). Higher flows in the spring would be the result of operations to release from Cougar Reservoir to reach spring drawdown elevation. Lower flows starting in June would be the result of reduced storage at Cougar Reservoir throughout the conservation season. Operations at Blue River Reservoir would be capable of making up some of the shortfall in releases from Cougar Reservoir.

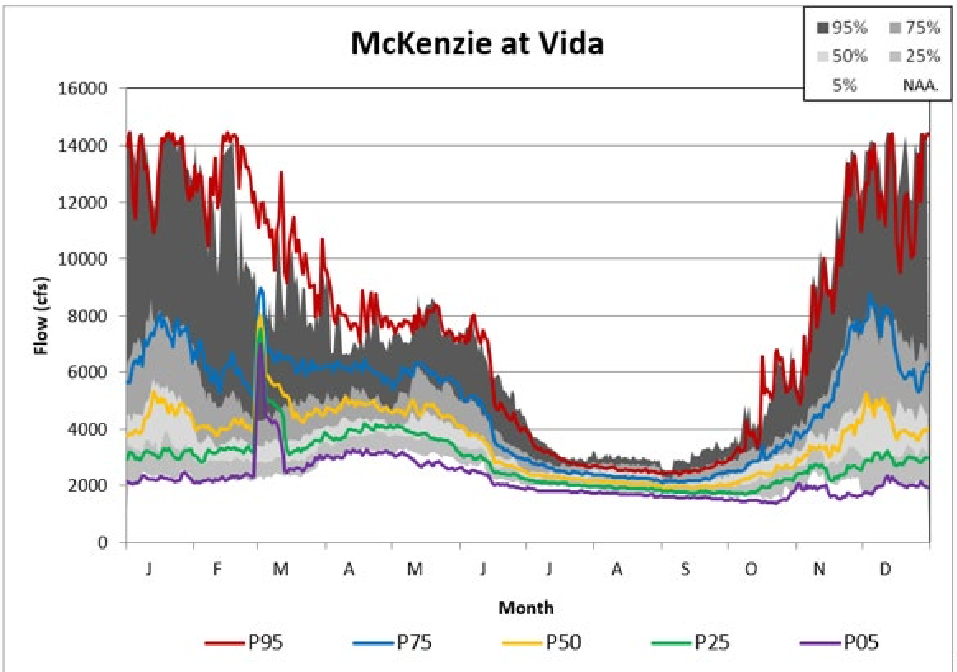


Figure 3-24. Alternative 6 McKenzie River at Vida, Oregon Flow Non-exceedance as Compared to the No-action Alternative.

Middle Fork Willamette River Subbasin

Hills Creek is used to help fill Lookout Point, and Lookout Point is relied on to supplement mainstem flows more heavily in Alternative 6 than in the NAA because Cougar Reservoir cannot explicitly release for the mainstem due to its spring delayed refill. As a result, Hills Creek and Lookout Point elevations are lower than in the NAA with an increased likelihood of running out of water in extremely dry years (Figure 3-25 and Figure 3-26).

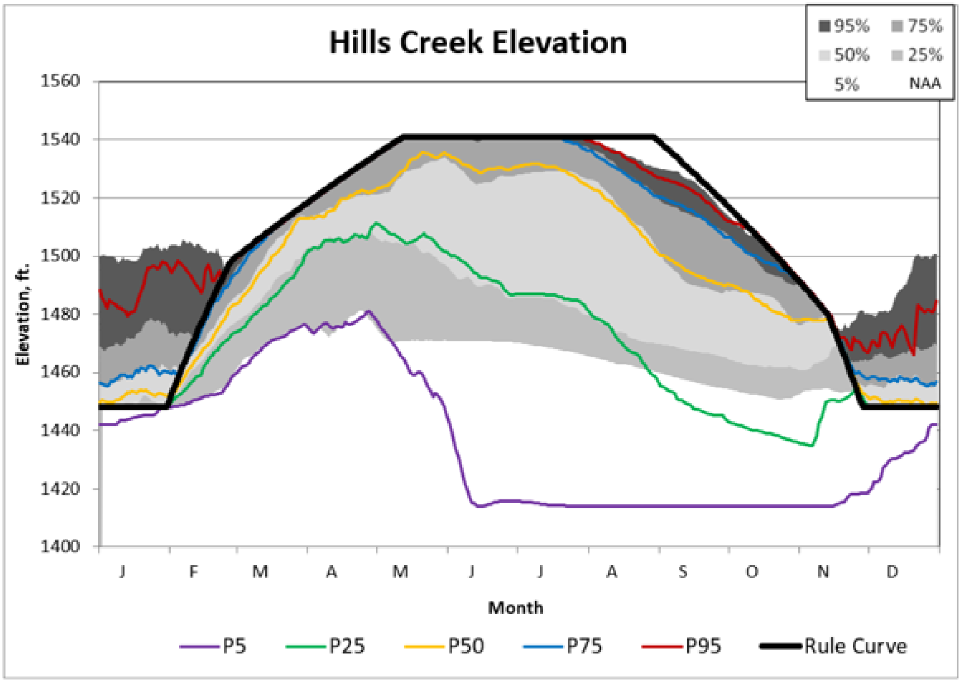


Figure 3-25. Alternative 6 Hills Creek Reservoir Water Surface Elevation Non-exceedance as Compared to the No-action Alternative.

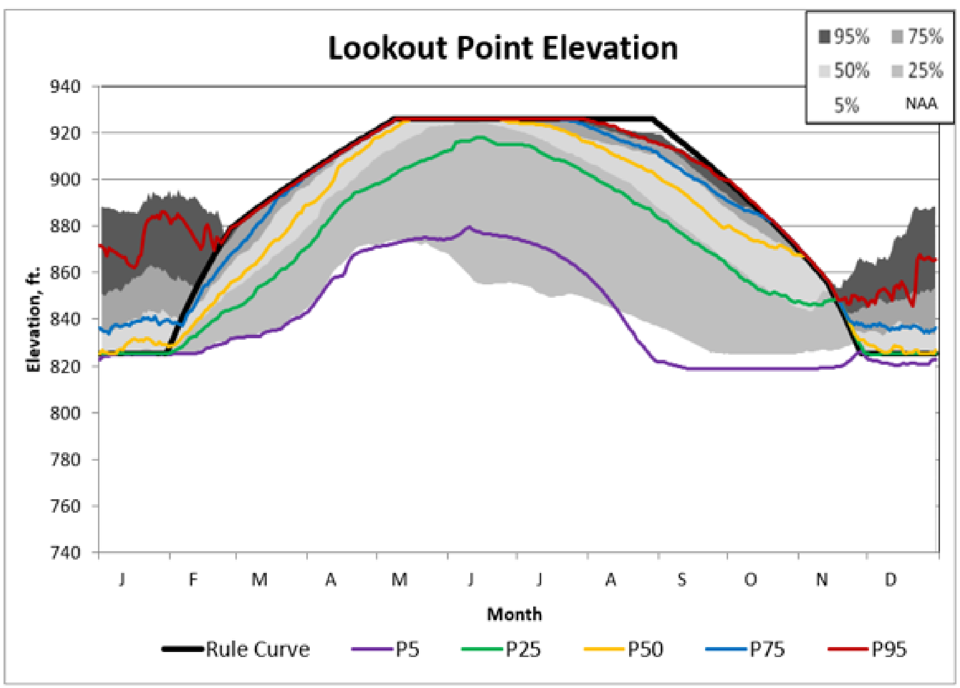


Figure 3-26. Alternative 6 Lookout Point Reservoir Water Surface Elevation Non-exceedance as Compared to the No-action Alternative.

Target elevations and releases in Alternative 6 are identical to the NAA at Fall Creek (Figure 3-27). Winter elevations are slightly lower because Cougar and Green Peter are absorbing more flood flows when below the flood pool because of their fall drawdowns allowing Fall Creek to release more flow.

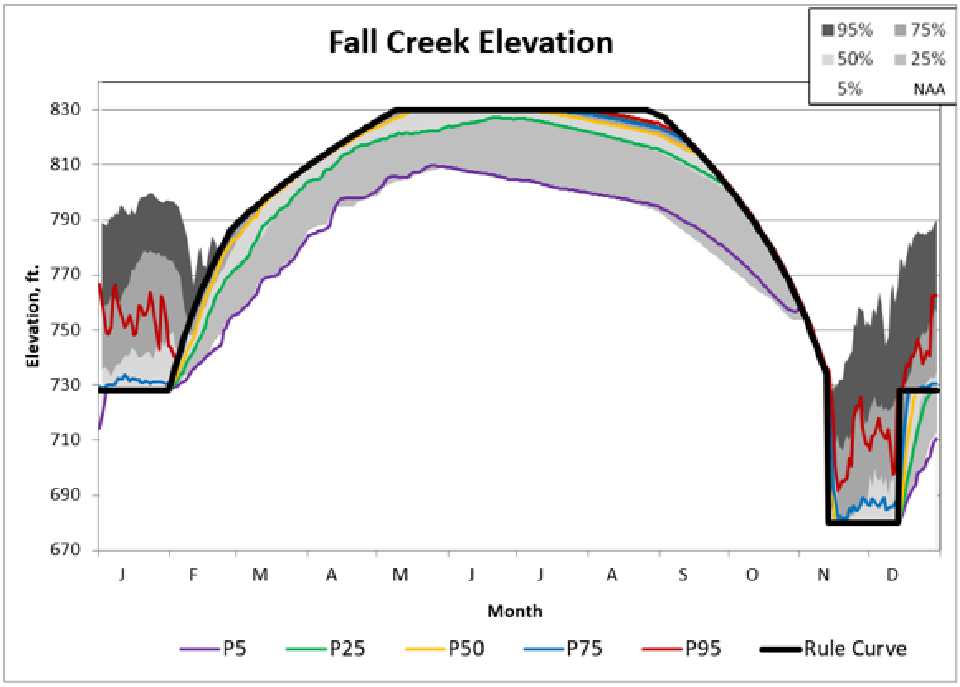


Figure 3-27. Alternative 6 Fall Creek Reservoir Water Surface Elevation Non-exceedance as Compared to the No-action Alternative.

Target tributary releases for reservoirs on the Middle Fork of the Willamette in Alternative 6 are identical to the NAA (Figure 3-28). Increased flows during portions of the conservation season are a result of Lookout Point supplementing mainstem targets to make up for the lack of releases from Cougar Reservoir.

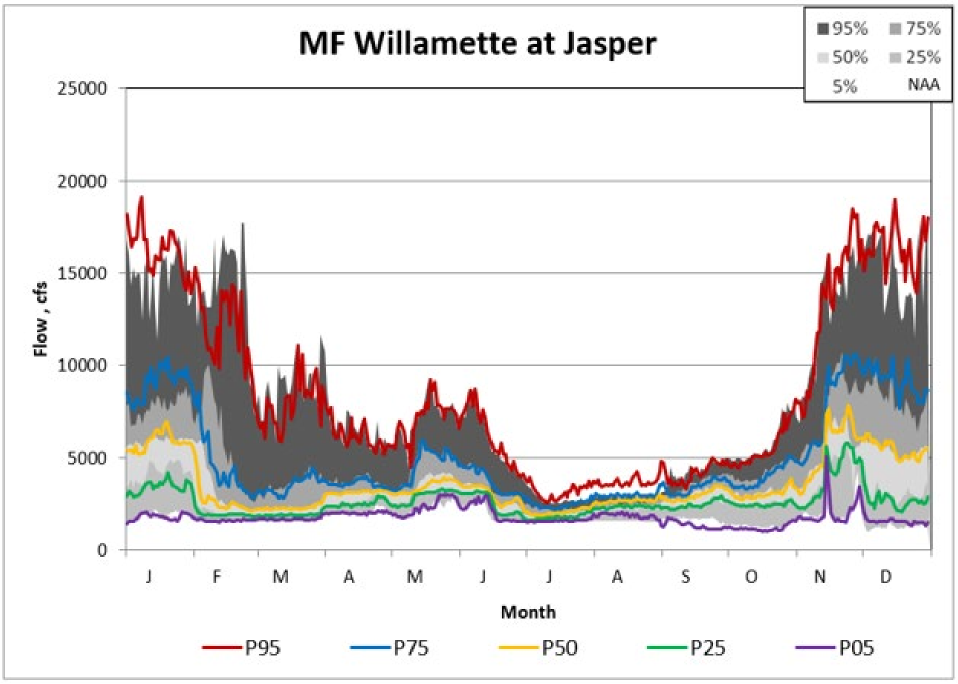


Figure 3-28. Alternative 6 Middle Fork Willamette River at Jasper, Oregon Flow Non-exceedance as Compared to the No-action Alternative.

Coast Fork Willamette River Subbasin

Target elevations and releases at Cottage Grove and Dorena in Alternative 6 are identical to the NAA. Subsequently, flows at Goshen in Alternative 6 are the same as in the NAA (Figure 3-29).

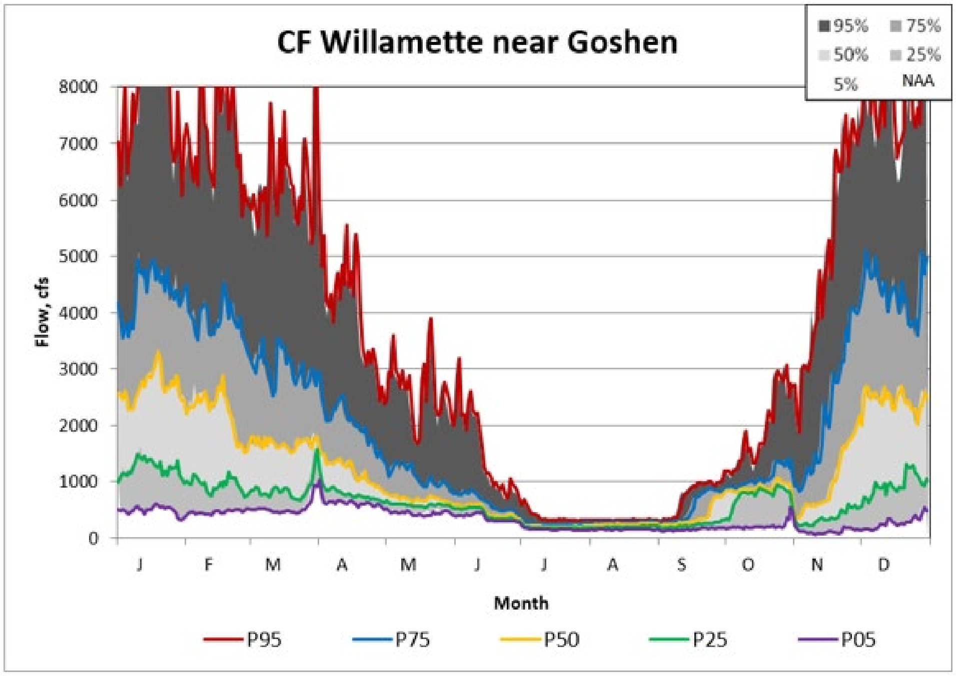


Figure 3-29. Alternative 6 Coast Fork Willamette River at Goshen, Oregon Flow Non-exceedance as Compared to the No-action Alternative.

Mainstem Willamette River Subbasins

The mainstem flow targets at Albany and Salem in Alternative 6 are the same as in the NAA. Higher flows at Albany in March are a result of the deep spring drawdown at Cougar Reservoir (Figure 3-30). Slightly higher flows at Salem in late summer are the result of the deep fall drawdowns at Green Peter (Figure 3-31).

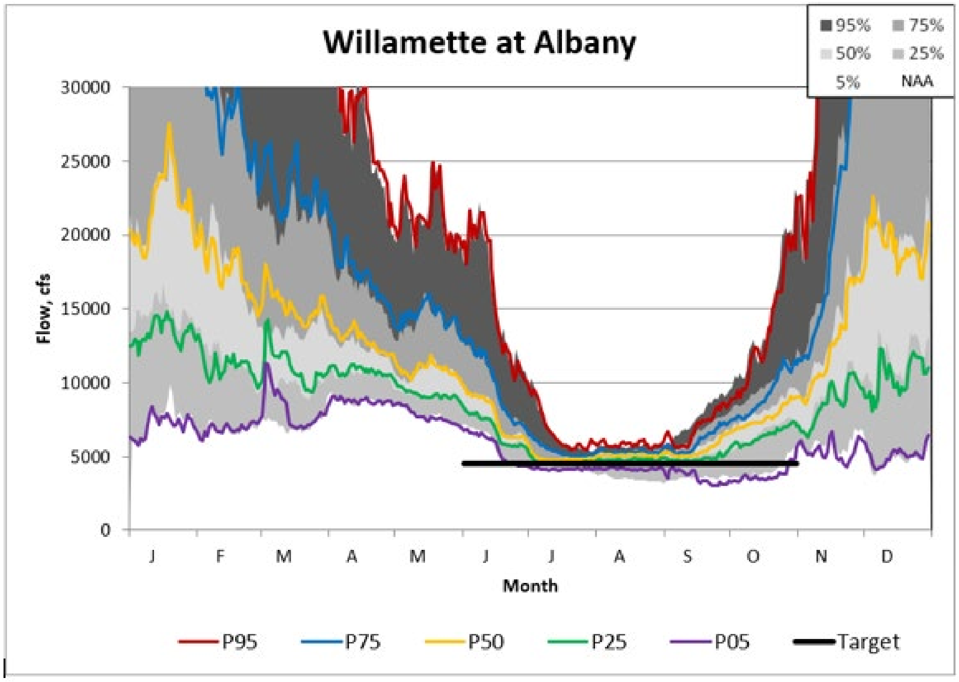


Figure 3-30. Alternative 6 Willamette River at Albany, Oregon Flow Non-exceedance as Compared to the No-action Alternative.

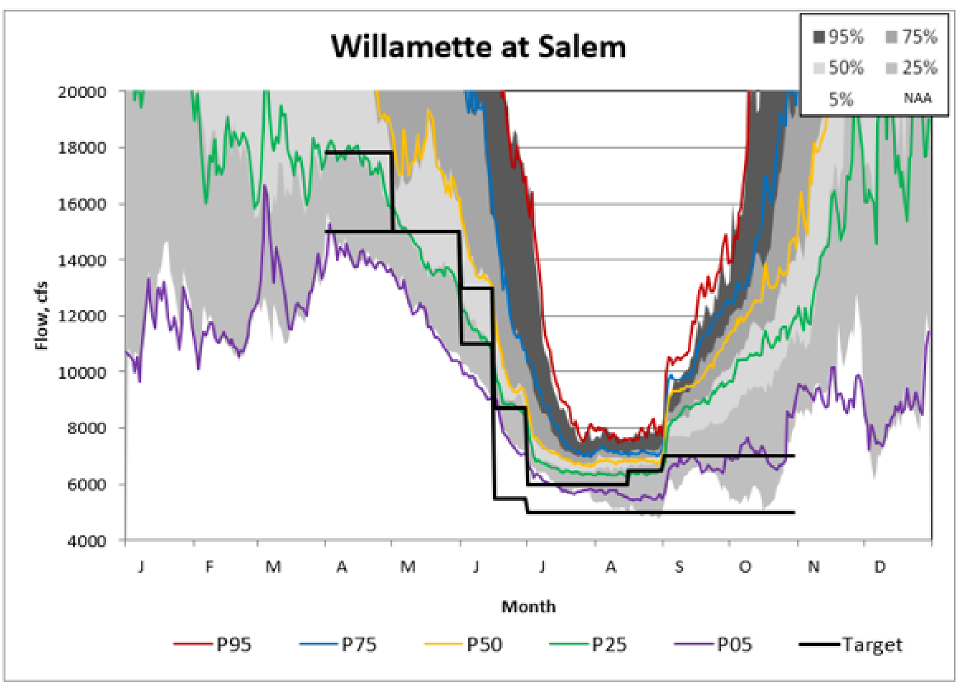


Figure 3-31. Alternative 6 Willamette River at Salem, Oregon Flow Non-exceedance as Compared to the No-action Alternative.

3.3 Section 3.3

This section was descoped from the FEIS.

3.4 Geology and Soils

3.4.1 Introduction

Incorporated by reference.

3.4.2 Affected Environment

Incorporated by reference.

3.4.3 Environmental Consequences

This section discusses the potential effects of Alternative 6 and the Interim Operations related to geology. The discussion includes the methodology used to assess effects, incorporated by reference, and a summary of the anticipated effects (Table 3-7).

Environmental Consequences from landslides are analyzed as impacts to slope stability. They are not analyzed as potential impacts to infrastructure or as impacts on other resources such as water quality from sediment movement. Information is not available to assess impacts from landslides on WVS infrastructure except for ongoing infrastructure repairs and maintenance related to ongoing slope instability. This is because slope failures are widely varied in location, size, and direction and site-specific information is not available for all slope conditions. Environmental consequences from the removal of geologic materials considers whether construction activities from measures would result in the removal of geologic materials.

Information on potential sediment movement is available in Appendix C, River Mechanics and Geomorphology Technical Information. Analyses of sediment movement as turbidity is in Section 3.5, Water Quality.

3.4.3.1 Methodology

Incorporated by reference.

Table 3-7. Summary of Effects to Geologic Materials and Soils as Compared to the No-action Alternative.

Location	No-action Alternative	Alternative 1	Alternative 2A	Alternative 2B	Alternative 3A	Alternative 3B
Cottage Grove (Coast Fork Willamette River Subbasin)	• Landslides Negligible • Removal None	Same as No-action Alternative	Same as No-action Alternative	Same as No-action Alternative	Same as No-action Alternative	Same as No-action Alternative
Dorena (Coast Fork Willamette River Subbasin)	• Landslides Negligible • Removal None	Same as No-action Alternative	Same as No-action Alternative	Same as No-action Alternative	Same as No-action Alternative	Same as No-action Alternative
Fern Ridge (Long Tom River Subbasin)	• Landslides Negligible • Removal None	Same as No-action Alternative	Same as No-action Alternative	Same as No-action Alternative	Same as No-action Alternative	Same as No-action Alternative
Blue River (McKenzie River Subbasin)	• Landslides Negligible • Removal None	Same as No-action Alternative	Same as No-action Alternative	Same as No-action Alternative	• Landslides Negligible • Removal Moderate	• Landslides Negligible • Removal Moderate
Cougar (McKenzie River Subbasin)	• Landslides Negligible • Removal None	Same as No-action Alternative	• Landslides Negligible • Removal Moderate	• Landslides Moderate • Removal Moderate	• Landslides Moderate • Removal Moderate	• Landslides Moderate • Removal Moderate
Dexter (Middle Fork Willamette River Subbasin)	• Landslides Negligible • Removal None	Same as No-action Alternative	Same as No-action Alternative	Same as No-action Alternative	Same as No-action Alternative	Same as No-action Alternative
Fall Creek (Middle Fork Willamette River Subbasin)	• Landslides Negligible • Removal None	Same as No-action Alternative	Same as No-action Alternative	Same as No-action Alternative	Same as No-action Alternative	Same as No-action Alternative
Hills Creek (Middle Fork Willamette River Subbasin)	• Landslides Negligible • Removal None	Same as No-action Alternative	Same as No-action Alternative	Same as No-action Alternative	• Landslides Moderate • Removal Moderate	• Landslides Moderate • Removal Moderate
Lookout Point (Middle Fork Willamette River Subbasin)	• Landslides Negligible • Removal None	• Landslides Negligible • Removal Moderate	• Landslides Negligible • Removal Moderate	• Landslides Negligible • Removal Moderate	• Landslides Moderate • Removal None	• Landslides Moderate • Removal None
Big Cliff (North Santiam River Subbasin)	• Landslides Negligible • Removal None	Same as No-action Alternative	Same as No-action Alternative	Same as No-action Alternative	Same as No-action Alternative	Same as No-action Alternative
Detroit (North Santiam River Subbasin)	• Landslides Negligible • Removal None	• Landslides Negligible • Removal Moderate	• Landslides Negligible • Removal Moderate	• Landslides Negligible • Removal Moderate	• Landslides Moderate • Removal None	• Landslides Moderate • Removal None
Foster (South Santiam River Subbasin)	• Landslides Negligible • Removal None	Same as No-action Alternative	Same as No-action Alternative	Same as No-action Alternative	Same as No-action Alternative	Same as No-action Alternative
Green Peter (South Santiam River Subbasin)	• Landslides Negligible • Removal None	• Landslides Negligible • Removal Moderate	• Landslides Minor • Removal Moderate	• Landslides Minor • Removal Moderate	• Landslides Minor • Removal Moderate	• Landslides Minor • Removal Moderate
Duration	• Long-term for landslide events • Permanent for removal of geologic material	Same as No-action Alternative	Same as No-action Alternative	Same as No-action Alternative	Same as No-action Alternative	Same as No-action Alternative

Table 3-7. Summary of Effects to Geologic Materials and Soils as Compared to the No-action Alternative (continued).

Location	No-action Alternative	Alternative 4	Alternative 5	Alternative 6	Interim Operations
Cottage Grove (Coast Fork Willamette River Subbasin)	• Landslides Negligible • Removal None	Same as No-action Alternative	Same as No-action Alternative	Same as No-action Alternative	Same as No-action Alternative
Dorena (Coast Fork Willamette River Subbasin)	• Landslides Negligible • Removal None	Same as No-action Alternative	Same as No-action Alternative	Same as No-action Alternative	Same as No-action Alternative
Fern Ridge (Long Tom River Subbasin)	• Landslides Negligible • Removal None	Same as No-action Alternative	Same as No-action Alternative	Same as No-action Alternative	Same as No-action Alternative
Blue River (McKenzie River Subbasin)	• Landslides Negligible • Removal None	Same as No-action Alternative	Same as No-action Alternative	Same as No-action Alternative	Same as No-action Alternative
Cougar (McKenzie River Subbasin)	• Landslides Negligible • Removal None	• Landslides Negligible • Removal Moderate	• Landslides Moderate • Removal Moderate	• Landslides Moderate • Removal Moderate	• Landslides Moderate based on modeled metrics; Minor based on realized conditions during 2023 and 2024 operations. • Removal None
Dexter (Middle Fork Willamette River Subbasin)	• Landslides Negligible • Removal None	Same as No-action Alternative	Same as No-action Alternative	Same as No-action Alternative	Same as No-action Alternative
Fall Creek (Middle Fork Willamette River Subbasin)	• Landslides Negligible • Removal None	Same as No-action Alternative	Same as No-action Alternative	Same as No-action Alternative	Same as No-action Alternative
Hills Creek (Middle Fork Willamette River Subbasin)	• Landslides Negligible • Removal None	• Landslides Negligible • Removal Moderate	Same as No-action Alternative	Same as No-action Alternative	Same as No-action Alternative
Lookout Point (Middle Fork Willamette River Subbasin)	• Landslides Negligible • Removal None	• Landslides Moderate • Removal None	• Landslides Moderate • Removal None	• Landslides Moderate • Removal None	• Landslides Moderate • Removal None
Big Cliff (North Santiam River Subbasin)	• Landslides Negligible • Removal None	Same as No-action Alternative	Same as No-action Alternative	Same as No-action Alternative	Same as No-action Alternative
Detroit (North Santiam River Subbasin)	• Landslides Negligible • Removal None	• Landslides Negligible • Removal Moderate	• Landslides Negligible • Removal Moderate	• Landslides Negligible • Removal Moderate	• Landslides Minor • Removal Moderate
Foster (South Santiam River Subbasin)	• Landslides Negligible • Removal None	Same as No-action Alternative	Same as No-action Alternative	Same as No-action Alternative	Same as No-action Alternative
Green Peter (South Santiam River Subbasin)	• Landslides Negligible • Removal None	Same as No-action Alternative	• Landslides Minor • Removal Moderate	• Landslides Minor • Removal Moderate	• Landslides Minor • Removal Moderate
Duration	• Long-term for landslide events • Permanent for removal of geologic material	Same as No-action Alternative	Same as No-action Alternative	Same as No-action Alternative	Same as No-action Alternative

Table 3.4-3 in the FEIS

3.4.3.2 Alternatives Analyses

Effects discussions for alternatives other than Alternative 6 and the Interim Operations are in the FEIS and incorporated by reference.

Alternative 6—Ceasing Federal Hydropower Operations

All Subbasins Activation of Landslides due to Deep Drawdowns and Removal of Geologic Material

Activities in all subbasins under Alternative 6 would be similar to those under Alternative 5 with respect to potential drawdown-related and construction-related effects on geologic resources. Consequently, impacts to geologic resources from landslide activation or removal of material under Alternative 6 in all subbasins would be the same as those described under Alternative 5.

3.4.4 Interim Operations under All Action Alternatives Except Alternative 1

This section is incorporated by reference with the following addition pertaining to the deep drawdown at Detroit Reservoir:

Unlike operations under the NAA, the Interim Operations would reduce the minimum pool elevation. Specifically, USACE would conduct a deep drawdown of the reservoir to within 35 feet of the regulating outlet invert at Green Peter Dam and within 50 feet of the upper regulating outlets at Detroit Dam.

Under the Interim Operations this operation would result in a drawdown below the minimum rule curve in all years at Green Peter and Detroit dams unlike the NAA. An increase in shoreline exposure due to reservoir drawdown is expected at Green Peter and Detroit reservoirs as compared to the NAA (Appendix C, River Mechanics and Geomorphology Technical Information).

As under the NAA, small-scale landslides that cause short-term infrastructure damage and require repairs would continue to occur at each dam under the Interim Operations over the 30-year implementation timeframe. The stability history of landslides around Detroit Reservoir has demonstrated that reductions in minimum pool elevations and surface exposure due to drawdowns have the potential to induce slope failures. Therefore, the potential for landslide activation at Detroit Dam would be moderate under the Interim Operations because large landslides are mapped adjacent to this reservoir with a history of movement since the beginning of reservoir operations. The potential of the drawdown to activate landslides from operations at Green Peter Dam would be minor under the Interim Operations because moderate-sized landslides adjacent to Green Peter Reservoir do not have a history of movement. Therefore, the stability history of landslides around Green Peter Reservoir has demonstrated that reductions in minimum pool elevations and surface exposure due to drawdown do not have the potential to induce slope failures.

3.4.5 Climate Change under All Alternatives

Incorporated by reference. This section was not updated to include Alternative 6. Prior to the release of this SEIS, Executive Order 14154 “Unleashing American Energy” was issued. Consistent with this Executive Order, a greenhouse gas analysis is not included here; however, this SEIS is consistent with the NEPA statute and existing agency regulations pertaining to air quality and emissions.

3.5 Water Quality

3.5.1 Introduction

Incorporated by reference.

3.5.2 Affected Environment

Incorporated by reference.

3.5.3 Environmental Consequences

This section discusses the potential direct, indirect, and climate change effects of the alternatives on water quality in the analysis area (Section 3.5.2, Affected Environment). The discussion includes the methodology used to assess effects, an analysis of effects by alternative, and a summary of the anticipated effects.

3.5.3.1 Methodology

Incorporated by reference. To support analysis of each subbasin in Section 3.5.3.2, the models and methodologies applied to specific parameters are detailed below.

<u>**Water Temperature Modeling**</u>

Incorporated by reference.

Supplemental Environmental Impact Statement (SEIS)

Modeled water temperatures below the dams were not simulated for Alternative 6 (Ceasing Federal Hydropower Operations) and Interim Operations. Instead, temperature summary values at each gage station are based on the outflow from the upstream dam, typically less than 3 miles upstream (Appendix D, Water Quality Analysis, Section 1.6.10, Supplemental EIS).

Interim Operations

Interim Operations are based on Interim Operations in the FEIS with updates to include deep winter drawdown at Detroit Dam and Reservoir and use of the 2008 Biological Opinion minimum flow targets basin wide. Summary tables of Interim Operations monthly mean water temperature and monthly mean difference between Interim Operations and the NAA for each of the three simulated years are in Appendix D, Water Quality Analysis, Section 1.6.10.2, Interim Operations.

Days Near Temperature Target

This discussion and data for Alternatives 1 – 4 from the FEIS is incorporated by reference. Temperature results for Alternative 6 and the Interim Operations, as revised for the SEIS, are in Table 3-8. Temperature targets used for the analysis below can be found in Appendix D, Water Quality Analysis, Section 1.4, Temperature Targets.

Table 3-8. Average Annual Days within 2 Degrees Fahrenheit of Temperature Target.

Location	NAA	Alt 1	Alt 2A	Alt 2B	Alt 3A	Alt 3B	Alt 4	Alt 5	Alt 6	Interim Operations
HCRO	69	63	67	63	142	103	157	55	68	75
DEXO	79	86	84	88	85	110	81	85	82	95
CGRO	238	248	216	182	186	178	221	177	176	200
SSFO	126	95	122	123	133	99	128	118	134	112
GPRO	99	250	183	184	181	105	142	179	167	102
BCLO	184	282	283	284	170	186	284	283	248	164

Table 3.5-10 in the FEIS

Locations:

HCRO = Hills Creek Reservoir, Middle Fork Willamette River Subbasin

DEXO = Dexter Reservoir, Middle Fork Willamette River Subbasin

CGRO = Cougar Reservoir, McKenzie River Subbasin

SSFO = Foster Reservoir, South Santiam River Subbasin

GPRO = Green Peter Reservoir, South Santiam River Subbasin

BCLO = Big Cliff Reservoir, North Santiam River Subbasin

Summer Extremes

This discussion and data for Alternatives 1 – 4 from the FEIS is incorporated by reference. Temperature results for Alternative 6 and the Interim Operations, as revised for the SEIS, are in Table 3-9. Temperature targets used for the analysis below can be found in Appendix D, Water Quality Analysis, Section 1.4, Temperature Targets.

Table 3-9. Average Days below 18°C (64.4°F) per Year.

Location	NAA	Alt 1	Alt 2A	Alt 2B	Alt 3A	Alt 3B	Alt 4	Alt 5	Alt 6	Interim Operations
HCRO	347	341	333	326	331	301	319	316	312	352
DEXO	165	156	169	169	135	159	150	168	167	162
CGRO	226	226	226	226	226	226	226	220	222	206
SSFO	205	170	208	208	209	160	224	212	214	220
BCLO	224	224	224	224	180	224	224	224	224	214
ALBO	130	125	130	130	121	128	126	131	---	---
SLMO	132	124	132	130	125	130	127	133	---	---

Table 3.5-11 in the FEIS

Locations:

HCRO = Hills Creek Reservoir, Middle Fork Willamette River Subbasin

DEXO = Dexter Reservoir, Middle Fork Willamette River Subbasin

CGRO = Cougar Reservoir, McKenzie River Subbasin

SSFO = Foster Reservoir, South Santiam River Subbasin

GPRO = Green Peter Reservoir, South Santiam River Subbasin

BCLO = Big Cliff Reservoir, North Santiam River Subbasin

ALBO = Albany, Mainstem Willamette River

SLMO = Salem, Mainstem Willamette River

Total Dissolved Gas Modeling

This discussion from the FEIS is incorporated by reference with additional discussion related to Alternative 6 and the Interim Operations, as revised to include the Detroit drawdown and 2008 Biological Opinion minimum flow targets. Impacts at GPR, HCR, LOP are under-estimates; extensive TDG data from spillgate operations at these projects did not exist at the time of the EIS development. The number of days with spill may be a more appropriate metric for effects at these locations (Appendix D, Water Quality Analysis, Section 2.2.10.1, Figure 2-54).

A TDG reduction structure below Big Cliff Dam was not analyzed as part of any alternative as it was under design during this process. If the structure works as designed, a minor beneficial reduction in TDG would occur under every alternative except the NAA.

Alternative 6

Alternative 6 includes removal of turbines and reconfiguration of the penstocks to dissipate energy, and the same fish passage and water quality measures as Alternative 5. Alternative 6 does not include specific measures to reduce TDG. Alternative 6 also includes the 2008 Biological Opinion minimum flow targets instead of the refined flow and temperature regime in Alternative 5. The change in minimum flow targets affects total outflow and spill rates. Overall, Alternative 6 results in significant increases to TDG levels compared to the NAA (Table 3-10).

The assumptions in Alternative 6 are similar to Alternative 5 and 2B except for the removal of hydropower turbines and changes to the spring flow targets at Salem. The targets are lower than biological opinion dry year targets in years when water supply forecasted flows at Salem are projected to be less than 25% of normal (Appendix D, Water Quality Analysis, Section 2.2.10.1, Alternative 6).

Interim Operations

Interim Operations are based on the Interim Operations in the Final EIS with updates to include deep fall drawdown at Detroit Dam and Reservoir and use of the 2008 Biological Opinion minimum flow targets basin wide. Results of the TDG modeling are in Table 3-10.

Table 3-10. Average Number of Days that Total Dissolved Gas Levels are above 110 Percent.

Location	NAA	Alt 1	Alt 2A	Alt 2B	Alt 3A	Alt 3B	Alt 4	Alt 5	Alt 6	Interim Operations
DEX	20	5	20	20	53	62	5	20	203	47
LOP	0	0	0	0	0	0	0	0	0	10
HCR	19	18	18	18	13	19	18	18	141	17
CGR	57	16	54	27	77	26	17	15	29	135
FOS	32	20	126	126	127	69	19	126	361	75
GPR	12	13	151	151	151	62	117	151	130	80
BCL	148	31	80	80	312	226	37	80	356	220
DET	115	39	39	39	307	203	39	39	361	201

Table 3.5-12 in the FEIS

Project locations:

DEX = TDG gage located downstream of Dexter Reservoir, Middle Fork Willamette River Subbasin

LOP = TDG gage located downstream of Lookout Point Reservoir, Middle Fork Willamette River Subbasin

HCR = TDG gage located downstream of Hills Creek Reservoir, Middle Fork Willamette River Subbasin

CGR = TDG gage located downstream of Cougar Reservoir, McKenzie River Subbasin

FOS = TDG gage located downstream of Foster Reservoir, South Santiam River Subbasin

GPR = TDG gage located downstream of Green Peter Reservoir, South Santiam River Subbasin

BCL = TDG gage located downstream of Big Cliff Reservoir, North Santiam River Subbasin

DET = Detroit Reservoir, North Santiam River Subbasin

Turbidity Qualitative Methodology

Incorporated by reference.

Harmful Algal Blooms and Cyanobacteria Qualitative Methodology

Incorporated by reference.

Head-of-Reservoir Metric

Incorporated by reference.

Sediment Entrainment Metric

Incorporated by reference.

Mainstem Willamette River

Incorporated by reference.

Mercury Qualitative Methodology

Incorporated by reference.

3.5.3.2 Alternatives Analyses

Effects discussions for alternatives other than Alternative 6 and the Interim Operations are incorporated by reference.

Alternative 6—Ceasing Federal Hydropower Operations

North Santiam River Subbasin

Water Temperature

As under the NAA, operations under Alternative 6 would result in adverse effects to water quality from temperature conditions in the North Santiam River Subbasin during times of year when water temperature targets are not met. However, under Alternative 6, USACE would operate a selective withdrawal structure and floating screen structure at Detroit Dam resulting in beneficial effects to water quality from improved temperature conditions downstream of Detroit and Big Cliff dams and substantially fewer adverse effects than the NAA. Temperature targets would be met more often under Alternative 6 as compared to the NAA.

There may be differences in the number of days Alternative 6 would meet water temperature standards; however, this would not alter the overall adverse effect on water quality from temperature conditions in this subbasin (Table 1-3 and Table 1-4, Appendix D, Water Quality Analysis).

Under Alternative 6, as compared to the NAA:

- Modeled water temperatures below Detroit and Big Cliff dams would be within 2°F of the temperature target by 64 more days per year on average (Table 3-8).
- Exceedance of the 64.4°F temperature threshold would remain the same (Table 3-9).

Total Dissolved Gas

Alternative 6 would substantially increase adverse effects to water quality from TDG exceeding the water quality standard in the North Santiam River Subbasin as compared to the NAA. The increase in TDG would be due to flow passing through a modified penstock, that is assumed to be controlled via cone valves instead of turbines, and changes to tributary targets below Detroit. While no TDG data exists for cone valves, it is assumed that cone valves would produce TDG similar to regulating outlets or spillways below a dam, given there would be an equivalent amount of energy associated with the water existing the structure.

However, there would be no specific measure to reduce TDG levels below Detroit and Big Cliff dams in the North Santiam Subbasin under Alternative 6; TDG levels would continue to have adverse effects on water quality as under the NAA in these downstream reaches.

Under Alternative 6 as compared to the NAA:

- TDG would exceed the water quality standard by 246 more days per year on average below Detroit Dam.
- TDG would exceed the water quality standard by 208 more days per year on average below Big Cliff Dam (Table 3-10) (Appendix D, Water Quality Analysis, Section 2.2, Total Dissolved Gas Results and Effects Analysis).

Turbidity, Harmful Algal Blooms, and Mercury

Alternative 6 effects on water quality from turbidity, harmful algal blooms, and mercury in the North Santiam River Subbasin would be the same as those described under Alternative 1.

South Santiam River Subbasin

Water Temperature

Under Alternative 6, adverse effects on water quality from temperature conditions in the South Santiam River Subbasin would continue as under the NAA during the times of the year when water temperature targets are not met. Adverse effects would occur under Alternative 6 operations during the times of year when water temperature targets are not met. However, Alternative 6 would result in improved water temperatures below Green Peter and Foster dams. This is due to using the regulating outlets to discharge colder water during drawdown operations in the fall and winter to reduce water temperatures and temperature improvements to the Foster adult fish facility. Alternative 6 would meet temperature targets slightly more often and result in slightly fewer adverse effects than the NAA.

Under Alternative 6 as compared to the NAA:

- Modeled water temperatures below Green Peter Dam would be within 2°F of the temperature targets by 68 more days per year on average. (Table 3.5-1 and Table 3.5-2).

- Modeled water temperatures below Foster Dam would be within 2°F of the temperature targets by 8 more days per year on average. However, modeled water temperatures below Foster Dam would be below 64.4°F temperature threshold by 9 more days per year on average.

Total Dissolved Gas

Alternative 6 would substantially increase adverse effects to water quality from TDG exceeding the water quality standard in the South Santiam River Subbasin as compared to the NAA. The increase in TDG exceedance of the 110 percent water quality standard would occur downstream of Green Peter and Foster dams. This would be due to an increase in spill operations at Green Peter Dam in the spring (fish passage operation) and summer (temperature management operation). There are no TDG abatement measures proposed under Alternative 6 for the South Santiam River Subbasin. There may be differences in the number of days of TDG exceeds the water quality standard; however, this would not alter the overall adverse effect on water quality from TDG in this subbasin (Table 3-10) (Appendix D, Water Quality Analysis, Section 2.2, Total Dissolved Gas Results and Effects Analysis).

Under Alternative 6 as compared to the NAA:

- TDG would exceed the water quality standard by 118 more days per year on average below Green Peter Dam.
- TDG would exceed the water quality standard by 329 more days per year on average below Foster Dam (Table 3-10) (Appendix D, Water Quality Analysis, Section 2.2, Total Dissolved Gas Results and Effects Analysis).

Turbidity, Harmful Algal Blooms, and Mercury

Under Alternative 6, effects on water quality from turbidity, harmful algal blooms, and mercury in the South Santiam River Subbasin would be the same as those described under Alternative 2B.

McKenzie River Subbasin

Water Temperature

Under Alternative 6, effects on water quality from temperature conditions in the McKenzie River Subbasin would be the same as effects described under Alternative 2B. Operations would result in continued adverse effects on water temperature during times of the year when temperature targets are not met. However, there would be an improvement to water temperature downstream of Cougar dam on the McKenzie River Subbasin because downstream conditions would nearly mimic upstream conditions, resulting in more frequent achievement of temperature targets as compared to the NAA. While temperature targets would be met less often, the similarity between Alternative 6 and upstream conditions would result in substantially fewer adverse effects as compared to the NAA

Under Alternative 6 as compared to the NAA:

- Modeled water temperatures below Cougar Dam would be within 2°F of the temperature target by 62 fewer days per year on average.
- Modeled water temperatures below Cougar Dam would be below the 64.4°F temperature threshold by 4 fewer days per year on average (Table 3.5-1 and Table 3.5-2).

Total Dissolved Gas

Similar to the NAA, adverse effects on water quality from TDG would continue under Alternative 6 operations; however, improvements in TDG conditions would be expected. Although there would be no measures implemented to reduce TDG below Cougar Dam under Alternative 6, TDG would exceed the 110 percent water quality standard less often, a moderately less adverse effect as compared to the NAA. This would likely result from use of the diversion tunnel at Cougar Dam for a deep drawdown in the spring and fall and limited refill from June 15 until November 15.

Under Alternative 6 as compared to the NAA:

- TDG would exceed the 110 percent water quality standard by 28 fewer days per year on average below Cougar Dam (Table 3-10) (Appendix D, Water Quality Analysis, Section 2.2, Total Dissolved Gas Results and Effects Analysis).

Exceptions may occur at the local level and in the short term, depending on specific annual or seasonal climate conditions and specific dam operations, but overall, operations and maintenance under Alternative 6, as compared to the NAA, would result in adverse effects on water quality in the McKenzie River Subbasin regardless of a slight improvement of TDG conditions.

Turbidity, Harmful Algal Blooms, and Mercury

Under Alternative 6, effects on water quality from turbidity, harmful algal blooms, and mercury in the McKenzie River Subbasin would be the same as those described under Alternative 2B.

Middle Fork Willamette River Subbasin

Water Temperature

Effects on water quality from temperature conditions in the Middle Fork Willamette River Subbasin would continue to be adverse, similar to the NAA. Adverse effects on water quality from water temperature conditions in the Middle Fork Willamette River Subbasin would continue as under the NAA during the times of the year when water temperature targets are not met.

Under Alternative 6 as compared to the NAA:

- Modeled water temperatures below Hills Creek Dam would be within 2°F of the water temperature target by 1 less day per year on average. In addition, modeled water temperatures below Hills Creek would be below the 64.4°F temperature threshold by 35 fewer days per year on average.
- Modeled water temperatures below Lookout Point/Dexter dams would be within 2°F of the temperature target by 3 more days per year on average and be below 64.4°F temperature threshold by 2 more days per year on average (Table 3.5-1 and Table 3.5-2).
- Effects below Fall Creek Dam would be the same.

Exceptions may occur at the local level and in the short term, depending on specific annual or seasonal climate conditions and specific dam operations, but overall, operations and maintenance under Alternative 6 would result in continuation of adverse effects on water quality from temperature conditions in this subbasin.

Total Dissolved Gas

Under Alternative 6, effects from TDG exceeding the 110 percent water quality standard in the Middle Fork Willamette River Subbasin would have a substantially more adverse effect as compared to the NAA. There may be differences in the number of days TDG exceeds the water quality standard; however, this would not alter the overall adverse effect on water quality from TDG in this subbasin (Table 3-10) (Appendix D, Water Quality Analysis, Section 2.2, Total Dissolved Gas Results and Effects Analysis).

Under Alternative 6 as compared to the NAA:

- TDG would exceed the water quality standard by 122 more days per year on average below Hills Creek Dam.
- TDG could not be estimated immediately below Lookout Point Dam; however, TDG would exceed the water quality standard by 183 more days per year on average below Dexter Dam (Table 3-10) (Appendix D, Water Quality Analysis, Section 2.2, Total Dissolved Gas Results and Effects Analysis).
- Effects below Fall Creek Dam would be the same (Table 3-10) (Appendix D, Water Quality Analysis, Section 2.2, Total Dissolved Gas Results and Effects Analysis).

Turbidity, Harmful Algal Blooms, and Mercury

Under Alternative 6, effects on water quality from turbidity, harmful algal blooms, and mercury in the Middle Fork Willamette River Subbasin would be the same as those described under Alternative 1.

Coast Fork Willamette River and Long Tom River Subbasins

Water Temperature and Total Dissolved Gas

Under Alternative 6, effects on water quality from temperature conditions and TDG in the Coast Fork Willamette River and Long Tom River Subbasins would be the same as under the NAA. There may be differences in the number of days where water temperatures meet standards or in the number of days TDG exceeds the water quality standard; however, this would not alter the overall adverse effect on water quality from temperature conditions and TDG in these subbasins (Table 3-8, Table 3-9, Table 3-10).

Turbidity, Harmful Algal Blooms, and Mercury

Under Alternative 6, effects on water quality from turbidity, harmful algal blooms, and mercury in the Coast Fork Willamette River and Long Tom River Subbasins would be the same as those described under the NAA.

Mainstem Willamette River

Water Temperature

Under Alternative 6, effects on water quality from temperature conditions in the Mainstem Willamette River would continue to be adverse and nearly the same as effects under the NAA.

Exceptions may occur at the local level and in the short term, depending on specific annual or seasonal climate conditions and specific dam operations, but overall, operations and maintenance under Alternative 6 would result in continuation of adverse effects on water quality from temperature conditions in this subbasin.

Total Dissolved Gas

Under Alternative 6, effects on water quality from TDG in the Mainstem Willamette River would be the same as described under the NAA. TDG is presumed not to be adverse because there are no dam operations on the Mainstem Willamette River. TDG produced from WVS dams will de-gas and dissipate as the water moves downstream towards the mainstem Willamette River (FEIS, Section 3.5.2.2, Water Quality Parameter Overview and Subbasin, Total Dissolved Gas).

Turbidity, Harmful Algal Blooms, and Mercury

Under Alternative 6, impacts to water quality from turbidity, harmful algal blooms, and mercury in the Mainstem Willamette River would be slightly more adverse than those described under the NAA. This is due to deeper drawdowns in many WVS reservoirs, increasing the likelihood of turbidity, harmful algal blooms, and mercury being passed downstream.

3.5.4 Interim Operations under All Action Alternatives Except Alternative 1

The timing and duration of Interim Operations would vary by alternative. Interim Operations could extend to nearly the 30-year implementation timeframe under Alternatives 2A, 2B, 4, 5, and 6. However, under Alternative 3A and Alternative 3B Interim Operations may not be implemented because long-term operational strategies are intended to be implemented immediately upon Record of Decision.

Interim Operations are not an alternative (Chapter 2, Alternatives, Section 2.8.6, Interim Operations). Interim Operations analyses did not include consideration of the impacts assessed under action Alternatives 2A, 2B, 3A, 3B, 4, 5, and 6 because Interim Operations would occur before, not in addition to, an action alternative.

Deep drawdowns, earlier drawdowns, and delayed refills for downstream fish passage would greatly increase erosion and bank instability, which would be a continuation of major, adverse effects to water quality.

3.5.4.1 North Santiam River Subbasin

Water Temperature

Under Interim Operations, effects on water quality from temperature conditions in the North Santiam River Subbasin would continue to be adverse, similar to the NAA. Temperature targets under the Interim Operations differ from targets modeled for the NAA.

Under the Interim Operations as compared to the NAA:

- Modeled water temperatures would be within 2°F of targets below Detroit and Big Cliff dams by 20 fewer days per year on average and be below 64.4°F temperature threshold by 10 fewer days per year on average (Table 3-8 and Table 3-9).

Exceptions may occur at the local level and in the short term, depending on specific annual or seasonal climate conditions and specific dam operations, but overall, operations and maintenance under the Interim Operations would result in continuation of adverse effects on water quality from temperature conditions in the North Santiam River Subbasin even though the Interim Operations are expected to provide some benefit to water temperature conditions.

Total Dissolved Gas

The Interim Operations would substantially adversely affect water quality from TDG in the North Santiam River Subbasin as compared to the NAA. This is because there would be a combination of measures that would increase the spill frequency, and increase instances of TDG exceeding the 110 percent water quality standard as compared to the NAA.

Specifically, under the Interim Operations as compared to the NAA:

- TDG would exceed the water quality standard by 86 more days per year on average below Detroit Dam and by 72 more days per year on average below Big Cliff Dam (Table 3-10) (Appendix D, Water Quality Analysis, Section 2.2, Total Dissolved Gas Results and Effects Analysis).

Exceptions may occur at the local level and in the short term, depending on specific annual or seasonal climate conditions and specific dam operations, but overall, operations and maintenance under the Interim Operations would result in adverse effects on water quality from TDG in the North Santiam River Subbasin.

Turbidity

Under the Interim Operations, effects on water quality from turbidity would be moderately more adverse than those described under the NAA during the 30-year implementation timeframe. The Interim Operations would increase sediment and turbidity levels downstream of Detroit Reservoir because of the deeper drawdown increasing the potential for bank erosion and sloughing as compared to NAA operations.

While some fine-grained sediment that enters Big Cliff Reservoir from Detroit Reservoir may partially settle, most fine-grained sediment would pass through Big Cliff Reservoir and be transported downstream, likely resulting in increased turbidity downstream during deeper drawdowns compared to NAA operations. While the incremental drawdown approach at Detroit Dam would span over three years and would dampen downstream elevated turbidity response from reservoir sediment erosion, some adverse effects would still exist due to deeper drawdown operations exposing bank shoreline.

As reservoir bed sediment is transported and re-deposited within the reservoir, turbidity levels due to deeper drawdowns are expected to continue to lessen in severity until they reach a new sediment equilibrium after years of the operation. Downstream turbidity effects will lessen over time becoming less adverse than the first few years of the deep drawdown.

Harmful Algal Blooms and Mercury

Under the Interim Operations, effects on water quality from harmful algal blooms, and mercury would have a slightly more adverse effect on the North Santiam River below Big Cliff Dam as compared to the NAA. This would be due to deeper drawdown operations exposing bank shoreline.

3.5.4.2 South Santiam River Subbasin

Water Temperature

Temperature targets under the Interim Operations differ from targets modeled for the NAA. However, effects on water quality from temperature conditions in the South Santiam River Subbasin would be adverse, similar to the NAA.

Specifically, under the Interim Operations as compared to the NAA:

- Modeled water temperatures below Foster Dam would be within 2°F of the water temperature target by 14 fewer days per year on average; additionally, temperatures would remain below the 64.4°F temperature threshold by 15 days per year on average more often than under the NAA.
- Modeled water temperatures below Green Peter Dam would be within 2°F of the water temperature target by 3 more days per year on average (Table 3-8 and Table 3-9).

Exceptions may occur at the local level and in the short term, depending on specific annual or seasonal climate conditions and specific dam operations, but overall, operations and maintenance under the Interim Operations would adversely affect temperature conditions in the South Santiam River Subbasin.

Total Dissolved Gas

Under the Interim Operations, there would be a moderately more adverse effect on water quality from TDG as compared to the NAA in the South Santiam River Subbasin. This is because there would be a combination of measures that would increase the spill frequency and increase instances of TDG exceeding the 110 percent water quality standard produced by operating Green Peter and Foster dams.

Specifically, under the Interim Operations as compared to the NAA:

- TDG would exceed the water quality standard by 68 more days per year on average below Green Peter Dam.
- TDG would exceed the water quality standard by 43 more days per year on average below Foster Dam (Table 3-10) (Appendix D, Water Quality Analysis, Section 2.2, Total Dissolved Gas Results and Effects Analysis).

Exceptions may occur at the local level and in the short term, depending on specific annual or seasonal climate conditions and specific dam operations, but overall, operations and maintenance under the Interim Operations would adversely affect TDG in the South Santiam River Subbasin.

Turbidity

Under the Interim Operations, turbidity would substantially adversely affect water quality more than under the NAA during the 30-year implementation timeframe. The Interim Operations, as compared to NAA operation, would increase sediment and turbidity levels downstream of Green Peter Reservoir because of deeper drawdowns increasing the potential for bank erosion and sloughing. While some fine-grained sediment that enters Foster Reservoir from Green Peter Reservoir may partially settle, most fine-grained sediment would pass through Foster

Reservoir and be transported downstream, likely resulting in increased turbidity downstream during deeper drawdowns compared to NAA operations.

As reservoir bed sediment is transported and re-deposited within the reservoir, turbidity levels due to deeper drawdowns are expected to continue to lessen in severity until they reach a new sediment equilibrium after years of the operation. Downstream turbidity effects will lessen over time becoming less adverse than the first few years of the deep drawdown.

Harmful Algal Blooms and Mercury

Under the Interim Operations, harmful algal blooms and mercury would moderately adversely affect the South Santiam River as compared to the NAA. This is because the Interim Operations, as compared to NAA operations, would increase sediment and nutrient loading from Green Peter Reservoir due to the increased bank erosion and sloughing from deeper drawdowns. Subsequently, there would be an increase in sediment and nutrient loading into Foster Reservoir, resulting in a moderate adverse effect to the South Santiam River as compared to the NAA.

3.5.4.3 McKenzie River Subbasin

Water Temperature

Effects on water temperature conditions in the McKenzie River Subbasin would be slightly more adverse under the Interim Operations as compared to the NAA even with operation of the Cougar Dam water temperature control tower.

Specifically, under the Interim Operations as compared to the NAA:

- Modeled water temperatures below Cougar Dam would be within 2°F of the water temperature target by 38 fewer days per year on average.
- Modeled water temperatures below Cougar Dam would be below the 64.4°F temperature threshold by 20 fewer days per year on average (Table 3-8 and Table 3-9) (Appendix D, Water Quality Analysis, Section 1.6, Supporting Data for Water Quality Effects Analysis).

Exceptions may occur at the local level and in the short term, depending on specific annual or seasonal climate conditions and specific dam operations, but overall, operations and maintenance under the Interim Operations would result in continuation of adverse effects on water quality in the McKenzie River Subbasin from temperature conditions.

Total Dissolved Gas

The Interim Operations would substantially adversely affect water quality from TDG exceeding the 110 percent water quality standard in the McKenzie River Subbasin as compared to the

NAA. This is because a combination of measures would increase frequency of spill through the regulating outlets resulting in elevated TDG levels downstream of Cougar Dam.

Specifically, under the Interim Operations as compared to the NAA:

- TDG would exceed the water quality standard by 78 more days per year on average below Cougar Dam (Table 3-10) (Appendix D, Water Quality Analysis, Section 2.2, Total Dissolved Gas Results and Effects Analysis).

Exceptions may occur at the local level and in the short term, depending on specific annual or seasonal climate conditions and specific dam operations, but overall, operations and maintenance under the Interim Operations would result in adverse effects on water quality from TDG in the McKenzie River Subbasin.

Turbidity, Harmful Algal Blooms and Mercury

Under the Interim Operations, effects on water quality from turbidity and mercury would have a slightly more adverse effect on the McKenzie River below Cougar and Blue River dams as compared to the NAA. Whereas effects on water quality from harmful algal blooms would have a moderately more adverse effect on the McKenzie River below Cougar and Blue River dams as compared to the NAA. Most fine-grained sediment would pass through Cougar Reservoir and be transported downstream, likely resulting in temporary increased turbidity downstream during deeper drawdowns compared to NAA operations. Increased sediment and nutrient loading into Cougar Reservoir and lower pool levels would occur due to the increased potential for bank erosion and sloughing as compared to NAA operations. Elevated turbidity has not been observed during recent drawdowns conducted at Cougar Reservoir, from 2022 through current, nor is this expected. Minor elevated turbidity increases are anticipated during rain events.

3.5.4.4 Middle Fork Willamette River Subbasin

Water Temperature

Effects on water quality from temperature conditions in the Middle Fork Willamette River Subbasin would continue to be adverse, similar to the NAA.

Specifically, under the Interim Operations as compared to the NAA:

- Modeled water temperatures below Hills Creek Dam would be within 2°F of the water temperature targets by 6 more days per year on average. Modeled water temperatures below Hills Creek Dam would be below the 64.4°F temperature threshold by 5 more days per year on average.
- Modeled water temperatures below Lookout Point/Dexter dams would be within 2°F of water temperature targets by 16 more days per year on average. Modeled water temperatures below Lookout Point/Dexter dams would be below the 64.4°F temperature threshold by 3 fewer days per year on average (Table 3-8 and Table 3-9)

(Appendix D, Water Quality Analysis, Section 1.6, Supporting Data for Water Quality Effects Analysis).

- Effects below Fall Creek Dam would be the same.

Exceptions may occur at the local level and in the short term, depending on specific annual or seasonal climate conditions and specific dam operations, but overall, operations and maintenance under the Interim Operations would result in continuation of adverse effects on water quality in the Middle Fork Willamette River Subbasin from temperature conditions.

Total Dissolved Gas

Under the Interim Operations, there would be a slightly more adverse effect to water quality from TDG as compared to the NAA in the Middle Fork Willamette River Subbasin. This is because of a combination of measures would increase spill frequency and increase TDG above the 110 percent water quality standard to occur downstream of the Middle Fork Willamette River dams.

Specifically, under the Interim Operations as compared to the NAA:

- TDG would exceed the water quality standard by 27 more days per year on average below Dexter Dam.
- TDG would exceed the water quality standard by 10 more days per year on average below Lookout Point Dam.
- TDG would exceed the water quality standard by 2 fewer days per year on average below Hills Creek Dam (Table 3-10) (Appendix D, Water Quality Analysis, Section 2.2, Total Dissolved Gas Results and Effects Analysis).
- Effects below Fall Creek Dam would be the same.

Exceptions may occur at the local level and in the short term, depending on specific annual or seasonal climate conditions and specific dam operations, but overall, operations and maintenance under the Interim Operations would result in adverse effects on water quality from TDG in the Middle Fork Willamette River Subbasin.

Turbidity

Under the Interim Operations, effects on water quality from turbidity would be substantially more adverse downstream of Dexter than those described under the NAA. Operations under the Interim Operations would cause an increase in sediment and turbidity levels downstream of Lookout Point Reservoir because of deeper drawdowns increasing the potential for bank erosion and sloughing as compared to NAA operations. While some fine-grained sediment that enters Dexter Reservoir from Lookout Point Reservoir may partially settle, most fine-grained sediment would pass through Dexter Reservoir and be transported downstream, likely increasing turbidity downstream during deeper drawdowns compared to NAA operations.

As reservoir bed sediment is transported and re-deposited within the reservoir, turbidity levels due to deeper drawdowns are expected to continue to lessen in severity until they reach a new sediment equilibrium after years of the operation. Downstream turbidity effects will lessen over time becoming less adverse than the first few years of the deep drawdown.

Harmful Algal Blooms

Under the Interim Operations, effects on water quality from harmful algal blooms would be moderately more adverse than those under the NAA. The Interim Operations would increase sediment and nutrient loading into Lookout Point Reservoir because deeper drawdowns would increase the potential for bank erosion and sloughing as compared to NAA operations.

Outflow and storage would decrease substantially during summer at Lookout Point Reservoir under the Interim Operations as compared to NAA operations. The operations would reduce the pool elevation and ability to release deeper reservoir water and, therefore, would avoid releasing surface water from the spillway that may contain cyanotoxins in Lookout Point Reservoir during harmful algal blooms. However, the reduced storage in Lookout Point Reservoir would reduce residence time in the reservoir, thereby decreasing the potential time that harmful algal blooms would be a concern.

Mercury

Under the Interim Operations, effects on water quality from mercury would be moderately more adverse than those described under the NAA. Operations under the Interim Operations would cause an increase in sediment and potential mercury loading into Lookout Point Reservoir because of deeper drawdowns, increasing the potential for bank erosion and sloughing as compared to NAA operations.

Impacts on water quality from mercury methylation[1] would depend on anoxic[2] conditions and the level of mercury in Lookout Point and Dexter Reservoirs at any given time. Dissolved oxygen monitoring downstream of Lookout Point Dam during deep drawdown operations in fall of 2023 did not result in values below 80 percent saturation. Therefore, any potential increases of anoxic water (or associated mercury methylation) from deep drawdown operations are expected to have low magnitude and be short-lived. Shoreline exposure would increase due to the Interim Operations, which would increase the likelihood of sedimentation, potential mercury loading, and the methylation process if anoxic conditions were to develop in Lookout Point Reservoir compared to NAA operations.

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[1] Methylation is the introduction of a methyl radical into a substance (Merriam-Webster 2023). Mercury is methylated by anaerobic microorganisms such as sulfate-reducing bacteria in water and sediment (Eckley et al. 2015).

[2] Anoxia is a condition of no, or at times very little, dissolved oxygen in marine or freshwater systems (Diaz 2016).

3.5.4.5 Coast Fork Willamette River and Long Tom River Subbasins

Water Temperature and Total Dissolved Gas

Under the Interim Operations, effects on water quality in the Coast Fork Willamette River and Long Tom River Subbasins from temperature conditions and TDG would be the same as described under the NAA. There may be differences in the number of days where water temperature standards would be met or in the number of days TDG meets targets; however, this would not alter the overall adverse effect on water quality from temperature conditions and TDG in these subbasins (Table 3-8, Table 3-9, Table 3-10) (Appendix D, Water Quality Analysis, Section 1.6, Supporting Data for Water Quality Effects Analysis, Section 2.2, Total Dissolved Gas Results and Effects Analysis).

Turbidity, Harmful Algal Blooms, and Mercury

Under the Interim Operations, effects on water quality from turbidity, harmful algal blooms, and mercury in the Coast Fork Willamette River and Long Tom River Subbasins would be the same as those described under the NAA.

3.5.4.6 Mainstem Willamette River

Water Temperature and Total Dissolved Gas

Under the Interim Operations, effects on water quality from temperature conditions and TDG in the Mainstem Willamette River would be the same as described under the NAA. There may be differences in the number of days where water temperature standards would be met; however, this would not alter the overall adverse effect on water quality from temperature conditions. TDG is presumed not to be adverse because there are no dam operations on the mainstem Willamette River.

Turbidity, Harmful Algal Blooms, and Mercury

Under the Interim Operations, effects on water quality from turbidity, harmful algal blooms, and the mercury in the Mainstem Willamette River would be moderately more adverse as compared to the NAA.

3.5.5 Climate Change Effects

Incorporated by reference. This section was not updated to include Alternative 6. Prior to the release of this SEIS, Executive Order 14154 “Unleashing American Energy” was issued. Consistent with this Executive Order, a greenhouse gas analysis is not included here; however, this SEIS is consistent with the NEPA statute and existing agency regulations pertaining to air quality and emissions.

3.5.6 Summary of Effects

The summary of effects to water quality parameters under the No Action Alternative and all action alternatives is in Table 3-11 through Table 3-16.

Table 3-11. Summary of Effects to Water Quality in the North Santiam River Subbasin as Compared to the No-action Alternative[1].

Location	No-action Alternative	Alternative 1	Alternative 2A	Alternative 2B	Alternative 3A	Alternative 3B
Detroit and Big Cliff Reservoirs	**Temp –** Moderate adverse effect. **TDG –** Moderate adverse effect. **Turbidity –** Adverse and beneficial effects. **HABs –** Slight adverse effect. **Mercury –** Slight adverse effect.	**Temp –** Substantially less adverse effects. **TDG –** Substantially less adverse effects. **Turbidity –** Same as the No-action Alternative. **HABs, Mercury –** Slightly more adverse effect.	**Temp –** Substantially less adverse effects. **TDG –** Substantially less adverse effects. **Turbidity –** Same as the No-action Alternative. **HABs, Mercury –** Slightly more adverse effect.	**Temp –** Substantially less adverse effects. **TDG –** Substantially less adverse effects. **Turbidity –** Same as the No-action Alternative. **HABs, Mercury –** Slightly more adverse effect.	**Temp –** Moderate increase to adverse effects. **TDG –** Substantial increase of adverse effects. **Turbidity –** Substantially more adverse effects. **HABs –** Moderately more Adverse effect. **Mercury –** Moderately more adverse effect.	**Temp –** Same as the No-action Alternative. **TDG –** Substantial increase of adverse effects. **Turbidity –** Substantially more adverse effects. **HABs –** Moderately more Adverse effect. **Mercury –** Moderately more adverse effect.

Table 3-11. Summary of Effects to Water Quality in the North Santiam River Subbasin as Compared to the No-action Alternative (continued)[1].

Location	No-action Alternative	Alternative 4	Alternative 5	Alternative 6	Interim Operations
Detroit and Big Cliff Reservoirs	**Temp –** Moderate adverse effect. **TDG –** Moderate adverse effect. **Turbidity –** Adverse and beneficial effects. **HABs –** Slight adverse effect. **Mercury –** Slight adverse effect.	**Temp –** Substantially less adverse effects. **TDG –** Substantially less adverse effects. **Turbidity –** Same as the No-action Alternative. **HABs, Mercury –** Slightly more adverse effect.	**Temp –** Substantially less adverse effects. **TDG –** Substantially less adverse effects. **Turbidity –** Same as the No-action Alternative. **HABs, Mercury –** Slightly more adverse effect.	**Temp –** Substantially less adverse effect. **TDG –** Substantially more adverse effect. **Turbidity –** Same as the No-action Alternative. **HABs, Mercury –** Slightly more adverse effect.	**Temp –** Same as the No-action Alternative. **TDG –** Substantially more adverse effect. **Turbidity –** Moderately more adverse effect. **HABs, Mercury –** Slightly more adverse effect.

Table 3.5-13 in the FEIS

Temp = temperature, TDG = total dissolved gas, HABs = harmful algal blooms

[1] Effects under all water quality parameters would occur seasonally/in the short term; however, overall effects would occur over the 30-year implementation timeframe.

Table 3-12. Summary of Effects to Water Quality in the South Santiam River Subbasin as Compared to the No-action Alternative[1].

Location	No-action Alternative	Alternative 1	Alternative 2A	Alternative 2B	Alternative 3A	Alternative 3B
Green Peter and Foster Reservoirs	**Temp –** Moderate adverse effect. **TDG –** Slight adverse effect. **Turbidity –** Adverse and beneficial effects. **HABs –** Slight adverse effect. **Mercury –** Slight adverse effect.	**Temp –** Slightly less adverse effects. **TDG –** Slightly less adverse effect. **Turbidity –** Same as the No-action Alternative. **HABs, Mercury –** Slightly more adverse effect.	**Temp –** Slightly less adverse effects. **TDG –** Substantially more adverse effect. **Turbidity –** Substantially more adverse effect. **HABs –** Moderately more adverse effect. **Mercury –** Moderately more adverse effect.	**Temp –** Slightly less adverse effects. **TDG –** Substantially more adverse effect. **Turbidity –** Substantially more adverse effect. **HABs –** Moderately more adverse effect. **Mercury –** Moderately more adverse effect.	**Temp –** Slightly less adverse effects. **TDG –** Substantially more adverse effect. **Turbidity –** Substantially more adverse effect. **HABs –** Moderately more adverse effect. **Mercury –** Moderately more adverse effect.	**Temp –** Slightly more adverse effects. **TDG –** Moderately more adverse effect. **Turbidity –** Substantially more adverse effect. **HABs –** Moderately more adverse effect. **Mercury –** Moderately more adverse effect.

Table 3.12. Summary of Effects to Water Quality in the South Santiam River Subbasin as Compared to the No-action Alternative[1] (continued).

Location	No-action Alternative	Alternative 4	Alternative 5	Alternative 6	Interim Operations
Green Peter and Foster Reservoirs	**Temp –** Moderate adverse effect. **TDG –** Slight adverse effect. **Turbidity –** Adverse and beneficial effects. **HABs –** Slight adverse effect. **Mercury –** Slight adverse effect.	**Temp –** Slightly less adverse effects. **TDG –** Slightly less adverse effects downstream of Foster Dam. Moderately more adverse below Green Peter Dam. **Turbidity –** Same as the No-action Alternative. **HABs, Mercury –** Slightly more adverse effect.	**Temp –** Slightly less adverse effects. **TDG –** Substantially more adverse effect. **Turbidity –** Substantially more adverse effect. **HABs, Mercury –** Moderately more adverse effect.	**Temp –** Slightly less adverse effect. **TDG –** Substantially more adverse effect. **Turbidity –** Substantially more adverse effect. **HABs, Mercury –** Moderately more adverse effect.	**Temp –** Same as the No-action Alternative. **TDG –** Moderately more adverse effect. **Turbidity –** Substantially more adverse effect. **HABs, Mercury –** Moderately more adverse effect.

Table 3.5-14 in the FEIS

Temp = temperature, TDG = total dissolved gas, HABs = harmful algal blooms

[1] Effects under all water quality parameters would occur seasonally/in the short term; however, overall effects would occur over the 30-year implementation timeframe.

Table 3-13. Summary of Effects to Water Quality in the McKenzie River Subbasin as Compared to the No-action Alternative[1].

Location	No-action Alternative	Alternative 1	Alternative 2A	Alternative 2B	Alternative 3A	Alternative 3B
Cougar and Blue River Reservoirs	**Temp –** Slight adverse effect. **TDG –** Moderate adverse effect. **Turbidity –** Adverse and beneficial effects. **HABs –** Slight adverse effect. **Mercury –** Slight adverse effect.	**Temp –** Slightly less adverse effect. **TDG –** Slightly less adverse effect. **Turbidity –** Same as the No-action Alternative. **HABs –** Slightly more adverse effect. **Mercury –** Slightly more adverse effect.	**Temp –** Same as the No-action Alternative. **TDG –** Same as the No-action Alternative. **Turbidity –** Same as the No-action Alternative. **HABs –** Slightly more adverse effect. **Mercury –** Slightly more adverse effect.	**Temp –** Substantially less adverse effect. **TDG –** Moderately less adverse effect. **Turbidity –** Substantially more adverse effects. **HABs –** Moderately more adverse effects. **Mercury –** Moderately more adverse effects.	**Temp –** Slightly more adverse effect. **TDG –** Slightly more adverse effect. **Turbidity –** Slightly more adverse effect. **HABs –** Moderately more adverse effect. **Mercury –** Slightly more adverse effect.	**Temp –** Substantially less adverse effect. **TDG –** Moderately less adverse effect. **Turbidity –** Substantially more adverse effects. **HABs –** Moderately more adverse effects. **Mercury –** Moderately more adverse effects.

Table 3-13. Summary of Effects to Water Quality in the McKenzie River Subbasin as Compared to the No-action Alternative[1] (continued).

Location	No-action Alternative	Alternative 4	Alternative 5	Alternative 6	Interim Operations
Cougar and Blue River Reservoirs	**Temp –** Slight adverse effect. **TDG –** Moderate adverse effect. **Turbidity –** Adverse and beneficial effects. **HABs –** Slight adverse effect. **Mercury –** Slight adverse effect.	**Temp –** Same as the No-action Alternative. **TDG –** Moderately less adverse effect. **Turbidity –** Same as the No-action Alternative. **HABs –** Slightly more adverse effect. **Mercury –** Slightly more adverse effect.	**Temp –** Substantially less adverse effect. **TDG –** Moderately less adverse effect. **Turbidity –** Substantially more adverse effects. **HABs –** Moderately more adverse effects. **Mercury –** Moderately more adverse effects.	**Temp –** Substantially less adverse effect. **TDG –** Moderately less adverse effect. **Turbidity –** Substantially more adverse effect. **HABs –** Moderately more adverse effect. **Mercury –** Slightly more adverse effect.	**Temp –** Slightly more adverse effect. **TDG –** Substantially more adverse effect. **Turbidity –** Slightly more adverse effect. **HABs –** Moderately more adverse effect. **Mercury –** Slightly more adverse effect.

Table 3.5-15 in the FEIS

Temp = temperature, TDG = total dissolved gas, HABs = harmful algal blooms

[1] Effects under all water quality parameters would occur seasonally/in the short term; however, overall effects would occur over the 30-year implementation timeframe.

Table 3-14. Summary of Effects to Water Quality in the Middle Fork Willamette River Subbasin as Compared to the No-action Alternative[1].

Location	No-action Alternative	Alternative 1	Alternative 2A	Alternative 2B	Alternative 3A	Alternative 3B
Hills Creek Reservoir	**Temp –** Moderate adverse effect. **TDG –** Slight adverse effect. **Turbidity –** Adverse and beneficial effects. **HABs –** Slight Adverse effect. **Mercury –** Slight adverse effect.	**Temp –** Same as the No-action Alternative. **TDG** Same as the No-action Alternative. **Turbidity –** Same as the No-action Alternative. **HABs –** Slightly more adverse effects. **Mercury –** Slightly more adverse effects.	**Temp –** Same as the No-action Alternative. **TDG –** Same as the No-action Alternative. **Turbidity –** Same as the No-action Alternative. **HABs –** Slightly more adverse effects. **Mercury –** Slightly more adverse effects.	**Temp –** Same as the No-action Alternative. **TDG –** Same as the No-action Alternative. **Turbidity –** Same as the No-action Alternative. **HABs –** Slightly more adverse effects. **Mercury –** Slightly more adverse effects.	**Temp –** Moderately less adverse effect. **TDG –** Slightly less adverse effects. **Turbidity –** Same as the No-action Alternative. **HABs –** Slightly more adverse effects. **Mercury –** Slightly more adverse effects.	**Temp –** Slightly less adverse effects. **TDG –** Same as the No-action Alternative. **Turbidity –** Substantially more adverse effects. **HABs –** Moderately more adverse effect. **Mercury –** Moderately more adverse effect.
Lookout Point and Dexter Reservoirs	**Temp –** Moderate adverse effect. **TDG –** Slight adverse effect. **Turbidity –** Adverse and beneficial effects. **HABs –** Slight adverse effect. **Mercury –** Slight adverse effect.	**Temp –S**imilar to the No-action Alternative. **TDG –** Same as the No-action Alternative. **Turbidity –** Same as the No-action Alternative. **HABs –** Slightly more adverse effects. **Mercury –** Slightly more adverse effects.	**Temp – S**imilar to the No-action Alternative. **TDG –** Same as the No-action Alternative. **Turbidity –** Same as the No-action Alternative. **HABs –** Slightly more adverse effects. **Mercury –** Slightly more adverse effects.	**Temp – S**imilar to the No-action Alternative. **TDG –** Same as the No-action Alternative. **Turbidity –** Same as the No-action Alternative. **HABs –** Slightly more adverse effects. **Mercury –** Slightly more adverse effects.	**Temp –** Slightly less adverse effect. **TDG –** Moderately more adverse effect. **Turbidity –** Substantially more adverse effect. **HABs –** Moderately more adverse effects. **Mercury –** Moderately more adverse effects.	**Temp –** Slightly less adverse effects. **TDG –** Moderately more adverse effects below Dexter Dam. **Turbidity –** Substantially more adverse effect. **HABs –** Moderately more adverse effect. **Mercury –** Moderately more adverse effects.
Fall Creek Reservoir	**Temp –** Moderate Adverse effect. **TDG –** N/A. **Turbidity –** Adverse and beneficial effects. **HABs –** Slight Adverse effect. **Mercury –** Moderate adverse effect.	**Temp –** Same as the No-action Alternative. **TDG –** Same as the No-action Alternative. **Turbidity –** Same as the No-action Alternative. **HAB –** Slightly more adverse effects. **Mercury –** Slightly more adverse effects.	**Temp –** Same as the No-action Alternative. **TDG –** Same as the No-action Alternative. **Turbidity –** Same as the No-action Alternative. **HABs –** Slightly more adverse effects. **Mercury –** Slightly more adverse effects.	**Temp –** Same as the No-action Alternative. **TDG –** Same as the No-action Alternative. **Turbidity –** Same as the No-action Alternative. **HABs –** Slightly more adverse effects. **Mercury –** Slightly more adverse effects.	**Temp –** Same as the No-action Alternative. **TDG –** Same as the No-action Alternative. **Turbidity –** Same as the No-action Alternative. **HABs –** Slightly more adverse effects. **Mercury –** Slightly more adverse effects.	**Temp –** Same as the No-action Alternative. **TDG –** Same as the No-action Alternative. **Turbidity, HABs, Mercury –** Same as the No-action Alternative.

Table 3.14. Summary of Effects to Water Quality in the Middle Fork Willamette River Subbasin as Compared to the No-action Alternative[1] (continued).

Location	No-action Alternative	Alternative 4	Alternative 5	Alternative 6	Interim Operations
Hills Creek Reservoir	**Temp –** Moderate adverse effect. **TDG –** Slight adverse effect. **Turbidity –** Adverse and beneficial effects. **HABs –** Slight Adverse effect. **Mercury –** Slight adverse effect.	**Temp –** Moderately less adverse effect. **TDG –** Same as the No-action Alternative. **Turbidity –** Same as the No-action Alternative. **HABs –** Slightly more adverse effects. **Mercury –** Slightly more adverse effects.	**Temp –** Same as the No-action Alternative. **TDG –** Same as the No-action Alternative. **Turbidity –** Same as the No-action Alternative. **HABs –** Slightly more adverse effect. **Mercury –** Slightly more adverse effect.	**Temp –** Same as the No-action Alternative. **TDG –** Substantially more adverse effect. **Turbidity –** Same as the No-action Alternative. **HABs –** Slightly more adverse effect. **Mercury –** Slightly more adverse effect.	**Temp –** Same as the No-action Alternative. **TDG –** Slightly more adverse effect. **Turbidity –** Same as the No-action Alternative. **HABs –** Slightly more adverse effect. **Mercury –** Slightly more adverse effect.
Lookout Point and Dexter Reservoirs	**Temp –** Moderate adverse effect. **TDG –** Slight adverse effect. **Turbidity –** Adverse and beneficial effects. **HABs –** Slight adverse effect. **Mercury –** Slight adverse effect.	**Temp –** Same as the No-action Alternative. **TDG –** Slightly less adverse effect. **Turbidity –** Same as the No-action Alternative. **HABs –** Slightly more adverse effects. **Mercury –** Slightly more adverse effects.	**Temp –** Same as the No-action Alternative. **TDG –** Same as the No-action Alternative. **Turbidity –** Same as the No-action Alternative. **HABs –** Slightly more adverse effect. **Mercury –** Slightly more adverse effect.	**Temp –** Same as the No-action Alternative. **TDG –** Substantially more adverse effect. **Turbidity –** Same as the No-action Alternative. **HABs –** Slightly more adverse effect. **Mercury –** Slightly more adverse effect.	**Temp –** Same as the No-action Alternative. **TDG –** Slightly more adverse effect. **Turbidity –** Substantially more adverse effect. **HABs –** Moderately more adverse effect. **Mercury –** Moderately more adverse effect.
Fall Creek Reservoir	**Temp –** Moderate Adverse effect. **TDG –** N/A. **Turbidity –** Adverse and beneficial effects. **HABs –** Slight Adverse effect. **Mercury –** Moderate adverse effect.	**Temp –** Same as the No-action Alternative. **TDG –** Same as the No-action Alternative. **Turbidity –** Same as the No-action Alternative. **HABs –** Slightly more adverse effects. **Mercury –** Slightly more adverse effects.	**Temp –** Same as the No-action Alternative. **TDG –** Same as the No-action Alternative. **Turbidity –** Same as the No-action Alternative. **HABs –** Slightly more adverse effect. **Mercury –** Slightly more adverse effect.	**Temp –** Same as the No-action Alternative. **TDG –** Same as the No-action Alternative. **Turbidity –** Same as the No-action Alternative. **HABs –** Slightly more adverse effect. **Mercury –** Slightly more adverse effect.	**Temp –** Same as the No-action Alternative. **TDG –** Same as the No-action Alternative. **Turbidity –** Same as the No-action Alternative. **HABs –** Slightly more adverse effect. **Mercury –** Slightly more adverse effect.

Table 3.5-16 in the FEIS

Temp = temperature, TDG = total dissolved gas, HABs = harmful algal blooms, N/A = Not Applicable

[1] Effects under all water quality parameters would occur seasonally/in the short term; however, overall effects would occur over the 30-year implementation timeframe.

Table 3-15. Summary of Effects to Water Quality in the Coast Fork Willamette River and Long Tom River Subbasins as Compared to the No-action Alternative[1].

Location	No-action Alternative	Alternative 1	Alternative 2A	Alternative 2B	Alternative 3A	Alternative 3B
Dorena Reservoir	**Temp –** Moderate adverse effect. **TDG –** N/A. **Turbidity –** Adverse and beneficial effects. **HABs –** Slight adverse effect. **Mercury –** Moderate adverse effect.	**Temp –** Same as the No-action Alternative. **TDG –** Same as the No-action Alternative. **Turbidity, HABs, Mercury –** Same as the No-action Alternative.	**Temp –** Same as the No-action Alternative. **TDG –** Same as the No-action Alternative. **Turbidity, HABs, Mercury –** Same as the No-action Alternative.	**Temp –** Same as the No-action Alternative. **TDG –** Same as the No-action Alternative. **Turbidity, HABs, Mercury –** Same as the No-action Alternative.	**Temp –** Same as the No-action Alternative. **TDG –** Same as the No-action Alternative. **Turbidity, HABs, Mercury –** Same as the No-action Alternative.	**Temp –** Same as the No-action Alternative. **TDG –** Same as the No-action Alternative. **Turbidity, HABs, Mercury –** Same as the No-action Alternative.
Cottage Grove Reservoir	**Temp –** Moderate adverse effect. **TDG –** N/A. **Turbidity –** Adverse and beneficial effects. **HABs –** Slight adverse effect. **Mercury –** Moderate adverse effect.	**Temp –** Same as the No-action Alternative. **TDG –** Same as the No-action Alternative. **Turbidity, HABs, Mercury –** Same as the No-action Alternative.	**Temp –** Same as the No-action Alternative. **TDG –** Same as the No-action Alternative. **Turbidity, HABs, Mercury –** Same as the No-action Alternative.	**Temp –** Same as the No-action Alternative. **TDG –** Same as the No-action Alternative. **Turbidity, HABs, Mercury –** Same as the No-action Alternative.	**Temp –** Same as the No-action Alternative. **TDG –** Same as the No-action Alternative. **Turbidity, HABs, Mercury –** Same as the No-action Alternative.	**Temp –** Same as the No-action Alternative. **TDG –** Same as the No-action Alternative. **Turbidity, HABs, Mercury –** Same as the No-action Alternative.
Fern Ridge Reservoir	**Temp –** Moderate adverse effect. **TDG –** N/A. **Turbidity –** Adverse and beneficial effects. **HABs –** Slight adverse effect. **Mercury –** Moderate adverse effect.	**Temp –** Same as the No-action Alternative. **TDG –** Same as the No-action Alternative. **Turbidity, HABs, Mercury –** Same as the No-action Alternative.	**Temp –** Same as the No-action Alternative. **TDG –** Same as the No-action Alternative. **Turbidity, HABs, Mercury –** Same as the No-action Alternative.	**Temp –** Same as the No-action Alternative. **TDG –** Same as the No-action Alternative. **Turbidity, HABs, Mercury –** Same as the No-action Alternative.	**Temp –** Same as the No-action Alternative. **TDG –** Same as the No-action Alternative. **Turbidity, HABs, Mercury –** Same as the No-action Alternative.	**Temp –** Same as the No-action Alternative. **TDG –** Same as the No-action Alternative. **Turbidity, HABs, Mercury –** Same as the No-action Alternative.

Table 3-15. Summary of Effects to Water Quality in the Coast Fork Willamette River and Long Tom River Subbasins as Compared to the No-action Alternative[1] (continued).

Location	No-action Alternative	Alternative 4	Alternative 5	Alternative 6	Interim Operation
Dorena Reservoir	**Temp –** Moderate adverse effect. **TDG –** N/A. **Turbidity –** Adverse and beneficial effects. **HABs –** Slight adverse effect. **Mercury –** Moderate adverse effect.	**Temp –** Same as the No-action Alternative. **TDG –** Same as the No-action Alternative. **Turbidity, HABs, Mercury –** Same as the No-action Alternative.	**Temp –** Same as the No-action Alternative. **TDG –** Same as the No-action Alternative. **Turbidity, HABs, Mercury –** Same as the No-action Alternative.	**Temp –** Same as the No-action Alternative. **TDG –** Same as the No-action Alternative. **Turbidity, HABs, Mercury –** Same as the No-action Alternative.	**Temp –** Same as the No-action Alternative. **TDG –** Same as the No-action Alternative. **Turbidity, HABs, Mercury –** Same as the No-action Alternative.
Cottage Grove Reservoir	**Temp –** Moderate adverse effect. **TDG –** N/A. **Turbidity –** Adverse and beneficial effects. **HABs –** Slight adverse effect. **Mercury –** Moderate adverse effect.	**Temp –** Same as the No-action Alternative. **TDG –** Same as the No-action Alternative. **Turbidity, HABs, Mercury –** Same as the No-action Alternative.	**Temp –** Same as the No-action Alternative. **TDG –** Same as the No-action Alternative. **Turbidity, HABs, Mercury –** Same as the No-action Alternative.	**Temp –** Same as the No-action Alternative. **TDG –** Same as the No-action Alternative. **Turbidity, HABs, Mercury –** Same as the No-action Alternative.	**Temp –** Same as the No-action Alternative. **TDG –** Same as the No-action Alternative. **Turbidity, HABs, Mercury –** Same as the No-action Alternative.
Fern Ridge Reservoir	**Temp –** Moderate adverse effect. **TDG –** N/A. **Turbidity –** Adverse and beneficial effects. **HABs –** Slight adverse effect. **Mercury –** Moderate adverse effect.	**Temp –** Same as the No-action Alternative. **TDG –** Same as the No-action Alternative. **Turbidity, HABs, Mercury –** Same as the No-action Alternative.	**Temp –** Same as the No-action Alternative. **TDG –** Same as the No-action Alternative. **Turbidity, HABs, Mercury –** Same as the No-action Alternative.	**Temp –** Same as the No-action Alternative. **TDG –** Same as the No-action Alternative. **Turbidity, HABs, Mercury –** Same as the No-action Alternative.	**Temp –** Same as the No-action Alternative. **TDG –** Same as the No-action Alternative. **Turbidity, HABs, Mercury –** Same as the No-action Alternative.

Table 3.5-17 in the FEIS

Temp = temperature, TDG = total dissolved gas, HABs = harmful algal blooms, N/A = Not Applicable

[1] Effects under all water quality parameters would occur seasonally/in the short term; however, overall effects would occur over the 30-year implementation timeframe.

Table 3-16. Summary of Effects to Water Quality in the Mainstem Willamette River as Compared to the No-action Alternative[1].

Location	No-action Alternative	Alternative 1	Alternative 2A	Alternative 2B	Alternative 3A	Alternative 3B
Willamette River at Albany, Oregon	**Temp –** Slight adverse effect. **TDG –** N/A. **Turbidity –** Adverse and beneficial effects. **HABs –** Slight adverse effect. **Mercury –** Slight adverse effect.	**Temp –** Same as the No-action Alternative. **TDG –** Same as the No-action Alternative. **Turbidity, HABs, Mercury –** Same as the No-action Alternative.	**Temp –** Same as the No-action Alternative. **TDG –** Same as the No-action Alternative. **Turbidity, HABs, Mercury –** Same as the No-action Alternative.	**Temp –** Same as the No-action Alternative. **TDG –** Same as the No-action Alternative. **Turbidity, HABs, Mercury –** Slightly more adverse effects.	**Temp –** Same as the No-action Alternative. **TDG –** Same as the No-action Alternative. **Turbidity, HABs, Mercury –** Moderately more adverse effects.	**Temp –** Same as the No-action Alternative. **TDG –** Same as the No-action Alternative. **Turbidity, HABs, Mercury –** Moderately more adverse effects.
Willamette River at Salem, Oregon	**Temp –** Slight to moderate adverse effect. **TDG –** N/A. **Turbidity –** Adverse and beneficial effects. **HABs –** Slight adverse effect. **Mercury –** Slight adverse effect.	**Temp –** Same as the No-action Alternative. **TDG –** Same as the No-action Alternative. **Turbidity, HABs, Mercury –** Same as the No-action Alternative.	**Temp –** Same as the No-action Alternative. **TDG –** Same as the No-action Alternative. **Turbidity, HABs, Mercury –** Same as the No-action Alternative.	**Temp –** Same as the No-action Alternative. **TDG –** Same as the No-action Alternative. **Turbidity, HABs, Mercury –** Slightly more adverse effects.	**Temp –** Same as the No-action Alternative. **TDG –** Same as the No-action Alternative. **Turbidity, HABs, Mercury –** Moderately more adverse effects.	**Temp –** Same as the No-action Alternative. **TDG –** Same as the No-action Alternative. **Turbidity, HABs, Mercury –** Moderately more adverse effects.

Table 3-16. Summary of Effects to Water Quality in the Mainstem Willamette River as Compared to the No-action Alternative[1] (continued).

Location	No-action Alternative	Alternative 4	Alternative 5	Alternative 6	Interim Operation
Willamette River at Albany, Oregon	**Temp –** Slight adverse effect. **TDG –** N/A. **Turbidity –** Adverse and beneficial effects. **HABs –** Slight adverse effect. **Mercury –** Slight adverse effect.	**Temp –** Same as the No-action Alternative. **TDG –** Same as the No-action Alternative. **Turbidity, HABs, Mercury –** Same as the No-action Alternative.	**Temp –** Same as the No-action Alternative. **TDG –** Same as the No-action Alternative. **Turbidity, HABs, Mercury –** Slightly more adverse effects.	**Temp –** Same as the No-action Alternative. **TDG –** Same as the No-action Alternative. **Turbidity, HABs, Mercury –** Slightly more adverse effect.	**Temp –** Same as the No-action Alternative. **TDG –** Same as the No-action Alternative. **Turbidity, HABs, Mercury –** Moderately more adverse effect.
Willamette River at Salem, Oregon	**Temp –** Slight to moderate adverse effect. **TDG –** N/A. **Turbidity –** Adverse and beneficial effects. **HABs –** Slight adverse effect. **Mercury –** Slight adverse effect.	**Temp –** Same as the No-action Alternative. **TDG –** Same as the No-action Alternative. **Turbidity, HABs, Mercury –** Same as the No-action Alternative.	**Temp –** Same as the No-action Alternative. **TDG –** Same as the No-action Alternative. **Turbidity, HABs, Mercury –** Slightly more adverse effects.	**Temp –** Same as the No-action Alternative. **TDG –** Same as the No-action Alternative. **Turbidity, HABs, Mercury –** Slightly more adverse effect.	**Temp –** Same as the No-action Alternative. **TDG –** Same as the No-action Alternative. **Turbidity, HABs, Mercury –** Moderately more adverse effect.

Table 3.5-18 in the FEIS

Temp = temperature, TDG = total dissolved gas, HABs = harmful algal blooms, N/A = Not Applicable

[1] Effects under all water quality parameters would occur seasonally/in the short term; however, overall effects would occur over the 30-year implementation timeframe.

3.6 Vegetation

3.6.1 Introduction

Incorporated by reference.

3.6.2 Affected Environment

Incorporated by reference.

3.6.3 Environmental Consequences

This section discusses the potential effects of Alternative 6 and the Interim Operations on vegetation. The discussion incorporates the methodology used to assess effects, by reference, and summarizes the anticipated effects (Table 3-17). Effects specific to subbasins address effects from dam operations.

3.6.3.1 Construction and Routine and Non-routine Maintenance Activities

Incorporated by reference.

3.6.3.2 Fern Ridge Dam and Reservoir Plant Communities

Incorporated by reference.

3.6.3.3 Activation of Landslides

Incorporated by reference.

3.6.3.4 Methodology

Incorporated by reference.

A summary of the effects for all alternatives is in Table 3-17.

Table 3-17. Summary of Effects to Vegetation as Compared to the No-Action Alternative[1].

Effect Category	No-action Alternative	Alternative 1	Alternative 2A	Alternative 2B	Alternative 3A	Alternative 3B
Reservoir-adjacent Vegetation	Minor, adverse effects to vegetation from frequent seasonally uncharacteristic water level fluctuations prohibiting native plant establishment and natural successional patterns, which may increase the potential for the establishment of invasive-dominated plant communities. Minor, beneficial effects to plant growth and biomass accumulation from high reservoir levels during the growing season. Negligible effects to vegetation from induced landslides compared to the NAA. Negligible effects from potential for reservoirs not to refill.	Minor, adverse effects to vegetation from frequent seasonally uncharacteristic water level fluctuations prohibiting native plant establishment and natural successional patterns, which may increase the potential for the establishment of invasive-dominated plant communities. Moderate, adverse effects to vegetation during spring refill on new plant establishment. Negligible effects to vegetation from induced landslides compared to the NAA. Negligible effects from potential for reservoirs not to refill.	Minor, adverse effects to vegetation from frequent seasonally uncharacteristic water level fluctuations prohibiting native plant establishment and natural successional patterns, which may increase the potential for the establishment of invasive-dominated plant communities. Moderate, adverse effects to vegetation during spring refill on new plant establishment. Minor, adverse effects to vegetation because of increased potential for slope failures at Green Peter Reservoir from fall and spring drawdowns for fish passage. Minor adverse effects to vegetation if Green Peter Reservoir is unable to refill during the 30-year implementation timeframe.	Minor, adverse effects to vegetation from frequent seasonally uncharacteristic water level fluctuations prohibiting native plant establishment and natural successional patterns, which may increase the potential for the establishment of invasive-dominated plant communities. Moderate, adverse effects to vegetation during spring refill on new plant establishment at all reservoirs, except Cougar Reservoir. Moderate, adverse effects to vegetation because of increased potential for slope failures at Cougar and Green Peter Reservoirs from fall and spring drawdowns for fish passage.	Minor, adverse effects to vegetation from frequent seasonally uncharacteristic water level fluctuations prohibiting native plant establishment and natural successional patterns, which may increase the potential for the establishment of invasive-dominated plant communities. Moderate, adverse effects to vegetation during spring refill on new plant establishment at all reservoirs except Cougar, Lookout Point, and Detroit Reservoirs. Moderate, adverse effects to vegetation because of increased potential for slope failures at Cougar, Lookout Point, and Detroit Reservoirs from fall and spring drawdowns for fish passage.	Minor, adverse effects to vegetation from frequent seasonally uncharacteristic water level fluctuations prohibiting native plant establishment and natural successional patterns, which may increase the potential for the establishment of invasive-dominated plant communities. Moderate, adverse effects to vegetation during spring refill on new plant establishment at all reservoirs except Cougar, Hills Creek, and Green Peter Reservoirs. Moderate, adverse effects to vegetation because of increased potential for slope failures at Cougar, Lookout Point, and Detroit Reservoirs from fall and spring drawdowns for fish passage.
Downstream Stream-adjacent Vegetation	Major, adverse effects to vegetation from limited floodplain connectivity. Negligible effects to vegetation from downstream flow operations.	Major, adverse effects to vegetation from limited floodplain connectivity. Major, beneficial effects to vegetation from connectivity improvements from gravel bars. Improved revetments may improve the native riparian seedbank. Minor, beneficial effects to vegetation from higher summer flows. Negligible effects to vegetation from flow differences.	Major, adverse effects to vegetation from limited floodplain connectivity. Major, beneficial effects to vegetation from connectivity improvements from gravel bars. Improved revetments may improve the native riparian seedbank. Negligible effects to vegetation from drawdown-related sediment releases. Minor, beneficial effects to vegetation from higher summer flows. Minor, adverse effects to vegetation from lowered spring flows in dry years.	Major, adverse effects to vegetation from limited floodplain connectivity. Major, beneficial effects to vegetation from connectivity improvements from gravel bars. Improved revetments may improve the native riparian seedbank. Negligible effects to vegetation from drawdown-related sediment releases. Minor, beneficial effects to vegetation from higher summer outflows. Potential for minor, adverse effects to vegetation in dry years from lower spring flows.	Major, adverse effects to vegetation from limited floodplain connectivity. Major, beneficial effects to vegetation from connectivity improvements from gravel bars. Improved revetments may improve the native riparian seedbank. Negligible effects to vegetation from drawdown-related sediment releases. Potential for moderate, adverse effects to vegetation from lowered reservoir elevations in the summer and fall. Minor, beneficial effects to vegetation from spring water releases during dry years.	Major, adverse effects to vegetation from limited floodplain connectivity. Major, beneficial effects to vegetation from connectivity improvements from gravel bars. Improved revetments may improve the native riparian seedbank. Negligible effects to vegetation from drawdown-related sediment releases. Minor, adverse effects to vegetation from lower summer flows.

Effect Category	No-action Alternative	Alternative 1	Alternative 2A	Alternative 2B	Alternative 3A	Alternative 3B
Invasive and Noxious Weed Presence	Major, adverse effects to vegetation in reservoirs from frequent reservoir elevation changes.	Major, adverse effects to vegetation from increased potential for invasive establishment compared to NAA from frequent reservoir elevation changes and deep drawdowns. Minor, beneficial effects to vegetation from spring refills controlling invasive species establishment.	Major, adverse effects to vegetation in reservoirs from frequent reservoir elevation changes. Minor, beneficial effects to vegetation from spring refills controlling invasive species establishment.	Major, adverse effects to vegetation in reservoirs from frequent reservoir elevation changes. Minor, beneficial effects to vegetation at all reservoirs except, Cougar Reservoir from spring refills controlling invasive species establishment.	Major, adverse effects to vegetation in reservoirs from frequent reservoir elevation changes. Minor, beneficial effects to vegetation in all reservoirs, except Cougar, Lookout Point, and Detroit Reservoirs from spring refills controlling invasive species establishment.	Major, adverse effects to vegetation in reservoirs from frequent reservoir elevation changes. Minor, beneficial effects to vegetation in all reservoirs, except Hills Creek, Cougar, and Green Peter Reservoirs from spring refills controlling invasive species establishment.
Wildfire Recovery and Fine Fuels	Analysis area forests would continue to recover; no effect on establishment of fine fuels in reservoir or downstream areas from USACE operations.	Same as No-action Alternative.	Same as No-action Alternative.	Same as No-action Alternative.	Same as No-action Alternative.	Same as No-action Alternative.
Special-status Plant Species	Minor, adverse effects to vegetation from frequent reservoir water elevation changes for special-status species. Negligible effects to special-status species from landslide activity. Negligible effect to wapato.	Moderate, adverse effects to special-status species from spring refill potential to inhibit species establishment. Minor, adverse effects to special-status species from frequent reservoir water elevation changes. Negligible effects to special-status species from landslide activity. Major, beneficial effects to habitat from gravel augmentation. Moderate, adverse effects to special-status plant species and wapato from use of power and inactive pools.	Moderate, adverse effects to special-status species from spring refill potential to inhibit species establishment. Minor, adverse effects to habitat from frequent reservoir water elevation changes. Minor, adverse effects to special-status species from potential plant community burial from landslide activity because of drawdowns at Green Peter Reservoir. Major, beneficial effects to habitat from gravel augmentation. Moderate, adverse effects to special-status species and wapato from use of power and inactive pools.	Moderate, adverse effects to special-status species at all reservoirs, except Cougar Reservoir from spring refill potential to inhibit species establishment. Minor, adverse effects to special-status species from frequent reservoir water elevation changes. Minor, adverse effects to special-status species from potential plant community burial from landslide activity because of drawdowns at Green Peter and Cougar Reservoirs. Major, beneficial effects to habitat from gravel augmentation. Moderate, adverse effects to special-status species and wapato from use of power and inactive pools.	Moderate, adverse effects to special-status species in all reservoirs, except Lookout Point, Cougar, and Detroit Reservoirs from spring refill potential to inhibit species establishment. Minor, adverse effects to special-status species from frequent reservoir water elevation changes. Minor, adverse effects to special-status species from potential plant community burial from landslide activity because of drawdowns at Green Peter, Lookout Point, Detroit, and Cougar Reservoirs. Major, beneficial effects to habitat from gravel augmentation. Moderate, adverse effects to special-status species and wapato from use of power and inactive pools.	Moderate, adverse effects to special-status species in all reservoirs, except Hills Creek, Cougar, and Green Peter Reservoirs from spring refill potential to inhibit species establishment. Minor, adverse effects to special-status species from frequent reservoir water elevation changes. Minor, adverse effects to special-status species from potential plant community burial from landslide activity as a result of drawdowns at Green Peter, Lookout Point, Detroit, and Cougar Reservoirs. Major, beneficial effects to habitat from gravel augmentation. Moderate, adverse effects to special-status species and wapato from use of power and inactive pools.
Ecoregions	Negligible	Major, beneficial effects from gravel augmentation.	Major, beneficial effects from gravel augmentation	Major, beneficial effects from gravel augmentation.	Major, beneficial effects from gravel augmentation.	Major, beneficial effects from gravel augmentation.

Table 3-17. Summary of Effects to Vegetation as Compared to the No-action Alternative[1] (continued).

Effect Category	No-action Alternative	Alternative 4	Alternative 5	Alternative 6	Interim Operations
Reservoir-adjacent Vegetation	Minor, adverse effects to vegetation from frequent seasonally uncharacteristic water level fluctuations prohibiting native plant establishment and natural successional patterns, which may increase the potential for the establishment of invasive-dominated plant communities. Minor, beneficial effects to plant growth and biomass accumulation from high reservoir levels during the growing season. Negligible effects to vegetation from induced landslides compared to the NAA. Negligible effects from potential for reservoirs not to refill.	Minor, adverse effects to vegetation from frequent seasonally uncharacteristic water level fluctuations prohibiting native plant establishment and natural successional patterns, which may increase the potential for the establishment of invasive-dominated plant communities. Moderate, adverse effects to vegetation during spring refill on new plant establishment. Negligible effects to vegetation from induced landslides compared to the NAA.	Minor, adverse effects to vegetation from frequent seasonally uncharacteristic water level fluctuations prohibiting native plant establishment and natural successional patterns, which may increase the potential for the establishment of invasive-dominated plant communities. Moderate, adverse effects to vegetation during spring refill on new plant establishment at all reservoirs, except Cougar Reservoir. Moderate, adverse effects to vegetation because of increased potential for slope failures at Cougar and Green Peter Reservoirs from fall and spring drawdowns for fish passage.	Negligible effects from removal of hydropower infrastructure and cessation of hydropower generation. Minor, adverse effects to vegetation from frequent seasonally uncharacteristic water level fluctuations prohibiting native plant establishment and natural successional patterns, which may increase the potential for the establishment of invasive-dominated plant communities. Moderate, adverse effects to vegetation during spring refill on new plant establishment at all reservoirs, except Cougar Reservoir. Moderate, adverse effects to vegetation because of increased potential for slope failures at Cougar and Green Peter Reservoirs from fall and spring drawdowns for fish passage.	Minor, adverse effects to vegetation at Detroit Reservoir from deep drawdowns increasing the potential for establishment of invasive-dominated plant communities. Minor adverse effects to vegetation from lower summer pool elevations during dry years resulting in less water available to reservoir adjacent vegetation communities during the growing season. Minor, adverse effects to vegetation from frequent seasonally uncharacteristic water level fluctuations prohibiting native plant establishment and natural successional patterns, which may increase the potential for the establishment of invasive-dominated plant communities. Moderate, adverse effects to vegetation during spring refill on new plant establishment. Minor adverse effects to vegetation if reservoirs are unable to refill during the 30-year implementation timeframe.
Downstream-Stream Adjacent Vegetation	Major, adverse effects to vegetation from limited floodplain connectivity. Negligible effects to vegetation from downstream flow operations.	Major, adverse effects to vegetation from limited floodplain connectivity. Major, beneficial effects to vegetation from connectivity improvements from gravel bars. Improved revetments may improve the native riparian seedbank. Negligible effects to vegetation from flow operations in average years.	Major, adverse effects to vegetation from limited floodplain connectivity. Major, beneficial effects to vegetation from connectivity improvements from gravel bars. Improved revetments may improve the native riparian seedbank. Negligible effects to vegetation from drawdown-related sediment releases. Minor, beneficial effects to vegetation from higher summer flows. Potential for minor, adverse effects to vegetation in dry years from lower spring flows.	Negligible effects from removal of hydropower infrastructure and cessation of hydropower generation. Major, adverse effects to vegetation from limited floodplain connectivity. Major, beneficial effects to vegetation from connectivity improvements from gravel bars. Improved revetments may improve the native riparian seedbank. Negligible effects to vegetation from drawdown-related sediment releases. Minor, beneficial effects to vegetation from higher summer flows. Potential for minor, adverse effects to vegetation in dry years from lower spring flows.	Major, adverse effects to vegetation from limited floodplain connectivity. Negligible effects to vegetation from downstream flow operations.

Effect Category	No-action Alternative	Alternative 4	Alternative 5	Alternative 6	Interim Operations
Invasive and Noxious Weed Presence	Major, adverse effects to vegetation in reservoirs from frequent reservoir elevation changes.	Major, adverse effects to vegetation from increased potential for invasive establishment compared to NAA from frequent reservoir elevation changes and deep drawdowns. Minor, beneficial effects to vegetation from spring refills controlling invasive species establishment.	Major, adverse effects to vegetation in reservoirs from frequent reservoir elevation changes. Minor, beneficial effects to vegetation at all reservoirs except Cougar from spring refills controlling invasive species establishment.	Negligible effects from removal of hydropower infrastructure and cessation of hydropower generation. Major, adverse effects to vegetation in reservoirs from frequent reservoir elevation changes. Minor, beneficial effects to vegetation at all reservoirs except Cougar from spring refills controlling invasive species establishment.	Major, adverse effects to from increased potential for invasive colonization of bare sediments exposed by deep drawdowns. Major, adverse effects to vegetation in reservoirs from frequent reservoir elevation changes allowing for establishment of invasive-dominated plant communities. Minor adverse effects to vegetation if reservoirs are unable to refill during the 30-year implementation timeframe.
Wildfire Recovery and Fine Fuels	Analysis area forests would continue to recover; no effect on establishment of fine fuels in reservoir or downstream areas from USACE operations.	Same as No-action Alternative.	Same as No-action Alternative.	Same as No-action Alternative.	Same as No-action Alternative.
Special-Status Plant Species	Minor, adverse effects to vegetation from frequent reservoir water elevation changes for special-status species. Negligible effects to special-status species from landslide activity. Negligible effect to wapato.	Moderate, adverse effects to special-status species from spring refill potential to inhibit species establishment. Minor, adverse effects to special-status species from frequent reservoir water elevation changes. Negligible effects to special-status species from landslide activity. Major, beneficial effects to habitat from gravel augmentation. Moderate, adverse effects to special-status species and wapato from use of power and inactive pools.	Moderate, adverse effects to special-status species at all reservoirs except, Cougar Reservoir from spring refill potential to inhibit species establishment. Minor, adverse effects to special-status species from frequent reservoir water elevation changes. Minor, adverse effects to special-status species from potential plant community burial from landslide activity because of drawdowns at Green Peter and Cougar Reservoirs. Major, beneficial effects to habitat from gravel augmentation. Moderate, adverse effects to special-status species and wapato from use of power and inactive pools.	Negligible effects from removal of hydropower infrastructure and cessation of hydropower generation. Moderate, adverse effects to special-status species at all reservoirs except Cougar Reservoir from spring refill potential to inhibit species establishment. Minor, adverse effects to special-status species from frequent reservoir water elevation changes. Minor, adverse effects to special-status species from potential plant community burial from landslide activity because of drawdowns at Green Peter and Cougar Reservoirs. Major, beneficial effects to habitat from gravel augmentation. Moderate, adverse effects to special-status species and wapato from use of power and inactive pools.	Minor, adverse effects to special status species habitat from deep drawdowns. Minor, adverse effects to special status vegetation habitat in reservoirs from frequent reservoir elevation changes.
Ecoregions	Negligible	Major, beneficial effects from gravel augmentation.	Major, beneficial effects from gravel augmentation.	Negligible effects from removal of hydropower infrastructure and cessation of hydropower generation. Major, beneficial effects from gravel augmentation.	Negligible effects from interim operations.

Table 3.6-4 in the FEIS

[1] The duration of all effects is the 30-year implementation timeframe.

3.6.3.5 Alternatives Analyses

Effects discussions for alternatives other than Alternative 6 and the Interim Operations are in the FEIS and incorporated by reference. A summary of the effects for all alternatives is in Table 3-17.

Alternative 6 – Ceasing Federal Hydropower Operations

Alternative 6 operations would have moderate adverse effects to vegetation as compared to the NAA. Under Alternative 6 the decommissioning and/or removal of hydropower infrastructure and cessation of hydropower generation would not affect vegetation within the Willamette Valley System because all activities would occur within existing infrastructure. Decommissioning of hydropower would not alter ecological processes associated with vegetation growth and succession. Additionally, Alternative 6 would replace the refined integrated temperature and habitat flow regime with the 2008 Biological Opinion mainstem and tributary flow management regime with the addition of temperature pulses as outlined in Measure 30b. Adoption of these flow pulses would have moderate adverse effects to vegetation as compared to the NAA.

3.6.4 Interim Operations under All Action Alternatives Except Alternative 1

This section is incorporated by reference with the following addition pertaining to the deep drawdown at Detroit Reservoir and adoption of 2008 Biological Opinion flows:

A winter deep drawdown at Detroit Reservoir could have minor adverse effects on reservoir adjacent vegetation. A deep drawdown of Detroit would increase the risk of lower summer pool elevations during dry years resulting in less water available to reservoir adjacent vegetation communities during the growing season. Additionally, lowered summer pool elevations during dry years would lead to increased exposed bare sediments along the periphery of the reservoir. These sediments would be susceptible to invasive plant species colonization which could have major adverse effects on invasive vegetation presence within Detroit reservoir.

3.6.5 Climate Change Effects under All Alternatives

Incorporated by reference. This section was not updated to include Alternative 6. Prior to the release of this SEIS, Executive Order 14154 “Unleashing American Energy” was issued. Consistent with this Executive Order, a greenhouse gas analysis is not included here; however, this SEIS is consistent with the NEPA statute and existing agency regulations pertaining to air quality and emissions.

3.7 Wetlands

3.7.1 Introduction

Incorporated by reference.

3.7.2 Affected Environment

Incorporated by reference.

3.7.3 Environmental Consequences

This section discusses the effects of Alternative 6 and the Interim Operations, which include the Detroit drawdown and adoption of 2008 Biological Opinion flows on wetlands. The discussion incorporates the methodology used to assess effects by reference, and summarizes the anticipated effects (Table 3-18).

3.7.3.1 Construction and Routine and Non-routine Maintenance Activities

Incorporated by reference.

3.7.3.2 Methodology

Incorporated by reference. A summary of the effects for all alternatives is in Table 3-18.

Table 3-18. Summary of Effects to Wetlands as Compared to the No-Action Alternative.

Effect Category	No-action Alternative	Alternative 1	Alternative 2A	Alternative 2B	Alternative 3A	Alternative 3B
Reservoir-adjacent Wetlands	Minor, adverse effects from frequent seasonally uncharacteristic water level fluctuations inhibiting native plant establishment and favoring conditions which allow for establishment of invasive-dominated plant communities. Minor, beneficial effects to plant growth and biomass accumulation from high reservoir levels during the growing season. Negligible effects to wetlands from the potential for induced landslides.	Minor, adverse effects from frequent seasonally uncharacteristic water level fluctuations inhibiting native plant establishment and favoring conditions which allow for establishment of invasive-dominated plant communities. Minor, beneficial effects to plant growth and biomass accumulation from high reservoir levels during the growing season. Negligible effects to wetlands from the potential for induced landslides.	Minor, adverse effects from frequent seasonally uncharacteristic water level fluctuations inhibiting native plant establishment and favoring conditions which allow for establishment of invasive-dominated plant communities. Minor, beneficial effects to plant growth and biomass accumulation from high reservoir levels during the growing season. Negligible effects from potential for reservoir to not refill. Minor, adverse effects from the potential for induced landslides at Green Peter Reservoir from fall and spring drawdowns.	Minor, adverse effects from frequent seasonally uncharacteristic water level fluctuations inhibiting native plant establishment and favoring conditions which allow for establishment of invasive-dominated plant communities. Minor, beneficial effects to plant growth and biomass accumulation from high reservoir levels during the growing season at reservoirs where refill is achieved. Moderate, adverse effects to wetlands at Cougar Reservoir if reservoir is not refilled. Moderate, adverse effects from the potential for induced landslides at Green Peter and Cougar Reservoirs from fall and spring drawdowns.	Minor, adverse effects from frequent seasonally uncharacteristic water level fluctuations inhibiting native plant establishment and favoring conditions which allow for establishment of invasive-dominated plant communities. Minor, beneficial effects to plant growth and biomass accumulation from high reservoir levels during the growing season at reservoirs where refill is achieved. Moderate, adverse effects to wetlands at Cougar, Lookout Point, and Detroit Reservoirs if unable to refill. Moderate, adverse effects from the potential for induced landslides at Green Peter, Lookout Point, Detroit, and Cougar Reservoirs from fall and spring drawdowns.	Minor, adverse effects from frequent seasonally uncharacteristic water level fluctuations inhibiting native plant establishment and favoring conditions which allow for establishment of invasive-dominated plant communities. Minor, beneficial effects to plant growth and biomass accumulation from high reservoir levels during the growing season at reservoirs where refill is achieved. Moderate, adverse effects to wetlands at Cougar, Hills Creek, and Green Peter Reservoirs if unable to refill. Moderate, adverse effects from the potential for induced landslides at Green Peter, Lookout Point, Detroit, Hills Creek, and Cougar Reservoirs from fall and spring drawdowns.
Downstream-adjacent Wetlands	Negligible effects from flow operations. Major, adverse effects from limited floodplain connectivity.	Negligible effects from flow operations. Major, adverse effects from limited floodplain connectivity. Major, beneficial effects from connectivity improvements from gravel bars. Improved revetments may improve the native riparian seedbank.	Minor, beneficial effects from increased summer flows. Minor, adverse effects from lower spring flows. Major, adverse effects from limited floodplain connectivity. Major, beneficial effects from connectivity improvements from gravel bars. Improved revetments may improve the native riparian seedbank. Negligible effects from sediment releases.	Minor, beneficial effects from increased summer flows. Minor, adverse effects from lower spring flows in dry years. Major, adverse effects from limited floodplain connectivity. Major, beneficial effects from connectivity improvements from gravel bars. Improved revetments may improve the native riparian seedbank. Negligible effects from sediment releases.	Moderate, adverse effects from lowered reservoir levels in summer and fall preventing flow operations. Minor benefit to wetlands from spring water releases during dry years. Major, adverse effects from limited floodplain connectivity. Major, beneficial effects from connectivity improvements from gravel bars. Improved revetments may improve the native riparian seedbank. Negligible effects from sediment releases.	Moderate, adverse effects from lowered reservoir levels in summer and fall preventing flow operations. Major, adverse effects from limited floodplain connectivity. Major, beneficial effects from connectivity improvements from gravel bars. Improved revetments may improve the native riparian seedbank. Negligible effects from sediment releases.

Effect Category	No-action Alternative	Alternative 1	Alternative 2A	Alternative 2B	Alternative 3A	Alternative 3B
Invasive and Noxious Weed Presence	Minor, adverse effects in reservoirs from frequent seasonally uncharacteristic reservoir elevation changes that increase the potential for the establishment of invasive dominated plant communities.	Major, adverse effects from increased potential for invasive establishment from frequent seasonally uncharacteristic reservoir elevation changes and deep drawdowns. Minor, beneficial effects from spring refills controlling invasive species establishment.	Major, adverse effects from increased potential for invasive establishment from frequent seasonally uncharacteristic reservoir elevation changes and deep drawdowns. Minor beneficial effects from spring refills controlling invasive species establishment. Potential for increased adverse effects because of deep drawdowns at reservoirs.	Major, adverse effects from increased potential for invasive establishment from frequent seasonally uncharacteristic reservoir elevation changes and deep drawdowns. Minor, beneficial effects in all reservoirs except Cougar Reservoir from spring refills controlling invasive species establishment. Potential for increased adverse effects because of deep drawdowns at reservoirs.	Major, adverse effects from increased potential for invasive establishment from frequent seasonally uncharacteristic reservoir elevation changes and deep drawdowns. Minor, beneficial effects in all reservoirs except Cougar, Lookout Point, and Detroit Reservoirs from spring refills controlling invasive species establishment. Potential for increased adverse effects because of deep drawdowns at reservoirs.	Major, adverse effects from increased potential for invasive establishment from frequent seasonally uncharacteristic reservoir elevation changes and deep drawdowns. Minor, beneficial effects in all reservoirs except Hills Creek, Cougar, and Green Peter Reservoirs from spring refills controlling invasive species establishment. Potential for increased adverse effects because of deep drawdowns at reservoirs.

Table 3-18. Summary of Effects to Wetlands as Compared to the No-Action Alternative (continued).

Effect Category	No-action Alternative	Alternative 4	Alternative 5	Alternative 6	Interim Operations
Reservoir-adjacent Wetlands	Minor, adverse effects from frequent seasonally uncharacteristic water level fluctuations inhibiting native plant establishment and favoring conditions which allow for establishment of invasive-dominated plant communities. Minor, beneficial effects to plant growth and biomass accumulation from high reservoir levels during the growing season. Negligible effects to wetlands from the potential for induced landslides.	Minor, adverse effects from frequent seasonally uncharacteristic water level fluctuations inhibiting native plant establishment and favoring conditions which allow for establishment of invasive-dominated plant communities. Minor, beneficial effects to plant growth and biomass accumulation from high reservoir levels during the growing season. Negligible effects from potential for reservoir to not refill. Negligible effects to wetlands from the potential for induced landslides.	Minor, adverse effects from frequent seasonally uncharacteristic water level fluctuations inhibiting native plant establishment and favoring conditions which allow for establishment of invasive-dominated plant communities. Minor, beneficial effects to plant growth and biomass accumulation from high reservoir levels during the growing season at reservoirs where refill is achieved. Moderate, adverse effects to wetlands at Cougar Reservoir if reservoir is unable to refill. Moderate, adverse effects from the potential for induced landslides at Green Peter and Cougar Reservoirs from fall and spring drawdowns.	Negligible effects from removal of hydropower infrastructure and cessation of hydropower generation. Minor, adverse effects from frequent seasonally uncharacteristic water level fluctuations inhibiting native plant establishment and favoring conditions which allow for establishment of invasive-dominated plant communities. Minor, beneficial effects to plant growth and biomass accumulation from high reservoir levels during the growing season at reservoirs where refill is achieved. Moderate, adverse effects to wetlands at Cougar Reservoir if reservoir is unable to refill. Moderate, adverse effects from the potential for induced landslides at Green Peter and Cougar Reservoirs from fall and spring drawdowns.	Minor, adverse effects in dry years from Detroit drawdown reducing potential for spring/summer refill which would reduce water available to wetland plant communities during the growing season. Minor, adverse effects from frequent seasonally uncharacteristic water level fluctuations inhibiting native plant establishment and favoring conditions which allow for establishment of invasive-dominated plant communities. Minor, beneficial effects to plant growth and biomass accumulation from high reservoir levels during the growing season. Minor adverse effects to wetlands if reservoirs are unable to refill during summer months resulting in wetlands transitioning to uplands. Minor, adverse effects from the potential for induced landslides at Green Peter Reservoir from fall and spring drawdowns.

Effect Category	No-action Alternative	Alternative 4	Alternative 5	Alternative 6	Interim Operations
Downstream-adjacent Wetlands	Negligible effects from flow operations. Major, adverse effects from limited floodplain connectivity.	Negligible effects from flow operations. Major, adverse effects from limited floodplain connectivity. Major, beneficial effects from connectivity improvements from gravel bars. Improved revetments may improve the native riparian seedbank.	Minor, beneficial effects from increased summer flows. Major, adverse effects from limited floodplain connectivity. Major, beneficial effects from connectivity improvements from gravel bars. Improved revetments may improve the native riparian seedbank. Negligible effects from sediment releases.	No effects from removal of hydropower infrastructure and cessation of hydropower generation. Minor, beneficial effects from increased summer flows. Major, adverse effects from limited floodplain connectivity. Major, beneficial effects from connectivity improvements from gravel bars. Improved revetments may improve the native riparian seedbank. Negligible effects from sediment releases.	Negligible effects from flow operations. Major, adverse effects from limited floodplain connectivity.
Invasive and Noxious Weed Presence	Minor, adverse effects in reservoirs from frequent seasonally uncharacteristic reservoir elevation changes that increase the potential for the establishment of invasive dominated plant communities.	Major, adverse effects from increased potential for invasive establishment from frequent seasonally uncharacteristic reservoir elevation changes and deep drawdowns. Minor, beneficial effects from spring refills controlling invasive species establishment.	Major, adverse effects from increased potential for invasive establishment from frequent seasonally uncharacteristic reservoir elevations changes and deep drawdowns. Minor, beneficial effects in all reservoirs except Cougar Reservoir from spring refills controlling invasive species establishment. Potential for increased adverse effects because of deep drawdowns at reservoirs.	Negligible effects from removal of hydropower infrastructure and cessation of hydropower generation. Major, adverse effects from increased potential for invasive establishment from frequent seasonally uncharacteristic reservoir elevations changes and deep drawdowns. Minor, beneficial effects in all reservoirs except Cougar Reservoir from spring refills controlling invasive species establishment. Potential for increased adverse effects because of deep drawdowns at reservoirs.	Major, adverse effects to from increased potential for invasive colonization of bare sediments exposed by drawdowns at Detroit Reservoir. Major, adverse effects from increased potential for invasive establishment from frequent seasonally uncharacteristic reservoir elevation changes and deep drawdowns. Minor beneficial effects from spring refills controlling invasive species establishment. Potential for increased adverse effects because of deep drawdowns at reservoirs.

Table 3.7-3 in the FEIS

3.7.3.3 Alternatives Analyses

Effects discussions for alternatives other than Alternative 6 and the Interim Operations are in the FEIS and incorporated by reference. A summary of the effects for all alternatives is in Table 3-18.

Alternative 6 – Ceasing Federal Hydropower Operations

Effects to wetlands under Alternative 6 would have moderate adverse effects to wetlands as compared to the NAA due to potential for reservoirs to not refill and increased potential for slope failures from drawdowns.

Under Alternative 6 the decommissioning of hydropower infrastructure and cessation of hydropower generation would have a negligible effect on wetlands within the Willamette Valley System because all activities would occur within existing infrastructure. Decommissioning of hydropower would not fundamentally alter ecological processes associated with wetlands.

3.7.4 Interim Operations under All Action Alternatives Except Alternative 1

This section is incorporated by reference with the following addition pertaining to the deep drawdown at Detroit Reservoir, and adoption of the interim flow operations:

A fall deep drawdown at Detroit reservoir would contribute to additional minor adverse effects to reservoir-adjacent wetland vegetation communities in dry years as it reduces the potential for spring/summer reservoir refill and reduces available water for wetland plant communities during the growing season. A deep drawdown of Detroit would increase the risk of lower summer pool elevations during dry years by exposing bare sediments along the periphery of the reservoir. These sediments would be susceptible to colonization by invasive plant species which could have major adverse effects on wetland vegetation community composition at Detroit reservoir. Some minor beneficial effects to biomass accumulation and invasive species control may result from higher reservoir elevations during the growing season and spring refill respectively.

3.7.5 Climate Change under All Alternatives

Incorporated by reference. This section was not updated to include Alternative 6. Prior to the release of this SEIS, Executive Order 14154 “Unleashing American Energy” was issued. Consistent with this Executive Order, a greenhouse gas analysis is not included here; however, this SEIS is consistent with the NEPA statute and existing agency regulations pertaining to air quality and emissions.

3.8 Fish and Aquatic Habitat

3.8.1 Introduction

Incorporated by reference.

3.8.2 Affected Environment

Incorporated by reference.

3.8.3 Environmental Consequences

This section discusses the potential effects of the Alternative 6 and Interim Operations on fish and habitat, including effects within each subbasin. The discussion incorporates the methodology used to assess effects by reference and summarizes the anticipated effects.

3.8.3.1 Methodology

Incorporated by reference.

3.8.3.2 Alternatives Analyses

Incorporated by reference.

Construction and Routine and Non-routine Maintenance under All Alternatives

Incorporated by reference.

Pollutants under All Alternatives

Incorporated by reference.

Aquatic Vegetation under All Alternatives

Incorporated by reference.

Aquatic Habitat Connectivity under All Alternatives

Incorporated by reference.

Streambank Modifications under All Alternatives

Incorporated by reference.

No-action Alternative

The analyses for the No-Action Alternative are incorporated by reference. FEIS Tables 3.8-13 through 3.8-18 contain a summary of attributes for all alternatives. Model results were not available for Alternative 6 and the Interim Operations. As a result, the following notes apply for each table:

FEIS Table 3.8-13 Summary of Attributes for Upper Willamette River Chinook Salmon in the North Santiam River Subbasin under All Alternatives: Due to similarities in the alternatives, attributes for Alternative 6 are expected to be similar to or slightly lower performing than Alternative 5. Attributes for the Interim Operations are expected to be similar to Alternative 3B.

FEIS Table 3.8-14: Due to similarities in the alternatives, attributes for Alternative 6 are expected to be similar to or slightly lower performing than Alternative 5. Attributes for the Interim Operations are expected to be similar to Alternative 2A.

FEIS Table 3.8-15: Due to similarities in the alternatives, attributes for Alternative 6 are expected to be similar to slightly lower performing than Alternative 5. Attributes for the Interim Operations are expected to be similar to slightly improved performance compared to the NAA.

FEIS Table 3.8-16: Due to similarities in the alternatives, attributes for Alternative 6 are expected to be similar to slightly lower performing than Alternative 5. Attributes for the Interim Operations are expected to be similar to Alternative 3B.

FEIS Table 3.8-17: Due to similarities in the alternatives, attributes for Alternative 6 are expected to be similar to slightly lower performing than Alternative 5. Attributes for the Interim Operations are expected to be similar to Alternative 3B.

FEIS Table 3.8-18: Due to similarities in the alternatives, attributes for Alternative 6 are expected to be similar to slightly lower performing than Alternative 5. Attributes for the Interim Operations are expected to be similar to Alternative 2A.

Alternative 1—Improve Fish Passage through Storage-focused Measures

Incorporated by reference.

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

Incorporated by reference.

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

Incorporated by reference.

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

Incorporated by reference.

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

Incorporated by reference.

Alternative 4—Improve Fish Passage with Structures-based Approach

Incorporated by reference.

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

Incorporated by reference.

Alternative 6—Ceasing Federal Hydropower Operations Alternative

Under Alternative 6, effects on habitat availability for fish would vary by river reach, species, life stage, and time of year. The majority of downstream migrating fish entering reservoir forebays near the water surface (i.e. surface-oriented), like juvenile spring Chinook salmon and steelhead, would be collected and passed downstream via structural downstream passage improvements at Detroit, Foster, and Lookout Point dams. Some resident fish and a small portion of the migratory surface-oriented fish would pass through the penstocks modified with cone valves or in-line orifices installed in place of turbines. Based on available information, fish passing downstream through cone valves and in-line orifices will experience high mortality. In addition, fish will be exposed to high TDG levels below dams modified with cone valves and in-line orifices.

Effects to fish species, including threatened and endangered species, would generally be the same as those described under Alternative 2B. However, compared to Alternative 2B, Alternative 6 would decrease downstream fish passage survival and increase impacts from high total dissolved gas discharged below hydropower dams where cone vales or in-line orifices are installed in place of turbines. In addition, effects to fish species below dams in dry years under Alternative 6 would be similar to the NAA in the North Santiam Subbasin.

Hatchery Mitigation in All Subbasins

The Willamette Hatchery Mitigation Program and associated effects would be the same under Alternative 6 as described under the NAA with the following exceptions:

- Alternative 6 operations would include adjustments to the number of hatchery-origin UWR Chinook salmon released upstream of some reservoirs.
- There would be a reduction in adverse impacts on UWR steelhead in the North Santiam River and South Santiam River Subbasins from hatchery-origin summer-run steelhead spawning in streams.
- There would be a reduction in adverse impacts on UWR Chinook salmon from hatchery-origin spring-run Chinook salmon spawners.
- There would be risks to bull trout from the rainbow trout hatchery program.

Under Alternative 6, Chinook salmon (hatchery-origin and natural-origin) adults would be released upstream of Green Peter Dam. The average proportion of hatchery-origin spawners, or pHOS, in all subbasins would decrease similar to Alternative 2B when compared to the NAA, although there would be some variability between years. This moderate reduction in adverse effects of pHOS would result from improved fish passage conditions, subsequent increases in natural-origin adult Chinook salmon, and commensurate decreases in pHOS in these subbasins as compared to NAA operations.

The percent of introgressive hybridization (transfer of genetic material from one species into another) in UWR steelhead in the North Santiam River and South Santiam River Subbasins would decrease as compared to the NAA because improved fish passage at dams in these subbasins under Alternative 6 operations would increase the abundance of UWR steelhead spawners. Improved passage would also increase areas where only natural-origin steelhead are spawned and reared (above dams), reducing competition and predation in the subbasins with hatchery summer steelhead (below dams). This would be a direct, moderate benefit to steelhead populations in the analysis area.

Conversely, unlike NAA operations, there would be slight to moderate adverse effects on bull trout from the rainbow trout hatchery program under Alternative 6. Deep reservoir drawdowns in spring and fall under Alternative 6 would increase the number of bull trout moving downstream of Cougar Dam in the McKenzie River Subbasin. This would increase the likelihood of incidental catch, misidentification, and poaching of bull trout from sport fishing for hatchery-released rainbow trout occurs in the analysis area as compared to NAA operations (USFWS 2008).

Reservoir/Lake-like Habitat in All Subbasins

Lake-like habitat refers to an aquatic environment that shares characteristics commonly associated with lakes. These habitats are typically large, still or slow-moving bodies of water that are relatively deep compared to other freshwater systems like ponds or wetlands. Lake-like habitats can support a diverse range of organisms and are often characterized by distinct zones, such as the littoral (nearshore), limnetic (open water), and benthic (bottom) zones.

Under Alternative 6, effects of reservoir operations on fish would be similar to Alternative 2B, providing a range of littoral (nearshore) and open water habitat conditions for fish, depending on species and lifestage, that varies with seasonal reservoir fluctuations. Comparatively, differences in water surface elevations and fluctuations may occur at the local level and in the short term at all WVS dams, including Green Peter and Cougar dams, depending on annual or seasonal hydrologic and meteorologic conditions and dam operations. In dry years, reservoir volumes would decrease to their lowest annual levels sooner under Alternative 6 compared to Alternative 2B due to differences in minimum flow targets, however, the effects on fish would remain similar. Effects of deep fall drawdowns of Green Peter Reservoir and Cougar Reservoirs would decrease the availability of reservoir habitat, resulting in adverse effects for species and life stages dependent on lake-like habitat, and beneficial effects for migratory species that prefer riverine habitat. Deep fall drawdowns at Green Peter Reservoir and Cougar Reservoir would result in substantially less open water habitat (lower water surface elevation and volume) and increased turbidity in late fall as compared to the NAA. The substantial, adverse effect of reduced reservoir habitat volume would increase competition and predation during fall and winter months and reduce water temperature stratification, decreasing habitat diversity.

Seasonal reductions in open water habitat would support persistence of some resident fish species; however, at a reduced level of abundance. Overall, there would be a moderate to substantial, adverse effect on resident fish species that are dependent on lake-like habitat.

Migratory species, including UWR Chinook salmon and steelhead, would benefit from reduced reservoir pool volumes, including reductions in predation from reduced resident fish abundance, disease risk, and travel times migrating through reservoirs. However, high growth rates of migratory fish in reservoirs may be reduced, depending on the annual hydrologic conditions, reservoir operating schedule, and the length of time fish reside in reservoirs. Resident species that prefer riverine habitat and can find adequate habitat upstream or downstream of dams during the deep drawdowns would also benefit under Alternative 6.

In the McKenzie River Subbasin, Alternative 6 would increase riverine habitat connectivity for bull trout in the South Fork McKenzie River, and conversely result in higher risk for bull trout from the rainbow trout hatchery program. Deep reservoir drawdowns in spring and fall would increase the number of bull trout moving downstream of Cougar Dam in the McKenzie River Subbasin. This would allow bull trout residing in Cougar Reservoir to move downstream into riverine habitat in the McKenzie River Subbasin, and would also increase the likelihood of incidental catch, misidentification, and poaching of bull trout from sport fishing for hatchery-released rainbow trout occurs in the analysis area (USFWS 2008).

Riverine Habitat in All Subbasins

Under Alternative 6, operations and management of bank protection structures in the analysis area would have similar effects on fish as described under Alternative 2B.

Unlike NAA operations, gravel placement below dams would decrease adverse effects of blocked sediment transport from the above dam watersheds. As a result, effects on fish in riverine habitat below WVS dams from these operations would trend toward less adverse as compared to the NAA.

Flow

Under Alternative 6, indirect effects of flow below WVS dams on fish due to operations of dams and reservoirs would be similar to those described under Alternative 2B except in dry years. In dry years, effects to fish species below dams in the North Santiam and Middle Fork Subbasins would be similar to the NAA.

Stranding Risk

Under Alternative 6, hydropower peaking operations would stop, reducing the frequency in daily fluctuations in flows below Detroit, Green Peter and Lookout Point dams. Peaking operations effect river and pool elevations between these dams downstream approximately 2-5 miles downstream, a relatively small percentage of the total habitat available in these subbasins. Other operational changes in discharges would be similar to the NAA because established down-ramping rates would be similar to those described under the NAA. Therefore, stranding risks to fish below WVS dams would be the same as or reduced under Alternative 6 compared to the NAA.

Materials Transport and Habitat Complexity

Under Alternative 6, effects on habitat complexity and food production would be the same as described under the NAA and Alternative 2A. However, gravel placement below dams under Alternative 6 would reduce the adverse effects of blocked sediment transport from above dams under NAA operations. Additionally, deep drawdowns of Cougar Reservoir would also result in short-term sediment transport and deposition similar to that observed at Fall Creek during deep reservoir drawdowns, with the largest volumes being transported in the first few years of the operations, and then lesser amounts in subsequent years.

Water Temperature

Indirect effects from water temperatures on fish in river reaches below Detroit and Big Cliff Dams in the North Santiam River Subbasin under Alternative 6, and on fish held in or released below hatcheries or adult fish facilities below WVS dams, would be slightly to moderately beneficial compared to the NAA. The benefits are due to reduced temperature-related stress in the North Santiam River Subbasin below Detroit and Big Cliff Dams, depending on species and life stage, resulting from operation of a selective withdrawal structure at Detroit Dam.

Indirect adverse effects on all fish from temperature-related stress would be similar to those described under Alternative 2A below Green Peter and Foster dams in the South Santiam River Subbasin.

Indirect effects on fish in river reaches below Cougar Dam in the McKenzie River Subbasin, and on fish held in or released below hatcheries or adult fish facilities in the McKenzie Subbasin would be slightly more adverse to slightly more beneficial as compared to the NAA because of changes in water quality from deep reservoir drawdowns in spring and fall, depending on the hatchery facility location, species and lifestage.

Indirect effects on all fish from continued adverse water temperature conditions in the Middle Fork Willamette River, Coast Fork Willamette River, and Long Tom River Subbasins and the Mainstem Willamette River would be the same as those described under the NAA (Section 3.5, Water Quality, Subsection 3.5.3.2, Alternatives Analyses, Alternative 2B).

Total Dissolved Gas

Under Alternative 6, effects to water quality from TDG would be more adverse in the North Santiam River Subbasin, South Santiam River Subbasin and Middle Fork Subbasin (except below Fall Creek Dam) (Section 3.5, Water Quality, Subsection 3.5.3.2, Alternatives Analyses, Alternative 6). The increase in TDG exceedance of the water quality standard would be due to flow passing through a modified penstock. Further, TDG exceedance of the water quality standard would occur downstream of Green Peter and Foster dams due to an increase in spill operations at Green Peter Dam in the spring (fish passage operation) and summer (temperature management operation). There would be an increase in indirect, adverse effects to fish in the North Santiam, South Santiam River, and Middle Fork Subbasins from TDG-related impacts under Alternative 6 as compared to NAA operations.

Under Alternative 6, there would be an adverse effect to water quality from TDG in the McKenzie River Subbasin. However, there would be an improvement to water quality because, although TDG levels would exceed the 110 percent TDG water quality standard, the average number of days above 110 percent annually would be fewer as compared to the NAA. Improvements in TDG would reduce risks to fish species in the McKenzie River Subbasin. As a result, there would be a reduction in indirect, adverse effects to fish in the McKenzie Subbasin from TDG-related impacts under Alternative 6 as compared to NAA operations.

Indirect, adverse effects to fish in the Middle Fork Willamette River Subbasin below Fall Creek Dam, and in the Coast Fork Willamette River, and Long Tom River Subbasins and the Mainstem Willamette River would be the same as those described under the NAA from TDG-related impacts under Alternative 6 as compared to NAA operations because effects on water quality from TDG in these areas would be the same as those described under the NAA.

Turbidity

Under Alternative 6, Indirect effects to fish species would be the same as those described under Alternative 1 in the North Santiam River Subbasin and Middle Fork Willamette River Subbasin because effects on water quality from turbidity would be same as those described under Alternative 1 in these subbasins (Section 3.5, Water Quality, Subsection 3.5.3.2, Alternatives Analyses, Alternative 1).

Effects on water quality from turbidity in the South Santiam River Subbasin under Alternative 6 would be same as those described under Alternative 2B (Section 3.5, Water Quality, Subsection 3.5.3.2, Alternatives Analyses, Alternative 2B). Therefore, indirect effects on fish species would be the same as those described under Alternative 2B.

In the McKenzie River Basin effects on water quality from turbidity would also be the same as those described under Alternative 2B. However, operations under Alternative 6 would cause an increase in sediment and turbidity levels downstream of Cougar Reservoir because of deeper drawdowns to near original streambed elevations, increasing bank erosion and sloughing as compared to NAA operations. Most fine-grained sediment would pass through Cougar

Reservoir and be transported downstream, likely resulting in seasonal increased turbidity downstream during deeper drawdowns compared to the NAA (Section 3.5, Water Quality, Subsection 3.5.3.2, Alternatives Analyses, Alternative 2B).

As a result of the deep reservoir drawdowns, sediment discharged below Cougar Dam would increase, resulting in short-term, moderate, adverse effects on all life stages of fish residing downstream from increased turbidity levels as compared to the NAA in the first few years of operations. In the long term, slight, adverse effects would occur in subsequent years due to a reduction in the amount of sediment and turbidity. Indirect effects on fish species from turbidity would also be substantially adverse downstream of Cougar Reservoir in the McKenzie River Subbasin under Alternative 2B.

Alternative 6 effects on water quality from turbidity would be the same as described under NAA operations in the Coast Fork Willamette River Subbasin and Long Tom River Subbasin (Section 3.5, Water Quality, Subsection 3.5.3.2, Alternatives Analyses, No-action Alternative). Indirect effects on fish species would be the same as those described under NAA operations.

Impacts to water quality from turbidity in the Mainstem Willamette River would be slightly more adverse than those described under the NAA. This would be due to deeper drawdowns in multiple WVS reservoirs, increasing turbidity downstream of these dams. These adverse effects would be re-occurring over the 30-year implementation timeframe during deep drawdown operational periods (Section 3.5, Water Quality, Subsection 3.5.3.2, Alternatives Analyses, Alternative 2B). Subsequent, indirect, adverse effects on fish species from turbidity-related impacts in the mainstem would be slight to moderate under Alternative 2B.

Alternative 6 indirect effects to fish from high turbidity would be minor to substantial during the fall and early winter drawdown period each year as compared to NAA operations. Indirect effects on fish habitat from fine sediment transport and deposition would be minorly beneficial to moderately adverse, depending on species and life stage.

Other Riverine Habitat Conditions in All Subbasins

Under Alternative 6, direct and indirect adverse effects on resident fish species entrained downstream during fall drawdowns would be the same as those described under the NAA. Downstream habitat competition and predation for fish present downstream would continue as described under the NAA.

Partial deep drawdowns of Green Peter Reservoir and Cougar Reservoir would increase entrainment of resident fish species below dams in the South Santiam River Subbasin and McKenzie River Subbasin, respectively, resulting in increases in competition and predation for fish in river reaches below these dams. Operations would also continue to create localized conditions favoring fish that prefer rocky, steeply sloped shorelines with limited riparian vegetation, particularly near bank protection structures, as described under the NAA.

Dam Passage Conditions in All Subbasins

Upstream Passage

Under Alternative 6, effects on upstream migrating fish would be the same as Alternative 1 but there will be increased indirect adverse effects due to high TDG below Detroit and Big Cliff dams in the North Santiam Subbasin, below Green Peter and Foster dams in the South Santiam River Subbasin, below Cougar Dam in the McKenzie River Subbasin, and below Dexter Dam in the Middle Fork River Subbasin. Adult fish facilities are located within the tailraces of these dams or downstream of the tailrace but within a distance directly affected by dam release conditions. Upstream migrating adult fish in these areas will more often be exposed to high TDG at these locations, typically for short durations however some individuals may hold in tailraces longer. Effects on adult fish from high TDG will vary by time of year and dam operations, and duration adult fish hold in dam tailrace areas. Alternative 6 would result in minor to moderate increases in adverse effects on adult upstream passage compared to the NAA.

Downstream Passage

Downstream passage conditions and associated effects on migratory and resident fish species under Alternative 6 would be similar as described under Alternative 2B.

Under Alternative 6, hydropower operations would cease at each hydropower dam, but the penstocks or intakes would be reconfigured to allow continued use of the outlets for releasing flows. The majority of fish migrating downstream into reservoir forebays and distributed near the water surface (i.e. surface-oriented), like juvenile spring Chinook salmon and steelhead, would be collected and passed downstream via structural downstream passage improvements at Detroit, Foster, and Lookout Point dams. Resident fish and a small portion of the surface-oriented fish would pass through the penstocks modified with cone valves or in-line orifices installed in place of turbines. Based on available information, fish passing downstream through cone valves and in-line orifices will experience high mortality (Appendix E, Fish and Aquatic Habitat Analyses, Part 3 – Supplemental WVS EIS Fish Benefit Workbook (FBW) Modeling Assumptions and Results). In addition, fish will be exposed to high TDG levels below dams modified with cone valves and in-line orifices.

Downstream passage at Cougar Dam under Alternative 6 would be provided operationally with a deep reservoir drawdown in the fall and spring to 25 feet over the diversion tunnel. The improved downstream dam passage through operations at Cougar Dam would result in direct, substantial reductions in adverse effects of dams on downstream fish passage compared to NAA operations.

Effects on resident fish under Alternative 6 would be the same as described under Alternative 2A throughout the analysis area, except in Cougar Reservoir more fish would be entrained or would migrate downstream in spring and fall when the reservoir is drawn down to 25 feet over the diversion tunnel. There would be mixed beneficial and adverse effects on non-migratory, resident fish species under Alternative 6 from an increase in downstream passage or entrainment at Cougar Dam compared to the NAA. Entrainment under Alternative 6 would force movement of individual fish from Cougar Reservoir in spring and fall. Indirect effects would occur to fish residing in reaches downstream of Cougar Dam, which would be slightly to moderately adversely affected by increased competition with, or predation by, fish entrained downstream from Cougar Reservoir.

While these improvements would directly benefit migrating and resident fish in the North Santiam River Subbasin, South Santiam River Subbasin, McKenzie River Subbasin, and Middle Fork Willamette River Subbasin as compared to NAA operations, upstream and downstream passage would remain adverse under Alternative 6.

Upper Willamette River Chinook Salmon and Steelhead

Effects from reservoir habitat, riverine habitat, and fish passage conditions would result in direct, moderate to substantial, adverse effects on UWR Chinook salmon and UWR steelhead under Alternative 6 compared to the NAA.

Reservoir/Lake-like Habitat in All Subbasins

Under Alternative 6, effects to UWR Chinook salmon and UWR steelhead would be the same as under Alternative 2B. In the McKenzie River Subbasin, there would be a moderate increase in adverse effects on UWR Chinook salmon from reduced in-reservoir rearing and foraging habitat from deep fall and spring drawdowns of Cougar Reservoir. However, there would be slight to moderate, beneficial effects from differences in competition, predation, and potential disease effects due to shifts in rearing locations for juvenile Chinook salmon from within Cougar Reservoir to below Cougar Dam in the McKenzie River Subbasin and Mainstem Willamette River as compared to NAA operations.

The Cougar Reservoir deep drawdowns to 25 feet over the diversion tunnel each spring and fall would substantially reduce the reservoir volume annually with limited opportunity to refill after the spring drawdown. These operations would reduce open water habitat availability and availability of seasonal vegetated nearshore areas resulting in a direct, substantial adverse effect on salmon species.

A large portion of Chinook salmon migrating downstream annually into the small remaining reservoir would proceed to emigrate downstream of Cougar Dam through the diversion tunnel in spring. For those remaining or entering the reservoir after the spring drawdown, competition and predation would increase compared to the NAA, along with food availability, in part due to turbidity and a smaller reservoir volume under Alternative 6.

Water temperatures would also differ from NAA operations, particularly during summer, due to the decreased volume of water in the reservoir. Temperature differences would depend on the extent the pool refills after the spring drawdown; water temperatures would continue to stratify especially at larger pool volumes. Inflows into the reservoir from surrounding streams would continue to maintain availability of cool water for juvenile Chinook salmon.

Chinook salmon remaining in the reservoir until fall would then emigrate downstream from the reservoir during the fall drawdown. Effects of reservoir rearing would be similar to the NAA.

Riverine Habitat in All Subbasins

Effects on downstream habitat under Alternative 6 would be the similar to those described under Alternative 2B. Due to the similarity in results of modeling riverine habitat availability and survival below WVS dams for UWR Chinook salmon and UWR winter steelhead, modeling of Alternative 6 was not completed. Results for Alternative 6 would be expected to be similar to Alternative 2B, except in dry years. In dry years, effects to fish species below dams in the North Santiam and Middle Fork Subbasins would be similar to the NAA.

Dam Passage Conditions in All Subbasins

Under Alternative 6, effects on upstream migrating fish would be the same as Alternative 1 but there will be increased indirect adverse effects due to high TDG below Detroit and Big Cliff dams in the North Santiam Subbasin, below Green Peter and Foster dams in the South Santiam River Subbasin, below Cougar Dam in the McKenzie River Subbasin, and below Dexter Dam in the Middle Fork River Subbasin. Downstream fish passage conditions would be similar to Alternative 2B; however, downstream passage survival (Table 3-19) would be negatively impacted due to the installation of cone-valves and in-line orifices as previously described above under Dam Passage Conditions in All Subbasins.

Table 3-19. Average, Minimum, and Maximum Juvenile Upper Willamette River Chinook Salmon and Juvenile Upper Willamette River Steelhead Downstream Dam Passage Survival Estimates (Percentage) under Alternative 6.

Species and Dam	Average Survival Estimate (%)	Minimum Survival Estimate (%)	Maximum Survival Estimate (%)
Chinook Salmon			
Cougar	78	74	84
Detroit	82	81	85
Foster	74	72	77
Green Peter	41	29	63
Hills Creek	N/A	N/A	N/A
Lookout Point	92	91	94
Steelhead			
Detroit	89	85	91
Foster	74	72	75

Species and Dam	Average Survival Estimate (%)	Minimum Survival Estimate (%)	Maximum Survival Estimate (%)
Green Peter	18	11	22

Source: Fish Benefits Workbook model survival estimates from simulated operations for years 1947 to 2019; Appendix E, Fish and Aquatic Habitat Analyses, Chapter 2, Fish Benefits Workbook Results.

N/A = Not Applicable.

Population Performance in All Subbasins

Population performance of UWR Chinook salmon and UWR steelhead above WVS dams is expected to be similar to slightly lower than estimated for Alternative 2B. A decrease in downstream passage survival with installation of cone valves and in-line orifices is expected to slightly reduce population performance under Alternative 6 compared to Alternative 2B.

Bull Trout in the Upper Willamette River Basin

Reservoir/Lake-like Habitat in All Subbasins

Effects on bull trout subadults and adults rearing, foraging, and overwintering in reservoirs under Alternative 6 would be the same as described under Alternative 2B.

Riverine Habitat in All Subbasins

Effects on bull trout downstream of dams under Alternative 6 would be similar to Alternative 2B but there will be increased indirect adverse effects due to high TDG below Detroit and Big Cliff dams in the North Santiam Subbasin, below Green Peter and Foster dams in the South Santiam River Subbasin, below Cougar Dam in the McKenzie River Subbasin, and below Dexter Dam in the Middle Fork River Subbasin. There will be flow and water quality variation in comparison due to differences in downstream minimum flow targets included in Alternative 6 compared to Alternative 2B, which will result in somewhat high spring and summer minimum flows and somewhat lower fall minimum flows; however, these changes are not expected to substantially change habitat availability for bull trout.

Dam Passage Conditions in All Subbasins

Under Alternative 6, direct and indirect adverse effects of upstream passage conditions on bull trout would be similar to Alternative 2B. Dam passage survival would be lower for the portion of fish passing downstream through penstocks, due to installation and operation of cone valves and in-line orifices. For bull trout subpopulations in the McKenzie and North Santiam Subbasins, the number passing downstream through penstocks would be low. Deep reservoir drawdowns of Cougar Reservoir in spring and fall using the diversion tunnel results in very few days when the reservoir is high enough to use the penstocks. Most bull trout migrating downstream from Detroit Reservoir will be collected using a floating surface collector at Detroit Dam. In the

Middle Fork Subbasin, there are no measures for fish passage at Hills Creek Dam under Alternative 6. As for Alternative 2B, bull trout migrating downstream at Hills Creek Dam must pass through either the regulating outlet or through penstocks. Few Bull trout are expected to move downstream to Lookout Point Dam due to warmer water temperature conditions, however those doing so will be collected using a floating screen structure and either passed downstream of Dexter Dam or back upstream as directed by State and Federal fish managers.

Pacific Lamprey in the Upper Willamette River Basin

Reservoir/Lake-like Habitat in All Subbasins

Effects of reservoir habitat and dam passage conditions under Alternative 6 on Pacific lamprey would be similar to those described under the NAA. Pacific lamprey are only transported above Fall Creek Dam, and the fall deep drawdown under Alternative 6 would be the same as that occurring under the NAA.

Riverine Habitat in All Subbasins

Downstream habitat improvements under Alternative 6 would slightly to moderately decrease adverse effects on spawning habitat availability, and associated incubation success and rearing and migrating opportunities, for Pacific lamprey compared to the NAA due to changes in river flows, sediment transport, gravel augmentation, water temperatures and TDG levels.

Under Alternative 6, effects of dam operations on riverine habitat conditions would be similar to Alternative 2B, except below Cougar Dam in the McKenzie River Subbasin. Effects on Pacific lamprey in the McKenzie River Subbasin from differences in flow and water quality conditions below Cougar Dam extend into the McKenzie River.

Temperature targets would be met more often during an average year under Alternative 6 as compared to the NAA. However as under the NAA, operations under Alternative 6 would result in adverse effects to water quality during times of year when temperature targets are not met in the North Santiam River Subbasin. Unlike the NAA, a selective withdrawal structure would be operated at Detroit Dam under Alternative 6 resulting in beneficial effects to water quality from improved temperature conditions downstream of Detroit Dam and Big Cliff Dam. Consequently, substantially fewer adverse effects on water quality would occur in the North Santiam River Subbasin as compared to the NAA.

Adverse effects on water quality from temperature conditions in the South Santiam River Subbasin under Alternative 6 would continue as under the NAA. However, these effects would trend toward fewer adverse effects on water temperature in the spring below Green Peter Dam due to use of the spillway for surface spill (fish passage operation) and summer (temperature management operation) under Alternative 6. Indirect effects on lamprey from water temperatures below Green Peter and Foster dams in the South Santiam River Subbasin would be similar to somewhat reduced compared to the NAA.

Alternative 6 operations would result in water temperature conditions that would more mimic water temperatures in the South Fork McKenzie upstream of Cougar Dam and Reservoir. Temperature targets would be met less often during an average year under Alternative 6 and result in a minor increase in the occurrence of water temperatures above targets and therefore an increase in adverse effects on fish below Cougar Dam as compared to the NAA (Section 3.5, Water Quality, Subsection 3.5.3.2, Alternatives Analyses, Alternative 6). Changes in water temperature would also result in indirect, minor adverse to beneficial effects to lamprey in the McKenzie River Subbasin, depending on species and lifestage.

Reduced flows due to limited to no streamflow augmentation below Cougar Dam in the summer and fall would adversely impact habitat availability for lamprey, depending on life stage, and river channel conditions. Conversely, deep reservoir drawdowns would increase sediment transport from above to below Cougar Dam, creating habitat for larval lamprey in the McKenzie River Subbasin in the South Fork McKenzie River and McKenzie River mainstem. Increased sediment discharge rates would adversely affect incubating eggs; however, over the long term, increased sediment discharge rates could increase rearing habitat availability for larval ammocoetes[3].

Under Alternative 6, effects on water quality from temperature conditions in the Middle Fork Willamette River, Coast Fork Willamette River, and Long Tom River Subbasins and the Mainstem Willamette River would be the similar as those described under the NAA. There would be a minor decrease, and minor to moderate decrease below Hills Creek Dam in the number of days temperature thresholds were met. There may be differences in the number of days where water temperature standards would be met or in the number of days TDG meets targets; however, this would not alter the overall adverse effect on water quality from temperature conditions in these subbasins (Section 3.5, Water Quality, Subsection 3.5.3.2, Alternatives Analyses, Alternative 6). Indirect effects on lamprey would be the same as described under the NAA.

Under Alternative 6, effects to water quality from TDG would be more adverse in the North Santiam River Subbasin, South Santiam River Subbasin and Middle Fork Subbasin (except below Fall Creek Dam) (Section 3.5, Water Quality, Subsection 3.5.3.2, Alternatives Analyses, Alternative 6). The increase in TDG exceedance of the water quality standard would be due to flow passing through a modified penstock. Further, TDG exceedance of the water quality standard would occur downstream of Green Peter and Foster dams due to an increase in spill operations at Green Peter Dam in the spring (fish passage operation) and summer (temperature management operation). There would be an increase in indirect, adverse effects to lamprey in the North Santiam, South Santiam River, and Middle Fork Subbasins from TDG-related impacts under Alternative 6 as compared to NAA operations.

[3] Ammocoetes are a larval stage of Pacific lamprey that are filter feeders that draw overlying water into burrows they dig into soft bottom substrates. During the larval stage, they spend most of their time feeding on algae, detritus, and microorganisms (Moyle, 2004).

Under Alternative 6, there would be an adverse effect to water quality from TDG in the McKenzie River Subbasin. However, there would be an improvement to water quality because, although TDG levels would exceed the 110 percent water quality standard, the average number of days above 110 percent annually would be fewer than the NAA. Improvements in TDG would reduce risks to lamprey in the McKenzie River Subbasin. There would be a reduction in indirect, adverse effects to lamprey in the McKenzie Subbasin from TDG-related impacts under Alternative 6 as compared to NAA operations.

Under Alternative 6, effects on water quality from TDG in the Middle Fork Willamette River Subbasin below Fall Creek Dam, and in the Coast Fork Willamette River, and Long Tom River Subbasins and the Mainstem Willamette River would be the same as the NAA. There may be differences in the number of days of TDG levels meeting targets; however, this would not alter overall adverse effects on water quality from TDG (Section 3.5, Water Quality, Subsection 3.5.3.2, Alternatives Analyses, Alternative 2B). Indirect, adverse effects to lamprey in the Middle Fork Willamette River Subbasin below Fall Creek Dam, and in the Coast Fork Willamette River, and Long Tom River Subbasins and the Mainstem Willamette River would be the same as those described under the NAA. from TDG-related impacts under Alternative 6 as compared to NAA operations.

Dam Passage Conditions in All Subbasins

Effects of WVS dam passage conditions on Pacific lamprey under Alternative 6 would be the same as the NAA.

Resident Fish in All Subbasins

Reservoir/Lake-like Habitat in All Subbasins

Effects of reservoir operations on resident fish species under Alternative 6 would be the same as described for Alternative 2B.

At Green Peter and Cougar Reservoirs, habitat for spawning, rearing, and foraging for resident reservoir fish species would be reduced due to seasonal changes in habitat availability. Increased competition and predation would result as fish that are concentrated into a smaller space during spring and fall drawdowns at Cougar Reservoir and during fall drawdowns at Green Peter Reservoir as compared to NAA conditions. This would be a moderate, direct, adverse effect on most resident fish species in Green Peter Reservoir, and a substantial direct, adverse effect on resident fish species in Cougar Reservoir. Conversely, piscivorous[4] fish would benefit from closer proximity to prey fish during periods reservoirs are drawdown each year.

Releases of hatchery rainbow trout and kokanee would help maintain sport fishing opportunities where these fish are stocked, but would otherwise decrease compared to the NAA. There were no fish stocked into Cougar Reservoir at the time the alternatives were

[4] A carnivorous animal that eats mostly fish.

analyzed. Therefore, effects on stocked gamefish under Alternative 6 would be the same as those described under the NAA.

Riverine Habitat in All Subbasins

Downstream habitat improvements under Alternative 6 would slightly decrease adverse effects on spawning habitat availability, and associated incubation success and rearing and migrating opportunities, for resident fish compared to the NAA.

Long term, effects from operations-related downstream habitat conditions on resident fish species would be similar to Alternative 2B, except in dry years. In dry years, effects to fish species below dams in the North Santiam and Middle Fork Subbasins would be similar to the NAA.

Reduction in TDG and improved temperature management under Alternative 6 would have long-term, moderate, beneficial effects on all resident fish species in reaches downstream of Detroit Dam in the North Santiam River Subbasin and below Lookout Point Dam in the Middle Fork Willamette River Subbasin. However, water quality conditions would remain adverse throughout the analysis area, which would continue to be an overall, adverse impact on fish due to exceeding temperature targets and TDG thresholds.

Dam Passage Conditions in All Subbasins

Effects on resident fish species under Alternative 6 would be similar to those described under Alternative 2B. Under Alternative 6, hydropower operations would cease at each hydropower dam, but the penstocks or intakes would be reconfigured to allow continued use of the outlets for releasing flows. The majority of fish migrating downstream into reservoir forebays which are distributed near the water surface (i.e. surface-oriented), would be collected and passed downstream via structural downstream passage improvements at Detroit, Foster, and Lookout Point dams. Other fish and a small portion of the surface-oriented fish would pass through the penstocks modified with cone valves or in-line orifices installed in place of turbines. Based on available information, fish passing downstream through cone valves and in-line orifices will experience high mortality (Appendix E, Fish and Aquatic Habitat Analyses, Part 3 – Supplemental Wvs Eis Fish Benefit Workbook (Fbw) Modeling Assumptions And Results). In addition, fish will be exposed to high TDG levels below dams modified with cone valves and in-line orifices.

As under the NAA, adult fish facilities operated under Alternative 6 would allow passage of resident fish upstream of all WVS dams over the 30-year implementation timeframe.

There were no fish stocked into Cougar Reservoir at the time the alternatives were analyzed. Therefore, effects on stocked gamefish under Alternative 6 would be the same as those described under the NAA.

3.8.4 Interim Operations under All Action Alternatives Except Alternative 1

The timing and duration of Interim Operations would vary by alternative. Interim Operations could extend to nearly the 30-year implementation timeframe under Alternatives 2A, 2B, 4, 5, and 6. However, under Alternative 3A and Alternative 3B Interim Operations may not be fully implemented or required because long-term operational strategies are intended to be implemented immediately upon Record of Decision.

Interim Operations are not an alternative (Chapter 2, Alternatives, Section 2.8.6, Interim Operations). Interim Operations analyses did not consider impacts assessed under action Alternatives 2A, 2B, 3A, 3B, 4, 5, and 6 because Interim Operations would be implemented before, not in addition to, an action alternative.

3.8.4.1 North Santiam River Subbasin

Interim Operations within the North Santiam River Subbasin include spring fish passage through strategic use of the spillway at Detroit Dam, fall downstream fish passage through the upper regulating outlets with strategic use of the turbines, use of available dam outlets for temperature management, and spreading spill to reduce total dissolved gas at Big Cliff Dam. For the winter downstream fish passage operation, the reservoir would be drawn down to 50 feet above the upper regulating outlet. A stepwise approach would be taken to reach the target elevation, with the annual minimum target pool surface elevation decreasing each year until the final target of 1395’ is achieved. Once the annual drawdown to the target elevation of 1395’ occurs, subsequent annual drawdowns will also be to the target elevation each year.

Direct and indirect effects on fish and aquatic habitat would be similar to those as described under the NAA, except during the fall deeper draw down of Detroit Reservoir. There may be differences at the local level and in the short term, depending on specific annual or seasonal climate conditions and specific dam operations; however, effects on fish in this subbasin would remain adverse. Increased indirect effects would occur under Interim Operations from adverse water quality due to high TDG and turbidity on fish in the reach below Detroit and Big Cliff dams in the North Santiam River Subbasin. There may be differences at the local level and in the short term, depending on specific annual or seasonal climate conditions and specific dam operations; however, effects on fish in this subbasin would remain adverse.

During the late fall/early winter deep drawdown of Detroit Reservoir for downstream fish passage, direct and indirect effects on fish and aquatic resources would be similar to those described under Alternative 3B. Effects will vary depending on species, lifestage and their locations during each fall drawdown. The deep reservoir drawdowns would beneficially affect downstream fish passage for Chinook and steelhead salmon, adding an option for greater survival for juvenile migrants through non-turbine routes when hydraulic conditions are safer (due to lower pool elevations), and allowing diverse migratory life history stages. Sport fishing in Detroit Reservoir is expected to be adversely affected due to changes in the reservoir habitat conditions and food availability affecting fish growth and survival, and increasing rates of entrainment for resident fish downstream of the dam (Appendix E, Chapter 6). Many entrained resident fish will be injured or not survive passage through the dam. For some species, significant reductions in abundance are possible. Future stocking of hatchery reared species (e.g., rainbow trout and kokanee) by ODFW in Detroit Reservoir will mitigate some of these effects.

Effects on water quality due to turbidity on the North Santiam River below Big Cliff would have a minor adverse effect under Interim Operations as compared to the NAA and would result in a minor adverse effect on fish in the North Santiam River below Big Cliff Dam. Moderate turbidity can reduce the ability of rearing juveniles to forage, and it can affect predation rate both positively and negatively (Parametrix, Inc., and Washington State Department of Transportation. 1999). At very high levels of turbidity fish can experience gill irritation and increased raspatory rates, it can also cause sedimentation of redds and reduce the survival of eggs and alevin. Levels of turbidity associated with these more intense effects are not likely due to the mitigative measures described as part of the operation to reduce turbidity (e.g., phased drawdown over years 1 & 2).

3.8.4.2 South Santiam River Subbasin

Interim Operations within the South Santiam Subbasin at Green Peter Dam would be the same as those described under Alternatives 2A, 2B, and 3A for Green Peter Dam and Reservoir operations, with use of the spillway in spring for temperature management and downstream fish passage, and a deep reservoir drawdown to 25 feet over the regulating outlets in fall. These operations provide slight to moderate reductions in adverse effects on fish passage at Green Peter Dam.

Upstream fish passage would be the same as described under the NAA. Therefore, direct and indirect effects on fish and aquatic habitat from operation of Green Peter Dam and Reservoir would be similar to those as described under the NAA and Alternatives 2A, 2B, and 3A.

At Foster Dam, Interim Operations would be similar to those described for Alternative 2A and Alternative 2B regarding effects from dam operations on reservoir and riverine habitat conditions. Specifically, effects of Green Peter Dam operations on downstream Foster Reservoir and Dam operations, and effects of Green Peter Dam operations on downstream flows and water quality. For fish passage conditions at Foster Dam, Interim Operations would be the same as those described under the NAA. Therefore, direct and indirect effects on fish and aquatic habitat would be similar to those as described under the NAA, Alternative 2A, and Alternative 2B.

There may be differences at the local level and in the short term, depending on specific annual or seasonal climate conditions and specific dam operations; however, this would not alter the overall adverse effects of fish in this subbasin.

3.8.4.3 Long Tom River Subbasin

There are no local operations proposed under Interim Operations within the Long Tom River Subbasin. Therefore, direct and indirect effects on fish and aquatic habitat would be the same as those as described under the NAA.

3.8.4.4 McKenzie River Subbasin

Interim Operations within the McKenzie River Subbasin include drawdowns to targets below minimum conservation elevation (1,532 feet) during the spring (1,505 feet) and fall (1,520 feet) at Cougar Reservoir. Interim Operations within the McKenzie River Subbasin at Cougar Reservoir would be similar to those described under Alternative 3A. Therefore, direct and indirect effects on fish and aquatic habitat would be similar to those as described under Alternatives 3A.

3.8.4.5 Middle Fork Willamette River Subbasin

Interim Operations within the Middle Fork Willamette River Subbasin include prioritized use of the regulating outlet for downstream fish passage at Hills Creek Dam in fall, use of the spillway for fish passage at Lookout Point Dam in the spring, and deep drawdown for fish passage at Lookout Point Dam in fall. Storage at Hills Creek Dam would be used for refilling Lookout Point Dam in early March. The existing adult facility at Fall Creek Dam in combination with the operational downstream passage from a fall reservoir deep drawdown would support maintaining the re-established UWR Chinook salmon local population above Fall Creek Dam.

Interim Operations within the Middle Fork Willamette River Subbasin would be similar to those described under Alternative 3A. Therefore, direct and indirect effects on fish and aquatic habitat would be similar to those as described under Alternatives 3A.

3.8.4.6 Coast Fork Willamette River Subbasin

There are no local operations proposed under the Interim Operations within the Coast Fork Willamette River Subbasin. Therefore, direct and indirect effects on fish and aquatic habitat would be the same as those as described under the NAA.

3.8.4.7 Mainstem Willamette River

Flows, water temperatures and TDG would be similar to the NAA under Interim Operations; however, effects on water quality from turbidity in the mainstem Willamette River would be moderately more adverse as compared to the NAA because deep drafting Detroit and Green Peter reservoirs in fall would slightly increase mainstem Willamette River flows below the Santiam River confluence and increase turbidity during the fall. Direct and indirect effects on fish and aquatic habitat in the Mainstem Willamette River would be similar to those as described under the NAA upstream of the Santiam River confluence with the mainstem Willamette River. Downstream of the Santiam River confluence, indirect effects to fish from high turbidity would be minor to moderate during the drawdown periods each year as compared to the NAA. Indirect effects on fish habitat from fine sediment transport and deposition would be minorly beneficial to moderately adverse, depending on species and life stage.

3.8.5 Climate Change Effects under All Alternatives

Incorporated by reference. This section was not updated to include Alternative 6. Prior to the release of this SEIS, Executive Order 14154 "Unleashing American Energy" was issued. Consistent with this Executive Order, a greenhouse gas analysis is not included here; however, this SEIS is consistent with the NEPA statute and existing agency regulations pertaining to air quality and emissions.

3.8.6 Summary of Effects on Fish and Aquatic Habitat

Table 3-20 summarizes the anticipated effects of the No Action Alternative and all action alternatives.

Table 3-20. Summary of Fish and Habitat Effects on Upper Willamette River Chinook Salmon as Compared to the No-action Alternative[1].

Effect Category	No-action Alternative	Alternative 1	Alternative 2A	Alternative 2B	Alternative 3A	Alternative 3B
Hatchery Mitigation in All Subbasins	Adverse effects from domestication and genetic introgression, increased competition, disease transfer, increased exploitation of native fish, effects on downstream water quality from effluent. Beneficial effects for sport fishing and harvest opportunities, prey sources for other fish, and increased Chinook salmon spawner abundance.	Same as the No-action Alternative, but with reduced number of hatchery Chinook salmon released upstream; reduced proportion of hatchery origin spawners, and increased risks to bull trout from the rainbow trout hatchery program and sport fishing.	Same as Alternative 1.	Same as Alternative 1.	Same as Alternative 1.	Same as Alternative 1.
Reservoir/Lake-like Habitat	**North Santiam -** Moderate to substantial, adverse effects on juveniles from reservoir operations due to delayed migration, increased predation, and disease. Beneficial effects on juveniles from high growth rates. **South Santiam –** Same as North Santiam, except at Green Peter Reservoir where Chinook salmon would not occur. **McKenzie –** Same as North Santiam, except at Blue River Reservoir where Chinook salmon would not occur. **Middle Fork –** Same as North Santiam, except at Fall Creek Reservoir where adverse effects would be minor due to annual reservoir drawdowns to streambed. **Coast Fork –** N/A **Long Tom –** N/A	**North Santiam –** Same as the No-action Alternative, but reduced adverse effects from Detroit Reservoir due to improved downstream passage reducing duration juveniles are in Detroit Reservoir. **South Santiam –** Same as North Santiam. **McKenzie –** Same as the No-action Alternative. **Middle Fork –** Same as the No-action Alternative, but reduced adverse effects from Lookout Point Reservoir due to improved downstream passage reducing duration juveniles are in the reservoir. **Coast Fork –** N/A **Long Tom –** N/A	**North Santiam –** Same as Alternative 1. **South Santiam –** Same as the No-action Alternative, but reduced adverse effects due to improved downstream passage reducing duration juveniles are in Foster Reservoir habitat. Increased adverse effects in Green Peter Reservoir during fall drawdowns. **McKenzie –** Same as the No-action Alternative, but reduced adverse effects due to improved downstream passage reducing duration juveniles are in Cougar Reservoir. **Middle Fork –** Same as Alternative 1. **Coast Fork –** N/A **Long Tom –** N/A	**North Santiam –** Same as Alternative 1. **South Santiam –** Same as 2A. **McKenzie –** Increased adverse effects within Cougar Reservoir during fall drawdowns. **Middle Fork –** Same as Alternative 1. **Coast Fork –** N/A **Long Tom –** N/A	**North Santiam –** Moderate reductions in adverse effects from reservoir habitat due to improved downstream passage reducing duration juveniles are in reservoirs. **South Santiam –** Same as the No-action Alternative at Foster Reservoir. Same as Alternative 2A at Green Peter Reservoir. **McKenzie –** Similar to the No-action Alternative. **Middle Fork –** Same as the No-action Alternative at Fall Creek and Hills Creek Reservoirs. Moderate reductions in adverse effects to from Lookout Point Reservoir due to improved downstream reducing duration juveniles are in the reservoir. **Coast Fork –** N/A **Long Tom –** N/A	**North Santiam –** Increased adverse effects within Detroit Reservoir during fall drawdowns. **South Santiam –** Same as the No-action Alternative at Foster Reservoir. Moderate reductions in adverse effects from Green Peter Reservoir due to improved downstream passage reducing duration juveniles are in the reservoir. **McKenzie –** Same as Alternative 2B. **Middle Fork –** Same as the No-action Alternative at Fall Creek and Hills Creek Reservoirs. Increased adverse effects within Lookout Point Reservoir during fall drawdowns. **Coast Fork –** N/A **Long Tom –** N/A
Riverine Habitat	**North Santiam –** Substantial, adverse effects in winter and spring from reduced peak flows and materials transport due to dam and reservoir operations. Beneficial effects from flow augmentation and water temperature management due to dam and reservoir operations during low flow seasons.	**North Santiam –** Similar to the No-action Alternative with slight to moderate improvements during low flow seasons from flow augmentation from minimum flow targets. Moderate increased improvements from temperature management and reduced TDG. **South Santiam –** Same as the North Santiam.	**North Santiam –** Similar to the No-action Alternative, but slight differences in benefits during spring and low flow seasons depending on reach and life stage. **South Santiam –** Similar to North Santiam with increased adverse effects on water quality below dams due to Green Peter Reservoir drawdown in fall.	**North Santiam –** Similar to Alternative 2A. **South Santiam –** Same as Alternative 2A. **McKenzie –** Same as the No-action Alternative, but with slight to moderate reductions in habitat due to lower stream flows in summer, slight increased benefits from water temperatures, and increased adverse effects (moderate in first few years,	**North Santiam –** Similar to Alternative 2A, but with increased adverse effects on water quality and habitat availability below dams due to Detroit Reservoir drawdown in spring and fall. **South Santiam –** Same as Alternative 2A. **McKenzie –** Similar to the No-action Alternative below Cougar Dam with	**North Santiam –** Similar to Alternative 2A in spring and summer. Increased adverse effects from water quality in fall below dams due to Detroit Reservoir drawdown. **South Santiam –** Increased adverse effects on water quality and habitat availability below dams due to Green Peter Reservoir drawdown in spring and fall.

Effect Category	No-action Alternative	Alternative 1	Alternative 2A	Alternative 2B	Alternative 3A	Alternative 3B
	Adverse effects from TDG below dams. **South Santiam –** Same as the North Santiam. **McKenzie –** Same as the North Santiam. **Middle Fork –** Same as the North Santiam. **Coast Fork –** N/A **Long Tom –** N/A	**McKenzie –** Same as the North Santiam. **Middle Fork –** Same as the North Santiam. **Coast Fork –** N/A **Long Tom –** Beneficial effects from increased rearing due to improved habitat access with removal of drop structures.	**McKenzie –** Same as the North Santiam. **Middle Fork –** Same as the North Santiam. **Coast Fork –** N/A **Long Tom –** N/A	slight in later years) from turbidity below Cougar Dam. **Middle Fork –** Same as Alternative 2A. **Coast Fork –** N/A **Long Tom –** N/A	slight reductions in habitat availability. Increased adverse effects on water quality due to Blue River Reservoir drawdown in fall. **Middle Fork –** Increased adverse effects on water quality and habitat availability due to Lookout Point Reservoir drawdown in spring and fall. **Coast Fork –** N/A **Long Tom –** N/A	**McKenzie –** Same as Alternative 3B. **Middle Fork –** Increased adverse effects on water quality and habitat availability due to Hills Creek Reservoir drawdown in spring and fall and Lookout Point Reservoir drawdown in fall. **Coast Fork –** N/A **Long Tom –** N/A
Dam Passage Conditions	**North Santiam –** Slight, adverse effects from collection and upstream transport of adults above dams. Substantial, adverse effects due to poor downstream passage conditions at Detroit and Big Cliff dams. **South Santiam –** Same as North Santiam from upstream passage effects. Moderate, adverse effects due to poor passage conditions at Foster Dam. **McKenzie -** Same as North Santiam from upstream and downstream passage at Cougar Dam. **Middle Fork –** Slight, adverse effects from collection and upstream transport of adults above Dexter and Lookout Point dams. Moderate, adverse effects above Hills Creek Dam due to transport distance from Dexter Adult Fish Facility. Slight to moderate, adverse effects from upstream and downstream passage at Fall Creek Dam. **Coast Fork –** N/A **Long Tom –** N/A	**North Santiam –** Slight, adverse effects from upstream and downstream passage at Detroit and Big Cliff dams. **South Santiam –** Slight, adverse effects from upstream, and downstream passage at Green Peter Dam. Negligible to slight, adverse effects at Foster Dam. **McKenzie –** Same as the No-action Alternative. **Middle Fork –** Slight, adverse effects from upstream and downstream passage at Fall Creek, Dexter, and Lookout Point dams. Same as the No-action Alternative at Fall Creek and Hills Creek Dams. **Coast Fork –** N/A **Long Tom –** Beneficial effects from increased rearing due to improved habitat access with removal of drop structures.	**North Santiam –** Same as Alternative 1. **South Santiam –** Slight, adverse effects from upstream passage at Foster and Green Peter dams. Slight, adverse effects at Foster Dam from downstream passage. Moderate, adverse effects at Green Peter Dam from downstream passage. **McKenzie –** Slight, adverse effects from upstream and downstream passage at Cougar Dam. Same as the No-action Alternative at Blue River Dam. **Middle Fork –**Slight, adverse effects from upstream passage above dams. Slight, adverse effects from downstream passage at Dexter and Lookout Point dams. Same as the No-action Alternative from downstream passage at Hills Creek and Fall Creek Dams. **Coast Fork –** N/A **Long Tom –** N/A	**North Santiam –** Same as Alternative 1. **South Santiam –** Same as Alternative 2A. **McKenzie –** Slight, adverse effects from upstream and downstream passage at Cougar Dam. Same as the No-action Alternative at Blue River Dam. **Middle Fork –** Same as Alternative 2A at Dexter and Lookout Point dams. Same as the No-action Alternative at Fall Creek and Hills Creek dams. **Coast Fork –** N/A **Long Tom –** N/A	**North Santiam –** Slight, adverse effects from collection and upstream transport of adults above Detroit and Big Cliff dams. Moderate, adverse effects due to poor passage conditions at Detroit and Big Cliff dams. **South Santiam –** Same as Alternative 2A at Green Peter Dam. Same as the No-action Alternative at Foster Dam. **McKenzie –** Similar to the No-action Alternative at Cougar Dam, but adverse effects trending toward beneficial. slight to moderate, adverse effects from downstream passage at Blue River Dam. **Middle Fork –** Slight, adverse effects from upstream passage above dams. Slight, adverse effects from downstream passage at Fall Creek, Dexter, Lookout Point, and Hills Creek dams. **Coast Fork –** N/A **Long Tom –** N/A	**North Santiam –** Slight, adverse effects from collection and upstream transport of adults above dams. Moderate, adverse effects due to poor passage conditions at Detroit and Big Cliff dams. **South Santiam –** Same as Alternative 2A at Green Peter Dam. Same as the No-action Alternative at Foster Dam. **McKenzie –** Same as Alternative 2B at Cougar Dam. Slight to moderate, adverse effects from downstream passage at Blue River Dam. **Middle Fork –** Same as Alternative 3A. **Coast Fork –** N/A **Long Tom –** N/A
Population Performance	**North Santiam –** Substantial, adverse effects. **South Santiam –** Moderate to substantial, adverse effects.	**North Santiam –** Slight, adverse effects. **South Santiam –** Moderate, adverse effects.	**North Santiam –** Sight, adverse effects. **South Santiam –** Moderate, adverse effects.	**North Santiam –** Slight, adverse effects. **South Santiam –** Moderate, adverse effects.	**North Santiam –** Moderate, adverse effects. **South Santiam –** Moderate, adverse effects.	**North Santiam –** Moderate, adverse effects. **South Santiam –** Moderate, adverse effects.

Effect Category	No-action Alternative	Alternative 1	Alternative 2A	Alternative 2B	Alternative 3A	Alternative 3B
	McKenzie – Substantial, adverse effects. **Middle Fork –** Substantial, adverse effects. **Coast Fork –** N/A **Long Tom -** N/A	**McKenzie –** Substantial, adverse effects. **Middle Fork –** Moderate to substantial, adverse effects. **Coast Fork –** N/A **Long Tom -** N/A	**McKenzie –** Slight, adverse effects. **Middle Fork –** Moderate, adverse effects. **Coast Fork –** N/A **Long Tom -** N/A	**McKenzie –** Moderate, adverse effects. **Middle Fork –** Moderate, adverse effects. **Coast Fork –** N/A **Long Tom -** N/A	**McKenzie –** Moderate, adverse effects. **Middle Fork –** Moderate to substantial, adverse effects. **Coast Fork –** N/A **Long Tom -** N/A	**McKenzie –** Moderate, adverse effects. **Middle Fork –** Moderate to substantial, adverse effects. **Coast Fork –** N/A **Long Tom -** N/A

Table 3-20. Summary of Fish and Habitat Effects on Upper Willamette River Chinook Salmon as Compared to the No-action Alternative[1] (continued).

Effect Category	No-action Alternative	Alternative 4	Alternative 5	Alternative 6	Interim Operations
Hatchery Mitigation in All Subbasins	Adverse effects from domestication and genetic introgression, increased competition, disease transfer, increased exploitation of native fish, effects on downstream water quality from effluent. Beneficial effects for sport fishing and harvest opportunities, prey sources for other fish, and increased Chinook salmon spawner abundance.	Same as Alternative 1.	Same as Alternative 1.	Same as Alternative 1.	Same as the No-action Alternative, but with minor reduction in the number of hatchery Chinook salmon released upstream, and minor reductions in the proportion of hatchery origin spawners
Reservoir/Lake-like Habitat	**North Santiam -** Moderate to substantial, adverse effects on juveniles from reservoir operations due to delayed migration, increased predation, and disease. Beneficial effects on juveniles from high growth rates. **South Santiam –** Same as North Santiam, except at Green Peter Reservoir where Chinook salmon would not occur. **McKenzie –** Same as North Santiam, except at Blue River Reservoir where Chinook salmon would not occur. **Middle Fork –** Same as North Santiam, except at Fall Creek Reservoir where adverse effects would be minor due to annual reservoir drawdowns to streambed. **Coast Fork –** N/A **Long Tom –** N/A	**North Santiam –** Same as Alternative 1. **South Santiam –** Same as the No-action Alternative, but improved downstream passage reducing adverse effects from Foster Reservoir. **McKenzie –** Same as Alternative 1. **Middle Fork –** Same as the No-action Alternative, but improved downstream passage reducing adverse effects from Lookout Point and Hills Creek Reservoirs. **Coast Fork –** N/A **Long Tom –** N/A	**North Santiam –** Same as Alternative 2A. **South Santiam –** Same as Alternative 2A. **McKenzie –** Same as Alternative 2B. **Middle Fork –** Same as Alternative 2A. **Coast Fork –** N/A **Long Tom –** N/A	**North Santiam –** Same as Alternative 2A. **South Santiam –** Same as Alternative 2A. **McKenzie –** Same as Alternative 2B. **Middle Fork –** Same as Alternative 2A. **Coast Fork –** N/A **Long Tom –** N/A	**North Santiam –** Similar to Alternative 3B. **South Santiam –** Similar to Alternative 2A. **McKenzie –** Same as the No-action Alternative, but with minor reductions in adverse effects due to improved downstream passage reducing residence time in Cougar Reservoir. **Middle Fork –** Similar to Alternative 3B. **Coast Fork –** N/A **Long Tom –** N/A
Riverine Habitat	**North Santiam –** Substantial, adverse effects in winter and spring from reduced peak flows and materials transport due to dam and reservoir operations. Beneficial effects from flow augmentation and water temperature management due to dam and reservoir operations during low flow seasons.	**North Santiam –** Similar to Alternative 2A. **South Santiam –** Similar to the No-action Alternative, but slight differences in benefits during spring and low flow seasons depending on reach and life stage. **McKenzie –** Same as Alternative 2A. **Middle Fork –** Same as Alternative 2A.	**North Santiam –** Similar to Alternative 2A. **South Santiam –** Similar to Alternative 2A. **McKenzie –** Same as Alternative 2B. **Middle Fork –** Same as Alternative 2A. **Coast Fork –** N/A **Long Tom –** N/A	**North Santiam –** Similar to Alternative 2A. **South Santiam –** Similar to Alternative 2A. **McKenzie –** Same as Alternative 2B. **Middle Fork –** Same as Alternative 2A. **Coast Fork –** N/A **Long Tom –** N/A	**North Santiam –** Similar to Alternative 3B but with minor to moderate increases in adverse effects on fish from high TDG and turbidity, depending on Subbasin. **South Santiam –** Similar to Alternative 2A. **McKenzie –** Same as the No-action Alternative, but reduced adverse effects from reservoir habitat due to improved

Effect Category	No-action Alternative	Alternative 4	Alternative 5	Alternative 6	Interim Operations
	Adverse effects from TDG below dams. **South Santiam –** Same as the North Santiam. **McKenzie –** Same as the North Santiam. **Middle Fork –** Same as the North Santiam. **Coast Fork –** N/A **Long Tom –** N/A	**Coast Fork –** N/A **Long Tom –** Beneficial effects from increased rearing due to improved habitat access with removal of drop structures.			downstream passage reducing residence time in Cougar Reservoir. **Middle Fork –** Similar to Alternative 3B. **Coast Fork –** N/A **Long Tom –** N/A
Dam Passage Conditions	**North Santiam –** Slight, adverse effects from collection and upstream transport of adults above dams. Substantial, adverse effects due to poor downstream passage conditions at Detroit and Big Cliff dams. **South Santiam –** Same as North Santiam from upstream passage effects. Moderate, adverse effects due to poor passage conditions at Foster Dam. **McKenzie -** Same as North Santiam from upstream and downstream passage at Cougar Dam. **Middle Fork –** Slight, adverse effects from collection and upstream transport of adults above Dexter and Lookout Point dams. Moderate, adverse effects above Hills Creek Dam due to transport distance from Dexter Adult Fish Facility. Slight to moderate, adverse effects from upstream and downstream passage at Fall Creek Dam. **Coast Fork –** N/A **Long Tom –** N/A	**North Santiam –** Same as Alternative 1. **South Santiam –** Slight, adverse effects from upstream and downstream passage at Foster Dam Same as the No-action Alternative at Green Peter Dam. **McKenzie –** Same as Alternative 2A. **Middle Fork –** Same as Alternative 2A at Fall Creek, Lookout Point, Dexter, and Hills Creek dams. **Coast Fork –** N/A **Long Tom –** N/A	**North Santiam –** Similar to Alternative 2A. **South Santiam –** Similar to Alternative 2A. **McKenzie –** Same as Alternative 2B. **Middle Fork –** Same as Alternative 2A. **Coast Fork –** N/A **Long Tom –** N/A	**North Santiam –** Similar to Alternative 2B but with minor increased adverse effects due to decreased survival of fish passing through penstocks modified with cone valves or in-line orifices. **South Santiam –** Similar Alternative 2A with moderate increased adverse effects due to decreased survival of fish passing through penstocks modified with cone valves or in-line orifices. **McKenzie –** Similar to Alternative 2B. **Middle Fork –** Similar to Alternative 2B but with moderate increased adverse effects at Hills Creek and Dexter dams, and minor increased adverse effects at Lookout Point Dam, due to decreased survival of fish passing through penstocks modified with cone valves or in-line orifices. **Coast Fork –** N/A **Long Tom –** N/A	**North Santiam –** Similar to Alternative 3B but with minor to moderate increases in adverse effects on fish from high TDG and turbidity. **South Santiam –** Similar to Alternative 3A. **McKenzie –** Similar to the No-action Alternative with slight trend toward beneficial effects from downstream passage due to regulating outlet improvements. **Middle Fork –** Similar to the No-action Alternative from upstream passage. Similar to Alternative 3A for downstream passage. **Coast Fork –** N/A **Long Tom –** N/A
Population Performance	**North Santiam –** Substantial, adverse effects. **South Santiam –** Moderate to substantial, adverse effects. **McKenzie –** Substantial, adverse effects. **Middle Fork –** Substantial, adverse effects. **Coast Fork –** N/A **Long Tom -** N/A	**North Santiam –** Slight, adverse effects. **South Santiam –** Moderate to substantial, adverse effects. **McKenzie –** Slight, adverse effects. **Middle Fork –** Moderate, adverse effects. **Coast Fork –** N/A **Long Tom -** N/A	Same as Alternative 2B.	Similar to Alternative 2B	**North Santiam –** Similar to Alternative 3B but with minor to moderate increases in adverse effects on fish from high TDG and turbidity. **South Santiam –** Similar to Alternative 3A. **McKenzie –** Similar to the No-action Alternative with slight trend toward beneficial effects from downstream passage due to regulating outlet improvements.

Effect Category	No-action Alternative	Alternative 4	Alternative 5	Alternative 6	Interim Operations
					Middle Fork – Similar to the No-action Alternative from upstream passage. Similar to Alternative 3A for downstream passage. **Coast Fork –** N/A **Long Tom –** N/A

Table 3.8-27 in the FEIS

N/A = Not Applicable. There are no UWR Chinook salmon populations above dams in these subbasins.

North Santiam = North Fork Santiam River Subbasin, South Santiam = South Fork Santiam River Subbasin, McKenzie = McKenzie River Subbasin, Middle Fork = Middle Fork Willamette River Subbasin, Coast Fork = Coast Fork Willamette River Subbasin, Long Tom = Long Tom River Subbasin

[1] All effects would occur or reoccur over the 30-year implementation timeframe.

Table 3-21. Summary of Fish and Habitat Effects on Upper Willamette River Steelhead as Compared to the No-action Alternative[1].

Effect Category	No-action Alternative	Alternative 1	Alternative 2A	Alternative 2B	Alternative 3A	Alternative 3B
Hatchery Mitigation in All Subbasins	Adverse effects from domestication and genetic introgression, increased competition, disease transfer, increased exploitation of native fish, effects on downstream water quality from effluent. Beneficial effects for sport fishing and harvest opportunities, prey sources for other fish, and increased steelhead spawner abundance.	Same as the No-action Alternative, but with adverse effects trending toward beneficial due to increased abundance of UWR steelhead.	Same as Alternative 1.	Same as Alternative 1.	Same as Alternative 1.	Same as Alternative 1.
Reservoir/Lake-like Habitat	**North Santiam -** Moderate to substantial, adverse effects on juveniles from reservoir operations due to delayed migration, increased predation, and disease. Beneficial effects on juveniles from high growth rates. **South Santiam –** Same as North Santiam, except at Green Peter Reservoir where UWR steelhead would not occur. **McKenzie –** N/A **Middle Fork –** N/A **Coast Fork –** N/A **Long Tom –** N/A	**North Santiam –** Same as the No-action Alternative, but reduced adverse effects due to improved downstream passage reducing duration juveniles are in Detroit Reservoir. **South Santiam –** Same as North Santiam. **McKenzie –** N/A **Middle Fork –** N/A **Coast Fork –** N/A **Long Tom –** N/A	**North Santiam –** Same as Alternative 1. **South Santiam –** Same as the No-action Alternative, but reduced adverse effects due to improved downstream passage reducing duration juveniles are in Foster Reservoir. **McKenzie –** N/A **Middle Fork –** N/A **Coast Fork –** N/A **Long Tom –** N/A	**North Santiam –** Same as Alternative 1. **South Santiam –** Same as Alternative 2A. **McKenzie –** N/A **Middle Fork –** N/A **Coast Fork –** N/A **Long Tom –** N/A	**North Santiam –** Moderate reductions in adverse effects due to improved downstream passage reducing duration juveniles in reservoirs. **South Santiam –** Same as the No-action Alternative at Foster Reservoir. Same as Alternative 2A at Green Peter Reservoir. **McKenzie –** N/A **Middle Fork –** N/A **Coast Fork –** N/A **Long Tom –** N/A	**North Santiam –** Increased adverse effects within Detroit Reservoir during fall drawdowns. **South Santiam –** Same as the No-action Alternative at Foster Reservoir. Moderate reductions in adverse effects due to improved downstream passage reducing duration juveniles are in Green Peter Reservoir. **McKenzie –** N/A **Middle Fork –** N/A **Coast Fork –** N/A **Long Tom –** N/A

Effect Category	No-action Alternative	Alternative 1	Alternative 2A	Alternative 2B	Alternative 3A	Alternative 3B
Riverine Habitat	**North Santiam –** Substantial, adverse effects in winter and spring from reduced peak flows and materials transport due to dam and reservoir operations. Beneficial effects from flow augmentation and water temperature management due to dam and reservoir operations during low flow seasons. Adverse effects from TDG below dams. **South Santiam –** Same as the North Santiam. **McKenzie –** N/A **Middle Fork –** N/A **Coast Fork –** N/A **Long Tom –** N/A	**North Santiam –** Similar to the No-action Alternative with slight to moderate benefits during low flow seasons from flow augmentation due to change in minimum flow targets, moderate increased benefits from temperature management, and reduced TDG. **South Santiam –** Same as the North Santiam. **McKenzie –** N/A **Middle Fork –** N/A **Coast Fork –** N/A **Long Tom –** N/A	**North Santiam –** Similar to the No-action Alternative, but slight differences in benefits during spring and low flow seasons depending on reach and life stage. South Santiam – Similar to North Santiam with increased adverse effects on water quality below dams due to Green Peter Reservoir drawdown in fall. **McKenzie –** N/A **Middle Fork –** N/A **Coast Fork –** N/A **Long Tom –** N/A	**North Santiam –** Similar to Alternative 2A. **South Santiam –** Same as Alternative 2A. **McKenzie –** N/A **Middle Fork –** N/A **Coast Fork –** N/A **Long Tom –** N/A	**North Santiam –** Similar to Alternative 2A, but with increased adverse effects on water quality and habitat availability below dams due to Detroit Reservoir drawdown in spring and fall. **South Santiam –** Same as Alternative 2A. **McKenzie –** N/A **Middle Fork –** N/A **Coast Fork –** N/A **Long Tom –** N/A	**North Santiam –** Similar to Alternative 2A in spring and summer. Increased adverse effects from water quality in fall below dams due to Detroit Reservoir drawdown. **South Santiam –** Increased adverse effects on water quality and habitat availability below dams due to Green Peter Reservoir drawdown in spring and fall. **McKenzie –** N/A **Middle Fork –** N/A **Coast Fork –** N/A **Long Tom –** N/A
Dam Passage Conditions	**North Santiam –** Slight, adverse effects from collection and upstream transport of adults above dams. Substantial, adverse effects due to poor downstream passage conditions at Detroit and Big Cliff dams. **South Santiam –** Slight, adverse effects from collection and upstream transport of adults above dams. Moderate, adverse effects due to poor passage conditions at Foster Dam. **McKenzie –** N/A **Middle Fork –** N/A **Coast Fork –** N/A **Long Tom –** N/A	**North Santiam –** Slight, adverse effects from upstream and downstream passage at Detroit and Big Cliff dams. **South Santiam –** Slight, adverse effects from upstream and downstream passage at Green Peter Dam. Negligible to slight adverse effects at Foster Dam. **McKenzie –** N/A **Middle Fork –** N/A **Coast Fork –** N/A **Long Tom –** N/A	**North Santiam –** Same as Alternative 1. **South Santiam –** Slight, adverse effects from upstream passage at Foster and Green Peter dams. Slight, adverse effects at Foster Dam from upstream passage. Moderate, adverse effects from downstream passage at Green Peter Dam. **McKenzie –** N/A **Middle Fork –** N/A **Coast Fork –** N/A **Long Tom –** N/A	**North Santiam –** Same as Alternative 1 **South Santiam –** Same as Alternative 2A **McKenzie –** N/A **Middle Fork –** N/A **Coast Fork –** N/A **Long Tom –** N/A	**North Santiam –** Slight, adverse effects from collection and upstream transport of adults above Detroit and Big Cliff dams. Moderate, adverse effects due to poor passage conditions at Detroit and Big Cliff dams. **South Santiam –** Same as Alternative 2A at Green Peter Dam Same as the No-action Alternative at Foster Dam. **McKenzie –** N/A **Middle Fork –** N/A **Coast Fork –** N/A **Long Tom –** N/A	**North Santiam –** Slight, adverse effects from collection and upstream transport of adults above dams. Moderate, adverse effects due to poor passage conditions at Detroit and Big Cliff dams. **South Santiam –** Same as Alternative 2A at Green Peter Dam. Same as the No-action Alternative at Foster Dam. **McKenzie –** N/A **Middle Fork –** N/A **Coast Fork –** N/A **Long Tom –** N/A

Effect Category	No-action Alternative	Alternative 1	Alternative 2A	Alternative 2B	Alternative 3A	Alternative 3B
Population Performance	**North Santiam –** Substantial, adverse effects. **South Santiam –** Moderate to substantial, adverse effects. **McKenzie –** N/A **Middle Fork –** N/A **Coast Fork –** N/A **Long Tom –** N/A	**North Santiam –** Slight, adverse effects. **South Santiam –** Moderate, adverse effects. **McKenzie –** N/A **Middle Fork –** N/A **Coast Fork –** N/A **Long Tom –** N/A	**North Santiam –** Same as Alternative 1. **South Santiam –** Same as Alternative 1. **McKenzie –** N/A **Middle Fork –** N/A **Coast Fork –** N/A **Long Tom –** N/A	**North Santiam –** Same as Alternative 1. **South Santiam –** Same as Alternative 1. **McKenzie –** N/A **Middle Fork –** N/A **Coast Fork –** N/A **Long Tom –** N/A	**North Santiam –** Moderate, adverse effects. **South Santiam –** Same as Alternative 1. **McKenzie –** N/A **Middle Fork –** N/A **Coast Fork –** N/A **Long Tom –** N/A	**North Santiam –** Moderate, adverse effects. **South Santiam –** Same as Alternative 1. **McKenzie –** N/A **Middle Fork –** N/A **Coast Fork –** N/A **Long Tom –** N/A

Table 3-21. Summary of Fish and Habitat Effects on Upper Willamette River Steelhead as Compared to the No-action Alternative[1] (continued).

Effect Category	No-action Alternative	Alternative 4	Alternative 5	Alternative 6	Interim Operations
Hatchery Mitigation in All Subbasins	Adverse effects from domestication and genetic introgression, increased competition, disease transfer, increased exploitation of native fish, effects on downstream water quality from effluent. Beneficial effects for sport fishing and harvest opportunities, prey sources for other fish, and increased steelhead spawner abundance.	Same as Alternative 1.	Same as Alternative 1.	Same as Alternative 1.	Same as Alternative 1.
Reservoir/Lake-like Habitat	**North Santiam -** Moderate to substantial, adverse effects on juveniles from reservoir operations due to delayed migration, increased predation, and disease. Beneficial effects on juveniles from high growth rates. **South Santiam –** Same as North Santiam, except at Green Peter Reservoir where UWR steelhead would not occur. **McKenzie –** N/A **Middle Fork –** N/A **Coast Fork –** N/A **Long Tom –** N/A	**North Santiam –** Same as Alternative 1. **South Santiam –** Same as the No-action Alternative, but improved downstream passage reducing adverse effects from Foster Reservoir. **McKenzie –** N/A **Middle Fork –** N/A **Coast Fork –** N/A **Long Tom –** N/A	**North Santiam –** Same as Alternative 2B. **South Santiam –** Same as Alternative 2A. **McKenzie –** N/A **Middle Fork –** N/A **Coast Fork –** N/A **Long Tom –** N/A	**North Santiam –** Same as Alternative 2A. **South Santiam –** Same as Alternative 2A. **McKenzie –** N/A **Middle Fork –** N/A **Coast Fork –** N/A **Long Tom –** N/A	**North Santiam –** Similar to Alternative 3B. **South Santiam –** Similar to Alternative 2A. **McKenzie –** N/A **Middle Fork –** Same as Alternative 3B. **Coast Fork –** N/A **Long Tom –** N/A
Riverine Habitat	**North Santiam –** Substantial, adverse effects in winter and spring from reduced peak flows and materials transport due to dam and reservoir operations. Beneficial effects from flow augmentation and water temperature management due to dam and reservoir operations during low flow seasons. Adverse effects from TDG below dams.	**North Santiam –** Similar to Alternative 2A. **South Santiam –** Similar to the No-action Alternative, but slight differences in benefits during spring and low flow seasons depending on reach and life stage. **McKenzie –** N/A **Middle Fork –** N/A **Coast Fork –** N/A	**North Santiam –** Same as Alternative 2B. **South Santiam –** Same as Alternative 2A. **McKenzie –** N/A **Middle Fork –** N/A **Coast Fork –** N/A **Long Tom –** N/A	**North Santiam –** Same as Alternative 2A. **South Santiam –** Same as Alternative 2A. **McKenzie –** N/A **Middle Fork –** N/A **Coast Fork –** N/A **Long Tom –** N/A	**North Santiam –** Similar to Alternative 3B but with minor to moderate increases in adverse effects on fish from high TDG and turbidity. **South Santiam –** Similar to Alternative 2A. **McKenzie –** N/A **Middle Fork –** N/A **Coast Fork –** N/A **Long Tom –** N/A

Effect Category	No-action Alternative	Alternative 4	Alternative 5	Alternative 6	Interim Operations
	South Santiam – Same as the North Santiam. **McKenzie –** N/A **Middle Fork –** N/A **Coast Fork –** N/A **Long Tom –** N/A	**Long Tom –** N/A			
Dam Passage Conditions	**North Santiam –** Slight, adverse effects from collection and upstream transport of adults above dams. Substantial, adverse effects due to poor downstream passage conditions at Detroit and Big Cliff dams. **South Santiam –** Slight, adverse effects from collection and upstream transport of adults above dams. Moderate, adverse effects due to poor passage conditions at Foster Dam. **McKenzie –** N/A **Middle Fork –** N/A **Coast Fork –** N/A **Long Tom –** N/A	**North Santiam –** Same as Alternative 1. **South Santiam –** Slight, adverse effects from upstream and downstream passage at Foster Dam. Same as the No-action Alternative at Green Peter Dam. **McKenzie –** N/A **Middle Fork –** N/A **Coast Fork –** N/A **Long Tom –** N/A	Same as Alternative 2B.	**North Santiam –** Similar to Alternative 2B but with minor increased adverse effects due to decreased survival of fish passing through penstocks modified with cone valves or in-line orifices. **South Santiam –** Similar Alternative 2A with moderate increased adverse effects due to decreased survival of fish passing through penstocks modified with cone valves or in-line orifices. **McKenzie –** N/A **Middle Fork –** N/A **Coast Fork –** N/A **Long Tom –** N/A	**North Santiam –** Similar to Alternative 3B. **South Santiam –** Similar to Alternative 2A. **McKenzie –** N/A **Middle Fork –** N/A **Coast Fork –** N/A **Long Tom –** N/A
Population Performance	**North Santiam –** Substantial, adverse effects. **South Santiam –** Moderate to substantial, adverse effects. **McKenzie –** N/A **Middle Fork –** N/A **Coast Fork –** N/A **Long Tom –** N/A	**North Santiam –** Same as Alternative 1. **South Santiam –** Same as the No-action Alternative. **McKenzie –** N/A **Middle Fork –** N/A **Coast Fork –** N/A **Long Tom –** N/A	Same as Alternative 2B.	Similar to Alternative 2B.	**North Santiam –** Similar to Alternative 3B. **South Santiam –** Similar to Alternative 3A. **McKenzie –** N/A **Middle Fork –** N/A **Coast Fork –** N/A **Long Tom –** N/A

Table 3.8-28 in the FEIS

N/A = Not Applicable. There are no steelhead populations in these subbasins.

North Santiam = North Fork Santiam River Subbasin, South Santiam = South Fork Santiam River Subbasin, McKenzie = McKenzie River Subbasin, Middle Fork = Middle Fork Willamette River Subbasin, Coast Fork = Coast Fork Willamette River Subbasin, Long Tom = Long Tom River Subbasin

[1] All effects would occur or reoccur over the 30-year implementation timeframe.

Table 3-22. Summary of Fish and Habitat Effects on Bull Trout as Compared to the No-action Alternative[1].

Effect Category	No-action Alternative	Alternative 1	Alternative 2A	Alternative 2B	Alternative 3A	Alternative 3B
Hatchery Mitigation in All Subbasins	Adverse effects from sport fishing, habitat competition, and effects on downstream water quality from effluent. Beneficial effects from increased forage where hatchery trout releases overlap with bull trout distributions.	Same as the No-action Alternative, but with increased risks to bull trout from the rainbow trout hatchery program and sport fishing below dams due to improved passage conditions at dams in the North Santiam River Subbasin.	Same as the No-action Alternative, but with increased risks to bull trout from the rainbow trout hatchery program and sport fishing below dams due to improved passage conditions at dams in the North Santiam River and McKenzie River Subbasins.	Same as Alternative 2A.	Same as Alternative 1.	Same as Alternative 2A.
Reservoir/Lake-like Habitat	**North Santiam -** Substantial, beneficial effects due to feeding and growth opportunities in reservoirs. **South Santiam –** N/A **McKenzie –** Substantial, beneficial effects due to feeding and growth opportunities in reservoirs. **Middle Fork –** Substantial, beneficial effects due to feeding and growth opportunities in reservoirs. **Coast Fork –** N/A **Long Tom –** N/A	**North Santiam –** Same as the No-action Alternative. **South Santiam –** N/A **McKenzie –** Same as the No-action Alternative. **Middle Fork –** Same as the No-action Alternative. **Coast Fork –** N/A **Long Tom –** N/A	**North Santiam –** Same as the No-action Alternative. **South Santiam –** N/A **McKenzie –** Same as the No-action Alternative. **Middle Fork –** Same as the No-action Alternative. **Coast Fork –** N/A **Long Tom –** N/A	**North Santiam –** Same as the No-action Alternative. **South Santiam –** N/A **McKenzie –** Substantial, adverse effects on habitat availability due to spring and fall reservoir drawdowns. **Middle Fork –** Same as the No-action Alternative. **Coast Fork –** N/A **Long Tom –** N/A	**North Santiam –** Moderate to substantial, adverse effects on habitat availability due to spring and fall reservoir drawdowns. **South Santiam –** N/A **McKenzie –** Similar to the No-action Alternative. **Middle Fork –** Moderate, adverse effects on habitat availability due to Hills Creek Reservoir drawdown in fall. **Coast Fork –** N/A **Long Tom –** N/A	**North Santiam –** Moderate, adverse effects on habitat availability due to fall reservoir drawdowns. **South Santiam –** N/A **McKenzie –** Same as Alternative 2B. **Middle Fork –** Same as Alternative 3A. **Coast Fork –** N/A **Long Tom –** N/A
Riverine Habitat	**North Santiam –** Substantial, adverse effects in winter and spring from reduced peak flows and materials transport due to dam and reservoir operations. Beneficial effects from flow augmentation and water temperature management due to dam and reservoir operations during low flow seasons. Adverse effects from TDG below dams. **South Santiam –** Same as the North Santiam. **McKenzie –** Same as the North Santiam. **Middle Fork –** Same as the North Santiam. **Coast Fork –** N/A	**North Santiam –** Similar to the No-action Alternative with slight to moderate benefits during low flow seasons from flow augmentation due to minimum flow targets, moderate increased benefits from temperature management, and reduced TDG. **South Santiam –** Same as the North Santiam. **McKenzie –** Same as the North Santiam. **Middle Fork –** Same as the North Santiam. **Coast Fork –** N/A **Long Tom –** Beneficial effects from increased rearing due to improved habitat access with removal of drop structures.	**North Santiam –** Similar to the No-action Alternative, but slight differences in benefits during spring and low flow seasons depending on reach and life stage. **South Santiam –** Similar to North Santiam effects, but increased, adverse effects on water quality below dams due to Green Peter Reservoir drawdown in fall. **McKenzie –** Same as the North Santiam. **Middle Fork –** Same as the North Santiam. **Coast Fork –** N/A **Long Tom –** N/A	**North Santiam –** Similar to Alternative 2A. **South Santiam –** Same as Alternative 2A. **McKenzie –** Same as the No-action Alternative, but with slight to moderate reductions in habitat due to lower stream flows in summer, slight increased benefits from water temperatures, and increased adverse effects from turbidity below Cougar Dam (moderate in first few years, slight in later years). **Middle Fork –** Same as Alternative 2A. **Coast Fork –** N/A **Long Tom –** N/A	**North Santiam –** Similar to Alternative 2A, but with increased adverse effects on water quality and habitat availability below dams due to Detroit Reservoir drawdown in spring and fall. **South Santiam –** Same as Alternative 2A. **McKenzie –** Similar to the No-action Alternative below Cougar Dam with slight reductions in habitat availability. Increased adverse effects on water quality due to Blue River Reservoir drawdown in fall. **Middle Fork –** Increased adverse effects on water quality and habitat availability due to Lookout Point Reservoir drawdown in spring and fall.	**North Santiam –** Similar to Alternative 2A in spring and summer. Increased adverse effects from water quality in fall below dams due to Detroit Reservoir drawdown. **South Santiam –** Increased adverse effects on water quality and habitat availability below dams due to Green Peter Reservoir drawdown in spring and fall. **McKenzie –** Same as Alternative 3B. **Middle Fork –** Increased adverse effects on water quality and habitat availability due to Hills Creek Reservoir drawdown in spring and fall and Lookout Point Reservoir drawdown in fall. **Coast Fork –** N/A **Long Tom –** N/A

Effect Category	No-action Alternative	Alternative 1	Alternative 2A	Alternative 2B	Alternative 3A	Alternative 3B
	Long Tom – N/A				**Coast Fork –** N/A **Long Tom –** N/A	
Dam Passage Conditions	**North Santiam –** Slight, adverse effects from collection and upstream transport of adults above dams. Substantial, adverse effects due to poor passage conditions at Detroit and Big Cliff dams. **South Santiam –** N/A **McKenzie –** Slight, adverse effects from collection and upstream transport of adults above dams. Substantial, adverse effects due to poor passage conditions at Cougar Dam. **Middle Fork –** Slight, adverse effects from collection and upstream transport of adults above Dexter and Lookout Point dams. Moderate to substantial, adverse effects from upstream passage conditions at Hills Creek Dam due to use of traps and angling for collection. Substantial, adverse effects due to poor downstream passage conditions at Hills Creek Dam. **Coast Fork –** N/A **Long Tom –** N/A	**North Santiam –** Slight, adverse effects from upstream and downstream passage at Detroit and Big Cliff dams. **South Santiam –** N/A **McKenzie –** Same as the No-action Alternative. **Middle Fork –** Same as the No-action Alternative at Hills Creek Dam. Slight, adverse effects from upstream and downstream passage at Dexter and Lookout Point dams. **Coast Fork –** N/A **Long Tom –** N/A	**North Santiam –** Same as Alternative 1. **South Santiam –** N/A **McKenzie –** Slight, adverse effects from upstream and downstream passage at Cougar Dam. Same as the No-action Alternative at Blue River Dam. **Middle Fork –** Slight, adverse effects from upstream passage above dams. Same as the No-action Alternative from downstream passage at Hills Creek Dam. Slight, adverse effects from downstream passage at Dexter and Lookout Point dams. **Coast Fork –** N/A **Long Tom –** N/A	**North Santiam –** Same as Alternative 1. **South Santiam –** N/A **McKenzie –** Slight, adverse effects from upstream and downstream passage at Cougar Dam. Same as the No-action Alternative at Blue River Dam. **Middle Fork –** Same as Alternative 2A at Dexter and Lookout Point dams. Same as the No-action Alternative at Hills Creek Dam. **Coast Fork –** N/A **Long Tom –** N/A	**North Santiam –** Slight, adverse effects from collection and upstream transport of adults above Detroit and Big Cliff dams. Moderate, adverse effects due to poor passage conditions at Detroit and Big Cliff dams. **South Santiam –** N/A **McKenzie –** Similar to the No-action Alternative at Cougar Dam, but adverse effects trending toward more beneficial. Slight to moderate, adverse effects from downstream passage at Blue River Dam. **Middle Fork –** Slight, adverse effects from upstream passage above dams. Slight, adverse effects from downstream passage at Fall Creek, Dexter, Lookout Point, and Hills Creek dams. **Coast Fork –** N/A **Long Tom –** N/A	**North Santiam –** Slight, adverse effects from collection and upstream transport of adults above dams. Moderate, adverse effects due to poor passage conditions at Detroit and Big Cliff dams. **South Santiam –** N/A **McKenzie –** Same as Alternative 2B at Cougar Dam. Slight to moderate, adverse effects from downstream passage at Blue River Dam. **Middle Fork –** Same as Alternative 3A. **Coast Fork –** N/A **Long Tom –** N/A

Table 3-22. Summary of Fish and Habitat Effects on Bull Trout as Compared to the No-action Alternative[1] (continued).

Effect Category	No-action Alternative	Alternative 4	Alternative 5	Alternative 6	Interim Measures
Hatchery Mitigation in All Subbasins	Adverse effects from sport fishing, habitat competition, and effects on downstream water quality from effluent. Beneficial effects from increased forage where hatchery trout releases overlap with bull trout distributions.	Same as the No-action Alternative, but with increased risks to bull trout from the rainbow trout hatchery program and sport fishing below dams due to improved passage conditions at dams in the North Santiam River and McKenzie River, and Middle Fork Willamette River Subbasins.	Same as Alternative 1.	Same as Alternative 1.	Similar to the No-action Alternative.
Reservoir/Lake-like Habitat	**North Santiam -** Substantial, beneficial effects due to feeding and growth opportunities in reservoirs.	**North Santiam –** Same as the No-action Alternative. **South Santiam –** N/A	**North Santiam –** Same as Alternative 3A. **South Santiam –** N/A	Similar to Alternative 2b.	Similar to the No-action Alternative.

Effect Category	No-action Alternative	Alternative 4	Alternative 5	Alternative 6	Interim Measures
	South Santiam – N/A **McKenzie –** Substantial, beneficial effects due to feeding and growth opportunities in reservoirs. **Middle Fork –** Substantial, beneficial effects due to feeding and growth opportunities in reservoirs. **Coast Fork –** N/A **Long Tom –** N/A	**McKenzie –** Same as Alternative 1. **Middle Fork –** Same as the No-action Alternative. **Coast Fork –** N/A **Long Tom –** N/A	**McKenzie –** Same as the No-action Alternative. **Middle Fork –** Same as Alternative 3A. **Coast Fork –** N/A **Long Tom –** N/A		
Riverine Habitat	**North Santiam –** Substantial, adverse effects in winter and spring from reduced peak flows and materials transport due to dam and reservoir operations. Beneficial effects from flow augmentation and water temperature management due to dam and reservoir operations during low flow seasons. Adverse effects from TDG below dams. **South Santiam –** Same as the North Santiam. **McKenzie –** Same as the North Santiam. **Middle Fork –** Same as the North Santiam. **Coast Fork –** N/A **Long Tom –** N/A	**North Santiam –** Similar to Alternative 2A. **South Santiam –** Similar to the No-action Alternative, but slight differences in benefits during spring and low flow seasons depending on reach and life stage. **McKenzie –** Same as Alternative 2A. **Middle Fork –** Same as Alternative 2A. **Coast Fork –** N/A **Long Tom –** Beneficial effects from increased rearing due to improved habitat access with removal of drop structures.	**Interim Operations** **North Santiam –** Same as Alternative 3B. **South Santiam –** Same as Alternative 2A. **McKenzie –** Same as the No-action Alternative, but reduced adverse effects due to improved downstream passage reducing duration juveniles are in Cougar Reservoir. **Middle Fork –** Same as Alternative 3B. **Coast Fork –** N/A **Long Tom –** N/A **Long-term Operations** Same as Alternative 2B.	Similar to Alternative 2b.	Similar to the No-action Alternative.
Dam Passage Conditions	**North Santiam –** Slight, adverse effects from collection and upstream transport of adults above dams. Substantial, adverse effects due to poor passage conditions at Detroit and Big Cliff dams. **South Santiam –** N/A **McKenzie –** Slight, adverse effects from collection and upstream transport of adults above dams. Substantial, adverse effects due to poor passage conditions at Cougar Dam. **Middle Fork –** Slight, adverse effects from collection and upstream transport of adults above Dexter and Lookout Point dams. Moderate to substantial, adverse effects from upstream passage conditions at Hills Creek	**North Santiam –** Same as Alternative 1. **South Santiam –** N/A **McKenzie –** Same as Alternative 2A. **Middle Fork –** Same as Alternative 2A at Fall Creek, Lookout Point, Dexter, and Hills Creek dams. **Coast Fork –** N/A **Long Tom –** N/A	**Interim Operations** **North Santiam –** Same as Alternative 3A. **South Santiam –** Same as Alternative 3A. **McKenzie –** Same as the No-action Alternative with slight trend toward beneficial effects from downstream passage due to regulating outlet improvements. **Middle Fork –** Same as the No-action Alternative from upstream passage. Same as Alternative 3A from downstream passage. **Coast Fork –** N/A **Long Tom –** N/A	Similar to Alternative 2b.	Similar to the No-action Alternative.

Effect Category	No-action Alternative	Alternative 4	Alternative 5	Alternative 6	Interim Measures
	Dam due to use of traps and angling for collection. Substantial, adverse effects due to poor downstream passage conditions at Hills Creek Dam. **Coast Fork –** N/A **Long Tom –** N/A		**Long-term Operations** Same as Alternative 2B.		

Table 3.8-29 in the FEIS

N/A = Not Applicable. Bull trout populations do not occur in these subbasins.

North Santiam = North Fork Santiam River Subbasin, South Santiam = South Fork Santiam River Subbasin, McKenzie = McKenzie River Subbasin, Middle Fork = Middle Fork Willamette River Subbasin, Coast Fork = Coast Fork Willamette River Subbasin, Long Tom = Long Tom River Subbasin

[1] All effects would occur or reoccur over the 30-year implementation timeframe.

Table 3-23. Summary of Fish and Habitat Effects on Pacific Lamprey as Compared to the No-action Alternative[1].

Effect Category	No-action Alternative	Alternative 1	Alternative 2A	Alternative 2B	Alternative 3A	Alternative 3B
Hatchery Mitigation in All Subbasins	Slight, adverse effects from predation and effects on downstream water quality from effluent.	Same as the No-action Alternative.	Same as the No-action Alternative.	Same as the No-action Alternative.	Same as the No-action Alternative.	Same as the No-action Alternative.
Reservoir/Lake-like Habitat	**North Santiam –** N/A **South Santiam –** N/A **McKenzie –** N/A **Middle Fork –** Moderate, adverse effects due to Fall Creek Reservoir drawdowns in fall. Lamprey are not above other Middle Fork Willamette River Subbasin dams. **Coast Fork –** N/A **Long Tom –** N/A	**North Santiam –** N/A **South Santiam –** N/A **McKenzie –** Same as the No-action Alternative. **Middle Fork –** Same as the No-action Alternative. **Coast Fork –** N/A **Long Tom –** N/A	**North Santiam –** N/A **South Santiam –** N/A **McKenzie –** N/A **Middle Fork –** Same as the No-action Alternative. **Coast Fork –** N/A **Long Tom –** N/A	**North Santiam –** N/A **South Santiam –** N/A **McKenzie –** N/A **Middle Fork –** Same as the No-action Alternative. **Coast Fork –** N/A **Long Tom –** N/A	**North Santiam –** N/A **South Santiam –** N/A **McKenzie –** N/A **Middle Fork –** Same as the No-action Alternative. **Coast Fork –** N/A **Long Tom –** N/A	**North Santiam –** N/A **South Santiam –** N/A **McKenzie –** Same as the No-action Alternative. **Middle Fork –** Same as the No-action Alternative. **Coast Fork –** N/A **Long Tom –** N/A
Riverine Habitat	**North Santiam –** Substantial, adverse effects in winter and spring from reduced peak flows and materials transport due to dam and reservoir operations. Beneficial effects from flow augmentation and water temperature management due to dam and reservoir operations during low flow seasons. Adverse effects from TDG below dams.	**North Santiam –** Similar to the No-action Alternative with slight to moderate benefits during low flow seasons from flow augmentation due to minimum flow targets. Moderate increased benefits from temperature management and reduced TDG. **South Santiam –** Same as the North Santiam. **McKenzie –** Same as the North Santiam.	**North Santiam –** Similar to the No-action Alternative, but slight differences in benefits during spring and low flow seasons depending on reach and life stage. **South Santiam –** Similar to North Santiam with increased adverse effects on water quality below dams due to Green Peter Reservoir drawdown in fall due to turbidity (moderate in first few years, slight in later years).	**North Santiam –** Similar to Alternative 2A. **South Santiam –** Same as Alternative 2A. **McKenzie –** Same as the No-action Alternative, but with slight to moderate reductions in habitat due to lower stream flows in summer. Slight increased benefits from water temperatures. Increased adverse effects from turbidity below Cougar Dam	**North Santiam –** Similar to Alternative 2A, but with increased adverse effects on water quality and habitat availability below dams due to Detroit Reservoir drawdown in spring and fall. **South Santiam –** Same as Alternative 2A. **McKenzie –** Similar to the No-action Alternative below Cougar Dam with slight reductions in habitat availability.	**North Santiam** – Similar to Alternative 2A in spring and summer. Increased adverse effects from water quality in fall below dams due to Detroit Reservoir drawdown. **South Santiam –** Increased adverse effects on water quality and habitat availability below dams due to Green Peter Reservoir drawdown in spring and fall. **McKenzie –** Same as Alternative 2B. **Middle Fork –** Increased adverse effects on water quality and habitat

Effect Category	No-action Alternative	Alternative 1	Alternative 2A	Alternative 2B	Alternative 3A	Alternative 3B
	South Santiam – Same as the North Santiam. **McKenzie –** Same as the North Santiam. **Middle Fork –** Same as the North Santiam. **Coast Fork –** Same as the North Santiam. **Long Tom –** Same as the North Santiam.	**Middle Fork –** Same as the North Santiam. **Coast Fork –** Same as the No-action Alternative. **Long Tom –** Beneficial effects from increased access upstream for spawning and rearing due to removal of drop structures.	**McKenzie –** Same as the North Santiam. **Middle Fork –** Same as the North Santiam. **Coast Fork –** Same as the No-action Alternative. **Long Tom –** Same as the No-action Alternative.	(moderate in first few years, slight in later years). **Middle Fork –** Same as Alternative 2A. **Coast Fork –** Same as the No-action Alternative. **Long Tom –** Same as the No-action Alternative.	Increased adverse effects on water quality due to Blue River Reservoir drawdown in fall. **Middle Fork –** Increased adverse effects on water quality and habitat availability due to Lookout Point Reservoir drawdown in spring and fall. **Coast Fork –** N/A **Long Tom –** Same as the No-action Alternative.	availability due to Hills Creek Reservoir drawdown in spring and fall and Lookout Point Reservoir drawdown in fall. **Coast Fork –** Same as the No-action Alternative. **Long Tom –** Same as the No-action Alternative.
Dam Passage Conditions	**North Santiam –** N/A **South Santiam –** N/A **McKenzie –** N/A **Middle Fork –** Moderate, adverse effects due to Fall Creek Reservoir drawdowns in fall. **Coast Fork –** N/A **Long Tom –** Adverse effects on upstream passage of lamprey at drop structures. Slight, adverse effects on downstream passage of lamprey at drop structures.	**North Santiam –** N/A **South Santiam –** N/A **McKenzie –** N/A **Middle Fork –** Same as the No-action Alternative. **Coast Fork –** N/A **Long Tom –** Beneficial effects from increased access upstream for spawning and rearing due to removal of drop structures.	**North Santiam –** N/A **South Santiam –** N/A **McKenzie –** N/A **Middle Fork –** Same as the No-action Alternative. **Coast Fork –** N/A **Long Tom –** Same as the No-action Alternative.	**North Santiam –** N/A **South Santiam –** N/A **McKenzie –** N/A **Middle Fork –** Same as the No-action Alternative. **Coast Fork –** N/A **Long Tom –** Same as the No-action Alternative.	**North Santiam –** N/A **South Santiam –** N/A **McKenzie –** N/A **Middle Fork –** Same as the No-action Alternative. **Coast Fork –** N/A **Long Tom –** Same as the No-action Alternative.	**North Santiam –** N/A **South Santiam –** N/A **McKenzie –** N/A **Middle Fork –** Same as the No-action Alternative. **Coast Fork –** N/A **Long Tom –** Same as the No-action Alternative.

Table 3-23. Summary of Fish and Habitat Effects on Pacific Lamprey as Compared to the No-action Alternative[1] (continued).

Effect Category	No-action Alternative	Alternative 4	Alternative 5	Alternative 6	Interim Operations
Hatchery Mitigation in All Subbasins	Slight, adverse effects from predation and effects on downstream water quality from effluent.	Same as the No-action Alternative.	Same as the No-action Alternative.	Same as the No-action Alternative.	Same as the No-action Alternative.
Reservoir/Lake-like Habitat	**North Santiam –** N/A **South Santiam –** N/A **McKenzie –** N/A **Middle Fork –** Moderate, adverse effects due to Fall Creek Reservoir drawdowns in fall. Lamprey are not above other Middle Fork Willamette River Subbasin dams. **Coast Fork –** N/A **Long Tom –** N/A	**North Santiam –** N/A **South Santiam –** N/A **McKenzie –** N/A **Middle Fork –** Same as the No-action Alternative. **Coast Fork –** N/A **Long Tom –** N/A	**North Santiam –** N/A **South Santiam –** N/A **McKenzie –** N/A **Middle Fork –** Same as the No-action Alternative. **Coast Fork –** N/A **Long Tom –** N/A	**North Santiam –** N/A **South Santiam –** N/A **McKenzie –** N/A **Middle Fork –** Same as the No-action Alternative. **Coast Fork –** N/A **Long Tom –** N/A	**North Santiam –** N/A **South Santiam –** N/A **McKenzie –** N/A **Middle Fork –** Same as the No-action Alternative. **Coast Fork –** N/A **Long Tom –** N/A

Effect Category	No-action Alternative	Alternative 4	Alternative 5	Alternative 6	Interim Operations
Riverine Habitat	**North Santiam –** Substantial, adverse effects in winter and spring from reduced peak flows and materials transport due to dam and reservoir operations. Beneficial effects from flow augmentation and water temperature management due to dam and reservoir operations during low flow seasons. Adverse effects from TDG below dams. **South Santiam –** Same as the North Santiam. **McKenzie –** Same as the North Santiam. **Middle Fork –** Same as the North Santiam. **Coast Fork –** Same as the North Santiam. **Long Tom –** Same as the North Santiam.	**North Santiam –** Similar to Alternative 2A. **South Santiam –** Similar to the No-action Alternative, but slight differences in benefits during spring and low flow seasons depending on reach, species, and life stage. **McKenzie –** Same as Alternative 2A. **Middle Fork –** Same as Alternative 2A. **Coast Fork –** Same as the No-action Alternative. **Long Tom –** Same as Alternative 1.	Same as Alternative 2B.	Similar to Alternative 2B.	**North Santiam –** Similar to Alternative 3B but with minor to moderate increases in adverse effects on fish from high TDG and turbidity. **South Santiam –** Similar to Alternative 2A. **McKenzie –** N/A **Middle Fork –** N/A **Coast Fork –** N/A **Long Tom –** N/A
Dam Passage Conditions	**North Santiam –** N/A **South Santiam –** N/A **McKenzie –** N/A **Middle Fork –** Moderate, adverse effects due to Fall Creek Reservoir drawdowns in fall. **Coast Fork –** N/A **Long Tom –** Adverse effects on upstream passage of lamprey at drop structures. Slight, adverse effects on downstream passage of lamprey at drop structures.	**North Santiam –** N/A **South Santiam –** N/A **McKenzie –** N/A **Middle Fork –** Same as the No-action Alternative. **Coast Fork –** N/A **Long Tom –** Same as Alternative 1	**Interim Operations** **North Santiam –** N/A **South Santiam –** N/A **McKenzie –** N/A **Middle Fork –**Same as the No-action Alternative. **Coast Fork –** N/A **Long Tom –** N/A **Long-term Operations** Same as Alternative 1.	Same as the No-action Alternative.	Same as the No-action Alternative.

Table 3.8-30 in the FEIS

N/A = Not Applicable. Lamprey do not occur above dams.

North Santiam = North Fork Santiam River Subbasin, South Santiam = South Fork Santiam River Subbasin, McKenzie = McKenzie River Subbasin, Middle Fork = Middle Fork Willamette River Subbasin, Coast Fork = Coast Fork Willamette River Subbasin, Long Tom = Long Tom River Subbasin

[1] All effects would occur or reoccur over the 30-year implementation timeframe.

Table 3-24. Summary of Fish and Habitat Effects on Resident Fish and Gamefish as Compared to the No-action Alternative[1].

Effect Category	No-action Alternative	Alternative 1	Alternative 2A	Alternative 2B	Alternative 3A	Alternative 3B
Hatchery Mitigation in All Subbasins	Adverse effects from sport fishing, habitat competition, and effects on downstream water quality from effluent. Beneficial effects from increased forage for some species and life stages.	Same as the No-action Alternative, but with increased risks from the rainbow trout hatchery program and sport fishing below dams due to increased movement of resident fish below dams with improved passage conditions in North Santiam River, South Santiam River, and Middle Fork Willamette River Subbasins.	Same as the No-action Alternative, but with increased risks from the rainbow trout hatchery program and sport fishing below dams due to increased movement of resident fish below dams with improved passage conditions in North Santiam River, South Santiam River, McKenzie, and Middle Fork Willamette River Subbasins.	Same as Alternative 2A.	Same as Alternative 1.	Same as Alternative 2A.
Reservoir/Lake-like Habitat	**North Santiam –** Substantial, beneficial effects due to feeding and growth opportunities in reservoirs. **South Santiam –** Same as North Santiam. **McKenzie –** Same as North Santiam. **Middle Fork –** Same as North Santiam. **Coast Fork –** Same as North Santiam. **Long Tom –** Same as North Santiam. **Gamefish in all Subbasins[2]** Adverse effects to sport fishing opportunities moderated by stocking of rainbow trout and kokanee as determined by ODFW.	**North Santiam –** Same as the No-action Alternative. **South Santiam –** Same as the No-action Alternative. **McKenzie –** Same as the No-action Alternative. **Middle Fork –** Same as the No-action Alternative. **Coast Fork –** Same as the No-action Alternative. **Long Tom –** Same as the No-action Alternative. **Gamefish in all Subbasins** Same as the No-action Alternative.	**North Santiam –** Same as the No-action Alternative. **South Santiam –** Moderate, adverse effects on habitat availability and entrainment of fish due to Green Peter Reservoir drawdown in fall. **McKenzie –** Same as the No-action Alternative. **Middle Fork –** Same as the No-action Alternative. **Coast Fork –** Same as the No-action Alternative. **Long Tom –** Same as the No-action Alternative. **Gamefish in all Subbasins** Adverse effects to sport fishing opportunities moderated by stocking of rainbow trout and kokanee as determined by ODFW. However, deep drawdowns at Green Peter Reservoir would reduce stocking benefits.	**North Santiam –** Same as the No-action Alternative. **South Santiam –** Same as Alternative 2A. **McKenzie –** Substantial, adverse effects on habitat availability and entrainment of fish due to Cougar Reservoir spring and fall drawdowns. **Middle Fork –** Same as the No-action Alternative. **Coast Fork –** Same as the No-action Alternative. **Long Tom –** Same as the No-action Alternative. **Gamefish in all Subbasins** Same as the Alternative 2A. Deep drawdowns at Cougar Reservoir would also reduce stocking benefits.	**North Santiam –** Substantial, adverse effects on habitat availability and entrainment of fish due to spring and fall reservoir drawdowns. **South Santiam –** Same as Alternative 2A. **McKenzie –** Similar to the No-action Alternative. **Middle Fork –** Substantial, adverse effects on habitat availability and entrainment of fish due to Lookout Point Reservoir spring and fall drawdowns. Moderate, adverse effects on habitat availability and entrainment of fish due to Hills Creek Reservoir and Fall Creek Reservoir drawdowns in fall. **Coast Fork –** Same as the No-action Alternative. **Long Tom –** Same as the No-action Alternative. **Gamefish in all Subbasins** Same as the Alternative 2A. Deep drawdowns at Detroit, Blue River, Lookout Point, and Hills Creek Reservoirs would also reduce stocking benefits.	**North Santiam –** Moderate, adverse effects on habitat availability and entrainment of fish due to fall reservoir drawdowns. **South Santiam –** Substantial, adverse effects on habitat availability and entrainment of fish due Green Peter Reservoir drawdowns in spring and fall. **McKenzie –** Same as Alternative 2B. **Middle Fork –** Substantial, adverse effects on habitat availability and entrainment of fish due to Hills Creek Reservoir spring and fall drawdowns. Moderate, adverse effects on habitat availability and entrainment of fish due to Lookout Point Reservoir and Fall Creek Reservoir drawdowns in fall. **Coast Fork –** Same as the No-action Alternative. **Long Tom –** Same as the No-action Alternative. **Gamefish in all Subbasins** Same as Alternative 3A. Deep drawdowns at Cougar Reservoir would also reduce stocking benefits.

Effect Category	No-action Alternative	Alternative 1	Alternative 2A	Alternative 2B	Alternative 3A	Alternative 3B
Riverine Habitat	**North Santiam –** Substantial, adverse effects in winter and spring from reduced peak flows and materials transport due to dam and reservoir operations. Beneficial effects from flow augmentation and water temperature management due to dam and reservoir operations during low flow seasons. Adverse effects from TDG below dams. **South Santiam –** Same as the North Santiam. **McKenzie –** Same as the North Santiam. **Middle Fork –** Same as the North Santiam. **Coast Fork –** Same as North Santiam. **Long Tom –** Same as North Santiam.	**North Santiam –** Similar to the No-action Alternative with slight to moderate benefits during low flow seasons from flow augmentation due to minimum flow targets. Moderate increased benefits from temperature management and reduced TDG. **South Santiam –** Same as the North Santiam. **McKenzie –** Same as the North Santiam. **Middle Fork –** Same as the North Santiam. **Coast Fork –** Same as the No-action Alternative. **Long Tom –** beneficial effects from increased rearing due to improved habitat access with removal of drop structures.	**North Santiam –** Similar to the No-action Alternative, but slight differences in benefits during spring and low flow seasons depending on reach, species, and life stage. **South Santiam –** Similar to North Santiam with increased adverse effects on water quality below dams due to Green Peter Reservoir drawdown in fall. **McKenzie –** Same as the North Santiam. **Middle Fork –** Same as the North Santiam. **Coast Fork –** Same as the No-action Alternative. **Long Tom –** Same as the No-action Alternative.	**North Santiam –** Similar to Alternative 2A. **South Santiam –** Same as Alternative 2A. **McKenzie –** Same as the No-action Alternative, but with slight to moderate reductions in habitat due to lower stream flows in summer. Slight increased benefits from water temperatures. Increased adverse effects from turbidity below Cougar Dam (moderate in first few years, slight in later years). **Middle Fork –** Same as Alternative 2A. **Coast Fork –** Same as the No-action Alternative. **Long Tom –** Same as the No-action Alternative.	**North Santiam –** Similar to Alternative 2A, but with increased adverse effects on habitat available and water quality below dams due to Detroit Reservoir drawdown in spring and fall. **South Santiam –** Same as Alternative 2A. **McKenzie –** Similar to the No-action Alternative below Cougar Dam with slight reductions in habitat availability. Increased adverse effects on water quality due to Blue River Reservoir drawdown in fall. **Middle Fork –** Increased adverse effects water quality and habitat availability due to Lookout Point Reservoir drawdown in spring and fall. **Coast Fork –** Same as the No-action Alternative. **Long Tom –** Same as the No-action Alternative.	**North Santiam –** Similar to Alternative 2A in spring and summer. Increased adverse effects from water quality in fall below dams due to Detroit Reservoir drawdown. **South Santiam –** Increased adverse effects on water quality and habitat availability below dams due to Green Peter Reservoir drawdown in spring and fall. **McKenzie –** Same as Alternative 3B. **Middle Fork –** Increased adverse effects on water quality and habitat availability due to Hills Creek Reservoir drawdown in spring and fall and Lookout Point Reservoir drawdown in fall. **Coast Fork –** Same as the No-action Alternative. **Long Tom –** Same as the No-action Alternative.

Effect Category	No-action Alternative	Alternative 1	Alternative 2A	Alternative 2B	Alternative 3A	Alternative 3B
Dam Passage Conditions	**North Santiam –** Slight, adverse effects from collection and upstream transport of adults above dams. Substantial, adverse effects due to poor downstream passage conditions at Detroit and Big Cliff dams. **South Santiam –** Same as North Santiam. **McKenzie –** Slight, adverse effects from collection and upstream transport of adults above dams. Substantial, adverse effects due to poor passage conditions at Cougar Dam. **Middle Fork –** Slight, adverse effects from collection and upstream transport of adults above Dexter and Lookout Point dams. Moderate to substantial, adverse effects from upstream passage conditions at Hills Creek Dam due to use of traps and angling for collection. Substantial, adverse effects due to poor passage conditions at Hills Creek Dam. **Coast Fork –** Substantial, adverse due to upstream and downstream passage conditions. **Long Tom –** Substantial, adverse due to upstream and downstream passage conditions.	**North Santiam –** Slight, adverse effects from upstream and downstream passage at Detroit and Big Cliff dams. **South Santiam –** Slight, adverse effects from upstream, and downstream passage at Green Peter Dam. Negligible to slight, adverse effects at Foster Dam. **McKenzie –** Same as the No-action Alternative. **Middle Fork –** Same as the No-action Alternative at Hills Creek Dam. Slight, adverse effects from upstream and downstream passage at Dexter and Lookout Point dams. **Coast Fork –** Same as the No-action Alternative. **Long Tom –** Same as the No-action Alternative.	**North Santiam –** Same as Alternative 1. **South Santiam –** Slight, adverse effects from upstream passage at Foster and Green Peter dams. Slight, adverse effects at Foster Dam from downstream passage. Moderate, adverse effects at Green Peter Dam from downstream passage. **McKenzie –** Slight adverse effects from upstream and downstream passage at Cougar Dam. Same as the No-action Alternative at Blue River Dam. **Middle Fork –** Slight, adverse effects from upstream passage above dams. Same as the No-action Alternative from downstream passage at Hills Creek Dam. Slight, adverse effects from downstream passage at Dexter and Lookout Point dams. **Coast Fork –** Same as the No-action Alternative. **Long Tom –** Same as the No-action Alternative.	**North Santiam –** Same as Alternative 1. **South Santiam –** Same as Alternative 2A. **McKenzie –** Slight, adverse effects from upstream and downstream passage at Cougar Dam. Same as the No-action Alternative at Blue River Dam. **Middle Fork –** Same as Alternative 2A at Dexter and Lookout Point dams. Same as the No-action Alternative at Hills Creek Dam. **Coast Fork –** Same as the No-action Alternative. **Long Tom –** Same as the No-action Alternative.	**North Santiam** – Slight, adverse effects from collection and upstream transport of adults above Detroit and Big Cliff dams. Moderate adverse effects due to poor passage conditions at Detroit and Big Cliff dams. **South Santiam –** Same as Alternative 2A at Green Peter Dam. Same as the No-action Alternative at Foster Dam. **McKenzie –** Similar to the No-action Alternative at Cougar Dam, but adverse effects trending toward beneficial. Slight to moderate, adverse effects from downstream passage at Blue River Dam. **Middle Fork –** Slight, adverse effects from upstream passage above dams. Slight, adverse effects from downstream passage at Fall Creek, Dexter, Lookout Point, and Hills Creek dams. **Coast Fork –** Same as the No-action Alternative. **Long Tom –** Same as the No-action Alternative.	**North Santiam –** Same as Alternative 3A. **South Santiam –** Same as Alternative 2A at Green Peter Dam. Same as the No-action Alternative at Foster Dam **McKenzie –** Same as Alternative 2B at Cougar Dam. Slight to moderate, adverse effects from downstream passage at Blue River Dam. **Middle Fork –** Same as Alternative 3A. **Coast Fork –** Same as the No-action Alternative. **Long Tom –** Same as the No-action Alternative.

Table 3-24. Summary of Fish and Habitat Effects on Resident Fish and Gamefish as Compared to the No-action Alternative[1] (continued).

Effect Category	No-action Alternative	Alternative 4	Alternative 5	Alternative 6	Interim operations
Hatchery Mitigation in All Subbasins	Adverse effects from sport fishing, habitat competition, and effects on downstream water quality from effluent. Beneficial effects from increased forage for some species and life stages.	Same as Alternative 2A.	Same as Alternative 1.	Same as Alternative 1.	Same as Alternative 1.
Reservoir/Lake-like Habitat	**North Santiam –** Substantial, beneficial effects due to feeding and growth opportunities in reservoirs. **South Santiam –** Same as North Santiam. **McKenzie –** Same as North Santiam. **Middle Fork –** Same as North Santiam. **Coast Fork –** Same as North Santiam. **Long Tom –** Same as North Santiam. **Gamefish in all Subbasins[2]** Adverse effects to sport fishing opportunities moderated by stocking of rainbow trout and kokanee as determined by ODFW.	**North Santiam –** Same as the No-action Alternative. **South Santiam –** Same as the No-action Alternative. **McKenzie –** Same as the No-action Alternative. **Middle Fork –** Same as the No-action Alternative. **Coast Fork –** Same as the No-action Alternative. **Long Tom –** Same as the No-action Alternative. **Gamefish in all Subbasins** Same as the No-action Alternative.	**North Santiam –** Same as Alternative 3A. **South Santiam –** Same as the No-action Alternative. **McKenzie –** Same as the No-action Alternative. **Middle Fork –** Same as Alternative 3A. **Coast Fork –** Same as the No-action Alternative. **Long Tom –** Same as the No-action Alternative. **Gamefish in all Subbasins** Same as the No-action Alternative. Deep drawdowns would also reduce stocking benefits where stocking occurs throughout all subbasins.	Similar to Alternative 2B.	**North Santiam –** Similar to Alternative 3B. **South Santiam –** Similar to Alternative 2A. **McKenzie –** Similar to the No-action Alternative. **Middle Fork –** Similar to Alternative 3B. **Coast Fork –** Same as the No-action Alternative. **Long Tom –** Same as the No-action Alternative
Riverine Habitat	**North Santiam –** Substantial, adverse effects in winter and spring from reduced peak flows and materials transport due to dam and reservoir operations. Beneficial effects from flow augmentation and water temperature management due to dam and reservoir operations during low flow seasons. Adverse effects from TDG below dams. **South Santiam –** Same as the North Santiam. **McKenzie –** Same as the North Santiam. **Middle Fork –** Same as the North Santiam. **Coast Fork –** Same as North Santiam. **Long Tom –** Same as North Santiam.	**North Santiam –** Similar to Alternative 2A. **South Santiam –** Similar to the No-action Alternative, but slight differences in benefits during spring and low flow seasons depending on reach, species, and life stage. **McKenzie –** Same as Alternative 2A. **Middle Fork –** Same as Alternative 2A. **Coast Fork –** Same as the No-action Alternative. **Long Tom –** Beneficial effects from increased rearing due to improved habitat access with removal of drop structures.	**Interim Operations** **North Santiam –** Same as Alternative 3B. **South Santiam –** Same as Alternative 2A. **McKenzie –** Same as Alternative 2B. **Middle Fork –** Same as Alternative 3B. **Coast Fork –** Same as the No-action Alternative. **Long Tom –** Same as the No-action Alternative. **Long-term Operations** Same as Alternative 2B.	Similar to Alternative 2B.	**North Santiam –** Similar to Alternative 3B. **South Santiam –** Similar to Alternative 2A. **McKenzie –** Similar to the No-action Alternative. **Middle Fork –** Similar to Alternative 3B. **Coast Fork –** Same as the No-action Alternative. **Long Tom –** Same as the No-action Alternative

Effect Category	No-action Alternative	Alternative 4	Alternative 5	Alternative 6	Interim operations
Dam Passage Conditions	**North Santiam –** Slight, adverse effects from collection and upstream transport of adults above dams. Substantial, adverse effects due to poor downstream passage conditions at Detroit and Big Cliff dams. **South Santiam –** Same as North Santiam. **McKenzie –** Slight, adverse effects from collection and upstream transport of adults above dams. Substantial, adverse effects due to poor passage conditions at Cougar Dam. **Middle Fork –** Slight, adverse effects from collection and upstream transport of adults above Dexter and Lookout Point dams. Moderate to substantial, adverse effects from upstream passage conditions at Hills Creek Dam due to use of traps and angling for collection. Substantial, adverse effects due to poor passage conditions at Hills Creek Dam. **Coast Fork –** Substantial, adverse due to upstream and downstream passage conditions. **Long Tom –** Substantial, adverse due to upstream and downstream passage conditions.	**North Santiam –** Same as Alternative 1. **South Santiam –** Slight, adverse effects from upstream and downstream passage at Foster Dam Same as the No-action Alternative at Green Peter Dam. **McKenzie –** Same as Alternative 2A. **Middle Fork –** Same as Alternative 2A at Fall Creek, Lookout Point, Dexter, and Hills Creek dams. **Coast Fork –** Same as the No-action Alternative. **Long Tom –** Same as the No-action Alternative.	**Interim Operations** **North Santiam –** Same as Alternative 3A. **South Santiam –** Same as Alternative 3A. **McKenzie –** Same as the No-action Alternative with slight trend toward beneficial from downstream passage due to regulating outlet improvements. **Middle Fork –** Same as the No-action Alternative from upstream passage. Same as Alternative 3A from downstream passage. **Coast Fork –** Same as the No-action Alternative. **Long Tom –** Same as the No-action Alternative. **Long-term Operations** Same as Alternative 2B.	Similar to Alternative 2B but with minor to moderate increased adverse effects due to decreased survival of fish passing through penstocks modified with cone valves or in-line orifices.	**North Santiam –** Similar to Alternative 3B. **South Santiam –** Similar to Alternative 2A. **McKenzie –** Similar to the No-action Alternative. **Middle Fork –** Similar to Alternative 3B. **Coast Fork –** Same as the No-action Alternative. **Long Tom –** Same as the No-action Alternative

Table 3.8-31 in the FEIS

North Santiam = North Fork Santiam River Subbasin, South Santiam = South Fork Santiam River Subbasin, McKenzie = McKenzie River Subbasin, Middle Fork = Middle Fork Willamette River Subbasin, Coast Fork = Coast Fork Willamette River Subbasin, Long Tom = Long Tom River Subbasin, ODFW = Oregon Department of Fish and Wildlife

[1] All effects would occur or reoccur over the 30-year implementation timeframe.

[2] Gamefish stocking in all reservoirs is managed by ODFW and may or may not occur throughout all subbasins during the 30-year implementation timeframe.

3.9 Wildlife and Habitat

3.9.1 Introduction

Incorporated by reference.

3.9.2 Affected Environment

Incorporated by reference.

3.9.3 Environmental Consequences

This section discusses the potential effects of Alternative 6 and the interim operations, which include the Detroit drawdown, on wildlife and habitat. The discussion incorporates the methodology used to assess effects by reference, summarizes the anticipated effects (Table 3-25).

3.9.3.1 Methodology

Incorporated by reference.

Table 3-25. Summary of Effects to Wildlife and Habitat as Compared to the No-action Alternative[1]

Effect Category	No-action Alternative	Alternative 1	Alternative 2A	Alternative 2B	Alternative 3A	Alternative 3B
Construction	Minor, adverse due to disturbances resulting from construction activities.	Minor, adverse due to disturbances resulting from construction activities.	Minor, adverse due to disturbances resulting from construction activities.	Minor, adverse due to disturbances resulting from construction activities.	Minor, adverse due to disturbances resulting from construction activities.	Minor, adverse due to disturbances resulting from construction activities.
Summer Water Surface Elevations	Moderate, beneficial due to sustained water source, supports the presence of aquatic prey species.	Moderate, beneficial due to sustained water source, supports the presence of aquatic prey species. Minor, adverse effects to northwestern pond turtle as nests may be inundated by high surface elevations.	Moderate, beneficial due to a sustained water source, supports the presence of aquatic prey species.	Moderate, beneficial due to sustained water source, supports the presence of aquatic prey species.	Moderate, beneficial due to sustained water source, supports the presence of aquatic prey species.	Moderate, beneficial due to sustained water source, supports the presence of aquatic prey species.
Winter Water Surface Elevations	Minor, adverse from increased distance from sheltering/foraging habitats to the water's edge requiring some species to travel longer distances for water.	Minor, adverse from increased distance from sheltering/foraging habitats to the water's edge requiring some wildlife species to travel longer distances for water.	Moderate, adverse due to the additional deep drawdown at Green Peter and increased distance from sheltering/foraging habitats to the water's edge requiring some wildlife species to travel longer distances for water. Moderate, adverse from dramatic changes in reservoir elevations over the year causing wetting/drying cycles for reservoir-adjacent habitats.	Moderate, adverse due to additional deep drawdown at Cougar and from increased distance from sheltering/ foraging habitats to the water's edge requiring some wildlife species to travel longer distances for water.	Moderate, adverse due to additional deep drawdown at multiple reservoirs and increased distance from sheltering/foraging habitats to the water's edge requiring some wildlife species to travel longer distances for water, which would have lasting generational impacts on wildlife populations.	Moderate, adverse due to the additional deep drawdown at multiple reservoirs and increased distance from sheltering/ foraging habitats to the water's edge requiring some wildlife species to travel longer distances for water, which would have lasting generational impacts on wildlife populations.
Downstream Habitat	Major, adverse due to flood operations/revetments causing floodplain disconnection, habitat fragmentation, and migration limitations. Minor, beneficial to riparian wildlife habitat from increased summer flows. No gravel augmentation or revetment improvements, so no benefits. No effect to northwestern pond turtle downstream habitat from gravel augmentation. No effects to prey and foraging availability from fish passage measures.	Major, adverse due to flood operations/revetments causing floodplain disconnection, habitat fragmentation, and migration limitations. Minor, beneficial due to maintained instream flows. Minor, beneficial effects to habitat connectivity and quality due to gravel augmentation and revetment improvements. Minor, adverse effects to northwestern pond turtle downstream habitat from gravel augmentation. No effects to prey and foraging availability from fish passage measures.	Major, adverse due to flood operations/revetments causing floodplain disconnection, habitat fragmentation, channel alteration, and migration limitations. Minor, adverse from spring drawdown and associated high flows/sediment releases dislodging amphibian egg masses and burying mussel beds and aquatic invertebrates. Minor, beneficial effects to habitat connectivity and quality due to gravel augmentation and revetment improvements. Minor, adverse to northwestern pond turtle downstream habitat from gravel augmentation.	Major, adverse due to flood operations/revetments causing floodplain disconnection, habitat fragmentation, channel alteration, and migration limitations. Minor, adverse from spring drawdown and associated high flows/sediment releases dislodging amphibian egg masses and burying mussel beds and aquatic invertebrates Minor, beneficial effects to habitat connectivity and quality due to gravel augmentation and revetment improvements. Minor, adverse to northwestern pond turtle downstream habitat from gravel augmentation.	Major, adverse due to flood operations/revetments causing floodplain disconnection, habitat fragmentation, and migration limitations. Minor, benefits from increased flows downstream. Minor, beneficial effects to habitat connectivity and quality due to gravel augmentation and revetment improvements. Minor, adverse to northwestern pond turtle downstream habitat from gravel augmentation. No effects to prey and foraging availability from fish passage measures.	Major, adverse due to flood operations and revetments causing floodplain disconnection, habitat fragmentation, and migration limitations. Minor, benefits from increased flows downstream. Minor, beneficial effects to habitat connectivity and quality due to gravel augmentation and revetment improvements. Minor, adverse to northwestern pond turtle downstream habitat from gravel augmentation. No effects to prey and foraging availability from fish passage measures.

Effect Category	No-action Alternative	Alternative 1	Alternative 2A	Alternative 2B	Alternative 3A	Alternative 3B
			Minor, beneficial effects to prey and foraging availability from fish passage measures.	Minor, beneficial effects to prey and foraging availability from fish passage measures		
ESA Threatened and Endangered Species	Negligible, adverse effects to Southern Resident killer whales from adverse effects to prey. Moderate, adverse effects to northwestern pond turtles from low winter reservoir elevations forcing turtles to travel farther from the aquatic environment to terrestrial overwintering habitat and increasing competition for resources. Minor benefits to northwestern pond turtles in summer with high water levels. No effect to northern spotted owl or streaked horned lark.	Negligible, adverse effects to Southern Resident killer whales from adverse effects to their prey. Moderate, adverse effects to northwestern pond turtles from low winter reservoir elevations forcing turtles to travel farther from the aquatic environment to terrestrial overwintering habitat and increasing competition for resources. Minor benefits to northwestern pond turtles in summer with high water levels. No effect to northern spotted owl or streaked horned lark.	Negligible, adverse effects to Southern Resident killer whales from adverse effects to their prey. Moderate, adverse effects to northwestern pond turtles from low winter reservoir elevations forcing turtles to travel farther from the aquatic environment to terrestrial overwintering habitat and increasing competition for resources. Minor benefits to northwestern pond turtles in summer with high water levels. No effect to northern spotted owl or streaked horned lark.	Negligible, adverse effects to Southern Resident killer whales from adverse effects to their prey. Moderate, adverse effects to northwestern pond turtles from low winter reservoir elevations forcing turtles to travel farther from the aquatic environment to terrestrial overwintering habitat and increasing competition for resources. Minor benefits to northwestern pond turtles in summer with high water levels. No effect to northern spotted owl or streaked horned lark.	Negligible, adverse effects to Southern Resident killer whales from adverse effects to their prey. Moderate, adverse effects to northwestern pond turtles from multiple deep drawdowns resulting in lowered winter reservoir elevations forcing turtles to travel farther from the aquatic environment to terrestrial overwintering habitat and increasing competition for resources. Spring deep drawdowns may negatively affect turtles by increasing the return distance to aquatic habitat. Minor, adverse effects from early drawdowns may reduce habitat availability and increase resource competition. Turtles that overwinter in reservoir bed may have to move to follow the drawdown resulting in greater energy expenditures. No effect to northern spotted owl or streaked horned lark.	Negligible, adverse effects to Southern Resident killer whales from adverse effects to their prey. Moderate, adverse effects to northwestern pond turtles from multiple deep drawdowns resulting in lowered winter reservoir elevations forcing turtles to travel farther from the aquatic environment to terrestrial overwintering habitat and increasing competition for resources. Spring deep drawdowns may negatively affect turtles by increasing the return distance to aquatic habitat. Minor, adverse effects from early drawdowns may reduce habitat availability and increase resource competition. Turtles that overwinter in reservoir bed may have to move to follow the drawdown resulting in greater energy expenditures. No effect to northern spotted owl or streaked horned lark.

Table 3-25. Summary of Effects to Wildlife and Habitat as Compared to the No-action Alternative[1] (continued).

Effect Category	No-action Alternative	Alternative 4	Alternative 5	Alternative 6	Interim Operations
Construction	Minor, adverse due to disturbances resulting from construction activities.	Minor, adverse due to disturbances resulting from construction activities.	Minor, adverse due to disturbances resulting from construction activities.	Moderate, adverse due to disturbances resulting from construction activities.	Minor, adverse
Summer Water Surface Elevations	Moderate, beneficial due to sustained water source, supports the presence of aquatic prey species.	Moderate, beneficial due to sustained water source, supports the presence of aquatic prey species. Minor adverse effect to northwestern pond turtle as nests may be inundated by high surface elevations.	Moderate, beneficial due to sustained water source, supports the presence of aquatic prey species. Minor adverse effect to northwestern pond turtle as nests may be inundated by high surface elevations.	Negligible effects from removal of hydropower infrastructure and cessation of hydropower generation. Minor adverse effects from flow pulses lowering reservoir elevations resulting in increased distance from sheltering/foraging habitats at the water's edge requiring some wildlife species to travel longer distances for water. Minor adverse effect to northwestern pond turtle as nests may be inundated by high surface elevations.	Moderate, beneficial due to sustained water source, supports the presence of aquatic prey species. Minor, adverse at Detroit reservoir in dry years from lowered summer surface elevations resulting in increased distance from sheltering/foraging habitats at the waters edge requiring some wildlife species to travel longer distances for water.
Winter Water Surface Elevations	Minor, adverse from increased distance from sheltering/foraging habitats to the water's edge requiring some species to travel longer distances for water.	Minor, adverse from increased distance from sheltering/foraging habitats to the water's edge requiring some wildlife species to travel longer distances for water.	Minor, adverse from increased distance from sheltering/foraging habitats to the water's edge requiring some wildlife species to travel longer distances for water.	Negligible effects from removal of hydropower infrastructure and cessation of hydropower generation Minor, adverse from increased distance from sheltering/foraging habitats to the water's edge requiring some wildlife species to travel longer distances for water. Moderate, adverse from dramatic changes in reservoir elevations over the year causing wetting/drying cycles for reservoir-adjacent habitats.	Minor, adverse from increased distance from sheltering/foraging habitats to the water's edge requiring some species to travel longer distances for water.

Effect Category	No-action Alternative	Alternative 4	Alternative 5	Alternative 6	Interim Operations
Downstream Habitat	Major, adverse due to flood operations/revetments causing floodplain disconnection, habitat fragmentation, and migration limitations. Minor, beneficial to riparian wildlife habitat from increased summer flows. No gravel augmentation or revetment improvements, so no benefits. No effect to northwestern pond turtle downstream habitat from gravel augmentation. No effects to prey and foraging availability from fish passage measures.	Major, adverse due to flood operations revetments causing floodplain disconnection, habitat fragmentation, and migration limitations. Minor, beneficial due to maintained instream flows. Minor, beneficial effects to habitat connectivity and quality due to gravel augmentation and revetment improvements. Minor, adverse to northwestern pond turtle downstream habitat from gravel augmentation. No effects to prey and foraging availability from fish passage measures.	Major, adverse due to flood operations revetments causing floodplain disconnection, habitat fragmentation, and migration limitations. Minor, beneficial due to maintained instream flows. Minor, beneficial effects to habitat connectivity and quality due to gravel augmentation and revetment improvements. Minor, adverse to northwestern pond turtle downstream habitat from gravel augmentation. No effects to prey and foraging availability from fish passage measures.	No effects from removal of hydropower infrastructure and cessation of hydropower generation. Major, adverse due to flood operations/revetments causing floodplain disconnection, habitat fragmentation, and migration limitations. Minor, adverse from spring drawdown and associated high flows and sediment releases dislodging amphibian egg masses and burying mussel beds and aquatic invertebrates. Minor, beneficial effects to habitat connectivity and quality due to gravel augmentation and revetment improvements. Minor, adverse to northwestern pond turtle downstream habitat from gravel augmentation. Minor, beneficial effects to prey and foraging availability from fish passage measures.	Major, adverse due to flood operations/revetments causing floodplain disconnection, habitat fragmentation, and migration limitations. Minor, beneficial to riparian wildlife habitat from increased summer flows. No effects to prey and foraging availability from fish passage measures.
ESA Threatened and Endangered Species	Negligible, adverse effects to Southern Resident killer whales from adverse effects to prey. Moderate, adverse effects to northwestern pond turtles from low winter reservoir elevations forcing turtles to travel farther from the aquatic environment to terrestrial overwintering habitat and increasing competition for resources. Minor benefits to northwestern pond turtles in summer with high water levels. No effect to northern spotted owl or streaked horned lark.	Negligible, adverse effects to Southern Resident killer whales from adverse effects to their prey. Moderate, adverse effects to northwestern pond turtles from low winter reservoir elevations forcing turtles to travel farther from the aquatic environment to terrestrial overwintering habitat and increasing competition for resources. Minor benefits to northwestern pond turtles in summer with high water levels. No effect to northern spotted owl or streaked horned lark.	Negligible, adverse effects to Southern Resident killer whales from adverse effects to their prey. Moderate, adverse effects to northwestern pond turtles from low winter reservoir elevations forcing turtles to travel farther from the aquatic environment to terrestrial overwintering habitat and increasing competition for resources. Minor benefits to northwestern pond turtles in summer with high water levels. No effect to northern spotted owl or streaked horned lark.	Negligible effects from removal of hydropower infrastructure and cessation of hydropower generation. Negligible, adverse effects to Southern Resident killer whales from adverse effects to their prey. Moderate, adverse effects to northwestern pond turtles from low winter reservoir elevations forcing turtles to travel farther from the aquatic environment to terrestrial overwintering habitat and increasing competition for resources. No effect to northern spotted owl or streaked horned lark.	Negligible, adverse effects to Southern Resident killer whales from adverse effects to prey. Moderate, adverse effects to northwestern pond turtles from low winter reservoir elevations forcing turtles to travel farther from the aquatic environment to terrestrial overwintering habitat and increasing competition for resources. No effect to northern spotted owl or streaked horned lark. Minor, short-term localized adverse effects to wildlife downstream of Lookout Point, Green Peter, and Detroit reservoirs from increased turbidity as a result of deep drawdowns.

Table 3.9-4 in the FEIS

[1] The duration of all effects would be long term.

3.9.3.2 Alternatives Analysis

Effects discussions for alternatives other than Alternative 6 are in the FEIS and incorporated by reference. A summary of the effects for all alternatives is in Table 3-25.

Alternative 6

Under Alternative 6 operations, effects to wildlife, including threatened and endangered species, in the analysis area would be the same as those described under Alternative 5.

The decommissioning of hydropower infrastructure and cessation of hydropower generation under Alternative 6 would have a negligible effect on wildlife and wildlife habitat within the Willamette Valley System.

3.9.4 Interim Operations under All Action Alternatives Except Alternative 1

This section is incorporated by reference with the following addition pertaining to the deep drawdown at Detroit Reservoir and interim operations:

The Alternative 6 fall deep drawdown at Detroit Reservoir may result in moderate adverse effects to some ESA species and wildlife. Specifically, the Northwestern pond turtle (a candidate for listing as threatened; see 88 FR 68370) is vulnerable. Lower reservoir elevations would force turtles to travel greater distances to terrestrial overwintering sites, intensifying competition for resources. Furthermore, increased fine sediment transport during deep drawdowns may cause minor, localized, short-term water quality declines with adverse effects on downstream wildlife.

3.9.5 Climate Change Effects under All Alternatives

Incorporated by reference. This section was not updated to include Alternative 6. Prior to the release of this SEIS, Executive Order 14154 “Unleashing American Energy” was issued. Consistent with this Executive Order, a greenhouse gas analysis is not included here; however, this SEIS is consistent with the NEPA statute and existing agency regulations pertaining to air quality and emissions.

3.10 Air Quality and Greenhouse Gas Emissions

3.10.1 Introduction

Incorporated by reference.

3.10.2 Affected Environment

Incorporated by reference.

3.10.3 Environmental Consequences

This section discusses the potential effects of Alternative 6 and Interim Operations to air quality and greenhouse gas emissions. The discussion includes the methodology used to assess effects and a summary of the anticipated effects (Table 3-26).

3.10.3.1 Methodology

Incorporated by reference.

Table 3-26. Summary of Effects on Air Quality and Compliance with Federal and State Regulations as Compared to the No-action Alternative.

Degree of Adverse or Beneficial Effect and Extent	No-action Alternative	Alternative 1	Alternative 2A	Alternative 2B	Alternative 3A	Alternative 3B
Short-term Duration						
Degree	• None	• Minor adverse.	• None	• None	• None	• None
Extent	• None	• Small (Fern Ridge Dam)	• None	• None	• None	• None
Medium-term Duration						
Degree	• Minor adverse	• Minor adverse.	• Minor adverse.	• Minor adverse.	• Minor adverse.	• Minor adverse.
Extent	• Small	• Small (Detroit Dam, Green Peter Dam, Lookout Point Dam, Foster Dam).	• Small (Detroit Dam, Green Peter Dam, Lookout Point Dam, Foster Dam, Cougar Dam).	• Small (Detroit Dam, Green Peter Dam, Lookout Point Dam, Foster Dam).	• Small (Blue River Dam, Green Peter Dam, Hills Creek Dam).	• Small (Blue River Dam, Green Peter Dam, Hills Creek Dam).
Long-term Duration (Permanent, Intermittent, and/or Recurring)						
Degree	• Negligible adverse. • Minor adverse for climate change effects.	• Minor adverse; minor beneficial. • Minor adverse for climate change effects.	• Minor adverse. • Minor adverse for climate change effects.	• Minor adverse. • Minor adverse for climate change effects.	• Minor adverse. • Minor adverse for climate change effects.	• Minor adverse. • Minor adverse for climate change effects.
Extent	• Large (Detroit Dam, Green Peter Dam, Lookout Point Dam, Foster Dam, Cougar Dam, Fall Creek Dam, Hills Creek Dam, Big Cliff Dam, Dexter Dam, Blue River Dam).	• Small (Fern Ridge Dam) • Large (Detroit Dam, Green Peter Dam, Lookout Point Dam, Foster Dam, Cougar Dam, Fall Creek Dam, Hills Creek Dam, Big Cliff Dam, Dexter Dam, Blue River Dam).	• Large (Detroit Dam, Green Peter Dam, Lookout Point Dam, Foster Dam, Cougar Dam, Fall Creek Dam, Hills Creek Dam, Big Cliff Dam, Dexter Dam, Blue River Dam).	• Large (Detroit Dam, Green Peter Dam, Lookout Point Dam, Foster Dam, Cougar Dam, Fall Creek Dam, Hills Creek Dam, Big Cliff Dam, Dexter Dam, Blue River Dam).	• Large (Detroit Dam, Green Peter Dam, Lookout Point Dam, Foster Dam, Cougar Dam, Fall Creek Dam, Hills Creek Dam, Big Cliff Dam, Dexter Dam, Blue River Dam).	• Large (Detroit Dam, Green Peter Dam, Lookout Point Dam, Foster Dam, Cougar Dam, Fall Creek Dam, Hills Creek Dam, Big Cliff Dam, Dexter Dam, Blue River Dam).

Table 3-26. Summary of Effects on Air Quality and Compliance with Federal and State Regulations as Compared to the No-action Alternative (continued).

Degree of Adverse or Beneficial Effect and Extent	No-action Alternative	Alternative 4	Alternative 5	Alternative 6	Interim Operations
Short-term Duration					
Degree	• None	• Minor adverse.	• None	• Minor adverse	• None
Extent	• None	• Small (Fern Ridge Dam)	• None	• Large (Detroit Dam, Green Peter Dam, Lookout Point Dam, Foster Dam, Cougar Dam, Hills Creek Dam, Big Cliff Dam, Dexter Dam,).	• None
Medium-term Duration					
Degree	• Minor adverse	• Minor adverse.	• Minor adverse.	• Minor adverse	• Minor adverse
Extent	• Small	• Small (Detroit Dam, Lookout Point Dam, Hills Creek Dam, Foster Dam, Cougar Dam).	• Small (Detroit Dam, Green Peter Dam, Lookout Point Dam, Foster Dam).	• Small (Detroit Dam, Green Peter Dam, Lookout Point Dam, Foster Dam).	• Small
Long-term Duration (Permanent, Intermittent, and/or Recurring)					
Degree	• Negligible adverse. • Minor adverse for climate change effects.	• Minor adverse; minor beneficial. • Minor adverse for climate change effects.	• Minor adverse. • Minor adverse for climate change effects.	• Minor adverse. • Minor adverse for climate change effects.	• Minor adverse. • Minor adverse for climate change effects.
Extent	• Large (Detroit Dam, Green Peter Dam, Lookout Point Dam, Foster Dam, Cougar Dam, Fall Creek Dam, Hills Creek Dam, Big Cliff Dam, Dexter Dam, Blue River Dam).	• Small (Fern Ridge Dam) • Large (Detroit Dam, Green Peter Dam, Lookout Point Dam, Foster Dam, Cougar Dam, Fall Creek Dam, Hills Creek Dam, Big Cliff Dam, Dexter Dam, Blue River Dam).	• Large (Detroit Dam, Green Peter Dam, Lookout Point Dam, Foster Dam, Cougar Dam, Fall Creek Dam, Hills Creek Dam, Big Cliff Dam, Dexter Dam, Blue River Dam).	•Large (Detroit Dam, Green Peter Dam, Lookout Point Dam, Foster Dam, Cougar Dam, Fall Creek Dam, Hills Creek Dam, Big Cliff Dam, Dexter Dam, Blue River Dam).	•Large (Detroit Dam, Green Peter Dam, Lookout Point Dam, Foster Dam, Cougar Dam, Fall Creek Dam, Hills Creek Dam, Big Cliff Dam, Dexter Dam, Blue River Dam).

Table 3.10-6 in the FEIS

Table 3-27. Summary of Effects on Greenhouse Gas Emissions as Compared to the No-action Alternative.

Degree of Adverse or Beneficial Effect and Extent	No-action Alternative	Alternative 1	Alternative 2A	Alternative 2B	Alternative 3A	Alternative 3B
Short-term Duration						
Degree	• Negligible adverse. • Moderate to substantial adverse for climate change effects.	• Minor adverse. • Moderate to substantial adverse for climate change effects.	• Minor adverse. • Moderate to substantial adverse for climate change effects.	• Minor adverse. • Moderate to substantial adverse for climate change effects.	• Minor adverse. • Moderate to substantial adverse for climate change effects.	• Minor adverse. • Moderate to substantial adverse for climate change effects.
Extent	• Large (state or beyond)	• Large (state or beyond)	• Large (state or beyond)	• Large (state or beyond)	• Large (state or beyond)	• Large (state or beyond)
Medium-term Duration						
Degree	• Slightly adverse.	• Slight to moderate adverse.	• Slight to moderate adverse.	• Slight to moderate adverse.	• Slight to moderate adverse.	• Slight to moderate adverse.
Extent	• Large (state or beyond)	• Large (state or beyond)	• Large (state or beyond)	• Large (state or beyond)	• Large (state or beyond)	• Large (state or beyond)
Long-term Duration (Permanent, Intermittent, and/or Recurring)						
Degree	• Moderate to substantial adverse. • Moderate to substantial adverse for climate change effects.	• Slight to moderate beneficial. • Moderate to substantial adverse for climate change effects.	• Slight to moderate adverse. • Moderate to substantial adverse for climate change effects.	• Slight to moderate adverse. • Moderate to substantial adverse for climate change effects.	• Moderate to substantial adverse. • Moderate to substantial adverse for climate change effects.	• Moderate to substantial adverse. • Moderate to substantial adverse for climate change effects.
Extent	• Large (state or beyond)	• Large (state or beyond)	• Large (state or beyond)	• Large (state or beyond)	• Large (state or beyond)	• Large (state or beyond)

Table 3-27. Summary of Effects on Greenhouse Gas Emissions as Compared to the No-action Alternative (continued).

Degree of Adverse or Beneficial Effect and Extent	No-action Alternative	Alternative 4	Alternative 5	Alternative 6	Interim Operations
Short-term Duration					
Degree	• Negligible adverse. • Moderate to substantial adverse for climate change effects.	• Minor adverse. • Moderate to substantial adverse for climate change effects.	• Minor adverse. • Moderate to substantial adverse for climate change effects.	• Minor adverse. • Moderate to substantial adverse for climate change effects.	• Minor adverse. • Moderate to substantial adverse for climate change effects.
Extent	• Large (state or beyond)	• Large (state or beyond)	• Large (state or beyond)	• Large (state or beyond)	•
Medium-term Duration					
Degree	• Slightly adverse.	• Slight to moderate adverse.	• Slight to moderate adverse.	• Slight to moderate adverse.	•
Extent	• Large (state or beyond)	• Large (state or beyond)	• Large (state or beyond)	• Large (state or beyond)	•
Long-term Duration (Permanent, Intermittent, and/or Recurring)					
Degree	• Moderate to substantial adverse. • Moderate to substantial adverse for climate change effects.	• Slightly beneficial. • Moderate to substantial adverse for climate change effects.	• Slight to moderate adverse. • Moderate to substantial adverse for climate change effects.	• Moderate to substantial adverse. • Moderate to substantial adverse for climate change effects.	• Slight to moderatel adverse. • Moderate to substantial adverse for climate change effects.
Extent	• Large (state or beyond)	• Large (state or beyond)	• Large (state or beyond)	• Large (state or beyond)	•

Table 3.10-7 in the FEIS

3.10.4 Alternatives Analyses

3.10.4.1 No-action Alternative

Incorporated by reference.

Fish Trucking Operations and Emergency Generator Activities

Incorporated by reference.

Construction Activities and Fugitive Dust

Incorporated by reference.

Greenhouse Gas Emissions

Incorporated by reference.

Climate Change

Incorporated by reference.

3.10.4.2 All Action Alternatives Except Alternative 6

Incorporated by reference.

3.10.4.3 Alternative 6 – Ceasing Federal Hydropower Operations

Fish Trucking Operations and Emergency Generator Activities

The effects from fish trucking operations would be identical to those described under Alternative 5. The continued operation of adult fish facilities and hatchery activities would require the use of additional emergency generators. As under alternatives 3A and 3B up to 32 emergency generators would operate under Alternative 6. Effects to air quality and greenhouse gas emissions under Alternative 6 would be the same as those described under Alternatives 3A and 3B.

Construction Activities and Fugitive Dust

Under Alternative 6 removal of hydropower infrastructure and associated retrofitting activities would have similar effects to those described under Alternative 5. However, unlike Alternative 5, in the short-term duration there will be minor adverse effects to air quality at dams where hydropower infrastructure will be removed. Construction vehicles and equipment, such as bulldozers, cranes, and other heavy equipment, would be required to complete these activities. The effects to air quality would include the combustion of diesel fuel to power for construction vehicles and machinery. During combustion, diesel engines emit large amounts of nitrogen oxides, particulate matter (in particular PM2.5), carbon, and other toxic air pollutants. The duration of the effect cannot be assessed without more site-specific information; however it is not anticipated that these activities will take greater than 2 years to complete. Although construction activities typically result in localized air pollution emissions the extent of these activities would be large because they would occur at all eight hydropower producing dams within the WVS. Removal of hydropower infrastructure and associated retrofitting activities will result in increased construction activity which would have adverse impacts to air quality. The degree of adverse effects from fugitive dust related to construction activities under Alternative 6 would be negligible because USACE would continue to comply with all Oregon Department of Environmental Quality management requirements for fugitive emissions.

Power Generation-related Greenhouse Gas Emissions

Hydropower and natural gas are currently the predominant energy sources to meet power demands in Oregon. Emissions from electric power generation in Oregon tend to fluctuate with the level of hydropower generation. In years where poor water conditions result in decreased hydropower generation emission rates are higher because the use of greenhouse gas generating resources increases to mitigate the reduction in hydropower generation. The primary source for greenhouse gas emissions in the WVS is not from hydropower generation itself, rather it is from conditions that limit the ability to generate hydropower. Limitations to hydropower generation have historically resulted in increased use of greenhouse gas emitting natural gas generation sources to meet power demands.

The effects to air quality and greenhouse gas emissions from Alternative 6 will be most similar to those under Alternatives 3A and 3B; however, hydropower will no longer be produced at Willamette Valley Dams under Alternative 6. If hydropower is no longer a viable option for power brokers in the region, then they may seek out alternative forms of energy to fill energy demand. Depending on the replacement generating resource that is identified to replace this power, the elimination of hydropower production in the Willamette Valley may or may not increase greenhouse gas emissions. If the region were able to attenuate the reduction in hydropower generation with non-emitting sources instead of natural gas, potential adverse effects could be reduced commensurate with the amount of natural gas that would be displaced. If no alternative non-emitting power sources are used to offset energy demands from hydropower loss, then large scale moderate to substantial adverse effects may result from Alternative 6.

Climate Change

Prior to the release of this SEIS, Executive Order 14154 “Unleashing American Energy” was issued. Consistent with this Executive Order, a climate change analysis is not included here; however, this SEIS is consistent with the NEPA statute and existing agency regulations pertaining to air quality and emissions.

3.10.5 Interim Operations

Effects to air quality and emissions as a direct result of interim operations would be the same as those under Alternative 5.

3.11 Socioeconomics

3.11.1 Introduction

Incorporated by reference.

3.11.2 Affected Environment

3.11.2.1 Analysis Area

The analysis area in the FEIS is applicable to alternative 6 and the interim operations and the description is therefore incorporated by reference.

3.11.3 Environmental Consequences

This section discusses the effects of Alternative 6 and the anticipated effects of the Interim Operations on economic resources and the economic relationship with communities. The Interim Operations includes the Detroit Drawdown. The discussion includes the methodology (Table 3-28) used to assess effects and a summary of anticipated effects.

The analyses address effects on Metropolitan Statistical Area (MSA) communities from operations, maintenance, construction, management, rehabilitation, and the alteration of reservoir outflows and water levels under the NAA and the action alternatives[5].

The discussion includes the methodology used to assess effects and a summary of the anticipated effects. Additional detail supporting the action alternatives analyses specific to capital costs associated with construction are in Appendix I, Socioeconomics Analysis, and Appendix K, Recreation Analysis, respectively.

Direct effects would occur from:

- Revenue opportunities within MSA communities.
- Employment earnings opportunities within MSA communities.
- Costs to MSA communities.

Indirect effects would occur if:

[5] The extent of effects analyzed under each alternative is the largest extent that would occur, even if the most severe adverse effect or the least beneficial effect would be localized.

- An MSA community is adversely impacted by a change in reservoir operations resulting in an employment industry shift to a different county associated with one or more other reservoirs in the analysis areas (i.e., displaced visitor use from one reservoir to another for recreation opportunities). The direct, adverse effect on the recreation socioeconomic factor in one county would, in turn, be an indirect, beneficial, or adverse effect to another county related to employment in the recreation industry.
- Managing agencies and organizations are required to adjust to visitor shifts resulting from alterations in water-based recreation opportunities, requiring staffing and financial resources to manage impacts. Impacts could include closure- and safety-related management, unauthorized dispersed recreation management, and possible financial burdens, including lost revenue or increases in revenue at the local level, among other unknown effects.
- The direct effect of drawdown operations on water quality results in indirect, increased water treatment costs or lack of potable water from turbidity increases in MSA communities.

3.11.3.1 Methodology

Incorporated by reference with the addition of the following for clarity:

The duration of all effects to MSA communities and counties would be occurring or reoccurring over the 30-year implementation timeframe.

Routine and non-routine maintenance would continue under all alternatives basin wide; however, it is unknown where activities associated with maintenance would occur, the extent of these activities, or the seasonality of these activities (Chapter 1, Introduction, Section 1.11.3, Operation, Maintenance, Repair, and Rehabilitation). Consequently, it is unknown if these activities would result in increased, temporary or long-term employment opportunities to MSA communities under a given alternative. Direct economic effects from routine and non-routine maintenance would be assessed under site-specific NEPA assessments prior to construction implementation. Extent criteria are defined in Table 3-28.

Table 3-28. Extent Criteria for Socioeconomics Effects.

Extent	Definition
Local	Effects are confined to the dam/reservoir and communities within these vicinities. This includes the MSAs and smaller communities.
Regional	Effects are perceived in communities throughout the MSA counties, multiple counties, or the entire Willamette River Basin.
Statewide	Effects are perceived in communities throughout the entire state.

Table 3.11-6 in the FEIS

Table 3-29. Summary of Socioeconomic Effects on Metropolitan Statistical Area Communities as Compared to the No-action Alternative[1].

Effect Category	No-action Alternative	Alternative 1	Alternative 2A	Alternative 2B	Alternative 3A	Alternative 3B
Arts, Entertainment, and Recreation Industry Employment	Negligible, direct, beneficial effect to any employment industry. Employment opportunities would not be a substantial contributor to MSA industry employment rates at the local, regional, or statewide levels.	Same as No-action Alternative.	Same as No-action Alternative.	Same as No-action Alternative.	Same as No-action Alternative.	Same as No-action Alternative.
Housing	None	None	None	None	None	None
Labor Force and Unemployment	Minor, beneficial effects	Same as No-action Alternative.	Same as No-action Alternative.	Same as No-action Alternative.	Same as No-action Alternative.	Same as No-action Alternative.
Art, Entertainment, and Recreation Industry	No measurable adverse or beneficial effect	Same as No-action Alternative.	Same as No-action Alternative.	Same as No-action Alternative.	Same as No-action Alternative.	Same as No-action Alternative.
Federal Spending for Construction	No benefit	Second most beneficial	Fourth most beneficial	Fifth most beneficial	Seventh most beneficial	Sixth most beneficial
Federal Spending for Operations and Maintenance	Slight, beneficial	Same as No-action Alternative.	Same as No-action Alternative.	Same as No-action Alternative.	Same as No-action Alternative.	Same as No-action Alternative.
Recreation-related Revenue and Employment Earnings at the Local, Reservoir Level	Substantial, beneficial	Same as NAA with slight increases in benefits, except a slight decrease in benefits to Eugene MSA communities localized to Lookout Point Reservoir in late summer.	Same as NAA with slight increases in benefits, except a slight decrease in benefits to Salem MSA communities localized to Green Peter Reservoir in late summer.	Same as NAA, except a substantial adverse effect to Eugene MSA communities localized to Cougar Reservoir.	Substantial, adverse effect to Salem and Eugene MSA communities localized to Detroit, Cougar, and Lookout Point Reservoirs.	Substantial, adverse effect to Eugene MSA communities localized to Cougar, Green Peter, and Hills Creek Reservoirs. Substantial, adverse effects to communities localized to Detroit, Blue River, and Lookout Point Reservoirs in late summer, depending on the amount of precipitation during the summer and timing of drawdown initiation at each reservoir.
Economic Relationship with Communities	Beneficial	Same as No-action Alternative.	Same as No-action Alternative.	Same as No-action Alternative with slightly fewer benefits.	Substantial, adverse	Substantial, adverse

Table 3-29. Summary of Socioeconomic Effects on Metropolitan Statistical Area Communities as Compared to the No-action Alternative[1] (continued).

Effect Category	No-action Alternative	Alternative 4	Alternative 5	Alternative 6	Interim Operations
Arts, Entertainment, and Recreation Industry Employment	Negligible, direct, beneficial effect to any employment industry. Employment opportunities would not be a substantial contributor to MSA industry employment rates at the local, regional, or statewide levels.	Same as No-action Alternative.	Same as No-action Alternative.	Same as No-action Alternative.	Same as No-action Alternative.
Housing	None	None	None	None	None
Labor Force and Unemployment	Minor, beneficial effects	Same as No-action Alternative.	Same as No-action Alternative.	Same as No-action Alternative.	None
Art, Entertainment, and Recreation Industry	No measurable adverse or beneficial effect	Same as No-action Alternative.	Same as No-action Alternative.	Same as No-action Alternative.	Same as No-action Alternative.
Federal Spending for Construction	No benefit	Most beneficial	Fifth most beneficial	Third most beneficial	No benefit
Federal Spending for Operations and Maintenance	Slight, beneficial	Same as No-action Alternative.	Same as No-action Alternative.	Same as No-action Alternative.	Same as No-action Alternative.
Recreation-related Revenue and Employment Earnings at the Local, Reservoir Level	Substantial, beneficial	Same as NAA with negligible decreases in benefits to Salem MSA communities localized to Detroit Reservoir and slight decreases in benefits to Albany MSA communities localized to Green Peter Reservoir.	Same as NAA with negligible decreases in benefits to Albany MSA and Salem MSA communities localized to Green Peter Reservoir and Detroit Reservoir and slight decreases in benefits to Eugene communities localized to Cougar Reservoir.	Same as NAA with negligible decreases in benefits to the Albany and Eugene MSA communities localized to Green Peter and Lookout Point Reservoir.	Same as No-action Alternative for the Albany MSA. A substantial adverse effect to Eugene MSA communities localized to Cougar Reservoir. Potential substantial adverse effect to benefits for Salem MSA communities localized to Detroit Reservoir during dry years.
Economic Relationship with Communities	Beneficial	Same as No-action Alternative.	Same as No-action Alternative with slightly fewer benefits.	Same as No-action Alternative with slightly fewer benefits.	Same as No-Action Alternative, except minor to moderate adverse effects to Salem MSA communities localized to Detroit Reservoir.

Table 3.11-7 in the FEIS

[1] All effects would occur or reoccur over the 30-year implementation timeframe (i.e., long term).

3.11.3.2 Alternatives Analyses

Effects discussions for alternatives other than Alternative 6 and the Interim Operations are in the FEIS and incorporated by reference. A summary of the effects for all alternatives is in Table 3-29.

Industry Employment under All Alternatives

Incorporated by reference.

Housing Characteristics under All Alternatives

Incorporated by reference.

Employment, Labor, and Earnings under All Alternatives

Labor Force and Unemployment Effects

Incorporated by reference.

Employment Industry Effects

Incorporated by reference.

Employment Industry Growth and Federal Spending

Under any alternative, industry labor and earnings resulting from business activity in the MSA communities are expected to continue growing at the rate when the alternatives were analyzed over the 30-year implementation timeframe independent of WVS operations and maintenance. This growth trend reflects the relative sizes of market-related economic activity performed in each MSA. This would be a long-term, beneficial effect on MSA communities as well as regionally.

No Federal spending for construction costs is included under the NAA. Under the action alternatives, Federal spending for construction costs in the MSAs would result in both direct and indirect, beneficial impacts. Economic activity, impacts, and contributions to the local, regional, and statewide[6] economies because of Federal spending are measured as economic output from sales, annual average jobs available monthly, income earned, and value added.

Consequently, local, regional, and statewide estimates of economic activity, direct and indirect impacts, and contributions from construction-related Federal spending would be greatest under Alternative 4, followed by Alternatives 1, 6, 2A, 2B/5, 3B, and 3A as generating the least

[6] It is possible that construction resources would be needed from sources outside of the state. This assumption is included in Appendix I, Socioeconomics Analysis, but national benefits are not analyzed here. The area for this analysis is the MSA communities, which would primarily be directly or indirectly affected.

economic benefit. However, these benefits would be a minor contribution to total economic benefits in the MSAs (Appendix I, Socioeconomics Analysis). Note the quantitative analyses address capital costs of construction under the action alternatives.

Recreation-related Revenue and Employment Earnings under All Alternatives

There are no significant changes to the recreation analysis in Appendix K Chapter 2, Recreation Effect, that would impact the scale of change in regional economic development of the FEIS alternatives. The alternative regional economic development analyses (Appendix K, Chapter 5) in the FEIS are applicable, but have been updated in this section for all alternatives and Revised Interim Operations (Table 3-30). The methodology is incorporated by reference for all alternatives analyses. The regional economic development modeling for Alternative 6 and the Revised Interim Operations, and the comparison of the effects to the NAA are below.

Table 3-30. Local Reservoir-induced Visitation and Direct Economic Activity for All Metropolitan Statistical Areas Combined under Each Alternative as Compared to the No-action Alternative (2025 Price Level)[1].

Alternative[1]	No-action	1	2A	2B	3A	3B	4	5	6	Interim Operations
Output[2]	$127,603,334	+$1,136,363	+$1,047,996	-$107,040	-$5,804,010	-$7,302,881	+$525,687	-$1,007,193	-$15,631	-$5,864,534
Jobs[3]	995	+15	+8	-1	-45	-61	+4	-8	0	-45
Labor Income[4]	$48,052,682	+$729,541	+$386,368	-$43,644	-$2,164,669	-$2,840,874	+$192,107	-$378,706	-$7,480	-$2,189,154
Value Added[5]	$73,501,003	+$1,125,384	+$613,359	-$57,770	-$3,345,591	-$4,111,994	+$309,719	-$580,815	-$7,365	-$3,401,476

Table 3.11-8 in the FEIS

Note: Results described represent the model "local" area. "Local" is a term defined by the RECONS model as the MSAs; it is not synonymous with the use of "local" throughout this analysis. "Local" as applied to the analyses refers to the communities in which reservoir-induced visitation and direct economic activity would occur (e.g., person-to-business monetary transactions that occur because of the existence of the reservoir). Economic effects at the local, community level could be more beneficial or adverse than those realized in an entire MSA.

[1] Values in each category under each action alternative represent amounts in addition to (+) or less than (-) amounts under the No-action Alternative.

[2] Output can be measured either by total value of purchases by intermediate and final consumers or by intermediate outlays plus value added. It is also known as gross revenues or sales.

[3] Jobs are presented in full-time (40 hours per week) equivalent jobs supported. Jobs also reflects the estimate based on Fiscal Year 2025 costs.

[4] Labor income represents all forms of employment earnings. In IMPLAN's regional economic model, it is the sum of employee compensation and proprietor income.

[5] Value added consists of employee compensation, proprietary income, other property type income, and indirect business taxes. Value added is an estimate of the gross regional or state product.

Alternative 6 Ceasing Federal Hydropower Operations

Reservoir operations under Alternative 6 would result in the same direct, beneficial effects on recreation-related revenue and employment earnings at all WVS reservoir locations compared to NAA benefits over the 30-year implementation timeframe with the exception slight decrease localized to Green Peter and Lookout Point reservoirs (Table 3-31).

Table 3-31. Degree of Adverse or Beneficial Effect on Recreation-related Revenue and Employment Earnings under Alternative 6 as Compared to the No-action Alternative[1].

Reservoir	Degree of Effect	MSA CBSA	MSA County
Detroit	Same as NAA	Salem	Marion
Foster	Same as NAA	Albany	Linn
Green Peter	Same as NAA with slight decrease in benefits	Albany	Linn
Cougar	Same as NAA with slight increase in benefits	Eugene	Lane
Blue River	Same as NAA	Eugene	Lane
Lookout Point	Same as NAA with slight decrease in benefits	Eugene	Lane
Hills Creek	Same as NAA	Eugene	Lane
Dexter	Same as NAA	Eugene	Lane
Fall Creek	Same as NAA	Eugene	Lane
Dorena	Same as NAA	Eugene	Lane
Cottage Grove	Same as NAA	Eugene	Lane
Fern Ridge	Same as NAA	Eugene	Lane

MSA = Metropolitan Statistical Area; CBSA = Core-based Statistical Area

Note: Does not represent degrees of effect anticipated during wet years within or outside of the peak recreation season.

[1] All effects would be long term.

Water-based recreation estimated availability during the peak recreation season consequently impacts demand for recreation-related services or employment to support these local services in the Albany and Eugene MSAs. A corresponding adverse localized effect on recreation-related employment earnings would occur under Alternative 6 in the Albany and Eugene MSAs if these changes in visitation occur. However, compared to the NAA the effect on recreation related benefits is the same across the WVS reservoirs (Chapter 3, Appendix K).

Employment effects under Alternative 6 from the Cougar Reservoir drawdown are anticipated to be long term and could result in indirect, beneficial effects to other MSA communities from increases in employment to address displaced visitation and/or adverse financial effects from closure-related management requirements. However, as under the NAA, displacement effects and management priority adjustments cannot be accurately assessed.

Impacts on recreation employment would depend on reservoir elevations, same as those described under NAA operations, in addition to any visitor displacement.

3.11.3.3 Economic Relationship with Communities under All Alternatives

Greenhouse Gas Emissions Community Costs

Incorporated by reference.

Prior to the release of this SEIS, Executive Order 14154 “Unleashing American Energy” was issued. Consistent with this Executive Order, a greenhouse gas analysis this section was not updated to include Alternative 6. However, this SEIS is consistent with the NEPA statute and existing agency regulations pertaining to air quality and emissions. See 3.1 for a description of how analysis changed from the FEIS due to recent changes in applicable laws, regulations, and executive orders.

Hydropower Generation, Transmission Reliability, and Economic Viability

Hydropower Generation and Transmission Reliability

Incorporated by reference, with the additional information specific to Alternative 6.

The WVS would not power islanded (isolated) communities in the Valley as needed since the dams would not generate power. Islanding[7] during power outages would no longer be possible for the communities of Blue River and Oakridge, Oregon in the event of system outages due primarily to severe weather events and wildfire during the 30-year implementation timeframe. This would be a substantial adverse effect to these MSA communities.

Economic Viability

Incorporated by reference, with the following addition specific to Alternative 6.

Under Alternative 6 power would no longer be generated, therefore economic viability is not calculated (Appendix G, Power Generation and Transmission). Generation would need to be replaced from more distant sources under some alternatives. There would be enough power generation in the hydropower/transmission analysis area to replace power under all alternatives. However, replacement would adversely affect existing congested transmission systems in the analysis area. It is possible that these impacts could lead to increased power costs to MSA communities.

[7] USACE operations generate power while isolated from the main system to provide power to local communities.

Water Quality Treatment Costs

Incorporated by reference and the effects also apply to Alternative 6.

Turbidity

Incorporated by reference and the effects of Alternative 5 also apply to Alternative 6.

Harmful Algal Blooms

Incorporated by reference and the effects also apply to Alternative 6.

Turbidity and Harmful Algal Bloom Effects on Drinking Water and Facility Operations

Incorporated by reference and the effects of Alternative 5 also apply to Alternative 6.

Water Availability in Dry Years

Incorporated by reference and the effects also apply to Alternative 6.

Water Supply

Groundwater Supply and Use

Incorporated by reference and the effects also apply to Alternative 6.

Water Availability in Dry Years

Incorporated by reference and the effects also apply to Alternative 6.

Stored Water Users

Incorporated by reference and the effects also apply to Alternative 6, though less stored water would be available under Alternative 6 than the NAA because of the change in flow targets.

Recreation Opportunities and Community Identity

Incorporated by reference and the effects also apply to Alternative 6 with the addition of the following information.

There would be substantial, adverse effects on these opportunities at Cougar Reservoir under Alternative 6, same as under Alternatives 2B and 5. This would result in adverse effects on community economies and identities each recreation season over the 30-year implementation timeframe. Land-based opportunities would be available at all reservoirs under all alternatives but would likely have low visitor interest if water-based opportunities are not available.

3.11.4 Interim Operations under All Action Alternatives Except Alternative 1

This section is incorporated by reference with the addition of analysis of the deeper drawdown at Detroit Reservoir.

The deeper drawdown for fish passage at Detroit Dam is not expected to impact recreation during the peak summer recreation season because the drawdown operation would end before refill season begins in February, with the reservoir reaching minimum conservation pool elevation prior to February most years. In years with an extremely dry late winter and early spring, like 2015, the reservoirs would not refill due to lack of rain. There would be substantial adverse impacts on recreation during extremely dry years as the reservoir would not refill to an elevation where most boat ramps are usable, thus the impact is the same as current operations (No Action Alternative) in extremely dry years. Adverse direct, substantial socioeconomics effects would occur at Detroit Reservoir, with adverse effects to benefits in the Salem MSA, same as under current operations. Sport fishing in Detroit Reservoir is expected to be adversely affected due to changes in the reservoir habitat conditions and food availability affecting fish growth and survival and increasing rates of entrainment for resident fish downstream of the dam (Appendix E, Chapter 6). For some species, significant reductions in reservoir abundance are possible. Future stocking of hatchery reared species (e.g. rainbow trout and kokanee) by ODFW in Detroit Reservoir will mitigate some of these effects.

3.11.5 Climate Change under All Alternatives

Incorporated by reference. Prior to the release of this SEIS, Executive Order 14154 “Unleashing American Energy” was issued. Consistent with this Executive Order, a greenhouse gas analysis this section was not updated to include Alternative 6. However, this SEIS is consistent with the NEPA statute and existing agency regulations pertaining to air quality and emissions. See 3.1 for a description of how analysis changed from the FEIS due to recent changes in applicable laws, regulations, and executive orders.

3.12 Power Generation and Transmission

3.12.1 Introduction

Incorporated by reference with the below additions.

This section analyzes the effects of Alternative 6 which would cease Federal hydropower operations in the WVS (Section 2.8.5). Ceasing Federal hydropower operations at these projects includes stopping generation at USACE’s dams; retrofitting the dams’ penstocks (the pipe that transfers water from the intake structure to the turbine), penstock outlets, and powerhouse systems to ensure safe operation; and finding alternate power sources because dams must have redundant power supplies in case of emergencies. USACE’s authority and control for hydropower is limited to the generation of the power at the dam. USACE then coordinates with BPA to transmit that power on to the grid. BPA is generally responsible for marketing that power to various utilities. Those utilities then provide the power to "rate payers" or the end users of the power.

The scope of analysis for Alternative 6 is different in this SEIS than for Alternatives 1 -5 (when USACE is generating power) in the FEIS. Under the No Action and Alternatives 1-5, USACE proposes to continue to generate hydropower for BPA to transmit and sell.

Under Alternative 6, USACE would not generate power, no longer fulfilling the hydropower purpose in the WVS. Since USACE would no longer generate power, it would not need to coordinate with BPA for the transmission or sale of that power. This change in activity changes the analysis for Alternative 6. For example, since USACE is not generating or working with BPA to transmit and market that generated power, it would no longer be responsible for analyzing others' actions to balance or transmit power. Instead, USACE's analysis of Alternative 6 focuses on impacts to national economic development (NED). See Chapter 3.12.3.1, Methodology.

To safely operate the dams without hydropower requires a retrofit of the dam to remove the hydropower infrastructure, reconfigure the penstock, and place something like a cone valve on the outlet to dissipate the potential energy created as the water falls from a great height inside the dam. The retrofitted outlet is necessary to reduce additional wear and tear on the dam and substantial erosion downstream. Both are serious dam safety concerns. The transmission lines at the WVS dams would remain, but instead of USACE electrifying those lines with hydropower generation, they would pull power off the grid like other rate payers who rely on utilities for power via power lines. The dams also need two sources of power to safely operate in case of an emergency. A second source of power, like a generator, would be needed at each project (see Appendix A for details associated with each dam).

BPA notified USACE they would not provide an analysis of regional power system reliability, transmission system, and economic viability of power generation impacts for Alternative 6 as they did for Alternatives 1-5 and the NAA. USACE appropriately determined that given the changes to USACE's action in Alternative 6 and changes in recent case law[8], those analyses were no longer required because they analyze actions outside of USACE's jurisdiction and control. How power marketers balance the grid, ensure power to the region remains reliable, or the potential costs to ratepayers from losing the existing source of low emission, renewable power is not under USACE jurisdiction and control because it is not a power marketer. Further, USACE would be unable to obtain that information itself within a reasonable timeframe or for a reasonable cost. While that information could be helpful to regional users in understanding potential impacts of alternative, NEPA does not require USACE to analyze secondary impacts outside its jurisdiction and control.

3.12.1.1 Power Generation and the Bonneville Power Administration

Incorporated by reference.

[8] *Seven County Infrastructure Coalition v. Eagle County*, 145 S. Ct. 1497 (2025); *Marin Audubon Society* v. *Federal Aviation Administration,* 121 F.4th 902 (D.C. Cir. 2024).

3.12.1.2 Non-Federal Hydropower Generation

Incorporated by reference.

3.12.2 Affected Environment

Incorporated by reference.

3.12.2.1 Federal Power

Incorporated by reference.

3.12.2.2 Pacific Northwest Regional Power Supply and Reliability

Incorporated by reference.

3.12.2.3 Transmission

Incorporated by reference

3.12.3 Environmental Consequences

A summary of effects to hydropower for the No Action Alternative and all action alternatives is included in Table 3-32. The detailed effects analyses for the No Action Alternative, Alternatives 1-5, and the Interim Operations is incorporated by reference.

3.12.3.1 Methodology

Incorporated by reference.

Table 3-32. Summary of Effects to Regional Power System Generation and Transmission as Compared to the No-action Alternative.

Effect Category	No-action Alternative	Alternative 1	Alternative 2	Alternative 2B	Alternative 3A	Alternative 3B
Regional Power System Reliability Impacts	Long-term, slight, beneficial.	Same as No-action Alternative, but more beneficial from slight, additional power generation.	Same as No-action Alternative, but less beneficial from slightly less power generation.	Same as No-action Alternative, but less beneficial from slightly less power generation.	Same as No-action Alternative, but less beneficial from substantially less power generation.	Same as No-action Alternative, but less beneficial from substantially less power generation.
Willamette Valley System Dam Generation Impacts	Long-term, substantial, beneficial.	Same as No-action Alternative, but more beneficial from slightly more additional power generation.	Same as No-action Alternative, but less beneficial from slightly less power generation.	Same as No-action Alternative, but less beneficial from slightly less power generation.	Same as No-action Alternative, but less beneficial from a 50 percent power generation decrease.	Same as No-action Alternative, but less beneficial from a 50 percent power generation decrease.
Transmission System Impacts	Long-term, slight, adverse. Power generated at Hills Creek and Cougar dams would continue to be able to operate islanded (isolated) as needed and to provide power to the Oakridge and Blue River communities, respectively, during outages.	Long-term, slight, adverse. Islanding during power outages would be the same as the No-action Alternative.	Long-term, moderate, adverse. Islanding during power outages would be the same as the No-action Alternative.	Long-term, moderate, adverse. Islanding during power outages from Hills Creek Dam would be the same as the No-action Alternative. Deep fall and spring drawdowns at Cougar Reservoir would likely compromise the ability to provide power to the community of Blue River, which would be a substantial, adverse effect to the community.	Long-term, moderate, adverse. Substantial, adverse community effects because operations at Hills Creek and Cougar Dams would not be able to continue to operate islanded (isolated).	Long-term, moderate, adverse. Substantial, adverse community effects because operations at Hills Creek and Cougar dams would not be able to continue to operate islanded (isolated).
Economic Viability of Power Generation Impacts	Long-term, slight, beneficial.	Long-term, substantial, adverse.	Long-term, substantial, adverse.	Long-term, substantial, adverse.	Long-term, substantial, adverse.	Long-term, substantial, adverse.

Table 3-32. Summary of Effects to Regional Power System Generation and Transmission as Compared to the No-action Alternative (continued).

Effect Category	No-action Alternative	Alternative 4	Alternative 5	Alternative 6	Interim Operations
Regional Power System Reliability Impacts	Long-term, slight, beneficial.	Same as No-action Alternative, but more beneficial from slightly more power generation.	Same as No-action Alternative, but less beneficial from slightly less power generation.	Long-term, adverse. Beyond USACE's authority and control to determine whether the effect is slight, moderate, or substantial.	Same as No-action Alternative, but medium term and less beneficial from less power generation and shorter term.
Willamette Valley System Dam Generation Impacts	Long-term, substantial, beneficial.	Same as No-action Alternative with negligible changes to power generation.	Same as No-action Alternative, but less beneficial from slightly less power generation.	Long-term, substantial, adverse. Power from WV plants would no longer be generated.	Same as No-action Alternative, but less beneficial from moderately less power generation. Interim Operations implementation would be shorter than an alternative implementation but may extend for nearly the full 30-year implementation timeframe.

Effect Category	No-action Alternative	Alternative 4	Alternative 5	Alternative 6	Interim Operations
Transmission System Impacts	Long-term, slight, adverse. Power generated at Hills Creek and Cougar dams would continue to be able to operate islanded (isolated) as needed and to provide power to the Oakridge and Blue River communities during outage, respectively.	Long-term, slight, adverse. Islanding during power outages would be the same as the No-action Alternative.	Long-term, moderate, adverse. Islanding during power outages from Hills Creek Dam would be the same as the No-action Alternative. Deep fall and spring drawdowns at Cougar Reservoir and limited ability to manage Cougar Dam for power generation would likely compromise the ability to provide power to the community of Blue River, which would be a substantial adverse effect to the community.	Long-term, moderate, adverse. As power would no longer be generated at any WV plant, both the communities of Oakridge and Blue River would no longer be able to operate islanded (isolated) as needed in emergency situations. As power would no longer be generated and transmitted from USACE projects effects were not analyzed in detail other than to disclose the impact to the communities that directly rely on USACE projects for emergencies.	Medium-term, moderate, adverse. Islanding during power outages from Hills Creek Dam would be the same as the No-action Alternative. Deep fall and spring drawdowns at Cougar Reservoir would likely compromise the ability to provide power to the community of Blue River, which would be a substantial, adverse effect to the community.
Economic Viability of Power Generation Impacts	Long-term, slight, beneficial.	Long-term, substantial, adverse.	Long-term, substantial, adverse.	As power would no longer be generated, economic viability no longer needs to be calculated.	Medium-term, substantial, adverse.

Table 3.12-5 in the FEIS

Effects Criteria

Incorporated by reference.

Analysis Process

Most of this section is incorporated by reference. The below text addresses new analysis process for Alternative 6.

Step 1 – Assess Hydropower Generation under Each Alternative

Step 2 – Regional Power Capacity and De-carbonization Policies

Step 3 – Identification of Potential Replacement Resources

Step 4a – Assessment of Effects on Transmission Reliability

Step 4b—Estimating Power Costs

Under Step 4b of the analysis in the FEIS, USACE considered the Net Present Value (NPV)[9] and levelized cost of generation (LCOG) resulting from the increased costs of providing power associated with the inclusion of any new capital investments under the NAA and Alternatives 1-5. The NPV analysis compared the expected revenue produced by each WVS dam with Federal hydropower facilities against their expected costs over the 30-year implementation timeframe (in U.S. dollars/MWh). A positive NPV indicates that power generation benefits outweigh the cost while a negative NPV indicates that the costs of power production outweigh the benefits. The NPV provides a relative measure of cost-competitiveness when compared to other generating resources or market purchases. Market price forecasts used in that analysis have a real levelized price over the 30-year implementation timeframe of $32.14/MWh as a point of comparison to impacts in the Willamette Valley.

As stated above, because Alternative 6 fundamentally changes the action USACE would take, USACE developed an additional methodology to evaluate the impacts to NED from eliminating Federal hydropower operations in the WVS. The NAA, Alternative 5, and Interim Operations were also analyzed using this process for comparative purposes in order to better contextualize and explain how hydropower is impacted under Alternative 6.

Dependable Capacity Process

Dependable capacity is a measure of the amount of capacity that the dam and reservoir can reliably contribute towards meeting system peak power demands. At storage dams, normal seasonal reservoir drawdowns can result in a reduction of capacity due to a loss in head. At other times, lower releases during low flow periods may result in insufficient generation to support the marketable capacity of the load. Dependable capacity accounts for these factors by

[9] NPV was calculated by BPA, which did not use USACE methodologies to evaluate economic impacts.

giving a measure of the amount of capacity that can be provided on average during peak demand periods. The capacity analysis intends to capture the costs of building additional resources to maintain the system capacity on average over the long term. In this case, it is being used to value the loss of the resource.

The most appropriate method, per USACE guidance, for evaluating a hydropower plant's dependable capacity is the average availability method (USACE 1985, Section 67g). The occasional unavailability of a portion of a hydropower project's generating capacity due to hydrologic variations is treated in the same manner as the occasional unavailability of all or part of a thermal plant's generating capacity due to forced outages. The average availability method estimates average capacity available during the peak demand periods of the year. This EM is currently undergoing a revision that would change this methodology, but this update has not been published as of this document.

To evaluate the average dependable capacity of a project during its peak demand season, a long-term record of dam operations must be used. Actual dam operating records can be used, but the period of operation may not be long enough to give a statistically reliable value. Furthermore, operating changes may have occurred over the life of the project, which would make actual data somewhat inconsistent. The Hydrologic Engineering Center's Reservoir Simulation (ResSim) model was used to simulate the operation of the Willamette Valley System dams on a daily time step for a period of record from 1928 – 2019.

The initial step is to calculate each project's contribution (average weekly generating hours) to the system's capacity for the regional critical year. The contribution estimate was determined by first calculating each project's average weekly energy produced (MWh) for the peak demand months of January and February in 1937, the critical period. That number was then divided by capacity (MW), giving an estimate of average weekly generating hours during the peak demand months.

Next, each project's average weekly energy (MWh) produced during the peak demand months was calculated for each simulated year. Dividing those values for each project by the average weekly generating hours from the critical period, as determined in the previous step, yields an array of yearly potential supportable capacity values. However, energy produced is limited by the machine capability of the project. The actual supportable capacity for any given year is consequently the lesser of the potential supportable capacity or the machine capability. With the average availability method, dependable capacity is the average actual supportable capacity over the period of record.

These values are defined in the following equations:

- Average Weekly Energy (MWh) (Jan 1-Feb 28) (year = i) = Total Energy (MWh)(Jan 1-Feb 28)/Number of Weeks (Jan 1-Feb 28) (year = i)
- Average Weekly Generating Hours (baseline critical period in 1937) = Average Weekly Energy (MWh) (baseline critical period 1937) / Potential Capacity (MW)

- Potential Supportable Capacity (MW) (year=i) = Average Weekly Energy (year=i) / Average Weekly Generating Hours (baseline critical period 1937)
- Machine Capability (MW) = Overload Capacity of Project (MW)
- Actual Supportable Capacity (MW) (year=i) = MIN (Potential Supportable Capacity (MW) (year=i), Machine Capability (MW))
- Dependable Capacity = Average Actual Supportable Capacity over the Period of Record

3.12.3.2 Alternatives Analyses

This section discusses the potential effects of Alternative 6 and the interim operations, which include the Detroit drawdown, on power generation and transmission; the effects discussions of the NAA, Alternative 1, 2A, 2B, 3A, 3B, 4, and 5 are incorporated by reference.

<u>Alternative 6— Cease Hydropower Operations</u>

Power Generation

Power generation from the WVS operations would completely cease under Alternative 6. This would constitute a loss of 171 aMW to the regional power system as compared to the NAA. This is the equivalent of powering about 136,650 homes annually during the 30-year implementation timeline. This would be considered a long-term, substantial, adverse impact to Willamette Valley System Dam generation.

Table 3-33. Willamette Valley System 73-year Average Generation (aMW) (Water Years 1936 through 2008) and Critical Water Year (1937) under Alternative 6.

Month[1]	No-action Alternative Average Generation	Alternative 6 Average Generation	Average Generation Difference	No-action Alternative Critical Water Year Generation	Alternative 6 Critical Water Year Generation	Critical Water Year Generation Difference
Oct	134	0	-134	119	0	-119
Nov	230	0	-230	156	0	-156
Dec	231	0	-231	80	0	-80
Jan	235	0	-235	47	0	-47
Feb	147	0	-147	67	0	-67
Mar	143	0	-143	121	0	-121
Apr I	177	0	-177	188	0	-188
Apr II	182	0	-182	227	0	-227
May	222	0	-222	356	0	-356
Jun	162	0	-162	264	0	-264
Jul	106	0	-106	111	0	-111
Aug I	114	0	-114	115	0	-115
Aug II	118	0	-118	124	0	-124
Sep	151	0	-151	155	0	-155
Annual Average[2]	**171**	**0**	**-171**	**150**	**0**	**-150**

Source: HYDSIM modeling results

[1] HYDSIM uses a 14-period time step. April and August are split into two half-month periods because these months tend to have substantial natural flow differences between their first and second halves.

[2] The Annual Average is a weighted average to account for the different number of days in the 14 periods.

The change in critical water year generation is a loss of 150 aMW under Alternative 6.

Federal hydropower operations in the WVS would cease under Alternative 6 and therefore the contribution to the regional power system would be zero over the 30-year implementation timeframe.

Given that the USACE is no longer generating power under this scenario and the reliability of the regional power system is beyond USACE's jurisdiction and control, the impact of the loss of the generation on the regional power system was not quantitatively analyzed for Alternative 6.

However, under Alternative 3B, which has the largest impact to generation of any alternative previously analyzed, LOLP increased by 0.5 percentage points, from 6.5% to 7%. It would be expected that this would increase further under Alternative 6. So, it follows that the effects are long-term and adverse compared to the NAA. However, the power generated by the WVS provides a minimal contribution to the regional power system as a whole.

Transmission

Transmission impacts were also not quantitively analyzed for alternative 6 as USACE would no longer be producing power to transmit. The loss of transmission is qualitatively described below and is based on the previous analysis of the other alternatives.

When compared to Alternative 3B, where generation decreased by 46%, effects were long-term, moderate, and adverse. It can be assumed that the impacts under Alternative 6, where generation is eliminated completely, would be long-term, moderate, and adverse compared to the NAA. It is uncertain whether Alternative 6 would lead to substantial impacts to transmission over the 30-year timeframe. Substantial impacts are possible due to increased congestion and the need to replace Willamette Valley generation from generating resources further away.

Unlike operations under the NAA, under Alternative 6, Cougar Dam and Hills Creek would not provide power to the communities of Blue River and Oakridge, respectively, during severe weather- or wildfire-related events. It should be noted that this capability is restricted under current operations, especially at Cougar Dam and that BPA is not required to provide the current islanding benefits, under the current reliability standards, to Blue River and Oakridge. This would be expected to be long-term, substantial, adverse effects to these communities.

Economic Viability of Power Generation

The net present value and levelized cost of generation in the Willamette Valley is no longer relevant under Alternative 6, as hydropower would cease to be produced at USACE hydropower projects. These values primarily effect the regional economic development and BPA operations and costs. The effects on BPA's costs impact regional ratepayers[10] and in turn, affect the regional economic development (RED) account, but the way these rates would change would be affected by the actions BPA takes.

Rates and how operating costs are incorporated into rate changes are outside USACE's jurisdiction and control. Information BPA previously provided for the FEIS was used to help qualitatively describe the effects of removing hydropower generation and capacity from Willamette Valley dams.

National Economic Development Framework

The framework for Alternative 6 is different than the hydropower analysis for the other alternatives because this alternative removes hydropower as an operating purpose. This fundamentally changes the system so Alternative 6 was considered under a NED framework. The alternatives analysis in the FEIS primarily considered the impacts of the relative decreases in power production within the Northwest regional energy market. Since Alternative 6 is considering and analyzing the removal of a purpose at a multipurpose project, USACE used a different methodology then the previous FEIS. The values in this section are compared to the

[10] Ratepayers are those who pay for a utility service, especially electricity, according to established rates.

NAA, interim operations, and Alternative 5 to help provide a comparative description of impacts. The analysis provides a more complete picture of the potential impacts from eliminating a project purpose.

Federal Interest in the hydropower purpose specifically includes net effects to the national economy (including effects on Federal, non-Federal, public and private), as well as other Federal priorities based on contributions to the USACE's four Principles and Guidelines accounts, defined as follows (USACE 2023c):

- The national economic development (NED) account displays changes in the economic value of the national output of goods and services.
- The environmental quality (EQ) account displays non-monetary effects on significant natural and cultural resources.
- The regional economic development account registers changes in the distribution of regional economic activity that result from each alternative plan. Evaluations of regional effects are to be carried out using nationally consistent projections of income, employment, output and population.
- The other social effects (OSE) account registers plan effects from perspectives that are relevant to the planning process but are not reflected in the other three accounts.

This section focuses on the NED account, as that is the primary focus for a USACE economics analysis, especially when considering the deauthorization of a purpose. For hydropower, this means the economic value of existing and future hydropower generation, dependable capacity, and ancillary services such as reserves or black start capability. The theoretical basis for the USACE economic analysis is "society's willingness to pay." The way this is incorporated in most USACE hydropower economics analyses is through determining the cost of the most likely thermal (i.e., fossil fuels) alternative per Engineering Manual (EM) 1110-2-1701, Hydropower (USACE 1985).

Dependable capacity is important to the NED consideration. Dependable capacity is a measure of the amount of capacity that the hydropower facility can reliably contribute towards meeting system peak power demands. Dependable capacity does not have a separate financial value in the Northwest regional energy market, as it does in some other regional markets. However, there is an economic value to dependable capacity and that is considered in this section. A significant loss of generating capacity will have implications for the economic viability of the hydropower purpose separate from energy impacts.

Hydropower and NED Impacts from Alternative 6

Power production in the Willamette Valley is operating at a loss under the current interim operations, due to decreases in reservoir levels and flow through the turbines. This is not true under the NAA. However, discussing how the interim operations effect the operation of hydropower is an important part of the overall consideration. Producing power (O&M, capital investment) costs more than selling the power to the energy market under the current conditions. The estimated loss is estimated to be -$569 million total over the 30-year implementation timeframe, based on BPA's analysis of the interim operations in the FEIS (FEIS, Section 3.12.4.2). The cost of producing the power is defined by the levelized cost of generation (LCOG). Under the interim operations, the LCOG is about $48.98/MWh, while current market prices are approximately $32.14/MWh. At this cost of production, with the current expected market prices, power produced in the Willamette is priced out of the regular energy market. If the WVS dams continue to produce power, it requires BPA to absorb the loss, likely increasing ratepayers' costs and effecting RED. It is unclear the extent of the impact this would have on energy rates.

Ceasing hydropower operations at the WVS hydropower dams is expensive. The dams were built and are operated as a multipurpose system and untangling that design and operation is complicated. Ceasing hydropower operations requires removal of the existing hydropower infrastructure, as well as reconfiguration of the penstock outlets to ensure dam safety and avoid future costs for obsolete equipment. Additionally, USACE would need to purchase power from the grid to operate both the existing facilities as well as the new structures in Alternative 6, since they currently use power from the existing equipment.

Alternative 5, the preferred alternative, is expected to cost between $1.9 and $2.9 billion for design and construction, and between $56 million and $74 million in annual O&M expenses to meet NMFS and USFWS criteria for downstream passage of ESA listed species. Alternative 6 includes all these costs as well as additional costs for removal of hydropower infrastructure, reconfiguration of the penstock outlets and powerhouse systems. The total cost for Alternative 6 is estimated to be between $2.5 and $3.7 billion dollars, with annual O&M of between $48 and $63 million. Alternative 6 adds an additional $630 - $818 million dollars in capital costs, though it does reduce overall O&M by between $8 and $11 million a year. Just as with Alternatives 1 - 5 in the FEIS, Alternative 6 did not distinguish between rate payer and taxpayer costs because who would be responsible for paying for the retrofits and structures is uncertain. Instead, the analysis provides the total cost of the alternative.

Though the WVS provides a small percentage of power relative to the regional system, about 2% of BPA's generating capacity and about 0.7% of the Pacific Northwest Region's capacity (Table 3.12-2 in the FEIS), it still provides existing generation and capacity. The Northwest Power and Conservation Council's latest forecast shows both energy and capacity demand for the region to grow by 60% by 2045 in the median scenario. Some of the projections indicate that the demand could double under certain conditions. (Simmons et al. 2025). Additionally, the Clean Energy Target Oregon House Bill 2021 requires that the state of Oregon reduce GHG emissions associated with electricity sold to Oregon consumers by 100% by 2040 (State of Oregon n.d.). Removing a non-emitting source of energy in an environment that will both soon require it and is currently experiencing long-term energy and capacity shortages could have long-term, moderate, adverse impacts to the region's energy supply.

The NED amount and value of this loss depends on the baseline selected for comparison. Table 3-34 lists the approximate potential NED loss as compared to the NAA, the Interim Operations, and Alternative 5. For the purposes of this analysis, some simplifying assumptions were made. The market value of $32.14/MWh established in Section 3.12.3 was used to value the energy generation. A dependable capacity value was developed using the methodology described in Section 3.12.3. The value for capacity was estimated to be $102,190 per MW per year using the FY25 Federal Interest rate of 3%. Table 3-35 lists the estimated annual generation and dependable capacity losses. Regardless of the starting point, the loss is at least 102.9 aMW in annual generation and 209.3 MW of dependable capacity.

Table 3-34. Summary of NED Generation and Dependable Capacity for NAA, Interim Operations, Alternative 5, and Alternative 6.

Metric	NAA	Interim Operations*	Alternative 5	Alternative 6
Willamette Valley System Generation (aMW)	171	102.9	152.4	0
Willamette Valley System Dependable Capacity (MW)	227.8	234.7	209.3	0

*This is Interim Operations data from the FEIS, as a quantitative generation analysis for Interim Operations was not completed in the SEIS for the reasons stated in Chapter 3.12.1.

The loss of this generation and dependable capacity is estimated to be between $48.1 million in annual energy value and $21.8 million in annual capacity value when compared to the NAA Using the NAA as the basis for the loss may overestimate the impact, given that the operations to establish those values are no longer conducted; therefore, other scenarios are included in the table. Regardless of the starting point for comparison, the loss of hydropower power under Alternative 6 is estimated to be between $52.9 million and $71.4 million in average annual losses.

It should be noted that there is currently no direct capacity market in the Northwest power market, so this is not a financial value that can be recouped by Bonneville. Additionally, this abbreviated analysis may overstate the dependability of these dams during peak events and it’s estimated value. However, there is still an economic value to this capacity, and it should be considered when the alternative under evaluation is eliminating all capacity in the Willamette Valley system.

Table 3-35. Estimated Willamette Valley System Annual Generation Value, Annual Dependable Capacity Value, and Annual Hydropower Value in FY25$ and 3% FY25 Federal Interest Rate for NAA, Interim Operations, Alternative 5, and Alternative 6.

Metric	NAA	Interim Operations*	Alternative 5	Alternative 6
Willamette Valley Annual Generation Value	$48,144,000	$28,971,000	$42,907,000	$0
Willamette Valley Annual Dependable Capacity Value	$23,279,000	$23,984,000	$21,388,000	$0
Total Annual Hydropower Value	$71,423,000	$52,955,000	$64,295,000	$0

* This is Interim Operations data from the FEIS, as quantitative generation data was not updated for Interim Operations in the SEIS for the reasons set forth in Chapter 3.12.1.

In summary, BPA operates in a commercial energy market where the power from the WVS dams will not be economically viable, while also adhering to the legal, political, and financial responsibilities for a Federal agency that markets power from multipurpose dams with many competing needs. Effects on BPA's operations, seen in the NPV calculations throughout this chapter, primarily impact ratepayers in the Northwest region and would be considered an RED impact.

However, the net effect of Alternative 6 over Alternative 5 is that removing hydropower from these dams increases the cost of implementing Alternative 5 by between $630 and $818 million dollars, regardless of how that cost is paid for (i.e., the ratepayers and taxpayers or just solely taxpayers), while also removing at least $875.5 million in generation and capacity value from the national economy over the 30-year implementation timeframe. With the exception of some decrease in annual O&M costs, the NED impact of Alternative 6 is negative due to the additional construction costs needed to retrofit the projects, plus the lost generation and capacity value, and the need to provide structural improvements for fish passage water quality for ESA listed species at the projects (Table 3-36).

Table 3-36. Summary of Power and Transmission Effects under the NAA and Alternative 6.

Metrics	No-action Alternative	Alternative 6	Alternative 6 Compared to the No-action Alternative
WVS Operations 73-year Average Generation (aMW)	171	0	-171
WVS Operations Critical Water year (1937) Average Generation (aMW)	150	0	-150
Loss of Load Probability (LOLP)	6.5%	Outside of scope and authority	Outside of scope and authority

Metrics	No-action Alternative	Alternative 6	Alternative 6 Compared to the No-action Alternative
Transmission Flow Paths[1] Cross Cascades South	W 6475.5 SP 4100.5 SU 5862.9	Outside of scope and authority	Outside of scope and authority
South of Allston	W 1183.0 SP 732.1 SU 2525.1	Outside of scope and authority	Outside of scope and authority
Transmission Reliability	Slightly Congested	Regionally: Outside of scope and authority Locally: unable to provide power to Blue River or Oakridge during emergency events	Outside of scope and authority
NPV (median)	$356 Million	NA	NA
LCOG ($/MWh)	$30.03	NA	NA

% = percent

aMW = average megawatts

Note: The estimated LOLP effect and resulting transmission and economic viability effects rely on the best available information regarding planned coal plant retirements as of 2017.

[1] The amount of loading (in MW) on the congested paths of Cross Cascades South and South of Allston are depicted during three seasonal cases (W= Winter Peak; SP= Spring Off-peak; SU= Summer Peak).

3.12.4 Interim Operations under All Action Alternatives Except Alternative 1

This section is incorporated by reference with the addition of the following information.

The information in this section remains substantially the same as in the FEIS without further update from additional hydrosimulation (HYDSIM) modeling. The change between the Interim Operations in the FEIS and the DSEIS are primarily due to the Detroit drawdown and the 2024 NMFS Biological Opinion requirement to use the 2008 Biological Opinion flow targets. The changes to the interim operations from the original interim operations, detailed in the FEIS, are likely to more negatively impact hydropower production than as it was described in the original FEIS and as it’s listed in the tables above, but should not change the degree, length or direction of the effects on hydropower.

3.12.4.1 Power Generation

Incorporated by reference.

3.12.4.2 Transmission

Incorporated by reference.

3.12.4.3 Economic Viability of Power Generation

Incorporated by reference.

3.12.5 Climate Change under All Alternatives

Incorporated by reference. This section was not updated to include Alternative 6. Prior to the release of this SEIS, Executive Order 14154 "Unleashing American Energy" was issued. Consistent with this Executive Order, a greenhouse gas analysis is not included here; however, this SEIS is consistent with the NEPA statute and existing agency regulations pertaining to air quality and emissions.

3.13 Water Supply

3.13.1 Introduction

Incorporated by reference.

3.13.2 Affected Environment

Incorporated by reference.

3.13.3 Environmental Consequences

This section discusses the potential effects of Alternative 6 and the Interim Operations on water supply. The discussion includes the methodology used to assess effects, incorporated by reference, and a summary of the anticipated effects. The analysis area for effects on water supply encompasses the subbasins in the Willamette River Basin and the Mainstem Willamette River.

Direct effects include effects on water supply from WVS operations, hydrologic conditions during dry years, and variations in river flow.

Indirect effects include effects on water users from direct water supply effects. Water user effects are indirect because the allocation of water supply is not a Congressionally authorized purpose for the WVS.

A summary of the effects for all alternatives is in Table 3-37.

3.13.3.1 Methodology

Incorporated by reference.

Table 3-37. Summary of Effects on Water Supply and to Water Users Dependent on Stored Water and River Flows as Compared to the No-action Alternative[1,2].

Effect Category	No-action Alternative	Alternative 1	Alternative 2A	Alternative 2B	Alternative 3A	Alternative 3B
System-wide Stored Water[1]	Substantially beneficial except during dry years or when reductions are needed to meet flow targets.	Substantially beneficial except during dry years or when reductions are needed to meet flow targets.	Substantially beneficial except during dry years or when reductions are needed to meet flow targets.	Moderately beneficial except during dry years or when reductions are needed to meet flow targets.	Substantially adverse	Substantially adverse
North Santiam River Flow	Beneficial except during dry years.	Beneficial except during dry years.	Beneficial except during dry years.	Beneficial except during dry years.	Adverse	Beneficial except during dry years.
South Santiam River Flow	Beneficial except during dry years.	Beneficial except during dry years.	Beneficial except during dry years.	Beneficial except during dry years.	Beneficial except during dry years.	Adverse
Santiam River Flow	Beneficial except during dry years.	Beneficial except during dry years.	Beneficial except during dry years.	Beneficial except during dry years.	Beneficial except during dry years.	Beneficial except during dry years.
Long Tom River Flow	Beneficial except during dry years.	Beneficial except during dry years.	Beneficial except during dry years.	Beneficial except during dry years.	Beneficial except during dry years.	Beneficial except during dry years.
McKenzie River Flow	Beneficial except during dry years.	Beneficial except during dry years.	Beneficial except during dry years.	Beneficial except during dry years.	Beneficial except during dry years.	Beneficial except during dry years.
Middle Fork Willamette River Flow	Beneficial except during dry years.	Beneficial except during dry years.	Beneficial except during dry years.	Beneficial except during dry years.	Beneficial except during dry years.	Beneficial except during dry years.
Coast Fork Willamette River Flow	Beneficial except during dry years.	Beneficial except during dry years.	Beneficial except during dry years.	Beneficial except during dry years.	Beneficial except during dry years.	Beneficial except during dry years.
Mainstem Willamette River Flow	Beneficial except during dry years.	Beneficial except during dry years.	Beneficial except during dry years.	Beneficial except during dry years.	Beneficial except during dry years.	Beneficial except during dry years.

Table 3-37. Summary of Effects on Water Supply and to Water Users Dependent on Stored Water and River Flows as Compared to the No-action Alternative[1,2] (continued).

Effect Category	No-action Alternative	Alternative 4	Alternative 5	Alternative 6	Interim Operations
System-wide Stored Water[1]	Substantially beneficial except during dry years or when reductions are needed to meet flow targets.	Substantially beneficial except during dry years or when reductions are needed to meet flow targets.	Moderately beneficial except during dry years or when reductions are needed to meet flow targets.	Slightly beneficial except during dry years or when reductions are needed to meet flow targets.	Slightly beneficial except during dry years or when reductions are needed to meet flow targets.
North Santiam River Flow	Beneficial except during dry years.	Beneficial except during dry years.	Beneficial except during dry years.	Beneficial except during dry years.	Beneficial except during dry years.
South Santiam River Flow	Beneficial except during dry years.	Beneficial except during dry years.	Beneficial except during dry years.	Beneficial except during dry years.	Beneficial except during dry years.
Santiam River Flow	Beneficial except during dry years.	Beneficial except during dry years.	Beneficial except during dry years.	Beneficial except during dry years.	Beneficial except during dry years.
Long Tom River Flow	Beneficial except during dry years.	Beneficial except during dry years.	Beneficial except during dry years.	Beneficial except during dry years.	Beneficial except during dry years.
McKenzie River Flow	Beneficial except during dry years.	Beneficial except during dry years.	Beneficial except during dry years.	Beneficial except during dry years.	Beneficial except during dry years.
Middle Fork Willamette River Flow	Beneficial except during dry years.	Beneficial except during dry years.	Beneficial except during dry years.	Beneficial except during dry years.	Beneficial except during dry years.
Coast Fork Willamette River Flow	Beneficial except during dry years.	Beneficial except during dry years.	Beneficial except during dry years.	Beneficial except during dry years.	Beneficial except during dry years.

Effect Category	No-action Alternative	Alternative 4	Alternative 5	Alternative 6	Interim Operations
Mainstem Willamette River Flow	Beneficial except during dry years.	Beneficial except during dry years.	Beneficial except during dry years.	Beneficial except during dry years.	Beneficial except during dry years.

Table 3.13-4 in the FEIS

[1] Although model results indicate an increase or decrease to June 1 in stored water volumes, the actual effects to specific stored water users are unknown because the annual management process in dry years has not been established as required by the Willamette Basin Review Feasibility Study Biological Opinion (NMFS 2019b) RPA. This metric considered the amount of stored water accumulated in the conservation pool only.

[2] Effect summaries include both direct effects on water supply and indirect effects on water users.

3.13.3.2 Alternatives Analyses

Effects discussions for alternatives other than Alternative 6 and the Interim Operations are in the FEIS and incorporated by reference. A summary of the effects for all alternatives is in Table 3-37.

Alternative 6—Ceasing Federal Hydropower Operations

Alternative 6 operations would include the 2008 Biological Opinion minimum mainstem and tributary flow targets similar to the NAA and the same fish passage and temperature management actions as under Alternative 5.

Stored Water

Direct effects on stored water supply and indirect effects to water users would be slightly beneficial under Alternative 6 because there would be some water available to consumptive users of stored water (Table 3-38). The reduction in peak stored water volumes (within the conservation pool) relative to Alternative 5 is due to the change in minimum flow targets, which impacts the ability to store more water in the spring, not the ceasing of hydropower. The effect is still beneficial because there would be stored water available to satisfy at least some of the expected future demands.

Table 3-38. Reservoir Stored Water Amounts Met in 80 Percent of Water Years under Alternative 6.

Reservoir	Peak Stored Water (acre-feet)	Percent Full (%)	Earliest Date of Maximum Storage[1]
Blue River	69,702	88	May 10
Cottage Grove	22,890	80	May 18
Cougar	0	0	Feb 1
Detroit	253,920	90	May 4
Dorena	53,758	83	May 16
Fall Creek	98,515	91	May 10
Fern Ridge	84,615	90	Apr 15
Foster	24,791	100	May 10
Green Peter	236,089	94	May 9
Hills Creek	123,987	64	Apr-17
Lookout Point	271,700	84	May 9
Willamette Valley System	1,171,649	74	May-18

[1] The 80 percent exceedance date of maximum storage does not correspond to the same year as the peak stored water in column 2. This date provides an understanding of when peak storage could be expected.

River Flow

Direct effects on river flow to water supply and indirect effects to water users under Alternative 6 would be the same as described under the NAA (Table 3-37). The Direct flow effect to water supply under Alternative 6 would be the same as those described under the NAA in every subbasin. Effects are based on modeled data from control points in corresponding subbasins or Mainstem Willamette River reaches.

3.13.4 Interim Operations under All Action Alternatives Except Alternative 1

The Interim Operations are a set of operations for downstream fish passage and temperature management that would be implemented until the long-term measure for fish passage or temperature management is being used. These operations would result in decreased system-wide stored water in the conservation pool.

The timing and duration of Interim Operations would vary by alternative. Interim Operations could extend to nearly the 30-year implementation timeframe under Alternatives 2A, 2B, 4, 5, and 6. However, under Alternative 3A and Alternative 3B Interim Operations may not be fully implemented or required because long-term operational strategies are intended to be implemented immediately upon the Record of Decision.

Interim Operations are not an alternative (Chapter 2, Alternatives, Section 2.8.6, Interim Operations). Interim Operations analyses did not consider the impacts assessed under Alternatives 2A, 2B, 3A, 3B, 4, 5, and 6 because Interim Operations will be implemented in before, and not in addition to, action alternative implementation.

3.13.4.1 Stored Water

There would be a slight, beneficial, direct effect on water supply and a slight, beneficial, indirect effect to users under Interim Operations during most times of the year because the amount of water stored systemwide in the conservation pools would be slightly more than the amount needed to support minimum flow targets with 80 percent likelihood during the 30-year implementation timeframe (Table 3-39). Stored water would be available to meet some municipal and industrial storage agreements and agricultural irrigation water service contracts under the Interim Operations.

Table 3-39. Reservoir Stored Water Amounts Met in 80 Percent of Water Years under Interim Operations.

Reservoir	Peak Stored Water (acre feet)[1]	Percent Full (%)	Earliest Date of Maximum Storage[2]
Blue River	70,134	89	May 10
Cottage Grove	23,326	81	May 18
Cougar	13,312	10	Jun 18
Detroit	253,917	90	May 4
Dorena	53,968	83	May 14

Reservoir	Peak Stored Water (acre feet)[1]	Percent Full (%)	Earliest Date of Maximum Storage[2]
Fall Creek	98,766	91	May 10
Fern Ridge	84,615	90	Apr 15
Foster	24,791	100	May 18
Green Peter	215,986	86	May 9
Hills Creek	140,665	72	May 13
Lookout Point	224,352	69	Mar 9
Willamette Valley System	1,170,360	74	May 25

Table 3.13-21 in the FEIS

[1] There is an 80 percent likelihood these values would be achieved or exceeded.

[2] The 80 percent exceedance date of maximum storage does not necessarily correspond to the same year as the peak stored water in column 2. This date provides an understanding of when peak storage could be expected.

3.13.4.2 River Flow

Direct effects on river flow to water supply and indirect effects to water users under the Interim Operations would be the same as described under the NAA (Table 3-40).

Table 3-40. Summary of Direct River Flow Effects to Water Supply under Interim Operations.

Location	Effects to River Flow[1]
North Santiam River	Effects would be the same as those described under the NAA.
South Santiam River	Effects would be the same as those described under the NAA.
Santiam River	Effects would be the same as those described under the NAA.
Long Tom River	Effects would be the same as those described under the NAA.
McKenzie River	Effects would be the same as those described under the NAA.
Middle Fork Willamette River	Effects would be the same as those described under the NAA.
Coast Fork Willamette River	Effects would be the same as those described under the NAA.
Mainstem Willamette River	Effects would be the same as those described under the NAA.

Table 3.13-22 in the FEIS

[1] Effects are based on data from gages in corresponding subbasins or Mainstem Willamette River reaches.

3.13.4.3 Groundwater

Incorporated by reference.

3.13.5 Climate Change under All Alternatives

Incorporated by reference. This section was not updated to include Alternative 6. Prior to the release of this SEIS, Executive Order 14154 “Unleashing American Energy” was issued.

Consistent with this Executive Order, a greenhouse gas analysis is not included here; however, this SEIS is consistent with the NEPA statute and existing agency regulations pertaining to air quality and emissions.

3.14 Recreation Resources

3.14.1 Introduction

Incorporated by reference.

3.14.2 Affected Environment

Incorporated by reference.

3.14.3 Environmental Consequences

This section discusses the potential effects of Alternative 6 and the Interim Operations, which includes the Detroit Drawdown, on all recreation opportunities identified in the Affected Environment. The discussion includes the methodology used to assess effects and a summary of the anticipated effects.

A summary of the effects for all alternatives is in Table 3-41. Additional discussion for this section from the FEIS is incorporated by reference.

3.14.3.1 Methodology

Incorporated by reference.

Table 3-41. Summary of Effects on Recreation Opportunities as Compared to the No-action Alternative[1].

Effect Category	No-action Alternative	Alternative 1	Alternative 2A	Alternative 2B	Alternative 3A	Alternative 3B
Water-based Opportunities	Substantial, beneficial. Potential direct, moderate to substantial, adverse effects during the latter portion of the recreation season in summer to some analysis area reservoirs depending on the amount of precipitation and timing of the drawdowns.	Same as the No-action Alternative at most reservoirs. Direct, slight, increased benefits at Detroit, Green Peter, Cougar, Hills Creek, Dorena, and Cottage Grove Reservoirs from earlier spring refill.	Same as No-action Alternative.	Same as the No-action Alternative at most reservoirs. Direct, substantial, adverse effects at Cougar Reservoir with slight to moderate, adverse effects on other analysis area reservoirs due to displaced visitor use.	Same as the No-action Alternative at some reservoirs. Direct, substantial, adverse effects at Lookout Point, Cougar, and Detroit Reservoirs with substantial adverse effects on other analysis area reservoirs due to displaced visitor use. Potential direct, substantial, adverse effects during the latter portion of the recreation season in late summer at Hills Creek, Blue River, and Green Peter Reservoirs.	Same as the No-action Alternative at some reservoirs. Direct, substantial, adverse effects at Green Peter, Hills Creek, and Cougar Reservoirs with substantial, adverse effects on other analysis area reservoirs due to displaced visitor use. Potential direct, substantial, adverse effects during the latter portion of the recreation season in late summer at Lookout Point, Detroit, and Blue River Reservoirs.
Land-based Opportunities	Substantial, beneficial because no change in land-based recreation opportunities.	Same as No-action Alternative.	Same as No-action Alternative.	Same as the No-action Alternative at most reservoirs. Reduced incentive to use facilities at Cougar Reservoir from lack of water-based opportunities during especially dry years.	Same as the No-action Alternative at some reservoirs. Reduced incentive to use facilities at Cougar, Detroit, and Lookout Point Reservoirs from lack of water-based opportunities during dry years.	Same as the No-action Alternative at some reservoirs. Reduced incentive to use facilities at Cougar, Green Peter, and Hills Creek Reservoirs from lack of water-based opportunities.
Recreation Site Management	Substantially beneficial. Potential indirect, moderate to substantial, adverse effects on management during the latter portion of the recreation season in late summer at some analysis area reservoirs depending on the amount of precipitation and timing of the drawdowns due to visitor displacement.	Same as the No-action Alternative at most reservoirs. Potential indirect, adverse impacts on management at Detroit, Green Peter, Cougar, Hills Creek, Dorena, and Cottage Grove Reservoirs due to increased visitor use.	Same as No-action Alternative.	Same as the No-action Alternative at most reservoirs. Indirect, adverse effects at Cougar Reservoir from management requirements. Potential indirect, adverse impacts on management at nearby reservoirs from displaced visitors and related management requirements.	Same as the No-action Alternative at some reservoirs. Indirect, adverse effects at Cougar, Detroit, and Lookout Point Reservoirs from management requirements. Potential indirect, moderate, adverse effects on management during the latter portion of the recreation season at Hills Creek, Green Peter, and Blue River Reservoirs from displaced, late summer visitor use.	Same as the No-action Alternative at some reservoirs. Indirect, adverse, substantial impacts at Green Peter, Hills Creek, and Cougar Reservoirs from management requirements. Potential indirect, moderate, adverse effects on management during the latter portion of the recreation season at Lookout Point, Detroit, and Blue River Reservoirs from late summer visitor use.

Table 3-41. Summary of Effects on Recreation Opportunities as Compared to the No-action Alternative[1] (continued).

Effect Category	No-action Alternative	Alternative 4	Alternative 5	Alternative 6	Interim Operations
Water-based Opportunities	Substantial, beneficial. Potential direct, moderate to substantial, adverse effects during the latter portion of the recreation season in summer to some analysis area reservoirs depending on the amount of precipitation and timing of the drawdowns.	Same as No-action Alternative.	Same as the Alternative 2B at most reservoirs.	Same as the Alternative 2B at most reservoirs.	Same as the No-action Alternative at most reservoirs. Direct, substantial, adverse effects at Cougar from lower summer pool elevations during most years with slight to moderate, adverse effects on other analysis area reservoirs due to displaced visitor use. As under the NAA, there would be potential direct, substantial, adverse effects during the recreation season in late summer at Detroit Reservoir due to lower reservoir levels.
Land-based Opportunities	Substantial, beneficial because no change in land-based recreation opportunities.	Same as No-action Alternative.	Same as Alternative 2B. Same as the No-action Alternative at most reservoirs. Reduced incentive to use facilities at Cougar Reservoir from lack of water-based opportunities.	Same as the Alternative 2B at most reservoirs.	Same as the No-action Alternative at most reservoirs. Reduced incentive to use facilities at Cougar and Detroit Reservoirs from lack of water-based opportunities during dry years.
Recreation Site Management	Substantially beneficial. Potential indirect, moderate to substantial, adverse effects on management during the latter portion of the recreation season in late summer at some analysis area reservoirs depending on the amount of precipitation and timing of the drawdowns due to visitor displacement.	Same as No-action Alternative.	Same as Alternative 2B. Same as the No-action Alternative at most reservoirs. Direct, substantial, adverse effects at Cougar Reservoir with slight to moderate, adverse effects on other analysis area reservoirs due to displaced visitor use.	Same as the No-action Alternative at most reservoirs.	Same as the No-action Alternative at most reservoirs. Indirect, adverse effects at Cougar and Detroit Reservoirs from management requirements. Potential indirect, adverse impacts on management at nearby reservoirs from displaced visitors and related management requirements.

Table 3.14-29 in the FEIS

[1] Effects would occur annually during the peak recreation season, May 15 to September 15. Some effects may occur into late summer past the peak recreation season as identified.

3.14.3.2 Alternatives Analysis

Effects discussions for alternatives other than Alternative 6 and the Interim Operations are in the FEIS and incorporated by reference. A summary of the effects for all alternatives is in Table 3-41.

Alternative 6—Ceasing Federal Hydropower Operations

Operations under Alternative 6 would be the same as operations under Alternative 2B. However, the Alternative 2B integrated temperature and habitat flow regime would be replaced with the 2008 Biological Opinion flow targets, same as the NAA, under Alternative 6.

Water-based Recreation and Land-based Recreation Opportunities and Recreation Site Management

Effects to water-based and land-based recreation opportunities and to recreation site management under Alternative 6 would be the same as those described under Alternative 2B, including impacts during years of low precipitation.

The decommission of hydropower infrastructure and cessation of hydropower generation under Alternative 6 would have a negligible effect on water-based and land-based recreation opportunities, and to recreation site management within the Willamette Valley System.

3.14.4 Interim Operations under All Action Alternatives Except Alternative 1

This section is incorporated by reference with additions pertaining to the deep drawdown at Detroit Reservoir.

The deeper drawdown for fish passage at Detroit Dam is not expected to impact recreation during the peak summer recreation season because the drawdown operation would end before refill season begins in February, with the reservoir reaching minimum conservation pool elevation prior to February most years. In years with an extremely dry late winter and early spring, like 2015, the reservoirs would not refill due to lack of rain. There would be substantial adverse impacts on recreation during extremely dry years as the reservoir would not refill to an elevation where most boat ramps are usable, thus the impact is the same as current operations (No Action Alternative) in extremely dry years. Sport fishing in Detroit Reservoir is expected to be adversely affected due to changes in the reservoir habitat conditions and food availability affecting fish growth and survival and increasing rates of entrainment for resident fish downstream of the dam (Appendix E, Chapter 6). For some species, significant reductions in reservoir abundance are possible. Future stocking of hatchery reared species (e.g. rainbow trout and kokanee) by ODFW in Detroit Reservoir would mitigate some of these effects.

3.14.5 Climate Change Effects under All Alternatives

Incorporated by reference. This section was not updated to include Alternative 6. Prior to the release of this SEIS, Executive Order 14154 "Unleashing American Energy" was issued. Consistent with this Executive Order, a greenhouse gas analysis is not included here; however, this SEIS is consistent with the NEPA statute and existing agency regulations pertaining to air quality and emissions.

3.15 Land Use

This section was descoped from the FEIS.

3.16 Hazardous Materials

This section is incorporated by reference. The effects of Alternative 6 and the Interim Operations on hazardous materials risk are the same as the other alternatives, including the NAA, except Alternative 6 reduces the risk of hazardous, toxic, and radioactive waste (HTRW) contamination because the turbines and transformers would be removed from the WVS dams and disposed of according to Resource Conservation and Recovery Act (RCRA) regulations. By removing and properly disposing of these materials, Alternative 6 reduces the risk of HTRW contamination compared to leaving them in place under the NAA.

3.17 Public Health and Safety—Harmful Algal Blooms

This section was descoped from the FEIS.

3.18 Public Health and Safety—Hazardous, Toxic, and Radioactive Waste

This section is incorporated by reference. The effects of Alternative 6 and the Interim Operations on hazardous materials risk are the same as the other alternatives, including the NAA, except Alternative 6 reduces the risk of HTRW contamination because the turbines and transformers would be removed from the WVS dams and properly disposed of according to RCRA regulations. By removing and properly disposing of these materials, Alternative 6 reduces the risk of HTRW contamination compared to leaving them in place under the NAA.

3.19 Public Health and Safety—Drinking Water

3.19.1 Introduction

Incorporated by Reference

3.19.2 Affected Environment

Incorporated by Reference.

3.19.3 Environmental Consequences

This section discusses the potential effects of Alternative 6 and the Interim Operations to public health and safety risk from drinking water quality and water supply effects. The discussion includes the methodology used to assess effects, incorporated by reference, and a summary of the anticipated effects (Table 3-42).

3.19.3.1 Methodology

Incorporated by reference.

Table 3-42. Summary of Effects to Public Health and Safety from Effects to Drinking Water[1].

Effect Category[2]	No-action Alternative	Alternative 1	Alternative 2A	Alternative 2B	Alternative 3A	Alternative 3B
Water Quality	**Turbidity –** Adverse, but benefits from sediment trapped at all reservoirs during high-flow events. Minor, short-term, adverse below Fall Creek Reservoir. **Harmful Algal Blooms –** Slightly adverse.	**Turbidity –** Same as No-action Alternative. **Harmful Algal Blooms –** Slightly more adverse.	**Turbidity –** Same as No-action Alternative but substantially more adverse below Foster Reservoir. **Harmful Algal Blooms –** Slightly more adverse. Moderately more adverse in Foster Reservoir.	**Turbidity –** Same as No-action Alternative but substantially more adverse below Foster and Cougar Reservoirs. **Harmful Algal Blooms –** Slightly more adverse. Moderately more adverse in Foster and Cougar Reservoirs.	**Turbidity –** Same as No-action Alternative below Hills Creek Reservoir. Slightly more adverse below Cougar Reservoir. Substantially more adverse below Dexter, Foster, and Big Cliff Reservoirs. **Harmful Algal Blooms –** Moderately more adverse, but slightly more adverse in Hills Creek Reservoir.	**Turbidity –** Substantially more adverse below Hills Creek, Dexter, Cougar, Foster, and Big Cliff Reservoirs. **Harmful Algal Blooms –** Moderately more adverse below the same reservoirs as for turbidity.
Water Supply	**Groundwater –** No effect. **Stored Water –** Substantial beneficial. **River Flow –** Beneficial but not all uses satisfied in all years.	**Groundwater –** Same as No-action Alternative. **Stored Water –** Same as No-action Alternative. **River Flow –** Same as No-action Alternative.	**Groundwater –** Same as No-action Alternative. **Stored Water –** Same as No-action Alternative. **River Flow –** Same as No-action Alternative.	**Groundwater –** Same as No-action Alternative. **Stored Water –** Slightly less beneficial than under the No-action Alternative. **River Flow –** Same as No-action Alternative.	**Groundwater** Same as No-action Alternative. **Stored Water** Substantial, adverse. **River Flow** Same as No-action Alternative except adverse effects below Detroit Reservoir.	**Groundwater –** Same as No-action Alternative. **Stored Water –** Substantial adverse. **River Flow –** Same as No-action Alternative except adverse effects below Green Peter Reservoir.

Table 3-42. Summary of Effects to Public Health and Safety from Effects to Drinking Water[1] (continued).

Effect Category	No-action Alternative	Alternative 4	Alternative 5	Alternative 6	Interim Operations
Water Quality[2]	**Turbidity –** Adverse, but benefits from sediment trapped at all reservoirs during high-flow events. Minor, short-term, adverse below Fall Creek Reservoir. **Harmful Algal Blooms –** Slightly adverse.	**Turbidity –** Same as No-action Alternative. **Harmful Algal Blooms –** Slightly more adverse.	**Turbidity –** Same as No-action Alternative but substantially more adverse below Foster and Cougar Reservoirs. **Harmful Algal Blooms –** Slightly more adverse. Moderately more adverse in Foster and Cougar Reservoirs.	**Turbidity –** Same as No-action Alternative but substantially more adverse below Foster and Cougar Reservoirs. **Harmful Algal Blooms –** Slightly more adverse. Moderately more adverse in Foster and Cougar Reservoirs.	**Turbidity –** Same as No-action Alternative but substantially more adverse below Green Peter, Foster, and Detroit reservoirs. **Harmful Algal Blooms –** Slightly more adverse. Moderately more adverse in Green Peter, Foster, and Detroit reservoirs.

Effect Category	No-action Alternative	Alternative 4	Alternative 5	Alternative 6	Interim Operations
Water Supply	**Groundwater –** No effect. **Stored Water –** Substantial beneficial. **River Flow –** Beneficial but not all uses satisfied in all years.	**Groundwater –** Same as No-action Alternative. **Stored Water –** Same as No-action Alternative. **River Flow –** Same as No-action Alternative.	**Groundwater –** Same as No-action Alternative. **Stored Water –** Slightly less beneficial than under the No-action Alternative. **River Flow –** Same as No-action Alternative.	**Groundwater –** Same as No-action Alternative. **Stored Water –** Slightly less beneficial than under the No-action Alternative. **River Flow –** Same as No-action Alternative.	**Groundwater –** Same as No-action Alternative. **Stored Water –** Slightly less beneficial than under the No-action Alternative. **River Flow –** Same as No-action Alternative.

Table 3.19-2 in the FEIS

[1] All effects would be long term, occurring or reoccurring over the 30-year implementation timeframe.

[2] Effects to water quality in this section refer to the quality of the raw water itself, not the finished drinking water. Adverse effects from increased turbidity may affect the drinking water facility, but the quality of the finished drinking water is outside the scope of the USACE.

3.19.3.2 Alternatives Analyses

Effects discussions for alternatives other than Alternative 6 and the Interim Operations are in the FEIS and incorporated by reference.

Construction and Routine and Non-routine Maintenance Activities under All Alternatives

Incorporated by reference.

Groundwater Supply for Drinking Water under All Alternatives

There would not likely be any direct effect to groundwater supply or indirect effect to water supply users for drinking water in the analysis area from operations under any alternative, including Alternative 6, during the 30-year implementation timeframe. The rest of this section is incorporated by reference.

Water Quality and Treatment Facility Operations under All Alternatives

USACE operations and precipitation during drawdowns could cause an increase in the amounts of turbidity and harmful algal blooms discharged downstream. Drinking water facility operations could be adversely affected by the liberation of previously stored sediments caused by construction activities or by deep reservoir drawdowns over the 30-year implementation timeframe. These effects would be basin-wide. These conditions would result in indirect, adverse, temporary treatment costs of additional chemicals, testing, and facility maintenance as well as administrative costs and delays in drinking water supplied to affected communities (Section 3.11, Socioeconomics).

Turbidity

Sediment-related processes would occur in all subbasins under all alternatives, resulting in adverse water quality from turbidity. The degree of effect to water quality depends on a variety of factors, including but not limited to, geography, geology, wildfires, land use/cover, climate conditions, and seasonal reservoir operations.

The deep fall drawdown at Fall Creek Reservoir would continue resulting in temporary elevation of suspended sediment levels discharged from the dam (USGS 2023). Minor, short-term, adverse effects from temporary elevated turbidity would continue at this location over the 30-year implementation timeframe.

Turbidity would become more adverse under all action alternatives as compared to the NAA except for Alternative 1 and Alternative 4 (Section 3.5, Water Quality) due to operations exposing additional reservoir bed sediments resulting in erosion of the sediments. Increased adverse conditions would vary by alternative and location downstream of a dam. Adverse conditions would range from slightly more adverse than NAA operations as measured at the Salem gage under Alternative 2B, Alternative 5 (Preferred Alternative), and Alternative 6 to substantially more adverse below Hills Creek, Lookout Point and Dexter, Cougar, Foster, and

Detroit and Big Cliff dams under Alternative 3B. Except for during drawdown operations, the reservoirs would continue to provide benefits to drinking water facilities by trapping sediments during high flow events. Most of the facilities were built after the dams were constructed and their designs based on the existing conditions at the time of construction.

Harmful Algal Blooms

Incorporated by reference.

Turbidity and Harmful Algal Bloom Effects to Drinking Water and Facility Operations

Incorporated by reference.

Water Availability in Dry Years under All Alternatives

Incorporated by reference.

Water Availability

USACE operations could cause a change in the quantity of water available for downstream drinking water entities to withdraw within limits of their state issued water rights. These effects are described below for Alternative 6 and the Interim Operations; the other alternatives are in the FEIS and incorporated by reference.

Alternative 6—Ceasing Federal Hydropower Operations

Stored Water

Direct effects to stored water supply and indirect effects to drinking water users would be the same as described under Alternative 5, though there would be less stored water amounts under Alternative 6 than under Alternative 5. USACE is not able to store as much water in the spring while meeting the 2008 Biological Opinion minimum flow targets which are higher than the minimum flow targets in Alternative 5. (Section 3.13, Water Supply, Table 3-37).

River Flow

Direct effects to river flow on water supply and indirect effects to drinking water users under Alternative 6 would be the same as described for the NAA (Section 3.13, Water Supply, Table 3-37).

3.19.4 Interim Operations under All Action Alternatives Except Alternative 1

This section is incorporated by reference with the following additional information on the Detroit drawdown for fish passage:

The Interim Operations are a set of operations for downstream fish passage and temperature management that would be implemented until the long-term measure for fish passage or temperature management is being used. These operations would result in decreased system-wide stored water in the conservation pool.

The timing and duration of Interim Operations would vary by alternative. Interim Operations could extend to nearly the 30-year implementation timeframe under Alternatives 2A, 2B, 4, 5, and 6. However, under Alternative 3A and Alternative 3B Interim Operations may not be fully implemented because long-term operational strategies for these alternatives are intended to be implemented immediately upon the Record of Decision.

Interim Operations are not an alternative (Chapter 2, Alternatives, Section 2.8.6, Interim Operations). Interim Operations analyses did not consider the impacts of Alternatives 2A, 2B, 3A, 3B, 4, 5, and 6 because Interim Operations will be implemented before, and not in addition to, an action alternative.

3.19.4.1 Turbidity

Interim Operations would increase sediment and turbidity levels downstream of Lookout Point, Dexter, Green Peter, Foster, Detroit, and Big Cliff Reservoirs because of deeper drawdowns of the large reservoirs. Deep drawdowns increase the potential for bank erosion and sloughing as compared to NAA operations. While some fine-grained sediment that enters Dexter, Foster, and Big Cliff Reservoirs may partially settle, most fine-grained sediment would pass through these reservoirs and be transported downstream, likely resulting in increased turbidity downstream during deeper drawdowns compared to NAA operations.

The deep drawdown operation at Lookout Point and Green Peter reservoirs in 2023 and 2024 was required by the injunction (Section 1.12.3). Bi-annual status reports finalized in February of 2024 and 2025 summarized effects to turbidity from the drawdowns. Turbidity downstream from Lookout Point Dam in 2024 was much less than in 2023. As noted in the USACE February 2025 Bi-Annual Status Report, while turbidity downstream of Green Peter Dam was less than during the 2023 operation, the elevated turbidity was still a concern for downstream drinking water facilities and the public downstream of Green Peter and Foster dams (USACE 2025).

The deeper drawdown at Detroit Dam has not started at the time of the SEIS development. USACE expects the drawdown to mobilize sediment, increasing turbidity downstream of Detroit and Big Cliff dams, but to a lesser extent than at Green Peter. The drawdown of Detroit reservoir will expose a significantly smaller area of sediment and retain a larger residual pool relative to the Green Peter drawdown operation (Figure 3-32), estimated to result in less turbidity in the North Santiam River. Additionally, USACE is proposing to draw down the reservoir in a stepwise manner, reaching the target elevation over the course of several fall/winters, minimizing how much new sediment is exposed each year. The larger residual pool is expected to act as a sediment sink more than the Green Peter residual pool, though the fine clay material eroded from exposed sediment is likely to stay in suspension and pass downstream of Detroit dam.

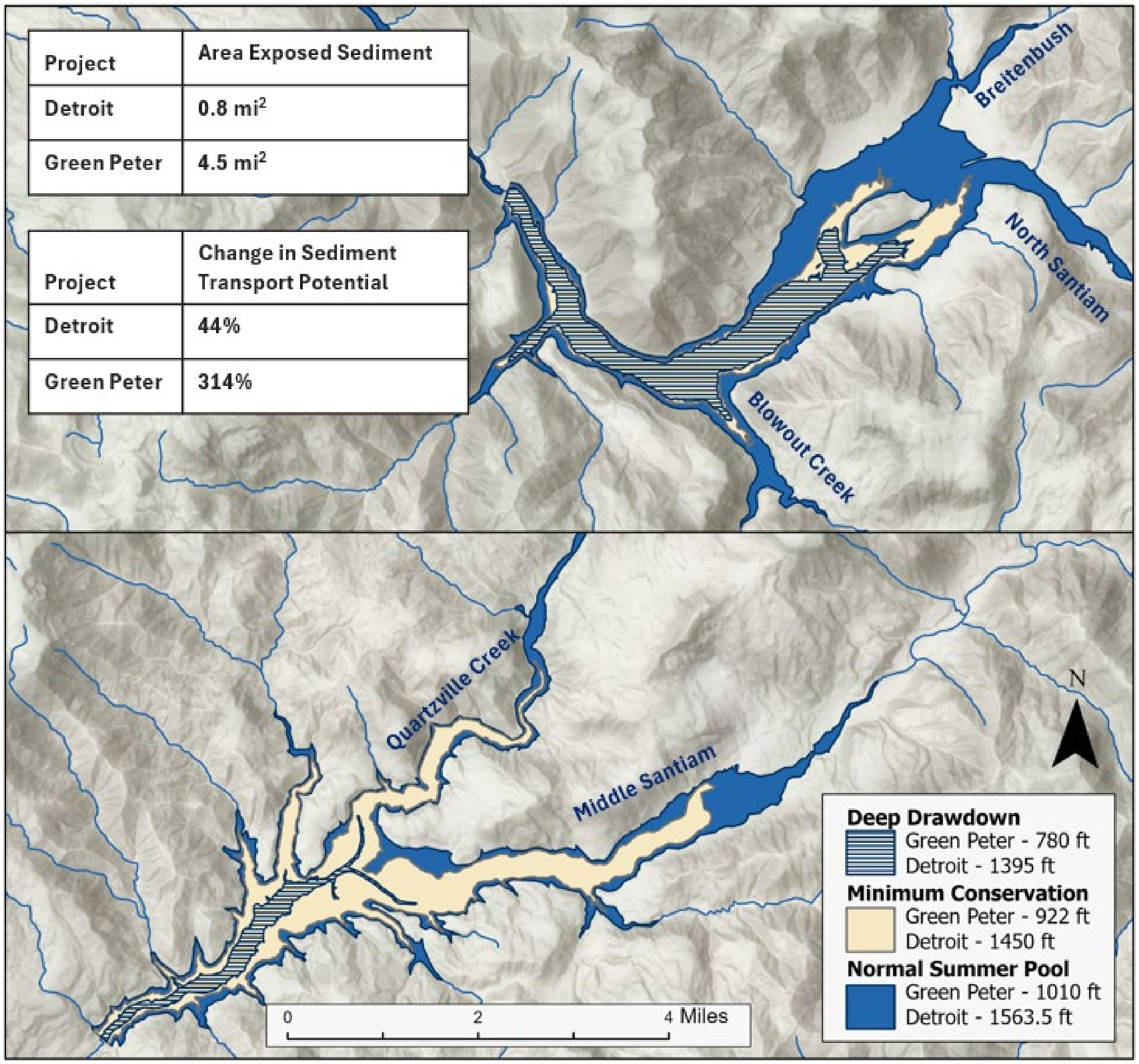

Figure 3-32. Green Peter (bottom) and Detroit (top) exposed areas between the normal minimum conservation pool and the deep drawdown elevations.

See Appendix C for full understanding of this figure.

Increased turbidity would result in adverse effects to drinking water facilities that use water from the North Santiam River below Detroit and Big Cliff reservoirs. Adverse effects could include increased maintenance of filters and increased staffing of the drinking water facility. A sediment transport modeling team will continue developing tools to inform adaptive management of future drawdown operations.

USACE would use the Deep Drawdown Emergency Response and Communications Plan for Detroit Reservoir deep drawdown operations to ensure strong communications with the State and cities of Salem, Stayton, and Gates's drinking water facilities during the drawdown of Detroit Reservoir to minimize impacts.

3.19.4.2 Harmful Algal Blooms

Under Interim Operations, effects to water quality from harmful algal blooms would be moderately adverse compared to the slightly adverse conditions described under the NAA during the 30-year implementation timeframe. Interim Operations would increase sediment and nutrient loading into Detroit and Big Cliff reservoirs because the deeper drawdown of Detroit Reservoir would increase the potential for bank erosion and sloughing as compared to NAA operations.

The Detroit drawdown could result in moderate adverse effects to drinking water facilities that use water from the North Santiam River below Big Cliff reservoir.

3.19.4.3 Stored Water

There would be a slight, beneficial, indirect effect to users under Interim Operations during most times of the year because the amount of water stored system wide would be slightly more than the amount needed to support minimum flow targets during the 30-year implementation timeframe with 80 percent likelihood (Section 3.13, Water Supply, Table 3-39). Stored water would be available to meet some municipal and industrial storage agreements and agricultural irrigation water service contracts under Interim Operations.

The drawdown operation at Detroit Dam would occur during the winter timeframe, allowing USACE to capture winter rains and refill the reservoir to minimum conservation pool by March 1 in most years. Same as under the NAA, during very dry years, there would likely not be enough water to refill the reservoir after winter flood risk management operations to meet consumptive demands from stored water, resulting in an adverse effect to users. In-season water management decisions could lessen the adverse effect, but there would likely still be an adverse effect.

3.19.4.4 River Flow

Direct effects to river flow on water supply and indirect effects to drinking water users under the Interim Operations would be the same as described under the NAA (Section 3.13, Water Supply, Table 3-37).

3.19.5 Climate Change under All Alternatives

Incorporated by reference. This section was not updated to include Alternative 6. Prior to the release of this SEIS, Executive Order 14154 “Unleashing American Energy” was issued. Consistent with this Executive Order, a greenhouse gas analysis is not included here; however, this SEIS is consistent with the NEPA statute and existing agency regulations.

3.20 Environmental Justice

This section was descoped from the FEIS.

3.21 Cultural Resources

3.21.1 Introduction

Incorporated by reference.

3.21.2 Affected Environment

Incorporated by reference, with additions since the publication of the FEIS.

In June 2023, USACE completed the Historic Properties Management Plan (Management Plan), which is a requirement of the *Programmatic Agreement Among the United States Army Corps of Engineers Portland District, the Oregon State Historic Preservation Officer, and the Advisory Council on Historic Preservation Regarding Compliance with Section 106 of the National Historic Preservation Act For Undertakings Related to the Operation and Maintenance of the Willamette Valley Project Benton, Lane, Linn, And Marion Counties, Oregon* (PA).

In 2024, USACE determined that water elevation changes that occur for the operations and maintenance of the WVS would adversely affect historic properties in the WVS reservoirs through the 30-year implementation timeframe. In May 2025, USACE and consulting parties agreed to amend the Management Plan, in accordance with Agreement Stipulation XVI Amendments, to include metrics and tasks that are appropriate for the scope, scale, and duration of the adverse effect. PA revisions for the resolution of adverse effects will include phased identification and evaluation, mitigation measures, and annual meeting and reporting requirements. USACE anticipates amending the Management Plan in early 2026 and beginning implementation no later than May of 2026.

3.21.3 Federal Laws and U.S. Army Corps of Engineers Regulations

Incorporated by reference.

3.21.4 Environmental Consequences

This section discusses the potential effects of Alternative 6 and the Interim Operations, including the Detroit drawdown, on cultural resources. Cultural resources effects are analyzed as impacts to archaeological sites and built resources in the historic districts under each alternative. The discussion includes the methodology used to assess effects, incorporated by reference, and a summary of the anticipated effects.

3.21.4.1 Methodology

<u>**Overview**</u>

Incorporated by reference.

Surveys

Incorporated by reference.

Qualitative and Quantitative Analyses

Incorporated by reference.

Measures with Effects to Cultural Resources under Each Alternative

A summary of the measures that could cause adverse effects to archaeological sites (Table 3-43) and built resources (Table 3-44) are included below. The effects criteria for the analyses are listed in Table 3-45. The remainder of this sub-section is incorporated by reference.

Table 3-43. Measures that Would Cause Adverse Effects to Archaeological Sites.

Measure Number	Measure Description	Reservoir Elevation Change	Deep Drawdown	Notes
721	Use spillway for surface spill in summer	Yes	No	Assumes water levels higher than spillway crest to implement.
30a	Integrated temperature and habitat flow regime	Yes	No	Flows (and elevations) are based on fullness of reservoir on June 1.
30b	Refined Integrated temperature and habitat flow regime	Yes	No	Flows (and elevations) are based on fullness of reservoir on June 1.
304	Augment instream flows by using the power pool	Yes	No	Can draft to minimum power pool.
718	Augment instream flows by using the inactive pool	Yes	No	Can draft to 10 feet above regulating outlets.
723	Reduce minimum flows to Congressionally authorized minimum flow requirements	See text in Notes column	No	Reduction in flows would support ability to maintain the rule curve, more stable elevation changes.
40	Deeper fall reservoir drawdowns for downstream fish passage	Yes	Yes	Target elevation 25 feet above regulating outlets
714	Pass water over spillway in spring for downstream fish passage	Yes	No	All flows to go over the spillway when greater than 25 feet over the spillway

720	Deep spring reservoir drawdown to regulating outlet (to diversion tunnel at Cougar Dam under Alternatives 2B and 3B) for downstream fish passage	Yes	Yes	Target elevation 25 feet above regulating outlets

Table 3.21-4 in the FEIS

Table 3-44. Measures that Would Cause Adverse Effects to Built Resources.

Measure Number	Measure Description	Add New Structures	Modify Existing Structure	Notes
105	Construct water temperature control tower	Yes	No	Modifies the character of resource type and overall aesthetic of a historic district.
174	Structural improvements to reduce TDG	No	Yes	Modifies internal or minor external components/aspects that do not impact the overall character of a resource type or aesthetic of a historic district.
392	Construct structural downstream fish passage	Yes	Yes	Modifies the character of resource type and overall aesthetic of a historic district.
52	Provide Pacific lamprey infrastructure	Yes	Yes	Modifies the character of resource type and overall aesthetic of a historic district.
639	Restore upstream and downstream passage at drop structures	Yes	Yes	Modifies the character of resource type and overall aesthetic of a historic district.
722	Construct adult fish facility	Yes	Yes	Modifies the character of resource type and overall aesthetic of a historic district.
726	Maintenance of existing and new fish release sites above dams	Yes	Yes	Assumes site-specific addition or modification that does not or is less likely to impact the overall character of a resource type or aesthetic of a historic district.
NA	Hydropower infrastructure removal or decommissioning	Yes	Yes	Modifies the character of resource type and overall aesthetic of a historic district.

Measure Number	Measure Description	Add New Structures	Modify Existing Structure	Notes
NA	Replace station service power with alternative to onsite hydropower	Yes	Yes	Modifies internal or minor external components/aspects that do not impact the overall character of a resource type or aesthetic of a historic district.
NA	Penstock reconfiguration	No	Yes	Modifies internal or minor external components/aspects that do not impact the overall character of a resource type or aesthetic of a historic district.
9	Maintain bank protection structures using nature-based engineering or alter revetments for aquatic ecosystem restoration	N/A	N/A	Unknown effects. Outside of the 13 historic districts, but historic in age, requires inventory and evaluation.

Table 3.21-5 in the FEIS

N/A = not applicable

Table 3-45. Archaeological Site and Built Environment Resources Effects Criteria.

Degree of Adverse or Beneficial Effect	Criteria
Negligible/None	Adverse or beneficial effects would occur to zero or a limited number of each resource type (archaeological sites or built resources) and would be a limited proportion of all known instances of that resource type by reservoir (less than 1 percent). There would be no or only a negligible impact to the population of a known cultural resource type in the WVS. Effects would not be demonstrable at the local or basin level. For archaeological resources, any damage would be permanent but apply to less than 1 percent of WVS archaeological resources. For built resources, these changes would be short-term and easily reversible or would result in no change to current conditions. Any internal changes would not be noticeable on the external face of a resource.

Degree of Adverse or Beneficial Effect	Criteria
Minor	Adverse or beneficial effects would occur to a small number of each resource type (archaeological sites or built resources) and would be a small proportion of all known instances of that resource type by reservoir (1.1 to 5 percent). The impact to the population of a known cultural resource type in the WVS would be minor. Effects would be demonstrable at the local or basin level. For archaeological resources, any damage would be permanent but would apply to 1.1 to 5 percent of WVS archaeological resources. For built resources, these impacts would be short-term, or if longer-term, easily reversible. Changes (internal or external) would not alter the aesthetic of the resource type and/or historic district.
Moderate	Adverse or beneficial effects would occur to many of each resource type (archaeological sites or built resources) and would be a greater proportion of all known instances of that resource type by reservoir (5.1 to 10 percent). The impact to the known population of the cultural resource type in the WVS would be moderate. Effects would be demonstrable at the local or basin level. For archaeological resources, any damage would be permanent but would apply to 5.1 to 10 percent of WVS archaeological resources. For built resources, these impacts would be long-term but potentially reversible. Changes (internal or external) would alter the aesthetic of the resource type and/or historic district.

Degree of Adverse or Beneficial Effect	Criteria
Major	Adverse or beneficial effects would occur to a high proportion of each resource type (archaeological sites or built resources) by reservoir (greater than 10 percent). Effects to the population of known instances of that cultural resource type in the WVS would be major. Effects would be demonstrable at the local or basin level. If effects are adverse, these impacts would be permanent and irreversible. For archaeological resources, any damage would be permanent but would apply to more than 10 percent of WVS archaeological resources. In the case of built resources, effects would be long-term and could be reversible but would require substantial resources to revert to prior conditions. Changes (internal or external) would alter the aesthetic of the resource type and/or historic district. If effects are beneficial, they would result in rehabilitation to original conditions or stabilization that stops future degradation to the resource. Stabilization could be applicable to archaeological sites and built resources.

Table 3.21-6 in the FEIS

Table 3-46. Summary of Effects to Cultural Resources as Compared to the No-action Alternative.

Effect Category	No-action Alternative	Alternative 1	Alternative 2A	Alternative 2B	Alternative 3A	Alternative 3B	Alternative 4	Alternative 5	Alternative 6	Interim Operations
Annual drawdowns and refill that would erode physical integrity of archaeological sites in reservoirs and expose them to unauthorized collection by the public.	Major, adverse effects at all reservoirs, except Big Cliff and Dexter Reservoirs.	Same as No-action Alternative.	Same as No-action Alternative.	Same as No-action Alternative.	Same as No-action Alternative.	Same as No-action Alternative.	Same as No-action Alternative.	Same as No-action Alternative.	Same as No-action Alternative.	Same as No-action Alternative.
Deep drawdowns that would increase erosion and exposure of archaeological sites in reservoirs.	Major, adverse effect at Fall Creek* Reservoir.	Same as No-action Alternative.	Same as No-action Alternative with the addition of Green Peter.	Same as No-action Alternative with the addition of Cougar and Green Peter.	Major, adverse effects at Lookout Point, Hills Creek, Cougar, Blue River, Green Peter, Detroit Reservoirs.	Major, adverse effects at Lookout Point, Hills Creek, Cougar, Blue River, Green Peter, Detroit Reservoirs.	Same as No-action Alternative.	Major adverse effects at Cougar, Green Peter Reservoirs.	Major adverse effects at Lookout Point, Cougar, and Green Peter Reservoirs.	Major adverse effects at Cougar, Green Peter, Foster, and Lookout Point Reservoirs.
Modify existing or build new structures that would change the aesthetic of a resource type or historic district.	None	Moderate to major, adverse effects at Fern Ridge, Dexter, Lookout Point, Foster, Green Peter, Detroit Reservoirs.	Moderate to major, adverse effects at Dexter, Lookout Point, Cougar, Foster, Green Peter, Detroit Reservoirs.	Moderate to major, adverse effects at Dexter, Lookout Point, Cougar, Foster, Green Peter, Detroit Reservoirs.	Moderate to major, adverse effects at Hills Creek, Cougar, Blue River, Green Peter Reservoirs.	Moderate to major, adverse effects at Hills Creek, Cougar, Blue River, Green Peter Reservoirs.	Moderate to major, adverse effects at Dexter, Lookout Point, Hills Creek, Cougar, Foster, Big Cliff, Detroit Reservoirs.	Moderate to major, adverse effects at Dexter, Lookout Point, Cougar, Foster, Green Peter, Detroit Reservoirs.	Moderate to major, adverse effects at Big Cliff, Detroit, Dexter, Lookout Point, Cougar, Foster, Green Peter, Hills Creek Reservoirs.	None, same as No-action Alternative.

Table 3.21-7 in the FEIS

*The NAA, interim operations, and all action alternatives include a deep drawdown at Fall Creek Reservoir that would cause major adverse effects to archaeological sites in the reservoir.

Table 3-47. Percent of Willamette Valley System Archaeological Sites that Would Be Adversely Affected under All Alternatives.

NAA	Alt 1	Alt 2A	Alt 2B	Alt 3A	Alt 3B	Alt 4	Alt 5	Alt 6	Interim Operations
80	80	80	80	80	80	80	80	80	80

Table 3.21-8 in the FEIS

Table 3-48. Percent of Willamette Valley System Historic Districts that would be Adversely Affected under All Alternatives.

NAA	Alt1	Alt 2A	Alt 2B	Alt 3A	Alt 3B	Alt 4	Alt 5	Alt 6	Interim Operations
0	46	46	46	31	31	54	46	61	0

Table 3.21-9 in the FEIS

3.21.4.2 Alternatives Analyses

A summary of effect for the No Action Alternative, Alternatives 1-6, and Interim Operations is provided in Table 3-47 through Table 3-48. The details of the analyses for all but Alternative 6 and the Interim Operations is incorporated by reference.

<u>Alternative 6—Ceasing Federal Hydropower Operations</u>

Archaeological Sites

Effects to archaeological sites under Alternative 6 would be very similar to the NAA. These effects would be major, long-term, and WVS-wide.

Under Alternative 6, there would be a 4 percent increase in site exposure from exposure under the NAA. Operations under Alternative 6 would be similar to those under Alternative 5, except there would be a removal or decommissioning of all hydropower infrastructure and reconfiguration of powerhouse systems, replacement of power to operate the dam and auxiliary facilities, and reconfiguration of the penstock outlets to allow for continuous flows and a dissipation of flow energy.

Under Alternative 6, adverse effects to archaeological sites at Cougar, Lookout Point, and Green Peter Reservoirs would be substantially higher than the NAA. Effects at Fall Creek would also be high but would be the same as the NAA.

Built Resources

Effects to historic districts in the analysis area under Alternative 6 would be the highest of all analyzed alternatives. The decommissioning and removal of hydropower within the WVS would result in the modification of structural components/aspects that would change the character or function of the resource types and the overall aesthetic of the historic districts. Alternative 6 would adversely affect built resources at Big Cliff, Detroit, Green Peter, Foster, Cougar, Dexter, Lookout Point, and Hills Creek Reservoirs.

3.21.5 Effects to Downstream Cultural Resources under All Alternatives

Incorporated by reference.

3.21.6 Interim Operations under All Action Alternatives Except Alternative 1

The timing and duration of Interim Operations would vary by alternative. Interim Operations could extend to nearly the 30-year implementation timeframe under Alternatives 2A, 2B, 4, 5 and, 6. However, under Alternative 3A and Alternative 3B Interim Operations may not be fully implemented because long-term operational strategies are intended to be implemented immediately upon the Record of Decision.

Interim Operations are not an alternative (Chapter 2, Alternatives, Section 2.8.6, Interim Operations). Interim Operations analyses did not consider the impacts assessed under action Alternatives 2A, 2B, 3A, 3B, 4, 5, and 6 because Interim Operations will be implemented before, not in addition to, an action alternative.

Major and long-term adverse impacts to archaeological sites under the Interim Operations would be the same under all action alternatives (except Alternative 1) because of the erosion effect of any drawdown and associated site exposure risks. Operations that focus on deep drawdowns, earlier drawdown, and delayed refills for downstream fish passage would greatly increase the erosion and exposure of archaeological sites at the reservoir level, which would be a continuation of major adverse effects under the NAA.

Archaeological resources would continue to steadily degrade with routine draft and fill operations. Delayed fills and early seasonal drawdowns would extend the length of time that most of the reservoir bed is exposed outside of the storage season (Table 3-49).

Table 3-49. Interim Operations that Would Cause Adverse Effects to Archaeological Sites.

Reservoir	Operation	Reservoir Elevation Change	Deep Drawdown
Big Cliff	Utilize spillway for improved downstream fish passage and water temperature management in the spring and summer.	No	No
Detroit	Utilize spillway for improved downstream fish passage and water temperature management in the spring and summer.	No	No
Detroit	Utilize lower regulating outlet for downstream water temperature management in the fall.	Yes	Yes

Reservoir	Operation	Reservoir Elevation Change	Deep Drawdown
Detroit	Fall drawdown for downstream fish passage through upper regulating outlets.	Yes	Yes
Green Peter	Utilize spillway for improved downstream fish passage in the spring; perform spill operation until May 1 or for 30 days, whichever is longer.	No	No
Green Peter	Deep drawdown and regulating outlet prioritization for improved downstream fish passage.	Yes	Yes
Foster	Earlier fall drawdown to reach 620 to 625 feet by October 1.	Yes	No
Foster	Delay refill and utilize spillway in the spring for improved downstream fish passage.	Yes	No
Cougar	Deep drawdown and regulating outlet prioritization for improved downstream fish passage.	Yes	Yes
Cougar	Delayed reservoir refill and regulating outlet prioritization for improved downstream fish passage.	Yes	No
Lookout Point	Deep drawdown and regulating outlet prioritization for improved downstream fish passage.	Yes	Yes
Lookout Point	Utilize spillway for improved downstream fish passage in the spring.	Yes	No
Hills Creek	Utilize regulating outlets at night-time for fish passage in the winter.	No	No

Table 3.21-10 in the FEIS

*Some aspects of this operation would not have adverse effects to archaeological sites.

Indirect adverse effects from public disturbance to archaeological sites under any of the action alternatives would be the same as those described under the NAA.

It is probable that within 15 years, many sites present in the Big Cliff, Detroit, Green Peter, Foster, Cougar, Lookout Point, and Hills Creek Reservoirs would be mostly or completely destroyed due to activities that directly cause erosion and exposure and indirectly result in unauthorized collection (Appendix T, Cultural Resources Effects Analysis). Planned fills in the spring would be controlled and would be kept at steady elevations as much as possible, resulting in infrequent or short-lived fluctuations in water elevation (which would increase site erosion within a narrow elevation range).

Interim Operations would include a deep drawdown and use of regulating outlets in the fall in Detroit Reservoir. The drawdown would be brief in duration and there is a relatively small number of known archaeological sites in the reservoir that would be exposed, therefore, these deep drawdowns would increase effects to archaeological sites in Detroit Reservoir by less than 1 percent more that the NAA.

None of the Interim Operations are structural; therefore, they would have no effect to the built resources of the analysis area.

3.21.7 Climate Change under All Alternatives

Incorporated by reference. This section was not updated to include Alternative 6. Prior to the release of this SEIS, Executive Order 14154 “Unleashing American Energy” was issued. Consistent with this Executive Order, a greenhouse gas analysis is not included here; however, this SEIS is consistent with the NEPA statute and existing agency regulations pertaining to air quality and emissions.

3.21.8 Mitigating Adverse Effects to Cultural Resources

Incorporate by reference.

Since 2024, USACE and consulting parties have collaborated to determine the best way to document an adequate plan to resolve the adverse effects, and in 2025, they decided to amend the PA Appendix E, Historic Properties Management Plan with metrics and tasks specific to these adverse effects per PA Stipulation XIV, Amendments. USACE anticipates that the consulting parties will develop an acceptable plan in early 2026 and begin implementation as early as May 2026.

3.22 Visual Resources

3.22.1 Introduction

Incorporated by reference.

3.22.2 Affected Environment

Incorporated by reference

3.22.3 Assessing Visual Quality

Incorporated by reference.

3.22.3 Visual Resource Inventory of Dams and Reservoirs

Incorporated by reference.

3.22.4 Visual Quality of Dams and Reservoirs in the Analysis Area

Incorporated by reference.

3.22.5 Environmental Consequences

This section discusses the potential effects of Alternative 6 and the Interim Operations to the visual quality of the analysis area described in the Affected Environment. The discussion includes the methodology, incorporated by reference, used to assess effects and a summary of the anticipated effects. The summary of effects for all alternatives and the Interim Operations is in Table 3-50.

3.22.5.1 Methodology

Incorporated by reference.

Table 3-50. Summary of Effects on Visual Resources as Compared to the No-action Alternative[1].

Degree of Adverse or Beneficial Effect and Extent	No-action Alternative	Alternative 1	Alternative 2A	Alternative 2B	Alternative 3A	Alternative 3B
Short-term Duration						
Degree	Negligible to major adverse	Moderate to major adverse	Moderate to major adverse	Moderate to major adverse	Moderate to major adverse	Moderate to major adverse
Extent	• Large for drawdowns (Fall Creek Dam) • Small to large depending on exterior maintenance activity	• Large (Foster Dam, Fall Creek Dam) • Same as the No-action Alternative for exterior maintenance	• Large (Foster Dam, Green Peter Dam, Fall Creek Dam) • Same as the No-action Alternative for exterior maintenance	• Small (Cougar Dam) • Large (Foster Dam, Green Peter Dam, Fall Creek Dam) • Same as the No-action Alternative for exterior maintenance	• Small (Hills Creek Dam, Cougar Dam, Blue River Dam) • Medium (Lookout Point) • Large (Green Peter Dam, Fall Creek Dam, Detroit Dam) • Same as the No-action Alternative for exterior maintenance	• Small (Hills Creek Dam, Cougar Dam, Blue River Dam) • Medium (Lookout Point) • Large (Green Peter Dam, Fall Creek Dam, Detroit Dam) • Same as the No-action Alternative for exterior maintenance
Medium-term Duration						
Degree	None	Minor adverse	Minor adverse	Minor adverse	Minor adverse	Minor adverse
Extent	None	• Medium (Lookout Point) • Large (Detroit Dam, Green Peter Dam)	• Small (Cougar Dam) • Medium (Lookout Point) • Large (Detroit Dam, Green Peter Dam)	• Medium (Lookout Point) • Large (Detroit Dam, Green Peter Dam)	• Small (Blue River Dam, Hills Creek Dam) • Large (Green Peter Dam)	• Small (Blue River Dam, Hills Creek Dam) • Large (Green Peter Dam)
	Long-term Duration (Permanent, Intermittent, and/or Recurring)					
Degree	Moderate adverse	Moderate adverse; minor beneficial	Moderate adverse; minor beneficial	Moderate adverse; minor beneficial	Moderate adverse; minor beneficial	Moderate adverse; minor beneficial
Extent	• Large (Fall Creek Dam)	• Medium (Lookout Point) • Large (Foster Dam, Green Peter Dam, Fall Creek Dam, Detroit Dam)	• Small (Cougar Dam) • Medium (Lookout Point) • Large (Foster Dam, Green Peter Dam, Fall Creek Dam, Detroit Dam)	• Small (Cougar Dam) • Medium (Lookout Point) • Large (Foster Dam, Green Peter Dam, Fall Creek Dam, Detroit Dam)	• Small (Hills Creek Dam, Cougar Dam, Blue River Dam) • Medium (Lookout Point) • Large (Green Peter Dam, Fall Creek Dam, Detroit Dam)	• Small (Hills Creek Dam, Cougar Dam, Blue River Dam) • Medium (Lookout Point) • Large (Green Peter Dam, Fall Creek Dam, Detroit Dam)
Duration Type	Recurring for drawdowns and maintenance, but not permanent for maintenance activities.	Permanent and/or recurring, but not permanent for maintenance activities.	Permanent and/or recurring, but not permanent for maintenance activities.	Permanent and/or recurring, but not permanent for maintenance activities.	Permanent and/or recurring, but not permanent for maintenance activities.	Permanent and/or recurring, but not permanent for maintenance activities.

Table 3-50. Summary of Effects on Visual Resources as Compared to the No-action Alternative[1] (continued).

Degree of Adverse or Beneficial Effect and Extent	No-action Alternative	Alternative 4	Alternative 5	Alternative 6	Interim Operations
Short-term Duration					
Degree	Negligible to major adverse	Moderate to major adverse	Moderate to major adverse	Moderate to major adverse	Moderate adverse
Extent	• Large for drawdowns (Fall Creek Dam) • Small to large depending on exterior maintenance activity	• Large (Foster Dam, Fall Creek Dam) • Same as the No-action Alternative for exterior maintenance	• Small (Cougar Dam) • Large (Foster Dam, Green Peter Dam, Fall Creek Dam) • Same as the No-action Alternative for exterior maintenance	• Small (Cougar Dam, Hills Creek Dam) •Medium (Lookout Point) • Large (Detroit Dam, Green Peter Dam, Foster Dam, Dexter)	• Small (Cougar Dam) • Medium (Lookout Point) • Large (Foster Dam, Green Peter Dam, Detroit Dam)
Medium-term Duration					
Degree	None	Minor adverse	Minor adverse	Minor adverse	Moderate adverse
Extent	None	• Small (Hills Creek Dam, Cougar Dam) • Medium (Lookout Point) • Large (Detroit Dam, Dexter Dam)	• Medium (Lookout Point) • Large (Detroit Dam, Green Peter Dam)	• Medium (Lookout Point) • Large (Detroit Dam, Green Peter Dam)	•Small (Cougar Dam) •Medium (Lookout Point) •Large (Foster Dam, Green Peter Dam, Detroit Dam)
Long-term Duration (Permanent, Intermittent, and/or Recurring)					
Degree	Moderate adverse	Moderate adverse; minor beneficial	Moderate adverse; minor beneficial	Moderate adverse; minor beneficial	Moderate adverse
Extent	• Large (Fall Creek Dam)	• Small (Hills Creek Dam, Cougar Dam) • Medium (Lookout Point) • Large (Foster Dam, Dexter Dam, Fall Creek Dam, Detroit Dam)	• Small (Cougar Dam) • Medium (Lookout Point) • Large (Foster Dam, Green Peter Dam, Fall Creek Dam, Detroit Dam)	• Small (Cougar Dam) • Medium (Lookout Point) • Large (Foster Dam, Green Peter Dam, Fall Creek Dam, Detroit Dam)	•Small (Cougar Dam) •Medium (Lookout Point) •Large (Foster Dam, Green Peter Dam, Detroit Dam)
Duration Type	Recurring for drawdowns and maintenance, but not permanent for maintenance activities.	Permanent and/or recurring, but not permanent for maintenance activities.	Permanent and/or recurring, but not permanent for maintenance activities.	Permanent and/or recurring, but not permanent for maintenance activities.	Permanent and/or recurring, but not permanent for maintenance activities.

Table 3.22-8 in the FEIS

[1] A range of effects may occur under each alternative, reflecting maintenance activities and drawdowns. Where a range of potential effects would occur, the most severe magnitude of adverse effects and the least magnitude of beneficial effects for each alternative is listed to present the most conservative range of potential effects. The extent of effects includes all reservoirs where potential effects would occur, even if the most severe adverse effect or the least beneficial effect does not occur at that reservoir.

3.22.5.2 Alternatives Analyses

Effects discussions for alternatives other than Alternative 6 and the Interim Operations are in the FEIS and incorporated by reference.

<u>Alternative 6 – Ceasing Federal Hydropower Operations</u>

The effects to visual resources under Alternative 6 would be the same as those described under all other Alternatives with the addition of the removal of hydropower infrastructure at Detroit, Big Cliff, Green Peter, Foster, Cougar, Hills Creek, Lookout Point, and Dexter dams. These actions would result in differences in effects from non-routine maintenance and construction activities between Alternative 5 and Alternative 6.

Routine and Non-routine Maintenance and Construction Activities

The effects to visual resources under Alternative 6 would be the same as those described under all other Alternatives with the addition of the removal of hydropower infrastructure at Detroit, Big Cliff, Green Peter, Foster, Cougar, Hills Creek, Lookout Point, and Dexter dams. Removal of hydropower infrastructure would necessitate construction activity. Construction work related to the removal of hydropower infrastructure may involve the use of trucks, work vehicles, excavators, bulldozers, heavy machinery, and various building materials. In contrast to Alternatives 1 through 5, where activity would not take place, these elements would be noticeable to observers near the dams and reservoirs throughout the construction proposed under Alternative 6. Nevertheless, the presence of vehicles and equipment is not expected to significantly impact the fundamental design features or alter the overall visual character of the surrounding landscapes and viewshed.

As a result, construction activities associated with Alternative 6 would have minor short term adverse effects on visual resources compared to the NAA, because vehicles, equipment, construction activities, and infrastructure impacts would be visible but unlikely to draw significant attention or overwhelm the landscape.

The extent of adverse visual impacts would range from small to large depending on the number of visitors that would be adversely affected by construction activities at a given dam under Alternative 6. The duration of effect would likely be short- to medium-term from construction activities and would not be permanent.

Scenic Quality Ratings would not be modified at any of the dams under Alternative 6 as a result of construction activities because these activities would not be permanent. Similarly, foreground-middle ground visibility distances from viewpoints in the analysis area to natural areas surrounding the dams and reservoirs under Alternative 6 would not be altered by temporary construction activities associated with the removal of hydropower infrastructure. Visual value classifications of any dam or reservoir affected by temporary construction activities associated with hydropower decommission would not be expected to change because there would be no substantial, long-term visual change as compared to the NAA.

3.22.6 Interim Operations under all Alternatives Except Alternative 1

The timing and duration of Interim Operations would vary by alternative. Interim Operations could extend to nearly the 30-year implementation timeframe under Alternatives 2A, 2B, 4, 5, and 6. However, under Alternative 3A and Alternative 3B Interim Operations may not be fully implemented or required because long-term operational strategies are intended to be implemented immediately upon the Record of Decision.

Interim Operations are not an alternative (Chapter 2, Alternatives, Section 2.8.6, Interim Operations). Interim Operations analyses did not include consider the impacts assessed under action Alternatives 2A, 2B, 3A, 3B, 4, 5 and 6 because Interim Operations will occur before, not in addition to, an action alternative.

The magnitude of effects on visual resources from Interim Operations would be moderate in the short term or in the medium term at all the dams from the following measures:

- Deep drawdown and regulating outlet prioritization for improved downstream fish passage at Detroit, Green Peter, Cougar, and Lookout Point dams.
- Delayed reservoir refill and regulating outlet prioritization for improved downstream fish passage at Cougar Dam.
- Delayed reservoir refill and utilization of the spillway in the spring for improved downstream fish passage at Foster Dam.

As under the NAA, potential adverse effects from revealed mudflats, substrate, tree stumps, and other submerged littoral zone attributes would be moderate in magnitude from Interim Operations.

Effects would be large in extent at Detroit, Green Peter, and Foster dams and Reservoirs because these dams recorded greater than 75,000 visitors in 2022, and would be medium at Lookout Point Dam and Reservoir because this dam recorded between 50,000 to 75,000 visitors, and small at Cougar Dam and Reservoir because this dam recorded less than 50,000 visits in 2022.

3.22.7 Climate Change under All Alternatives

Incorporated by reference. This section was not updated to include Alternative 6. Prior to the release of this SEIS, Executive Order 14154 “Unleashing American Energy” was issued. Consistent with this Executive Order, a greenhouse gas analysis is not included here; however, this SEIS is consistent with the NEPA statute and existing agency regulations pertaining to air quality and emissions.

3.23 Noise

This section was descoped from the FEIS.

3.24 Tribal Resources

3.24.1 Introduction

This section is incorporated by reference.

3.24.2 Affected Environment

The entirety of the Willamette River Basin landscape and resources are tribal resources when taking the views and beliefs of the tribes into consideration. Consequently, the analysis area broadly covers the Willamette River Basin. The Willamette River Basin encompasses the WVS—the 13 dams and reservoirs managed by USACE.

The health and viability of the economy, environment, and society of the Willamette Valley and connected areas are important to the individual American citizens who also belong to sovereign nations of Federally recognized tribes. Federally recognized tribes with a vested interest in and deep historical connection to the Willamette Valley have reiterated this through the consultation process with USACE on a government-to-government basis and through project-specific consultation that has and continues to occur.

There are 10 Federally recognized Indian tribes with interests pertaining to the analysis area, which were consulted for EIS development[11] (Appendix O, Tribal Coordination and Perspectives):

- Confederated Tribes and Bands of the Yakama Nation (Yakama)
- Confederated Tribes of Coos, Lower Umpqua, and Siuslaw Indians (CTCLUSI)
- Confederated Tribes of the Grand Ronde Community of Oregon (Grand Ronde)
- Confederated Tribes of Siletz Indians of Oregon (Siletz)
- Confederated Tribes of the Umatilla Indian Reservation (Umatilla)
- Confederated Tribes of Warm Springs Reservation of Oregon (Warm Springs)
- Coquille Indian Tribe (Coquille)
- Cow Creek Band of Umpqua Tribe of Indians (Cow Creek)
- Klamath Tribes (Klamath)
- Nez Perce Tribe (Nez Perce)

[11] In response to USACE requests for consultation dated September 30, 2021, representatives from the CTCLUSI, Coquille, and Klamath Tribes declined to consult on EIS development and deferred to other tribes.

In response to USACE's requests to consult, the Coquille, CTCLUSI, and Klamath Tribes deferred involvement to the appropriate tribes, while the Cow Creek, Grand Ronde, Siletz, Nez Perce, Umatilla, Warm Springs, and Yakama Tribes have expressed continued interest in EIS development.

USACE routinely consults with the Cow Creek, Grand Ronde, Siletz, and Warm Springs Tribes for WVS actions that require NEPA review and undertakings that require NHPA compliance (Chapter 1, Introduction, Section 1.3.1, National Environmental Policy Act; Section 3.21.3, Federal Laws and U.S. Army Corps of Engineers Regulations). As a result, USACE invited the four Tribes to participate as Cooperating Agencies in development of the EIS. Only the Grand Ronde Tribe signed a Memorandum of Understanding with USACE to formalize their cooperator status. USACE did not invite other tribes to participate as Cooperating Agencies.

In 2020–2023, USACE also partnered with the Cow Creek, Grand Ronde, Siletz, and Warm Springs Tribes, as well as several Federal and state partners and other interested parties, to execute a program-level programmatic agreement and related historic property management plan. This agreement modifies the NHPA Section 106 process to follow a streamlined and standardized approach to manage historic properties that have the potential to be impacted by the current and future operations of the WVS. As part of the agreement, USACE continues consultation for a finding of adverse effect related to water elevation change in WVS reservoirs, and for an amendment to the historic property management plan, which should conclude by May 2026 (Section 3.21.3, Federal Laws and U.S. Army Corps of Engineers Regulations).

3.24.3 Environmental Consequences

This section is incorporated by reference.

3.25 Summary of Direct and Indirect Environmental Consequences

In the FEIS this section was a reproduction of the effects tables found earlier in this chapter. This section has not been reproduced for the SEIS.

3.26 Unavoidable Adverse Effects

This section in the FEIS included a review of the unavoidable adverse effects of the NAA and the Preferred Alternative, Alternative 5. These alternatives remain unchanged in this SEIS; therefore, this section is not being updated.

3.27 Relationship between Short-term and Long-term Productivity

This section in the FEIS qualitatively evaluated the relationship between short-term uses of the environment and the maintenance and enhancement of long-term productivity of the operation and maintenance of the WVS. The evaluation is common to all alternatives and applicable to Alternative 6. Therefore, this section is incorporated by reference.

3.28 Irreversible and Irretrievable Commitments of Resources

This section is incorporated by reference.

3.29 Intentional Destructive Acts

This section is incorporated by reference.

CHAPTER 4 - CUMULATIVE EFFECTS

This chapter was not updated for the SEIS. The cumulative effects for Alternative 6 and for the Interim Operations are very similar if not identical to the other alternatives analyzed in Chapter 4 of the FEIS, with the range of effects falling within those described for the NAA and Alternative 5. The detailed analysis in the FEIS is incorporated by reference. Further, since the start of the SEIS there have been several key changes to federal law, regulations, and case law[12]. On February 25, 2025, the Council on Environmental Quality (CEQ) published an Interim Final Rule removing CEQ's NEPA implementing regulations, effective April 11, 2025 (90 Fed. Reg. 10610). As a result, the Fiscal Responsibility Act (FRA) of 2023 (Pub. L. No. 118-5, 137 Stat. 10) and USACE's implementing regulations at 33 C.F.R. §230 are applicable to this document but CEQ's previous regulations are not.

The decision maker will not consider areas analyzed that are no longer required to be considered by regulation, case law, or executive order in their decision. However, to keep the process efficient and timely, as emphasized in the FRA, some references to cumulative impacts may appear in the draft SEIS. The analysis in the SEIS instead focuses on the reasonably foreseeable effects of the actions, which are described in Chapter 3.

[12] *Seven County Infrastructure Coalition v. Eagle County*, 145 S. Ct. 1497 (2025); *Marin Audubon Society* v. *Federal Aviation Administration,* 121 F.4th 902 (D.C. Cir. 2024).

CHAPTER 5 - PREFERRED ALTERNATIVE

USACE identified Alternative 5 as the Preferred Alternative. Identification of a preferred alternative does not prevent USACE from selecting a different alternative once the public has reviewed and commented on the SEIS. It also does not preclude USACE from considering different factors before selecting an action in its record of decision. Including a preferred alternative provides the public with the opportunity to understand the agency's current reasoning so that they may provide meaningful comments. A more detailed explanation of the objectives, tradeoffs, and methodologies used by the agency in developing and identifying this alternative is in Appendix A.

Interim operations including the Detroit fall drawdown are not analyzed as part of the alternatives comparison because they are a temporary action the USACE is proposing to take before the alternatives compared below can be fully implemented. For a description of the effects associated with interim operations please see Chapter 3.

5.1 Comparison of Alternatives

Chapter 3 and the associated appendices describe the potential effects of each alternative. There was little difference among the levels of environmental and social impacts across alternatives and these effects were generally not useful in comparing the alternatives when selecting a preferred alternative. To identify a preferred alternative, USACE identified metrics for each of the seven objectives developed to formulate alternatives. Two additional objectives, not used for alternative formulation, cost and economic impacts to recreation, were also evaluated. This section describes how each alternative meets these objectives.

5.1.1 Objective 1 - Allow greater flexibility in water management

Two metrics were used to evaluate how each alternative met Objective 1:

- The volume of conservation storage systemwide measured in acre feet
- Impacts to downstream flows

Conservation storage is the maximum volume of water in acre-feet the WVS can hold during the storage season. The more water the WVS can store in the spring, fall, and summer, the more efficiently the system operates to support various competing uses, including flows for water supply, hydropower generation, water quality, and fish and wildlife as well as maintaining reservoir elevations for recreational use. Conservation storage was assessed using a reservoir simulation system model (ResSim) (FEIS and SEIS Section 3.2 Hydrologic Processes). The greater the number of acre feet of storage than stored under the NAA, the more effectively an alternative meets Objective 1.

The impact to flows at downstream control points is a qualitative assessment of the difference in flows at Salem between the NAA and each action alternative. Impacts were rated as high, medium, or low. Flows at Salem were assessed under each alternative using ResSim in Section

3.2. The less impact to downstream flows, the more effectively an alternative meets Objective 1.

5.1.2 Objective 2 - Increase opportunities for the creation of nature-based structures

This includes maintaining revetments using nature-based engineering or altering revetments for aquatic ecosystem restoration. All action alternatives increase opportunities to create nature-based structures during maintenance of USACE-owned revetments. As such, this objective was weighted equally across alternatives thus was not dispositive in identifying a preferred.

5.1.3 Objective 3 - Allow greater flexibility in hydropower production

Objective 3 uses average annual hydropower generation from the combined WVS compared to the NAA to measure effectiveness. The greater an alternative's average annual generation (average megawatts [aMW]), the more effective the long-term hydropower generation capability. For the SEIS, the Objective measurement 3 was changed from net present value to aMW to more clearly represent the flexibility of hydropower generation. NPV is an economic metric associated with a dollar value, not a measurement of how much energy is generated. Average annual generation is a better measure of how much power the WVS could generate under each alternative.

5.1.4 Objectives 4 through 6 - ESA-listed fish

Objectives 4 through 6 prioritize the needs of ESA-listed fish species:

- Objective 4. Increase anadromous ESA-listed fish upstream and downstream passage survival.
- Objective 5. Improve water management during the conservation season to benefit anadromous ESA-listed species.
- Objective 6. Reduce pollutant levels to restore impaired water quality to benefit anadromous ESA-listed species.

Section 3.8.2 of the FEIS and the SEIS evaluate effects on ESA-listed fish species and aquatic habitat using quantitative methods for ESA-listed salmon and steelhead and critical habitat, and qualitative methods for bull trout and habitat. The quantitative framework uses models developed for ESA-listed salmon and steelhead, including the Ecological Diagnosis Treatment (EDT) model, the Integrated Passage Assessment (IPA) model, and the National Oceanic and Atmospheric Administration Life Cycle Model (LCM).

The fish models account for the effects of an alternative's measure at a population scale cumulatively with the other major factors in the watershed. As all major factors outside the alternative measures are the same across alternatives, the model outputs inform the level of effects each alternative would have on the species at a population level.

These models use inputs for fish passage survival at dams (Objective 4), flows for habitat conditions for different life stages within the river system during the conservation season (Objective 5), and water quality (Objective 6). Therefore, the outputs of these population models demonstrate the effectiveness of an alternative for all three ESA-specific objectives.

Five metrics assess how effectively each alternative meets Objectives 4, 5, and 6. Only the UWR spring Chinook salmon modeling results were applied because USACE found that inclusion of UWR steelhead results and the UWR steelhead information does not change the rankings of the alternatives.

The five metrics for how effectively the alternatives meet Objectives 4, 5, and 6 are:

- **Number of populations where maximum recruits/spawner (R/S) is greater than (>) 1:** The number of UWR spring Chinook salmon populations (four are affected by the WVS) modeled to achieve spawner replacement on average over a 30-year timeframe. Spawner replacement occurs when offspring return to spawn in numbers equal to or greater than the number of parental spawners. When the population replacement rate is less than 1, on average the population declines.
- **Number of populations with high persistence:** The number of UWR spring Chinook salmon populations, out of four, modeled to exceed a minimum adult abundance threshold. The Technical Recovery Team identified minimum adult abundance thresholds for each UWR spring Chinook salmon population.
- **Legacy population risk of extinction:** Indicates McKenzie Core Legacy spring Chinook salmon population is at low risk of extinction. Improvement is measured by a change in risk.
- **Downstream survival relative rank:** Relative rankings of model results of UWR spring Chinook salmon populations, out of four, and UWR steelhead survival below dams as affected by flow and water temperatures.
- **Habitat gains for bull trout populations:** Habitat gains from fish passage improvements allowing access downstream of WVS dams. This assessment assumes bull trout are reintroduced above Detroit Dam. Of the WVS dams, bull trout currently reside above Cougar and Hills Creek.

5.1.5 Objective 7 - Reduce spawning and rearing habitat competition caused by hatchery fish

All action alternatives effectively reduce spawning or rearing competition caused by hatchery fish by including hatchery measures. As such, this objective was not analyzed as part of the selection of a preferred alternative.

5.1.6 Cost Criteria and Metrics

The cost of an alternative was determined using the annual costs over the 30-year period of analysis in 2025 dollars. The annual cost includes annualized first costs for design and construction as well as the annual cost for operations, maintenance, repair, replacement and rehabilitation. Costs were estimated based on existing studies for similar projects (Appendix M, Costs).

5.1.7 Economic Metrics for Effects to Recreation

During public scoping, stakeholders identified effects to recreation and the associated economic effects as important (Appendix P, Public Scoping Report). The following metrics assessed effects to recreation:

- **Average annual recreation benefits (total for all reservoirs):** Changes in the availability of reservoir boat ramps and the changes in visitation across recreation activities when boat ramps are available versus when they are not available. The measure of changes is the dollar value of reservoir recreational visitations during the recreation season (April 15 through Sept 15). The dollar value of visitations is derived from the Institute for Water Resources Unit Day Value (USACE 2021). The higher the value, the greater the economic benefits.
- **Regional economic development (RED) impact from recreation effects:** This qualitative assessment considers the full-time jobs created/lost by the changes in water levels under each alternative, making conditions conducive to water-based recreation and the regional (subbasin) output. The regional output is equal to the sum of employee compensation, plus proprietor income, plus other property type income, plus indirect business taxes. The analysis does not reflect the transfer of recreation utility from one site to another within the collective basin.

  This analysis was based on the effects to localized jobs associated with dollars gained or lost as a function of water level fluctuation at a particular project's county. This effect of visitor spending o accommodations, restaurants, retail and other purchases is most critical within the local impact area. The higher the impact the greater the change in projected number of jobs and regional output. A low impact means there would be negligible impact to the change in the number of jobs and little to no change in regional output. A medium impact is greater than 1 job up to a 2% change in any local area and up to a 2% change in regional output in multiple basins. A high impact means greater than 2% projected for a change in jobs and a corresponding regional output greater than $2,552,066 in multiple counties or basins.

5.1.8 Summary of Alternatives Comparison

Table 5-1 details the results of the alternatives comparison of the objective's metrics. The NAA does not meet any objective. The information provided for the NAA is used as the baseline for comparing the action alternatives. Table 5-2 is a matrix showing the operational or structural measures for fish passage, temperature management, and TDG abatement included for each alternative. Cottage Grove and Dorena dams are not included in Table 5-2 as there are no fish passage or water quality measures at these two dams. While modifications to the drop structures below Fern Ridge Dam are included in Alternatives 1 and 4, those structures are not germane to the identification of the preferred alternative; therefore, Fern Ridge Dam is also not included in Table 5-2.

Table 5-1. Alternatives Criteria Comparison to NAA.

Criteria/Metric	No Action Alternative	Alt 1	Alt 2A	Alt 2B	Alt 3A	Alt 3B	Alt 4	Alt 5	Alt 6
Effectiveness meeting Objective 1: Change in Conservation Storage from NAA (acre-feet)	1,323,300	+204,300	+153,300	-39,200	-729,800	-557,500	+153,200	-54,200	-153,000
Effectiveness meeting Objective 1: Impact to flows compared to NAA	–	Low	Low	Medium	High	High	Low	Medium	Medium
Effectiveness meeting Objective 3: Change in aMW[1]	171	+8	-4	-18	-87	-78	+1	-19	-171
Effectiveness meeting Objectives 4-6: UWR spring Chinook salmon populations reaching replacement	2 of 4 populations	+1 population	+2 populations	+2 populations	+2 populations	+2 populations	+1 population	+2 populations	+2 populations
Effectiveness meeting Objectives 4-6: UWR spring Chinook salmon population persistence	1 of 4 populations	+1 population	+2 population	+1 population	+0 populations	+1 population	+1 population	+1 population	+1 population
Effectiveness meeting Objectives 4-6: McKenzie Core Legacy Spring Chinook salmon population risk	Population is at risk	No change in risk	Risk reduced	Risk reduced	No change in risk	No change in risk	Risk reduced	Risk reduced	Risk reduced
Effectiveness meeting Objectives 4-6: Downstream survival relative rank: 1=best, lower scores increasing worse	5	3	1	2	4	4	2	2	4
Effectiveness meeting Objectives 4-6: Bull trout habitat gains	No habitat gains	Least habitat gains	Habitat gains	Habitat gains	Habitat gains	No habitat gains	Habitat gains	Habitat gains	Habitat gains
Increase in Estimated Total Annual Cost: Millions of US $	$45	+$126	+$82	+$73	+$23	+$27	+$137	+$73	+$88
Economic impact to recreation: Change in Average Annual NED Recreation Benefits (total for all reservoirs in millions of dollars) from NAA	$127	+$1.13	+$1.04	-$0.1	-$5.8	-$7.3	+$5.2	+$1.0	-$0.01
Acceptability Criteria: Economic: Impact to RED from Recreation Effects	–	Medium	Medium	Medium	High	High	Medium	Medium	Low

*Alternatives rank within 2%.

1) For the SEIS, the Objective measurement 3 was changed from net present value to aMW to more clearly represent the flexibility of hydropower generation.

Table 5-2. Structural and Operational Measures Included in Each Alternative.

Alternative	–	DEX	LOP	HCR	FCR	CGR	BLU	FOS	GPR	BCL	DET
NAA	**Upstream passage**	Structural	Structural	–	Structural	Structural	–	Structural	–	Structural	Structural
	Downstream passage	–	–	–	Operational	–	–	Operational	–	–	–
	Temperature control	–	–	–	Operational	Structural	–	Operational	–	–	Operational
	TDG abatement	Operational	Operational	Operational	–	Operational	–	Operational	Operational	Operational	Operational
1	**Upstream passage**	–	–	–	–	–	–	–	Structural	–	–
	Downstream passage	fish collected at LOP	Structural	–	–	–	–	Structural	Structural	fish collected at DET	Structural
	Temperature control	–	Structural	–	–	–	–	Structural	Structural	–	Structural
	TDG abatement	Structural	Structural	–	–	Structural	–	Structural	Structural	–	Structural
2A	**Upstream passage**	–	–	–	–	–	–	–	Structural	–	–
	Downstream passage	–	Structural	–	–	Structural	–	Structural	Operational	fish collected at DET	Structural
	Temperature control	–	–	–	–	–	–	Structural	Operational	–	Structural
	TDG abatement	–	–	–	–	–	–	–	–	–	–
2B	**Upstream passage**	–	–	–	–	–	–	–	–	–	–
	Downstream passage	–	Structural	–	–	Operational	–	Structural	Operational	fish collected at DET	Structural
	Temperature control	–	–	–	–	–	–	Structural	Operational	–	Structural
	TDG abatement	–	–	–	–	–	–	–	–	–	–
3A	**Upstream passage**	–	–	Structural	–	–	Structural	–	Structural	–	–
	Downstream passage	Operational	Operational	Operational	Operational	Operational	Operational	–	Operational	Operational	Operational
	Temperature management	–	Operational	Operational	Operational	–	Operational	Operational	Operational	–	Operational
	TDG abatement	–	–	–	–	–	–	–	–	–	–

Alternative	–	DEX	LOP	HCR	FCR	CGR	BLU	FOS	GPR	BCL	DET
3B	**Upstream passage**	–	–	–	–	–	Structural	–	Structural	–	–
	Downstream passage	Operational	Operational	Structural	–	Operational	Operational	–	Operational	Operational	Operational
	Temperature control	–	Operational	Operational	–	–	Operational	Operational	Operational	–	Operational
	TDG abatement	–	–	–	–	–	–	–	–	–	–
4	**Upstream passage**	–	–	Structural	–	–	–	–	–	–	–
	Downstream passage	–	Structural	Structural	–	Structural	–	Structural	–	–	Structural
	Temperature control	–	Structural	Structural	–	–	–	Structural	Operational	–	Structural
	TDG abatement	Structural	Structural	–	–	Structural	–	Structural	Structural	–	Structural
5	**Upstream passage**	–	–	–	–	–	–	–	Structural	–	–
	Downstream passage	–	Structural	–	–	Operational	–	Structural	Operational	fish collected at DET	Structural
	Temperature control	–	–	–	–	–	–	Structural	Operational	–	Structural
	TDG abatement	–	–	–	–	–	–	–	–	–	–
6	**Upstream passage**	–	–	–	–	–	–	–	Structural	–	–
	Downstream passage	–	Structural	–	–	Operational	–	Structural	Operational	fish collected at DET	Structural
	Temperature control	–	–	–	–	–	–	Structural	Operational	–	Structural
	TDG abatement	–	–	–	–	–	–	–	–	–	–

5.1.9 Summary of Effects

This section summarizes how alternatives met the objectives and how each action alternative compares to the NAA. Through this analysis and detailed in the section, USACE identified key risks and uncertainty that influenced identifying the Preferred Alternative. This section does not discuss the Interim Operations, which occur before the full implementation of the selected alternative.

5.1.9.1 No-action Alternative

The NAA is the continued operation and maintenance of the WVS as of publication of the notice of intent for the EIS in April 2019. Similar to Chapter 3, in this section the NAA serves as a benchmark to compare effects across action alternatives.

Under the NAA, conservation storage would store enough water to meet the M&I and agricultural irrigation (AI) demands in almost all years. Water released from the reservoirs would satisfy projected demands of stored water for M&I uses at the 2050 demand level and AI demands as of April 2019. Recreation would not change, meaning there would be no effects to average annual visits or average annual benefits, and no changes to full-time jobs or the regional output. Power generation from the WVS would contribute 171 aMW (average annual megawatts) to the grid.

The NAA would cause major adverse effects to UWR spring Chinook salmon and UWR winter steelhead. High extinction risk in all subbasins is predicted for both species. The NAA would not meet Objectives 4-6 for ESA-listed fish. Of the four Chinook salmon populations, two populations would decline and only one population would have low extinction risk. Additionally, the McKenzie Core Legacy spring Chinook salmon population would be at risk and there would be major adverse effects to the UWR winter steelhead resulting in a high risk of extinction.

The NAA does not result in habitat gains for bull trout due to lack of effective downstream passage at dams. However, adverse effects on bull trout would be minor. Bull trout above Cougar Dam have been stable for several years and have been increasing above Hills Creek. All known spawning habitat for bull trout remains available, and 70 percent of the rearing habitat in the subbasins bull trout currently occupy. Passage conditions at dams limit bull trout access to below dam rearing habitat.

The NAA uses the flow targets established in 2008 Biological Opinion (FEIS Section 2.10.3.1). Under the NAA the 80 percent exceedance level of system-wide stored water is 1,323,300 acre-feet, and there would be no to negligible effect on hydrologic processes or flows downstream. The NAA does not provide flexibility in water management related to refill, drawdown timing, and other water management measures. The NAA does not include measures that use the power pool or inactive pool to augment flows for biological purposes (FEIS Sections 2.8.1.3 and

2.8.1.4). Instead, only the conservation pool is used to meet flow targets late in the fall, restricting operational flexibility.

The estimated total annual cost for the NAA is $45 million (Appendix M, Costs). The NAA provides a comparison point to understand the costs associated with operating and maintaining the WVS. Under the NAA, agencies would continue to maintain system infrastructure, and fund O&M costs for hydropower, cultural resources, recreation, fish and wildlife, and other routine activities. The NAA includes some proposed funding increases for routine O&M activities at Detroit, Big Cliff, Foster, Cougar, Lookout Point, Dexter, and Fall Creek reservoirs but these are minor compared to any other alternative.

Overall, the NAA performs the best for hydropower and recreational interests with benefits to stored water users but limited flexibility in using additional water in the inactive and power pools. This alternative has the greatest adverse effects on ESA listed fish species. The primary purpose of the NAA is to be a benchmark against which to compare the benefits and adverse effects of the action alternatives as it is not a viable alternative for selection due to ESA requirements.

5.1.9.2 Alternative 1. Improve Fish Passage Through Storage-focused Measures

Alternative 1 maximizes the refill volumes of WVS reservoirs conservation pools to meet M&I and AI water supply, recreation, and water quality and it also shows the greatest improvement to ESA-listed fish passage through the WVS dams via the structural improvements. Alternative 1 increases the probability of refilling the WVS reservoirs to the maximum conservation pool elevations during the conservation season (summer). It also utilizes for the first time the inactive and power pools. One goal of Alternative 1 is to fill the reservoirs as often as possible and to supply water from storage as late as possible into the conservation season through changes in operations.

The main operational features of Alternative 1 are reducing minimum flows to congressionally authorized minimum flow requirements and augmenting instream flows by using the power and inactive pools. Alternative 1 focuses on structural measures to accomplish downstream fish passage and water quality management, making it one of the more expensive alternatives. Alternative 1 also includes restoring upstream and downstream passage at drop structures and structures to abate TDG.

Alternative 1 would increase the probability of refilling the WVS reservoirs and the amount of water available for conservation purposes later in the season. This alternative would result in the greatest increase in total water stored by mid-May of all alternatives; therefore, Alternative 1 meets Objective 1.

The additional stored water in Alternative 1 would increase average annual hydropower generation by 8 aMW, roughly enough to power 6,371 households annually. There would also be negligible risk to local hydropower generation as Hills Creek and Cougar Dams would continue to be able to operate islanded (isolated) from the rest of the power system, providing power to the communities of Oakridge and Blue River, respectively, during power system outages due primarily to weather events or fires like the NAA. Alternative 1 is the most effective at meeting Objective 3.

Alternative 1 meets some of the metrics for Objectives 4-6. Alternative 1 ranks 3rd for downstream fish passage survival, three out of four Chinook salmon populations would reach replacement, and only two out of four Chinook salmon populations would have a low risk of extinction. Additionally, the McKenzie Core Legacy spring Chinook salmon population would be at risk of extinction. Alternative 1 would have major effects on Chinook salmon and minor adverse effects on winter steelhead populations in the North and South Santiam sub-basins. Adverse effects on bull trout would be like the NAA, with minor effects predicted. Habitat availability for bull trout would be only marginally better than under the NAA with rearing habitat increases for North Santiam bull trout below Detroit. Alternative 1 has the least habitat gains for bull trout due to lack of effective downstream passage at Cougar Dam.

Under Alternative 1, the increased stored water and reduction in minimum flows would mean that reservoir levels stay higher for more of the conservation season resulting in minor to moderate benefits to reservoir recreation. This would translate into slight increases in annual visitations, resulting in an approximate increase of $300,000 (1.5%) in annual economic benefits.

Alternative 1 is the second most expensive alternative, primarily driven by the cost to design, construct, operate, and maintain structural measures for temperature control, fish passage, and TDG abatement. The estimated total annual cost for Alternative 1 is $171 million over 30 years, $126 million more than the NAA.

Alternative 1 meets objectives 1, 3, 4, 5 and 6.

5.1.9.3 Alternative 2A. Integrated Water Management Flexibility and ESA-listed Fish Alternative (Includes Structural Downstream Passage at Cougar Dam)

Alternative 2A improves fish passage through the WVS dams using a combination of modified operations and structural improvements, along with other measures to increase water management flexibility and to meet requirements for ESA-listed fish. This combination approach utilizes operations at key locations to provide immediate improvements for ESA listed species and a higher likelihood of success in carrying out the actions due to a reduction in overall cost of structural modifications. Alternative 2A includes structural downstream passage at Detroit, Foster, Cougar and Lookout Point dams, and operational passage at Green Peter Dam. A fall deep reservoir drawdown at Fall Creek Dam would continue. Alternative 2A uses a combination of structural measures for temperature control. There are no structural improvements for TDG abatement.

The “Integrated Temperature and Habitat Flow Regime” replaces the 2008 Biological Opinion flows. This shifts the release of stored water from the spring to the summer and fall in dry years. This approach reduces flows to minimums needed for fish survival when reservoirs are under 90% of rule curve elevation to preserve storage to be used in later summer and fall. While these minimums appear to be less than the 2008 Biological Opinion targets on paper, in order to account for dry years, they contain an adaptive management component so wet or normal water years levels could be higher than the 2008 Biological Opinion flows.

Alternative 2A augments instream flows using the power and inactive pools. Alternative 2A includes spring spill and a deep drawdown for fish passage at Green Peter as well as the use of the spillway and regulating outlets for temperature management at Green Peter Dam. This action provides improved passage as soon as the ROD is signed but has negative tradeoffs for recreation and water quality due to increased TDG and turbidity.

Alternative 2A would store up to 153,300 acre-feet more water system-wide by mid-May, meeting Objective 1. The Integrated Flow Regime has lower spring mainstem requirements than the 2008 Biological Opinion flows. Because of the structural measures, only Green Peter would be drawn down for temperature management and downstream fish passage during the conservation season. The combination of lower spring flow targets and minimal drawdowns during the conservation season would store more water in the driest years.

The anticipated flow measures and increase in total system-wide stored water would result in the same or higher downstream flows in the summer as compared to the NAA. The Integrated Flow Regime would include additional flow releases based on the air temperature, compared to the 2008 Biological Opinion flows.

Under Alternative 2A, flow in the mainstem at Salem would be lower than the NAA about 25% of the time from April through June, but flows would remain high, usually above 10,000 cfs. During the summer, flows at Salem would be higher than the NAA, rarely dropping below 6,000 cfs.

Alternative 2A would decrease average annual hydropower generation by 4 aMW, roughly enough to power 3,185 households annually due to reduced power output during deep drawdowns and prioritizing flow over the spillway for fish passage instead of flow through the turbines for power generation. There would be negligible risk to local hydropower generation as Hills Creek and Cougar dams would continue to be able to operate islanded (isolated) from the rest of the power system. They would provide power to the communities of Oakridge and Blue River, respectively, during power system outages due primarily to weather events or fires.

Alternative 2A most effectively meets Objectives 4-6 for most dams. Alternative 2A ranks the highest for downstream fish passage survival, with all four Chinook salmon populations reaching replacement, and three out of four Chinook salmon populations with low risk of extinction. Alternative 2A would reduce risk to the McKenzie Core Legacy spring Chinook salmon population and provide more habitat gains for bull trout due to the inclusion of effective downstream passage at Cougar Dam. In addition, structural fish passage at Detroit Dam would provide bull trout access to more habitat once they are introduced above that dam. Alternative 2A would have moderate adverse effects on Chinook salmon, producing the most viable populations, and would retain the McKenzie Core Legacy spring Chinook salmon population. However, there is uncertainty in the level of performance structural downstream fish passage will achieve. Performance will depend on future design efforts using the latest available scientific and engineering information.

Under Alternative 2A, the additional water stored system-wide would mean reservoir levels stay higher for more of the conservation season. There would be minor to moderate benefits to reservoir recreation except at Green Peter Reservoir. Further the drawdowns adversely affect sport fishing. Despite the fall drawn down at Green Peter Reservoir, Alternative 2A would slightly increase annual visitations across the Willamette River Basin, resulting in an approximate increase of $169,000 (0.83%) in annual economic benefits.

The regional economic impact from recreation effects would be medium. The regional economic effects would be associated with the potential loss of 1.7 jobs in the South Santiam subbasin due to the drawdown at Green Peter and a moderate reduction in regional output.

Alternative 2A is the fourth costliest alternative to implement, surpassed by Alternative 1 and 4, due to the structural measures. The estimated total annual cost for Alternative 2A is $127 million, $82 million greater than the NAA.

Alternative 1 meets objectives 1, 3, 4, 5 and 6, but there is risk of Alternative 2A not meeting Objectives 4 - 6 at Cougar Dam. This is due to a higher uncertainty of the proposed floating screen structure performance. However, if the structure once designed and implemented is successful, it would outperform other alternatives.

5.1.9.4 Alternative 2B. Integrated Water Management Flexibility and ESA-listed Fish Alternative (Includes Operational Downstream Passage at Cougar – Drawdown to Diversion Tunnel)

Alternative 2B improves fish passage through the WVS dams using a combination of modified operations and structural improvements, along with other measures to increase water management flexibility and to meet requirements for ESA-listed fish. This combination approach utilizes operations at key locations to provide immediate improvements for ESA listed species and a higher likelihood of success in carrying out the actions due to a reduction in overall cost of structural modifications. This alternative includes structural downstream passage at Detroit, Foster, and Lookout Point dams, and operational passage at Green Peter Dam. A fall deep reservoir drawdown at Fall Creek Dam would continue. Instead of a floating screen structure, Alternative 2B includes a reservoir drawdown to elevation 1330’ to use the diversion tunnel at Cougar Dam to pass fish. The adverse impacts to recreation and water quality and the beneficial effect of immediate action for ESA listed species associated with the Green Peter Fall drawdown are the same as those described for Alternative 2A.

Alternative 2B would decrease total water stored by 39,200 acre-feet primarily due to the fish passage operation at Cougar Dam, but there would still be a benefit to M&I water supply and AI users of the conservation storage space because there would be stored water to meet both instream and consumptive allocations. Though there is still a benefit to users of stored water, Alternative 2B does not meet Objective 1 storage metrics because it does not increase stored water.

Alternative 2B would meet flow targets in the summer and fall more frequently due to the additional stored water at WVS reservoirs other than Cougar and Green Peter. However, the spring and early summer flows would be similar or somewhat lower across the WVS because of the spring drawdown at Cougar Dam during the refill period. Alternative 2B would have medium impacts to flows.

Prioritizing the spillway and deep drawdowns for fish passage would decrease the average annual hydropower generation by 18 aMW, roughly enough to power 14,334 households annually. Additionally, the fish passage operation at Cougar Dam would result in infrequent, temporary moderate adverse effects on transmission services to Blue River. Deep fall and spring drawdowns at Cougar Dam would compromise the ability to provide power to Oakridge and serve this islanded (isolated) community under temporary outage conditions. Generation at Hills Creek Dam would operate islanded (isolated), providing transmission services to Oakridge. Alternative 2B does not meet Objective 3.

Alternative 2B meets the Objectives 4-6 more effectively than most alternatives. Alternative 2B ranks second for downstream survival with all Chinook salmon populations anticipated to reach replacement. Alternative 2B would reduce risk to the McKenzie Core Legacy spring Chinook salmon population and would provide more habitat gains for bull trout due to effective downstream passage at Cougar Dam. Alternative 2B would result in only two of the four Chinook salmon populations with high persistence. Models used in assessing downstream fish passage survival assume less optimistic downstream survival drawing down the reservoir to the diversion tunnel compared to structural downstream passage in Alternative 2A. It is expected that more extreme operations, like a deep drawdown, may have adverse effects on fish populations downstream.

Alternative 2B would result in the smallest increase in annual visitations, approximately $12,000 (0.06%) in annual economic benefits. Although this would be a negligible beneficial effect on recreation across the WVS, the near loss of the conservation pool at Cougar Reservoir would result in major adverse effects to reservoir recreation at this location. The regional economic effects would have the potential loss of 1.7 jobs in the South Santiam subbasin due to the drawdown at Green Peter Dam and a moderate reduction in regional output.

Alternative 2B is the fourth costliest alternative to implement (surpassed by Alternatives 1, 2A, and 4) due to the structural measures. The estimated total annual cost for Alternative 2B is $118 million, $73 million greater than the NAA.

Alternative 2B does not meet Objectives 1 and 3. Although Alternative 2B meets the Objectives 4-6, with input from USFWS and NMFS, USACE deemed Alternatives 2A, 2B, and 5 too similar to effectively differentiate between the effects on ESA-listed species overall. However, there is high confidence that when reservoirs are drafted very low, juvenile Chinook salmon would successfully pass downstream under Alternative 2B (NMFS, 2014).

5.1.9.5 Alternative 3A. Improve Fish Passage Through Operations-focused Measures (Includes Operational Downstream Passage at Cougar – Drawdown to Regulating Outlet)

Alternatives 3A operates WVS dams for water quality and fish passage. Alternative 3A does not include structural measures for temperature control, TDG abatement, or downstream fish passage. Alternative 3A increases the use of dam flow outlets to control temperature, with the spillway supplying warmer water from the upper reservoir and the deeper outlets – regulating outlets and turbines – supplying cooler water. Alternative 3A would implement spring and fall drawdowns at Detroit, Cougar (to the regulating outlet), and Lookout Point dams. Spring surface spill and fall deep drawdowns would occur at Green Peter and Hills Creek dams for volitional downstream fish passage. A fall deep drawdown at Fall Creek would continue as under the NAA. Additionally, Alternative 3A proposes new adult fish facilities at Hills Creek and Blue River dams.

Alternative 3A uses the "Integrated Temperature and Habitat Flow Regime" instead of the 2008 Biological Opinion flows. Alternative 3A would augment instream flows by using the power and inactive pools, allowing reservoirs to draft below the rule curves to meet minimum flow requirements. This would usually occur during the fall of drier years at reservoirs that do not have a fall drawdown operation.

By combining spring spill and drawdowns with fall drawdowns at 6 of the 11 storage projects, Alternative 3A would substantially affect the ability to store water system-wide. These operations would result in a 56% reduction of system-wide stored water, or a reduction of 729,800 acre-feet. Depending on how and when the fish and wildlife conservation storage allocation takes priority over other uses, it would leave little conservation storage available for M&I water supply or AI.

Alternative 3A flows during dry years would be lower starting in April, dropping below 5,000 cfs in August at Salem. This would likely cause more frequent shut offs to water users, resulting in a moderate adverse effect to M&I water supply and AI.

The decrease in stored water would decrease the average annual hydropower generation by 87 aMW, roughly enough to power 69,283 households annually. Alternative 3A would have the greatest decrease to hydropower production of any alternative that retains hydropower generation; it does not meet Objective 3.

The fish passage operations at Hills Creek and Cougar dams would cause infrequent, temporary moderate adverse effects on transmission services to Oakridge and Blue River. Deep fall and spring drawdowns would compromise the ability to serve these communities from Hills Creek and Cougar dams under temporary storm or fire related outage conditions.

Alternative 3A would not effectively meet Objectives 4-6. Although all four Chinook salmon populations would reach replacement under Alternative 3A, only one out of four Chinook salmon populations would have low risk of extinction, which would not be an improvement from the NAA. Alternative 3A ranks fourth for downstream survival, and the McKenzie Core Legacy spring Chinook salmon population would remain at risk of extinction. There would be habitat gains for bull trout.

Alternative 3A is one of two alternatives that would result in decreases in annual visitations. This would be a major, long-term adverse effect to recreation in the WVS, resulting in an approximate decrease of $769,000 (-3.76%) in annual economic benefits. The effects to recreation would have a high regional economic impact with close to a 50% reduction in recreation-related jobs in the North Santiam (14 jobs lost) and Middle Fork Willamette (13.7 jobs lost) sub-basins and a reduction greater than $150,000 in regional output in multiple basins.

Alternative 3A, at $68 million annually for 30 years, is the least expensive alternative because it has the fewest new structures. Alternative 3A would be approximately $114 million less annually than the costliest alternative, Alternative 4. Alternative 3A has the worst outcome for Objective 1, and would perform poorly for Objectives 3, 4, 5 and 6. This alternative exemplifies the tradeoffs between lower cost operations and the various impacts to other project purposes.

5.1.9.6 Alternative 3B. Improve Fish Passage Through Operations-focused Measures (Includes Operational Downstream Passage at Cougar – Drawdown to Diversion Tunnel)

Alternatives 3B would operate WVS dams for water quality and fish passage. Deep reservoir drawdowns would occur in spring and fall at Green Peter, Cougar, and Hills Creek dams. Spring surface spill and fall deep drawdowns would occur at Detroit and Lookout Point dams. A fall deep drawdown at Fall Creek Dam would continue as under the NAA. Under Alternative 3B, the spring and fall drawdowns would target the Cougar Dam diversion tunnel resulting in a much lower drawdown than Alternative 3A.

By combining spring spill and drawdowns with fall drawdowns at 6 of the 11 storage projects, Alternative 3B would substantially affect the ability to store water system-wide. These operations would reduce the amount water stored system-wide by 50%, or 557,500 acre-feet. Depending on how and when the fish and wildlife conservation storage allocation and flows potentially take priority over other consumptives uses it would leave very little conservation storage available for M&I water supply or AI. Alternative 3B would have a major adverse effect to M&I water supply and irrigation.

Alternative 3B would fill Detroit Reservoir for a spring spill fish passage operation; flows at Salem in Alternative 3B would rarely drop below 5,000 cfs in the summer, though they would be lower than under the NAA in dry years. Alternative 3B includes a spring drawdown at Hills Creek Dam instead of Lookout Point Dam, so Lookout Point reservoir could store water flowing through Hills Creek Dam, which would preserve more water than Alternative 3A.

The decrease in stored water would decrease in average annual hydropower generation by 79 aMW, roughly enough to power 62,912 households annually. Alternative 3B does not meet

Objective 3. The fish passage operations at Hills Creek and Cougar Dams would result in infrequent, temporary moderate adverse effects on transmission services to Oakridge and Blue River. Deep fall and spring drawdowns would compromise abilities of Hills Creek and Cougar dams to operate islanded and to serve these communities under temporary storm or fire related outage conditions.

Alternative 3B would not effectively meet Objectives 4-6. Four Chinook salmon populations would reach replacement, and two of four Chinook salmon populations would have low risk of extinction. Alternative 3B ranks fourth for downstream fish passage survival, the lowest ranking of the action alternatives, though it is still an improvement over the NAA. Additionally, the McKenzie Core Legacy spring Chinook salmon population is at risk of extinction, and there would be no habitat gains for bull trout.

Alternative 3B would result in the largest decreases in annual visitations, decreasing annual economic benefits by $1,274,000 (-6.23%). The effects to recreation would also have a high regional economic impact with a 50% reduction in recreation related jobs in the South Santiam sub-basin and a reduction in regional output greater than $150,000 in multiple basins.

The estimated total annual cost for Alternative 3B is $72 million, $27 million greater than the NAA. Alternative 3B is the second least expensive alternative due to fewer structural measures but has a high level of adverse impacts to other authorized purposes of the WVS. Only Alternative 3A is less expensive. Alternative 3B includes additional costs associated with modifying the diversion tunnel for drawdown operation at Cougar Dam.

Alternative 3B would perform poorly for Objectives 1, 3, 4, 5 and 6.

5.1.9.7 Alternative 4. Improve Fish Passage with Structures-based Approach

Alternative 4 uses structures to improve fish passage through the WVS dams to increase the survival of ESA-listed fish. Alternative 4 proposes structures for water quality and downstream fish passage, shifting the release of stored water from the spring into the summer and fall and augmenting instream flows by using the power and inactive pools. Alternative 4 includes large floating fish passage structures coupled with temperature structures in the North Santiam, McKenzie and the Middle Fork sub-basins. Smaller structures are included at Foster Dam in the South Santiam. A fall deep drawdown at Fall Creek would continue as under the NAA.

Alternative 4 uses the “Integrated Temperature and Habitat Flow Regime,” which includes higher and more variable targets than congressionally authorized minimum flow requirements. Alternative 4 has the most structural measures for fish passage and water quality. Alternative 4 includes a fish passage structure and water temperature control tower at Hills Creek Dam and a fish passage structure at Cougar Dam. Alternative 4 uses the spillway and regulating outlets for temperature management at Green Peter Dam.

Alternative 4 would increase water stored system-wide by 153,200 acre-feet from the combination of lower spring flow targets and no reservoir drawdowns during the conservation season. The increased stored water would result in a beneficial effect to M&I water supply and AI users. The Integrated Flow Regime would include additional flow based on the air temperature, compared to the 2008 Biological Opinion flows. Flows later in the summer and fall would be higher due to the additional accumulated stored water. Alternative 4 would meet Objective 1.

The additional stored water would contribute to an overall slight increase in average annual hydropower generation by 1 aMW, roughly enough to power 796 households annually. There would also be negligible risk to local hydropower generation as Hills Creek and Cougar Dams would continue to be able to operate islanded (isolated) from the rest of the power system, providing power to the communities of Oakridge and Blue River, respectively, during power system outages due primarily to weather events or fires. Alternative 4 would meet Objective 3.

Alternative 4 would have moderate adverse effects for UWR spring Chinook salmon, minor for UWR winter steelhead, and moderate for bull trout. Habitat for bull trout would increase in all three sub-basins due to passage actions. However, access to below-dam habitat would increase demographic risks especially below Hills Creek Dam and below Detroit Dam where human disturbance is higher. By increasing the number of bull trout passing downstream and becoming exposed to these disturbances compared to the NAA, there is an increase in demographic risk.

Despite the most spending on structural measures, Alternative 4 would not perform the best for Objectives 4-6. Although Alternative 4 ranks second for downstream survival, and three out of four Chinook salmon populations would reach replacement; only two out of four Chinook salmon populations would low risk of extinction. Alternative 4 would reduce risk to the McKenzie Core Legacy spring Chinook salmon population and would provide more habitat gains for bull trout due to the inclusion of effective downstream passage at Cougar Dam. However, there is uncertainty in the level of performance structural downstream fish passage will achieve and will depend on future design efforts using the latest available scientific and engineering information.

Under Alternative 4, the additional stored water would mean the reservoirs stay higher for more of the conservation season, resulting in minor to moderate benefits to reservoir recreation. This translates into slight increases in annual visitations, resulting in an approximate increase of $167,000 (0.82%) in annual economic benefits.

The regional economic impact from recreation effects would be medium. The regional economic effects would be associated with a moderate reduction in regional output and the potential loss of 1.7 jobs in the South Santiam and McKenzie sub-basins due to the drawdown at Green Peter and operations at Blue River Dam.

Alternative 4 is the most expensive alternative, driven by the cost to design, construct, operate, and maintain the structures for temperature control, fish passage, and TDG abatement. The estimated total annual cost for Alternative 4 is $182 million, $137 million greater than the NAA.

Alternative 4 would meet Objectives 1,3, 4, 5, and 6, but be the most expensive alternative.

5.1.9.8 Alternative 5. Refined Integrated Water Management Flexibility and ESA-listed Fish Alternative (Includes Operational Downstream Passage at Cougar – Drawdown to Diversion Tunnel) - Preferred Alternative

Alternative 5 improves fish passage through the WVS using modified operations and structural improvements. This includes structural downstream passage at Detroit, Foster, and Lookout Point dams, and operational passage at Green Peter Dam. A fall deep reservoir drawdown at Fall Creek Dam would continue as under the NAA. Alternative 5 includes a reservoir drawdown to elevation 1330' to use the diversion tunnel at Cougar Dam to pass fish.

Alternative 5 is the same as Alternative 2B except for the proposed flow regime, a modified version of the "Integrated Temperature and Habitat Flow Regime." The refined flow operation would result in higher flows at Foster, Detroit, and Cougar Dams compared to all alternatives. The refinement for Cougar Dam flows would be much smaller, because the drawdown to the diversion tunnel for fish passage results in much less storage compared to Foster and Detroit Dams to supplement flow. Additionally, the mainstem Willamette River flows would have different flow levels reflective of a basin-wide hydrology forecast.

Alternative 5 would decrease systemwide water storage by 54,200 acre-feet primarily due to the fish passage operation at Cougar Dam. Though there is a decrease in stored water under Alternative 5, there would still be a beneficial effect to M&I water supply and AI users of the conservation storage space because there would be stored water available to meet most demands. Alternative 5 does not meet Objective 1 storage metrics because stored water is reduced.

Alternative 5 would meet flow targets in the summer and fall more frequently due to the additional stored water at WVS reservoirs other than Cougar and Green Peter. However, the spring and early summer flows would be similar or somewhat lower across the WVS because of the spring drawdown at Cougar Dam during the refill period.

Alternative 5 prioritizes the spillway and deep drawdowns for fish passage, decreasing the average annual hydropower generation by 19 aMW, roughly enough to power 15,130 households annually. Deep fall and spring drawdowns at Cougar Dam would compromise the ability to provide power to the community of Blue River and serve this islanded (isolated) community under temporary outage conditions. Generation at Hills Creek Dam would operate islanded (isolated), providing transmission services to Oakridge. Alternative 5 is not effective in meeting Objective 3.

The effects to UWR spring Chinook salmon, UWR steelhead, and bull trout would be the same under Alternative 5 as under Alternative 2B. Passage through the diversion tunnel is more certain to occur compared to structural downstream passage at Cougar Dam, as the implementation of a surface collector at Cougar is uncertain given the layout of the reservoir.

Alternative 5 is the third most cost effective (same cost as Alternative 2B) and effectively meet the Objectives 4-6 at lower risk and substantially lower costs than Alternative 1, 2A, or 4.

5.1.9.9 Alternative 6. Ceasing Hydropower Alternative

Alternative 6 improves fish passage through the WVS using modified operations and structural improvements. This includes structural downstream passage at Detroit, Foster, and Lookout Point dams, and operational passage at Green Peter Dam. A fall deep reservoir drawdown at Fall Creek Dam would continue as under the NAA. Alternative 6 includes a reservoir drawdown to elevation 1330' to use the diversion tunnel at Cougar Dam to pass fish. Alternative 6 includes additional measures to remove and/or modify the existing hydropower infrastructure at the eight Federal hydropower dams to safely operate. Alternative 6 includes the 2008 Biological Opinion flow targets, the same as under the NAA.

The effects to UWR spring Chinook salmon, and bull trout under Alternative 6 would be similar to Alternative 5 effects. Though downstream fish passage conditions are similar to Alternative 5, downstream passage survival would be negatively impacted due to the installation of cone-valves and in-line orifices which have more adverse effects on fish than turbines. Fish would also experience higher TDG due to installation of energy dissipation devices in the penstocks.

Alternative 6 would end hydropower production, decreasing average annual hydropower generation by 171 aMW. The dams would lose the ability to island the communities of Blue River and Oakridge. Alternative 6 does not meet Objective 3.

Alternative 6 is one of the more expensive alternatives, $133 million annually, due to the cost associated with removing hydropower infrastructure and reconfiguring the penstocks as usable outlets for dam safety and flow management. These are additional costs to those associated with necessary structural modifications to meet ESA passage requirements for ESA listed species.

Alternative 6 would decrease systemwide water storage by 153,000 acre-feet; therefore, does not meet Objective 1. The reduced conservation storage in Alternative 6 relative to Alternative 5 is a result of the change from an integrated habitat and flow regime to use of the 2008 Biological Opinion flow targets. Alternative 6 would store less water during the spring in dry years, resulting in less stored water for use during the conservation season. Reservoir drafting during the conservation season and early flood seasons would result in stream flows remaining above minimums in both alternatives, though dry years would see lower flows in both alternatives. The changes in flows downstream of the dams is a result of the changes in the flow targets, not the ceasing of hydropower.

5.2 Preferred Alternative

Alternative 5 is identified as the Preferred Alternative. It includes structural and operational measures to meet the Proposed Action objectives. It reduces the high cost of building downstream fish passage structures by proposing fish passage and water quality temperature operations at key locations. This strategic approach also reduces the adverse impacts to other purposes from operational drawdowns occurring at multiple reservoirs. Alternative 5 has mixed outcomes for Objective 1, resulting in a decrease in storage, but a medium impacts to flows. Objective 3 metrics are ineffective, with 19 aMW lost annually. Alternative 5 also includes the flow refinements that resulted from engagement with cooperators on life history of the listed species.

Alternative 5 meets ESA Objectives 4-6. During the tradeoffs analyses, and with input from cooperating agencies, USACE decided effects on ESA listed species under Alternatives 2A, 2B, and 5 were so similar, when accounting for uncertainty in the analysis, that it was difficult to differentiate between them on that basis, however they are all an improvement for ESA species given the fish passage, flow, and water quality measures as compared to the NAA.

The modifications required to operate the diversion tunnel for fish passage increase the risk of Alternative 5's effectiveness. The diversion tunnel was originally constructed for temporary use during dam construction and was not designed for regular operation. Without detailed investigation and designs, the dam safety and operational feasibility of an annual draw down for fish passage is uncertain. However, unlike the floating screen structure, which has limited corrective actions to address the fish collection risks with current technology, there are clear engineering options to manage risk associated with dam safety and operational feasibility of a dam outlet. There is also uncertainty in the level of performance structural downstream fish passage will achieve, however future design efforts will apply the latest available scientific and engineering information and take advantage of additional performance information from similar structures.

The measures proposed in Alternative 5 improve conditions for ESA-listed fish while providing more flexible ways for USACE to meet demands for fish and wildlife, flood risk management, water supply for M&I, water quality, water supply, irrigation, hydropower generation, and recreation. This alternative was the most successful at balancing costs, impacts, and the ESA objectives.

5.3 Implementation Plan Summary

Incorporated by reference.

5.4 Adaptive Management Plan

Incorporated by reference.

CHAPTER 6 - PUBLIC INVOLVEMENT

Discussion of public involvement for the draft Environmental Impact Statement (EIS) is incorporated by reference. The information below relates to the Supplemental Environmental Impact Statement (SEIS).

6.1 Introduction

Public involvement begins with scoping, which is the process of soliciting input from tribes and stakeholders such as the public (both private citizens and non-governmental organizations) and other agencies primarily to identify significant issues related to the Proposed Action. Scoping also gives the lead agency perspectives from various stakeholders, helps to develop aspects of the purpose of and need for the Proposed Action, and assists with development of preliminary alternatives to the Proposed Action.

Federal agencies must make Draft Environmental Impact Statements available for public review and comment via a Notice of Availability posted to the Federal Register. Public meetings can be held during the public comment period to describe the proposal and to provide an opportunity for the public to ask questions and make comments. The comments received and any underlying documents must be made available to the public per the provisions of the Freedom of Information Act (5 U.S.C. 552).

6.1.1 Public Scoping Outreach

Discussion of public scoping for the draft EIS is incorporated by reference. The information below relates to the SEIS.

USACE began public outreach for the development of this SEIS in the spring of 2025 with press releases and updates to the USACE EIS website. Flyers and handouts were posted at USACE properties and distributed at local Willamette Valley events, and stakeholders were notified of the SEIS development via email[13]. News articles discussed the SEIS process and scoping in the following local and regional news publications: *Clearing Up, Columbia Basin Bulletin, The New Era, Statesman Journal, The Waterways Journal,* and *The Canyon Weekly*.

6.1.1.1 Notification of Public Scoping Meetings

Scoping for the SEIS formally began on May 16, 2025, with publication of a Notice of Intent in the Federal Register (90 FR 21015). The Notice of Intent described USACE's intent to prepare this SEIS. In addition to addressing the continued operations and maintenance of the WVS in accordance with Congressionally authorized purposes while meeting ESA obligations to avoid jeopardizing the continued existence of ESA-listed species (Section 1.10, Congressionally Authorized Purposes; Section 2.4, Purpose of and Need for the Proposed Action), this SEIS

[13] USACE developed an SEIS distribution list of over 2,000 individuals. Data include contact information for interested stakeholders and people who requested to receive SEIS updates. The distribution list was updated throughout the SEIS process. Anyone can request to be added to this list.

scoping was focused on the following two new Federal requirements related to the operations and maintenance of the WVS:

- Implementing a deeper fall drawdown of Detroit Reservoir
- Studying ending Federal hydropower operations at Willamette Valley projects USACE accepted public comments until June 21, 2025. The Notice of Intent notified the public of the scoping meetings from May 28 to June 3, 2025. The meetings were also advertised in press releases, flyers, the EIS website, email distributions, and social media.

6.1.1.2 Public Scoping Meetings

The WVS is in Oregon's Willamette Valley, which includes a mix of metropolitan and rural communities. Two scoping meetings were held in person, the first in Detroit, Oregon and the second Salem, Oregon. Two additional virtual meetings were held on Microsoft (MS) Teams. The purpose of these meetings was to provide an opportunity for interested stakeholders from different communities to attend (Appendix P, Public Scoping). All meetings included a presentation. The virtual meeting presentations were followed by an open question and answer period. At the in-person meetings, an open house format followed the presentation to encourage discussion and information sharing and to ensure the public had opportunities to speak with USACE representatives.

Meeting participants included private citizens; utility board/councils; watershed councils; non-governmental organizations; city, state, and Federal representatives; and elected officials. An average of 20 people attended each scoping meeting.

Materials Provided at Public Meetings

Informational posters   Public comment brochure   Scoping informational brochure

Public scoping meeting handout providing instructions on use of the public comment portal

Frequently Asked Question Handouts related to the SEIS, the deep drawdown at Detroit Reservoir, and the alternative to cease Federal hydropower across the WVS

6.1.2 Scoping Comments

A total of 117 correspondence documents were received via email, mail, and comment brochures that were distributed and then collected at meetings. Many of the correspondence documents contained multiple comments on different topics.

A total of 246 comments were received from private citizens, non-governmental organizations, government agencies, and tribes (Table 6-1). To ensure all comments were identified and properly reviewed, the comments were first assigned a comment identification number and documented in a database. The comments were organized, analyzed, and categorized according to four topics:

1. Hydropower
2. Deep drawdown
3. NEPA process
4. Environmental impacts

Table 6-1. Public Scoping Comments Received by Topic.

Topic	Number of Comments Received
Hydropower	30
Deep Drawdown	133
NEPA process	65
Environmental impacts	18
Total	**246**

Table 6-1 in the FEIS

Comments informed the scope of analysis, alternatives development, and identification of potentially significant issues to be addressed in the Draft SEIS.

Appendix P includes more details on the scoping process and comments, a database of comments received, and all scoping materials (Appendix P, Public Scoping Report).

6.2 Key Issues and Resource Concerns

The NEPA public scoping process identified issues important to WVS stakeholders. The following list of key issues and resource concerns associated with the proposed alternatives is not all-inclusive.

6.2.1 Hydropower

Thirty (30) comments were received regarding hydropower. Overall, commenters were concerned with operation impacts, removal of infrastructure, economic impacts, grid reliability, and energy production.

6.2.2 NEPA Process

There were sixty-five (65) comments pertaining to the NEPA Process. Commenters focused on the schedule of the SEIS, process and legal compliance along with requests for scoping comment time extensions.

6.2.3 Environmental Impacts

There were eighteen (18) comments pertaining to environmental impacts associated with the WVS SEIS. Comments received included water quality concerns regarding turbidity, sediment transportation related to the Detroit deep drawdown, impacts on fish species (in particular, kokanee), effects to fish and wildlife and their associated habitat, total maximum daily load compliance, climate change considerations, ecosystem functions, harmful algal blooms, and downstream habitat restoration opportunities.

6.2.4 Deep Drawdown

There were one hundred and thirty-three (133) comments pertaining to the deep drawdown at Detroit Dam. Comments were received concerning impacts of a deep drawdown on water quality downstream, impacts to municipal water supplies, impacts to recreation, economic impacts, and negative impacts to kokanee within Detroit Reservoir.

6.3 Interagency Coordination

USACE held one meeting prior to scoping and several meetings following the end of scoping with the Cooperating Agencies to provide updates to the SEIS status and to solicit feedback (Appendix L, Cooperating Agencies).

6.4 Tribal Consultation

Executive Order 13175 requires Federal departments and agencies to consult with Indian Tribal Governments when considering policies that are anticipated to have substantial direct effects on one or more Indian tribe, on the relationship between the Federal Government and Indian tribes, or on the distribution of power and responsibilities between the Federal Government and Indian tribes (65 FR 67249). USACE committed from the outset to consult with Federally recognized tribes throughout the EIS development process. Tribal consultation for this EIS development began in 2018 and is detailed in Appendix O, Tribal Coordination and Perspectives.

6.5 Draft EIS Public Outreach Summary

Incorporated by reference.

CHAPTER 7 - RELATIONSHIP TO OTHER ENVIRONMENTAL PLANS, POLICIES, AND REGULATIONS

This chapter is incorporated by reference with the exception of Executive Order 11514 Protection and Enhancement of Environmental Quality which is removed from consideration.

CHAPTER 8 - GLOSSARY

This chapter is incorporated by reference.

CHAPTER 9 - LIST OF PREPARERS

Table 9-1. List of Preparers.

Name	Title	Years of Experience	Professional Discipline and Expertise	Agency	EIS Areas Authored/Contributed
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Steven J. Clark	NEPA Subject Matter Expert	25	M.S., Fisheries Biology B.S., Biology NEPA and Environmental Compliance	USACE	Lead NEPA Coordinator and compliance reviewer, assisted with various analyses, coordinated document development Co-author Executive Summary, Chapters 1, 2, 4; Section 3.01, 3.25-3.28.
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Carley Smith	Archaeologist	18	M.S., Anthropology, Archaeology	USACE	Author: Section 3.24, Tribal Resources; 3.21, Cultural Resources; Appendix O, Tribal Coordination and Perspectives; Appendix T, Cultural Resources
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CHAPTER 10 - REFERENCES

This section is incorporated by reference with the following additions:

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USACE 2025. Willamette Basin Bi-Annual Status Report. U.S. Army Corps of Engineers, 28 February 2025.

CHAPTER 11 - ANALYSIS AREA SUBBASINS

This chapter, analysis area subbasin maps, is incorporated by reference in its entirety.